Appendix C – Agency Correspondence and Consultation on Federally Listed Threatened and Endangered Species (Except Bats, Bog Turtle, Monarch Butterfly and Alligator Snapping Turtle) on the Impacts of Routine Vegetation Management Activities

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Tennessee ES Office
446 Neal Street
Cookeville, Tennessee 38501

December 18, 2018

Mr. John T. Baxter
Manager, Biological Compliance
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902

Re: FWS #2018-F-0958; Programmatic Consultation for Right-of-Way Vegetation Management that May Affect Endangered or Threatened Plants in the Tennessee Valley Authority Service Area

Dear Mr. Baxter:

This letter acknowledges the U.S. Fish and Wildlife Service's (Service) November 21, 2018, receipt of your November 19, 2015, letter requesting initiation of formal section 7 consultation under the Endangered Species Act (Act). The consultation concerns the possible effects of your proposed Programmatic Strategy for Right-of-Way Vegetation Management that May Affect Endangered or Threatened Plants in the Tennessee Valley Authority Service Area (TVA) (the Proposed Action) on 18 federally listed plants, including:

- Price's potato-bean (*Apios priceana*)
- Braun's rock-cress (*Arabis perstellata*)
- Pyne's ground plum (*Astragalus bibullatus*)
- Morefield's leather-flower (*Clematis morefieldii*)
- Alabama leather flower (*Clematis socialis*)
- leafy prairie-clover (*Dalea foliosa*)
- whorled sunflower (*Helianthus verticillatus*)
- small whorled pogonia (*Isotria medeoloides*)
- fleshy-fruit gladecress (*Leavenworthia crassa*)
- lyre-leaf bladderpod (*Lesquerella lyrata*)
- Spring Creek bladderpod (*Lesquerella perforata*)
- Mohr's Barbara's buttons (*Marshallia mohrii*)
- Cumberland sandwort (*Minuartia cumberlandensis*)
- Short's bladderpod (*Physaria globosa*)
- white fringeless orchid (*Platanthera integrilabia*)
- green pitcher plant (*Sarracenia oreophila*)
- large-flowered skullcap (*Scutellaria montana*)
- Tennessee yellow-eyed grass (*Xyris tennesseensis*)

All information required of you to initiate consultation was either included with your letter or is otherwise accessible for our consideration and reference. We have assigned log number FWS 2018-F-0958 to this consultation. Please refer to that number in future correspondence on this consultation.

Based on the information provided, the Service agrees that the Proposed Action may affect and is likely to adversely affect the 18 plant species listed above and that initiation of formal consultation is appropriate for the Proposed Action. Section 7 allows the Service up to 90 calendar days to conclude formal consultation with your agency and an additional 45 calendar days to prepare a biological opinion (unless we mutually agree to an extension). Therefore, we expect to provide you with a final biological opinion no later than April 5, 2019. As has been previously discussed, we also agree to provide TVA a draft biological opinion for review by March 5, 2019.

As a reminder, the Act requires that after initiation of formal consultation, the federal action agency may not make any irreversible or irretrievable commitment of resources that limits future options. This practice insures agency actions do not preclude the formulation or implementation of reasonable and prudent alternatives that avoid jeopardizing the continued existence of endangered or threatened species or destroying or modifying their critical habitats.

In your letter, TVA also determined that the proposed Action is not likely to adversely affect the listed species and designated critical habitats on the attached list. The Service has reviewed the data and rationale for these determinations that was provided in the BA. We agree that the proposed best management practices, standard operating procedures, and appropriate avoidance measures associated with the activities that may affect these species and critical habitats will limit any adverse effects to an insignificant scale or discountable probability. Therefore, we concur with TVA's determinations for the listed species and designated critical habitats in the attached list, and this letter concludes consultation for the Action relative to those listed species and designated critical habitats. However, reinitiating consultation relative to the species and critical habitats in the attached list is required if TVA retains discretionary involvement or control over the Action (or is authorized by law) when:

- new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BA;
- the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BA; or
- a new species is listed or critical habitat designated that the Action may affect.

If you have any questions or concerns about this consultation or the consultation process in general, please feel free to contact myself or Todd Shaw of this office at 931/525-4985, or at *ross_shaw@fws.gov*.

Sincerely,

VIRGIL ANDREWS

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Virgil Lee Andrews, Jr.
Acting Field Supervisor

xc: Christine Willis, USFWS, Region 4
attachment – NLAA Species and Critical Habitats List

Listed species (LE=listed as endangered; LT=listed as threatened) and designated critical habitats (DCH) that TVA has determined the proposed Action is not likely to adversely affect (NLAA).

Scientific Name	Common Name	Federal Status	DCH (Y=Yes)	TVA Species Determination	TVA DCH Determination
Mammals					
Glaucomys sabrinus coloratus	Carolina Northern Flying Squirrel	LE	-	NLAA	-
Birds					
Charadrius melodus	Piping Plover	LT	-	NLAA	-
Grus americana	Whooping Crane	LE	-	NLAA	-
Mycteria americana	Wood Stork	LT	-	NLAA	-
Picoides borealis	Red-cockaded Woodpecker	LE	-	NLAA	-
Sterna antillarum athalassos	Interior Least Tern	LE	-	NLAA	-
Reptiles					
Graptemys oculifera	Ringed Map Turtle	LT	-	NLAA	-
Sternotherus depressus	Flattened Musk Turtle	LT	-	NLAA	-
Amphibians					
Gyrinophilus gulolineatus	Berry Cave Salamander	C	-	NLAA	-
Necturus alabamensis	Black Warrior Waterdog	LE	Y	NLAA	NLAA
Fishes					
Acipenser oxyrinchus desotoi	Gulf Sturgeon	LT	-	NLAA	-
Chrosomus saylori	Laurel Dace	LE	Y	NLAA	NLAA
Cottus paulus (pygmaeus)	Pygmy Sculpin	LT	Proposed	NLAA	NE*
Crystallaria cincotta	Diamond Darter	LE	Y	NLAA	NLAA
Cyprinella caerulea	Blue Shiner	LT	-	NLAA	-
Elassoma alabamae	Spring Pygmy Sunfish	LT	Proposed	NLAA	NLAA
Erimonax monachus	Spotfin Chub	LT	Y	NLAA	NLAA
Erimystax cahni	Slender Chub	LT	Y	NLAA	NLAA
Etheostoma akatulo	Bluemask Darter	LE	-	NLAA	-
Etheostoma boschungi	Slackwater Darter	LT	Y	NLAA	NLAA
Etheostoma chermocki	Vermilion Darter	LE	Y	NLAA	NE*
Etheostoma chienense	Relict Darter	LE	-	NLAA	-
Etheostoma nuchale	Watercress darter	LE	-	NLAA	-
Etheostoma percnurum	Duskytail Darter	LE	-	NLAA	-
Etheostoma phytophilum	Rush Darter	LE	Y	NLAA	NE*
Etheostoma rubrum	Bayou Darter	LT	-	NLAA	-
Etheostoma spilotum	Kentucky Arrow Darter	LT	-	NLAA	-
Etheostoma susanae	Cumberland Darter	LE	Y	NLAA	NLAA
Etheostoma trisella	Trispot Darter	PT	-	NLAA	-
Etheostoma wapiti	Boulder Darter	LE	-	NLAA	-
Moxostoma sp. 2	Sicklefin Redhorse	Under Review	-	NLAA	-
Notropis albizonatus	Palezone Shiner	LE	-	NLAA	-
Notropis cahabae	Cahaba Shiner	LE	Proposed	NLAA	NE*

Scientific Name	Common Name	Federal Status	DCH (Y=Yes)	TVA Species Determination	TVA DCH Determination
Noturus baileyi	Smoky Madtom	LE	Y	NLAA	NE*
Noturus crypticus	Chucky Madtom	LE	Y	NLAA	NE*
Noturus flavipinnis	Yellowfin Madtom	LT	Y	NLAA	NE*
Noturus stanauli	Pygmy Madtom	LE	-	NLAA	-
Percina antesella	Amber Darter	LE	Y	NLAA	NLAA
Percina aurolineata	Goldline Darter	LT	Proposed	NLAA	NE*
Percina aurora	Pearl Darter	LT	-	NLAA	-
Percina jenkinsi	Conasauga Logperch	LE	Y	NLAA	NLAA
Percina tanasi	Snail Darter	LT	-	NLAA	-
Phoxinus cumberlandensis	Blackside Dace	LT	-	NLAA	-
Scaphirhynchus albus	Pallid Sturgeon	LE	-	NLAA	NLAA
Scaphirhynchus suttkusi	Alabama Sturgeon	LE	-	NLAA	-
Speoplatyrhinus poulsoni	Alabama Cavefish	LE	Y	NLAA	NE*
Freshwater mussels					
Alasmidonta atropurpurea	Cumberland Elktoe	LE	Y	NLAA	NLAA
Alasmidonta raveneliana	Appalachian Elktoe	LE	Y	NLAA	NE*
Cumberlandia monodonta	Spectaclecase	LE	-	NLAA	-
Cyprogenia stegaria	Fanshell	LE	-	NLAA	-
Dromus dromas	Dromedary Pearlymussel	LE	-	NLAA	-
Epioblasma brevidens	Cumberlandian Combshell	LE	Y	NLAA	NLAA
Epioblasma capsaeformis	Oyster Mussel	LE	Y	NLAA	NLAA
Epioblasma florentina florentina	Yellow-blossom Pearlymussel	LE	-	NLAA	-
Epioblasma florentina walkeri	Tan Riffleshell	LE	-	NLAA	-
Epioblasma metastriata	Upland Combshell	LE	Y	NLAA	NLAA
Epioblasma obliquata obliquata	Purple Catspaw	LE	-	NLAA	-
Epioblasma othcaloogensis	Southern Acornshell	LE	Y	NLAA	NLAA
Epioblasma penita	Southern Combshell	LE	-	NLAA	-
Epioblasma torulosa gubernaculum	Green Blossom Pearlymussel	LE	-	NLAA	-
Epioblasma torulosa rangiana	Northern Riffleshell	LE	-	NLAA	-
Epioblasma torulosa torulosa	Tuberculed Blossom Pearlymussel	LE	-	NLAA	-
Epioblasma triquetra	Snuffbox	LE	-	NLAA	-
Epioblasma turgidula	Turgid Blossom Pearlymussel	LE	-	NLAA	-
Fusconaia cor	Shiny Pigtoe Pearlymussel	LE	-	NLAA	-

Scientific Name	Common Name	Federal Status	DCH (Y=Yes)	TVA Species Determination	TVA DCH Determination
Fusconaia cuneolus	Fine-rayed Pigtoe	LE	-	NLAA	-
Hemistena lata	Cracking Pearlymussel	LE	-	NLAA	-
Lampsilis abrupta	Pink Mucket	LE	-	NLAA	-
Lampsilis altilis	Fine-lined Pocketbook	LT	Y	NLAA	NLAA
Lampsilis perovalis	Orange-nacre Mucket	LT	Y	NLAA	NLAA
Lampsilis virescens	Alabama Lampmussel	LE	-	NLAA	-
Lemiox rimosus	Birdwing Pearlymussel	LE	-	NLAA	-
Leptodea leptodon	Scaleshell	LE	-	NLAA	-
Medionidus acutissimus	Alabama Moccasinshell	LT	Y	NLAA	NLAA
Medionidus parvulus	Coosa Moccasinshell	LE	Y	NLAA	NLAA
Obovaria retusa	Ring Pink	LE	-	NLAA	-
Pegias fabula	Little-wing Pearlymussel	LE	-	NLAA	-
Plethobasus cicatricosus	White Wartyback	LE	-	NLAA	-
Plethobasus cooperianus	Orange-foot Pimpleback	LE	-	NLAA	-
Plethobasus cyphyus	Sheepnose	LE	-	NLAA	-
Pleurobema clava	Clubshell	LE	-	NLAA	-
Pleurobema curtum	Black Clubshell	LE	-	NLAA	-
Pleurobema decisum	Southern Clubshell	LE	Y	NLAA	NLAA
Pleurobema furvum	Dark Pigtoe	LE	Y	NLAA	NLAA
Pleurobema georgianum	Southern Pigtoe	LE	-	NLAA	-
Pleurobema gibberum	Cumberland Pigtoe	LE	-	NLAA	-
Pleurobema hanleyianum	Georgia Pigtoe	LE	-	NLAA	-
Pleurobema marshalli	Flat Pigtoe	LE	-	NLAA	-
Pleurobema perovatum	Ovate Clubshell	LE	Y	NLAA	NLAA
Pleurobema plenum	Rough Pigtoe	LE	-	NLAA	-
Pleurobema taitianum	Heavy Pigtoe	LE	-	NLAA	-
Pleuronaia dolabelloides	Slabside Pearlymussel	LE	Y	NLAA	NLAA
Potamilus capax	Fat Pocketbook	LE	-	NLAA	-
Potamilus inflatus	Alamabama (inflated) Heelsplitter	LT	-	NLAA	-
Ptychobranchus greenii	Triangular Kidneyshell	LE	Y	NLAA	NLAA
Ptychobranchus subtentum	Fluted Kidneyshell	LE	Y	NLAA	NLAA
Quadrula cylindrica	Rabbitsfoot	LT	Y	NLAA	NLAA
Quadrula cylindrica strigillata	Rough Rabbitsfoot	LE	Y	NLAA	NLAA
Quadrula fragosa	Winged Mapleleaf	LE	-	NLAA	-
Quadrula intermedia	Cumberland Monkeyface	LE	-	NLAA	-
Quadrula sparsa	Appalachian Monkeyface	LE	-	NLAA	-
Quadrula stapes	Stirrupshell	LE	-	NLAA	-
Toxolasma cylindrellus	Pale Lilliput	LE	-	NLAA	-
Villosa fabalis	Rayed Bean	LE	-	NLAA	-
Villosa perpurpurea	Purple Bean	LE	Y	NLAA	NLAA
Villosa trabalis	Cumberland Bean	LE	-	NLAA	-
Snails					

Scientific Name	Common Name	Federal Status	DCH (Y=Yes)	TVA Species Determination	TVA DCH Determination
Anguispira picta	Painted Snake Coiled Forest Snail	LT	-	NLAA	-
Athearnia anthonyi	Anthony's River Snail	LE	-	NLAA	-
Campeloma decampi	Slender Campeloma	LE	-	NLAA	-
Leptoxis ampla	Round Rocksnail	LT	-	NLAA	-
Leptoxis foremani	Interrupted Rocksnail	LE	Y	NLAA	NLAA
Leptoxis plicata	Plicate Rocksnail	LE	-	NLAA	-
Leptoxis taeniata	Painted Rocksnail	LT	-	NLAA	-
Lioplax cyclostomaformis	Cylindrical Lioplax	LE	-	NLAA	-
Pleurocera foremani	Rough Hornsnail	LE	-	NLAA	-
Pyrgulopsis ogmorhaphe	Royal Marstonia	LE	-	NLAA	-
Pyrgulopsis pachyta	Armored Marstonia	LE	-	NLAA	-
Insects					
Neonympha mitchellii	Mitchell's Satyr	LE	-	NLAA	-
Crustaceans					
Orconectes shoupi	Nashville Crayfish	LE	-	NLAA	-
Flowering Plants					
Arabis georgiana	Georgia Rock-cress	LT	Y	NLAA	NE*
Conradina verticillata	Cumberland Rosemary	LT	-	NLAA	-
Liatris helleri	Heller's Blazing Star	LT	-	NLAA	-
Lindera melissifolia	Pondberry	LE	-	NLAA	-
Ptilimnium nodosum	Harperella	LE	-	NLAA	-
Sagittaria secundifolia	Kral's Water-plantain	LT	-	NLAA	-
Spigelia gentianoides	Gentian Pinkroot	LE	-	NLAA	-
Spiraea virginiana	Virginia Spiraea	LT	-	NLAA	-

*NE = No Effect

Biological Opinion

Programmatic Strategy for Right-of-Way Vegetation Management that May Affect Endangered or Threatened Plants in the Tennessee Valley Authority Service Area

FWS Log #: 04ET1000-2018-F-0958

Prepared by:

U.S. Fish and Wildlife Service
Tennessee Ecological Services Field Office
446 Neal Street
Cookeville, Tennessee 38501

VIRGIL ANDREWS Digitally signed by VIRGIL ANDREWS
Date: 2019.05.08 15:38:58 -04'00'

Virgil Lee Andrews, Jr.
Acting Field Office Supervisor

Date

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Abbreviations/Acronyms

ac	acre(s)
ADCNR	Alabama Department of Conservation and Natural Resources
ANHP	Alabama Natural Heritage Program
AMM	avoidance and minimization measure
ATV	all-terrain vehicle
BA	biological assessment
BISO	Big South Fork National Scenic River and Recreation Area
BMP	best management practices
BO	biological opinion
CFR	Code of Federal Regulations
CH	federally designated critical habitat
cm	centimeter(s)
COE	United States Army Corps of Engineers
CR/CAP	Condition Report/Corrective Action Plan
dc	decimeter(s)
DOD	United States Department of Defense
EO	element occurrence
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act of 1973
FY	fiscal year
FO	field office (refers to a state U.S. Fish and Wildlife Ecological Services Office)
FR	Federal Register
Ft	Foot or Feet
GDNR	Georgia Department of Natural Resources
GIS	Geographic Information System
IDNR	Indiana Department of Natural Resources
in	inch(es)
KNHP	Kentucky Natural Heritage Program
KSNPC	Kentucky State Nature Preserves Commission (recently renamed as the Office of Kentucky Nature Preserves)
km	kilometer(s)
km^2	square kilometer(s)
LAA	may affect, and is likely to adversely affect
LBL	Land Between the Lakes National Recreation Area
LRCNP	Little River Canyon National Preserve
LTNA	Land Trust of North Alabama
m	meter(s)
m^2	square meter(s)
mi	mile(s)
mi^2	square mile(s)
mm	millimeter(s)
mph	miles per hour
NEPA	National Environmental Policy Act
NB	National Battlefield

NF	National Forest
NLAA	may affect, but not likely to adversely affect
NMLT	North Mississippi Land Trust
NRCS	Natural Resources Conservation Service
NP	Nature Preserve
NPS	National Park Service
O&M	operations and maintenance
ORV	off-road vehicle
O-SAR	Office Level Sensitive Area Review
PSA	Power Service Area
PSF	Pickett State Forest
PSP	Pickett State Park
QA/QC	quality assurance/quality control
RM	river mile(s)
RO	United States Fish and Wildlife Service, Southeast Regional Office
ROW	rights-of-way
SMZ	streamside management zone
SNA	State Natural Area
SNHP	State Natural Heritage Program
SOP	standard operating procedure
TDEC	Tennessee Department of Environment and Conservation
TL	transmission line
TDNA	Tennessee Division of Natural Areas
TNC	The Nature Conservancy
TNFO	Tennessee Ecological Services Field Office
TNHP	Tennessee Natural Heritage Program
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WMA	Wildlife Management Area
WWC	Wet Weather Conveyance

CONSULTATION HISTORY

This section lists key meetings and correspondence (events) during the course of this consultation. A complete administrative record of this consultation is on file in the U.S. Fish and Wildlife Service's (USFWS) Tennessee Ecological Services Field Office (TNFO).

Date	Event	Participants	Discussion Topic
Nov. 27, 2017	Telephone call	Tennessee Valley Authority (TVA) staff; USFWS TNFO staff	Scope of consultation and TVA interest in having a meeting with Field Offices (FOs) from all seven states intersected by the TVA power service area (PSA). TNFO is lead office.
Dec. 18, 2017	Video Conference hosted by TVA, Knoxville, TN	TVA Staff; USFWS TN, KY, GA, MS, and VA FO staff	Discussion of consultation scope, TVA right-of-way (ROW) vegetation management practices, and proposed project schedule.
Jan. 3, 2018	Postal correspondence	TVA to USWFS TNFO	Letter requesting early coordination, including draft species list and proposed schedule.
Feb. 28, 2018	Video Conference hosted by TVA, Knoxville, TN	TVA Staff; USFWS TN, AL, and GA FO staff	Presentation of TVA debris management techniques and rationale behind TVA preliminary species determinations.
Mar. 6, 2018	Conference call	Staff from TVA and USFWS Southeast Regional Office (RO)	Recent retirement of TNFO Field Supervisor and discussion of moving the consultation forward.
Mar. 14, 2018	Conference call	Staff from TVA and USFWS Southeast RO	USFWS Southeast RO clarified that it would function as a facilitator and provide a support role during the consultation, and the TNFO would retain responsibility for development and completion of the biological opinion (BO).
Mar. 14, 2018	E-mail correspondence	GIS staff from USFWS TNFO and TVA staff	Initiated coordination with TVA to acquire maps, illustrating locations of TVA transmission lines (TLs) to overlay listed species occurrences.
Mar. 20, 2018	Telephone call	Staff from TVA and USFWS Southeast RO	USFWS Southeast RO provided updates on recent USFWS

Date	Event	Participants	Discussion Topic
			activities and upcoming meetings.
Mar. 22, 2018	Postal correspondence	TVA to USFWS Southeast RO	TVA sent a non-disclosure agreement to USFWS for release of map data with TVA TL locations.
Apr. 4, 2018	E-mail correspondence	Staff from TVA, USFWS Southeast RO, and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	TVA responded to USFWS questions from recent internal meeting.
Apr. 16, 2018	Telephone call	Staff from TVA, USFWS Southeast RO, and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	Discussed what actions and species should be covered in the consultation and reviewed TVA's ROW Vegetation Management methods and tools and project scope.
June 13, 2018	Video Conference hosted by TVA, Knoxville, TN	Staff from TVA, Southeast RO and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	Discussed species determinations for all listed species in the Action Area.
July 10, 2018	E-mail correspondence	Staff from USFWS ALFO and TVA	Discussed effect determinations for Black Warrior waterdog, flattened musk turtle, and whooping crane.
July 13, 2018	E-mail correspondence	Staff from USFWS GA and TNFOs, USFWS Southeast RO and TVA	Discussed effect determinations for species found in the Conasauga River in TN and GA.
July 18, 2018	Telephone call	Staff from MSFO and TVA	Discussed effect determinations for Mitchell's satyr and red-cockaded woodpecker.
July 24, 2018	Telephone call	Staff from VAFO and TVA	Discussed effect determinations for aquatic species, particularly those in the Clinch and Powell rivers.
July 24, 2018	E-mail correspondence	Staff from TVA, USFWS Southeast RO, and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	TVA sent message with complete species list and all species determinations discussed by USFWS and TVA.

Date	Event	Participants	Discussion Topic
Aug. 13, 2018	Conference call	Staff from TVA, USFWS Southeast RO, and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	TVA discussed rationale underlying determinations for designated critical habitats (CH). TVA provided the schedule for remainder of consultation.
Sept. 14, 2018	E-mail correspondence	Staff from TVA, USFWS Southeast and Northeast ROs, and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	TVA submitted draft biological assessment (BA).
Oct. 2018	E-mail correspondence	Staff from TVA and USFWS GAFO	Discussion of the potential effects of mechanical tree clearing on aquatic species in the Conasauga River basin.
Nov. 19, 2018	E-mail and postal correspondence	TVA provided to USFWS Southeast RO and USFWS AL, GA, NC, MS, KY, TN, and VA FOs	TVA submitted the Final BA.
Dec. 18, 2018	E-mail correspondence, letter attached	USFWS TNFO provided to TVA	The TNFO initiated formal consultation and indicated that the subject draft BO would be provided to TVA no later than Mar. 5, 2019 and the final BO provided to TVA no later than Apr. 5, 2019.
Feb. 20, 2019	E-mail correspondence	USFWS TNFO provided to TVA	Based on a Feb. 8, 2019 conference call between the USFWS Southeast RO, USFWS TNFO and TVA, the TNFO provided revised due dates for the draft and final BO (due to a several week government shutdown, deliverable dates had to be extended). The revised draft BO due date was indicated as Apr. 9, 2019, and the revised final BO due date was indicated as May 10, 2019.
Apr. 9, 2019	E-mail correspondence	USFWS TNFO provided to TVA	The TNFO notified TVA that the draft BO would be forthcoming on April 10, 2019.

Date	Event	Participants	Discussion Topic
Apr. 10, 2019	E-mail correspondence	USFWS TNFO provided to TVA	The TNFO forwarded the draft BO to TVA for review and comment.
Apr. 11 – May 3, 2019	Telephone calls and E-mail correspondence	Staff from USFWS TNFO and TVA	The TNFO and TVA coordinated regarding reviews and necessary revisions to the draft BO.
Apr. 29, 2019	E-mail correspondence	TVA provided to USFWS TNFO	The TVA provided comments on the draft BO to the TNFO for consideration and incorporation into the document.
Apr. 30, 2019	E-mail correspondence	USFWS TNFO provided to TVA	The TNFO provided the final draft BO to TVA for review and comment.
May 3, 2019	E-mail correspondence	TVA provided to USFWS TNFO	The TVA provided comments on the final draft BO to the TNFO for consideration and incorporation into the document.
May 8, 2019	E-mail correspondence	USFWS TNFO provided to TVA	The TNFO provided the signed, final BO to TVA.

BIOLOGICAL OPINION

1. INTRODUCTION

A biological opinion (BO) is the document that states the opinion of the USFWS under section 7 of the Endangered Species Act of 1973, as amended (ESA), as to whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat (CH).

The Federal action addressed in this BO is the TVA proposed programmatic strategy for ROW vegetation management that may affect 18 endangered or threatened plants in the TVA Power Service Area (PSA) (the Action). The TVA's request for formal consultation was received on November 21, 2018, and formal consultation was initiated on that date. With that correspondence, TVA enclosed a Biological Assessment (BA) for the Action, dated November 2018, which describes how three overarching categories and 13 methods of vegetation management, that TVA authorizes, funds, or carries out, would be carried out over the next 20 years. Four bat species, and all potential effects to bats from TVA ROW vegetation management activities were previously addressed in the recently finalized BO, *Programmatic Strategy for Routine Actions that May Affect Endangered or Threatened Bats* (signed April 12, 2018).

The BA addresses potential effects to all 163 plant and animal species, federally-listed as endangered or threatened at the date of the BA, that could occur in the 209 county area that intersects the TVA PSA and associated TLs. TVA also addresses how the proposed vegetation management methods and tools may affect CHs for a number of species. The TVA transmission system intersects CH for 35 species. Bat species are not analyzed here because the recent Biological Opinion *Programmatic Strategy for Routine Actions that May Affect Endangered or Threatened Bats* (signed April 12, 2018) accounts for all effects of TVA ROW vegetation management on those species.

The TVA determined that all 13 of methods of vegetation management have no effect on one arachnid, one snail, three crustaceans, and 13 plants or designated CH for 12 species (Appendix I). The TVA also determined that all 13 of methods of vegetation management are "may affect, but not likely to adversely affect" (NLAA) 127 species, including one mammal, five birds, two reptiles, two amphibians, 36 fish, 60 freshwater mussels, eleven snails, one insect, one crustacean, and eight flowering plants; TVA also made a NLAA determination for CH designated for one amphibian, 14 fish, 19 mussels, and one snail (Appendix I). By letter dated December 18, 2018, the USFWS concurred with TVA's NLAA determinations, which concluded the consultation relative to these species, CHs, and activities. Until new information warrants a reinitiation of the consultation that supported these activity-specific findings, projects that are fully consistent with the activity description in the BA do not require further consultation with the USFWS regarding the species and CHs for which the USFWS provided programmatic concurrence. TVA will annually report all project-level activities that complied with ESA §7(a)(2) by relying on the programmatic consultation (see Section 21 below).

Finally, the TVA determined in the BA that the Action "may affect, and is likely to adversely affect" (LAA) the eighteen plant species, listed below:

- Price's potato-bean (*Apios priceana*)
- Braun's rock-cress (*Arabis perstellata*)
- Pyne's ground plum (*Astragalus bibullatus*)
- Morefield's leather-flower (*Clematis morefieldii*)
- Alabama leather-flower (*Clematis socialis*)
- leafy prairie-clover (*Dalea foliosa*)
- whorled sunflower (*Helianthus verticillatus*)
- small whorled pogonia (*Isotria medeoloides*)
- fleshy-fruit gladecress (*Leavenworthia crassa*)
- lyrate (*a.k.a.*, lyreleaf) bladderpod (*Lesquerella lyrata*)
- Spring Creek bladderpod (*Lesquerella perforata*)
- Mohr's Barbara's buttons (*Marshallia mohrii*)
- Cumberland sandwort (*Minuartia cumberlandensis*)
- Short's bladderpod (*Physaria globosa*)
- white fringeless orchid (*Platanthera integrilabia*)
- green pitcher plant (*Sarracenia oreophila*)
- large-flowered skullcap (*Scutellaria montana*)
- Tennessee yellow-eyed grass (*Xyris tennesseensis*)

This BO is limited in scope to evaluating the effects of 12 of the 13 methods of ROW vegetation management that TVA determined would LAA the 18 plant species listed above. One method of vegetation management (Reseeding, Restoration) is considered further in the BO as explained later in Section 2.

ESA §9(a)(2) prohibits certain acts with respect to endangered plant species, including acts that:

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

Regulations issued under ESA §4(d) extend the prohibition under (a) above to threatened plant species (50 CFR §17.71). The damage or destruction of endangered and threatened plants that is incidental to (not the purpose of) an otherwise lawful activity is not prohibited. A Federal action that is likely to jeopardize the continued existence of listed plant species is not lawful; therefore, our BO evaluates the effects of the Action to the 18 listed plant species included under this consultation.

A Federal action that is likely to destroy or adversely modify designated CH is not lawful. Based on the information provided in the BA, the USFWS concurred with TVA's NLAA

determinations for CH potentially affected by the Action. Since no CH for listed plant species will be destroyed or adversely modified, this BO does not further mention or address CH.

A BO evaluates the effects of a Federal action along with those resulting from interrelated and interdependent actions, and from non-federal actions unrelated to the proposed Action (cumulative effects), relative to the status of listed species and the status of CH. A USFWS opinion that concludes a proposed Federal action is *not* likely to jeopardize species and is *not* likely to destroy or adversely modify CH fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA. "*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

2. PROPOSED ACTION

TVA proposes a Vegetation Management Programmatic Strategy (the Action) to streamline the manner in which the agency fulfills its responsibilities under ESA §7 relative to ESA-listed plant species. TVA's BA for the Action describes various methods that may affect listed plant species and conservation measures, including best management practices (BMPs), standard operating procedures (SOPs), and avoidance and minimization measures (AMMs), that TVA will apply to ameliorate adverse effects. Addressing these activities programmatically is intended to promote consistency, predictability, and efficiency of project-level consultations, and to more effectively address the conservation needs of listed plants at local and landscape scales.

The Action is comprised of 13 methods of vegetation management under the following three general action categories that TVA authorizes, funds, or carries out:

1) vegetation control;
2) debris management; and
3) ROW restoration.

The Action does *not* include activities associated with:

- Maintenance work on existing TL infrastructure (*e.g.*, pole/structure replacement, addition of grillage/surcharge, installation of lightning arrestors, overhead ground wire replacement, reconductoring, or any other work on TL assets).
- Intentional ground disturbance (excavation/fill, access road construction, *etc*.), work within a stream channel, and placing fill in wetland.
- Future ROW acquisitions and new TL construction.[1]

TVA determined that 12 of the 13 methods of vegetation management under two of the three general action categories, listed above, are LAA the 18 endangered and threatened plants discussed in Section 1:

[1] To address potential impacts of vegetation management along new TL ROW, TVA would tier from this programmatic ROW vegetation management consultation unless the environmental conditions projected to be present in the new ROW are not addressed in this document.

1) Manual Clearing – cutting or pulling using hand tools or chainsaws;
2) Mechanical Clearing – clearing of trees and shrubs where previous vegetation maintenance has been infrequent and woody plants have encroached into the ROW or removal of vegetation in areas where trees were never cleared. Mechanical clearing can also be used to safely remove off-ROW danger trees;
3) Mechanical Mowing – mowing of herbaceous plants and seedlings to maintain vegetation within the floor area of the ROW;
4) Mechanical, Side-Wall Trimming – tree trimming, from ground or air, on the ROW edge;
5) Herbicide, Spot Treatment – highly targeted herbicide application, such as stump treatment or hack and squirt;
6) Herbicide, Localized – low volume foliar application is most common, but basal treatment, localized granular application, and bareground treatments are also included;
7) Herbicide, Broadcast (ground) – non-selective herbicide application made from the ground;
8) Herbicide, Broadcast (aerial) – non-selective herbicide application made from the air using a fixed-wing airplane or helicopter equipped with a boom-type spray assembly;
9) Manual, Debris Management – cut and leave trees, but material may be cut into smaller pieces to facilitate decomposition;
10) Mechanical, Debris Management – chipping, mulching, and off-site hauling of debris;
11) Burning, Debris Management – burning in piles or containers; and
12) Landowner Use, Debris Management – debris can be provided to the landowner in the form of firewood or mulch.

In this BO, we do not further address the one method of vegetation management (Reseeding, Restoration) described for the Action that TVA determined is NLAA listed plants. The USFWS concurs with that determination based on the discountable nature of affects associated with that method. As a result, the scope of the BO is limited to the 12 methods of vegetation management included above that are LAA the 18 listed plants, and to the proposed conservation measures that are relevant to these species.

In the context of consultation under ESA §7(a)(2), the Action is consistent with the regulatory definition at 50 CFR §402.02 of a "framework programmatic action," which is a Federal action that approves a framework for the development of future actions that are authorized, funded, or carried out at a later time, and are subject to further consultation.

2.1. Action Area

For purposes of consultation under ESA §7, the action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). The 13 vegetation management methods of the programmatic Action will occur on lands associated with the three general action categories listed in the previous section.

TVA's transmission system consists of a network of more than 16,000 miles (mi) of electric TLs and about 500 power substations, which are all contained within 238,196 acres (ac) of utility ROW. The ROW width for a single line varies from approximately 75 feet (ft) to 200 ft, increasing with the voltage of the line. ROWs containing multiple lines can be larger depending on the number of lines and voltage. As summarized in Table 2-1, TVA's transmission ROW can be classified into three broad categories based on the need for routine vegetation maintenance. TVA has management responsibility for the entirety of the 238,196 ac of transmission ROW; however, TVA actively maintains only approximately 47 percent or 110,752 ac. This is because approximately 52 percent of the transmission ROW is used as cropland, golf courses, orchards or similar uses that integrate compatible vegetation, which is primarily maintained by the respective landowners.

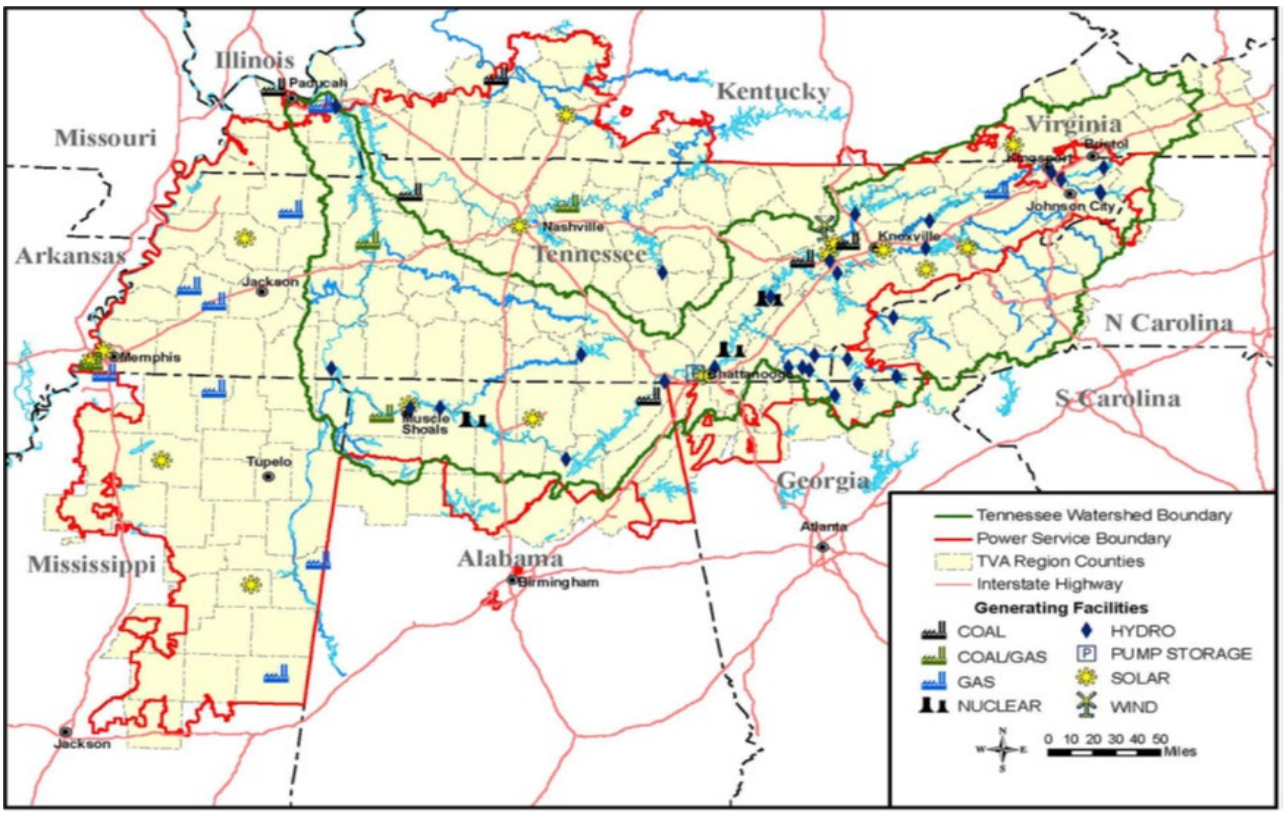
A relatively small amount of the TVA transmission system ROW (4,720 ac) does not require routine vegetation management by TVA or the landowner. These areas include transmission ROW that spans open water or deep valleys where vegetation growing at lower elevations does not threaten the TL.

Table 2-1. Summary of routine vegetation maintenance responsibility and extent within TVA transmission rights-of-way (source: BA Table 1-1).

Broad Land Management Category	**ROW (ac)**	**Percent of ROW**
Lands Primarily Maintained by Others	122,724	51.5%
Lands Not Subject to Management	4,720	2.0%
Lands Actively Managed by TVA	110,752	46.5%
Total	**238,196**	**100%**

The 238,196 ac reported in Table 2-1 are distributed throughout TVA's more than 82,000-square-mile (mi^2) (approximately 52.5-million ac) PSA (Figure 2-1) in Tennessee, northern Alabama, northern Georgia, southern Kentucky, eastern Mississippi, western North Carolina, and southwestern Virginia. TVA has described the total 238,196 ac of transmission ROW lands that may receive effects of project activity at any time during the next 20 years as the "Action Area" for this consultation. The BA does not provide maps delineating Action lands within the TVA PSA, because many are difficult to display effectively at a regional scale (*e.g.,* where various vegetation methods would be applied within the existing transmission ROW network). However, the BA does provide a map of six regions consisting of 12 sectors that TVA has designated for vegetation management purposes (Figure 2-2). The Action Area represents 0.5 percent of the entire 52.5-million acre PSA, within the 82.8 million acre TVA Region.

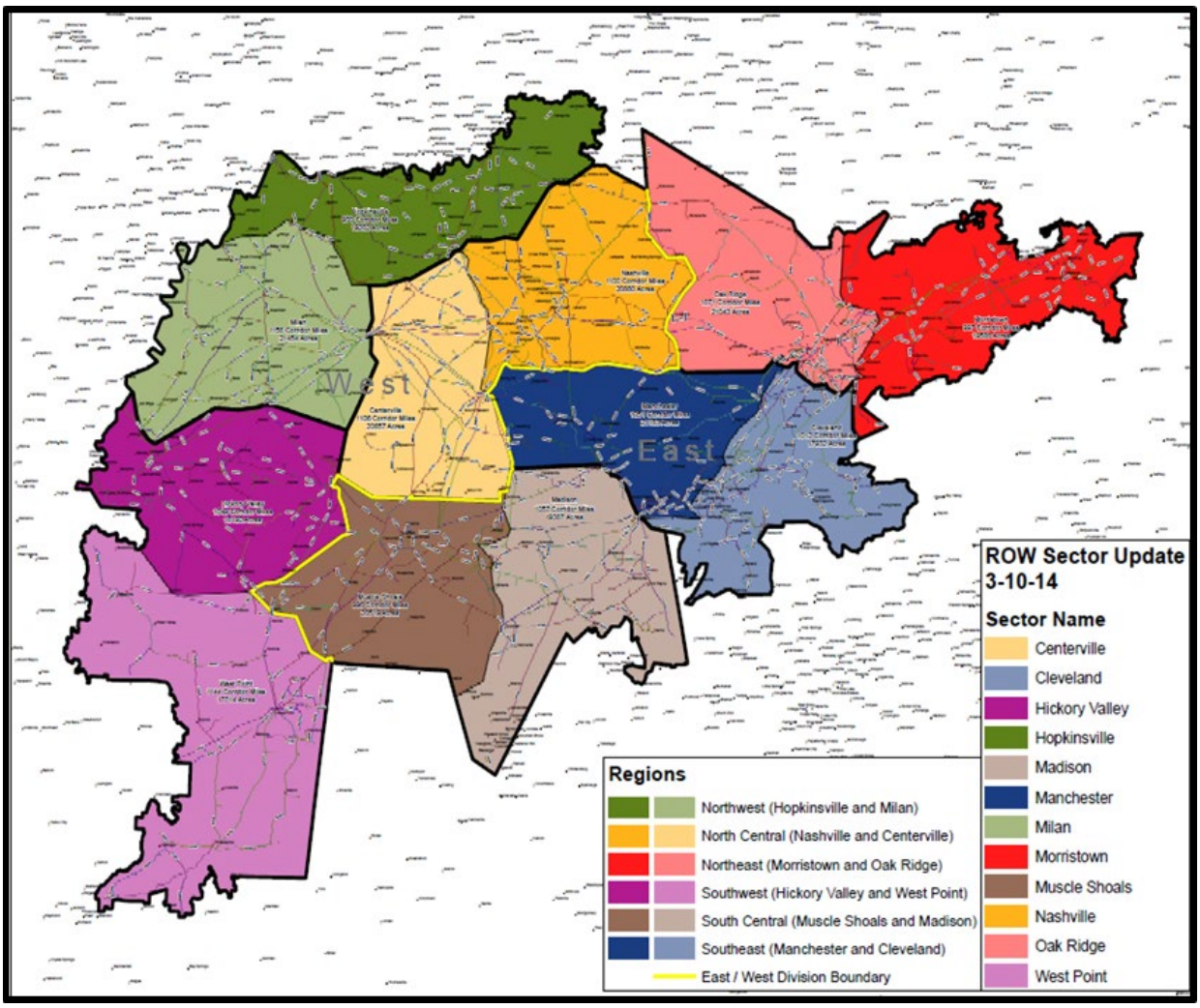
Figure 2-1. TVA Power Service Area (source: BA Figure 1-1).



TVA must continuously manage vegetation occurring on TL ROW in order to ensure reliability of the system. The BA does not provide a project-specific schedule or map of activities over the 20-year Action duration, but TVA does develop annual plans to maintain TL ROWs within each of the 12 vegetation management sectors (Figure 2-2). Routinely, TVA estimates that approximately 47 percent or about 110,752 ac of the 238,196 ac of the Action lands for which the programmatic Action is formulated will receive direct and indirect effects from project activity; therefore, the majority (approximately 52 percent) of the Action lands will receive no effects. Vegetation management activities will likely occur at irregular timeframes due to environmental and site-specific factors. This will mean that some areas may receive vegetation management activities infrequently or that some may be treated on multiple occasions over the 20-year term of the consultation. We have adopted TVA's definition of the Action Area for this programmatic consultation, but we recognize that application and distribution of the vegetation management activities likely will not be uniform; TVA will rely on its annual plan to determine where, when, and which activities are undertaken to meet its overall vegetation management objectives.

Chapter 2 of the BA, "Description of Action Area," provides data about terrestrial vegetation, terrestrial wildlife, and aquatic ecology of the 238,196 ac PSA (i.e., the Action Area), distributed in linear corridors (e.g., transmission ROWs) throughout the region.

Figure 2-2. TVA's vegetation management regions and sectors (source: BA Figure 1-2).



2.2. Vegetation Control

TVA is considering eight methods of vegetation control that can be used alone or in combination to manage vegetation within the TL ROW including:

- Manual clearing;
- Mechanical clearing;
- Mechanical mowing;
- Mechanical side-wall trimming;
- Herbicide, spot treatment;
- Herbicide, localized;
- Herbicide, broadcast (ground); and
- Herbicide, broadcast (aerial).

These vegetation control methods, and the advantages and disadvantages of each method (as perceived by TVA, are described in Table 2-2.

Table 2-2. Transmission Line Right-of-Way Vegetation Control Methods (Source: BA Table 3-1).

Description	Advantages	Disadvantages
Manual Clearing (Hand Work - Pulling or Cutting)		
Chainsaw, machete, brush hooks, axes, bush blades		
Hand clearing work is effective for selective vegetation removal and may be necessary in select areas where mechanical or chemical methods cannot be used. Hand clearing is likely most effective for minor projects or sensitive areas such as wetlands, steep slopes, or where restrictions are imposed on other viable methods.	Selective – Only targeted vegetation is removed. Lighter footprint – Causes less ground disturbance, which mitigates potential impacts to sensitive cultural or biological areas. Can be employed under most field conditions.	Prohibitively expensive for large areas. Labor intensive, less safe to workers, and more intrusive than some herbicide treatments. Typically, most effective for areas of low density vegetation. Can create an environment where resprouting occurs, which increases the woody stem count. Resprouting leads to increased safety concerns and higher costs due to the need for increased long-term vegetation management. Not effective for noxious weeds and can facilitate the expansion of invasive plant communities. Chainsaw use may be restricted at certain times in areas with protected animal species.
Mechanical Clearing (Cutting and Trimming)		
Bulldozer, track-hoe, skid steer, shears (*e.g.*, feller-buncher), mulcher/chipper, Hydro-ax including various other attachments, tracked equipment such as Compact Track Loader		
Clearing of trees and shrubs where previous vegetation maintenance has been infrequent and woody plants have encroached into ROW or removal of vegetation in areas where trees were never cleared. Can also be used to safely remove off-ROW danger trees.	Efficient and lowest cost methods of re-clearing, especially for areas of dense vegetation. The use of mechanized equipment can also be used to mitigate certain hazard exposures due to working near energized TLs. Can fell, lift, and stack trees; or mulch trees; or selectively cut trees depending on the machine and attachments. Mechanical equipment that can mulch or chip eliminates removal of large debris, hastens decomposition, adds organic matter to the soil (keeps nutrients in place), and reduces erosion potential.	Used on large, accessible areas. May not be appropriate for sensitive areas (*e.g.*, archeological sites). Cannot be used on steep slopes (>30%). Negative environmental impacts include non-selective removal of vegetation, ground agitation, noise, and possible oil leaks and spills. Not effective against noxious weeds, as the machines scatter seeds and leave roots. Shatters stumps and supporting near-surface root crowns. Resprouting from shattered stumps and root crowns can produce multi-stem dense stands, which can result in a monoculture (single species vegetation cover).

Description	Advantages	Disadvantages
		Potential seasonal restrictions for sensitive species (*e.g.*, federally listed bat species and ground-nesting birds).
Mechanical Mowing (Mower or brush hog)		
Involves mowing of herbaceous plants and seedlings to maintain vegetation within the floor area of the ROW. Typically performed on a short-term basis (cycle is 3 years or less). Removes and grinds brush and fells small trees.	Effective at grinding brush and felling small trees. Grinding and scattering improves aesthetics, facilitates debris decomposition, and reduces fire hazards. Mowing reduces debris size (creates mulch), hastens decomposition, and adds organic matter to the soil (keeps nutrients in place). Appropriate timing can affect plant community development by selecting for low-growing plants.	Disadvantages are typically the same as those for clearing.
Mechanical (Side-Wall Trimming)		
From air – Helicopter tree saw		
Trimming trees immediately adjacent to the ROW to prevent encroachment within the ROW.	Can prune trees quickly and efficiently.	Requires repeated treatments that may not keep up with fast growing species and leads to ongoing vegetation management cost.
From ground – Hydro-ax, Jarraff & Kershaw line trimmers, aerial lifts		
Trimming trees immediately adjacent to the ROW to prevent encroachment.	Efficient and safer than other trimming methods.	Same as side-wall trimming from air.
Herbicide, Spot Treatment		
Stump spray following cutting to control re-growth. Hack and squirt involves making small cuts in the trunk of target trees and squirting herbicide into the cut. Growth regulators are designed to reduce growth rates of some fast-growing species.	Stump spraying kills unwanted woody plants by preventing re-growth or sucker growth. Growth regulators are helpful to slow growth and avoid removal where tree removals or vegetation conversions are prohibited or impractical (*e.g.*, urban forests). Result in better erosion protection, more wildlife food and cover plants, and often yield an increase in flowering plants and shrubs which enhances available pollinator habitat. Select herbicides retain ground cover, which helps reduce erosion issues in the transmission ROW, and the ground cover provides habitat, which helps retain the biological communities associated with those habitats.	Effectiveness varies by season (works best when plants are taking up nutrients for the winter). Growth regulators are not economical on a large scale. Applicators must be trained, follow applicable state guidelines for licensure and charter requirements. Applicators must also follow manufacturer instructions and U.S. Environmental Protection Agency (EPA) guidelines. Application can require written permissions or permits. Multiple, specific restrictions on applications around waterbodies, agricultural areas, urban areas, federal and state parks and forests, and other sensitive areas. Herbicides must be prevented from reaching streams whether by direct

Description	Advantages	Disadvantages
		application or through runoff (unless labeled for aquatic use). Timing of application is seasonally dependent.
Herbicide, Localized		
Individually treats selected species or groups of species within a limited area using a variety of techniques including: Basal treatments – herbicides are applied by hand via squirt bottle or backpack to the base of the plant from the ground up to knee height. Low-volume foliar treatments – herbicides primarily are applied by workers using backpack sprayers and applicator. An all-terrain vehicle (ATV) or tractor with a spray-gun attachment also can be used. Herbicide is applied to the foliage of individual or clumps of plants according to the label directions during the growing season. Localized granular application – granular or pellet forms of herbicide are hand-applied to the soil surface beneath the drip lines of an individual plant or as close to a tree trunk or stem base as possible. Herbicide is applied when there is enough moisture to dissolve and carry the herbicide to the root zone. Bare-ground treatments – applications made via backpack sprayer, ATV, tractor with a spray-gun, or hand disbursed. This approach treats the ground to keep any vegetation from growing rather than treating the vegetation itself. The herbicide used can be in liquid or granular formulations. This technique commonly would be used in an electric yard (substation) and around wood transmission poles within the transmission ROW.	Species-specific, low-volume applications of herbicides using a variety of techniques and timing show definite improvement of ROW plant diversity. Work well in treating deciduous tree stumps to prevent resprout and regrowth in the transmission ROW. Selective treatment of vegetation at a distance allows for less ground disturbance, which minimizes inadvertent damage to sensitive areas or compatible (non-targeted) vegetation. Result in better erosion protection, more wildlife food and cover plants, and often yield an increase in flowering plants and shrubs which enhances available pollinator habitat. Select herbicides retain ground cover, which helps reduce erosion issues in the transmission ROW, and this ground cover provides habitat, which helps retain the biological communities associated with those habitats.	Applicators must be trained, follow applicable state guidelines for licensure and charter requirements. Applicators must also follow manufacturer instructions and U.S. EPA guidelines. Application can require written permissions or permits. Multiple, specific restrictions on applications around waterbodies, agricultural areas, urban areas, federal and state parks and forests, and other sensitive areas. Herbicides must be prevented from reaching streams whether by direct application or through runoff (unless labeled for aquatic use). Timing of application is seasonally dependent.
Herbicide, Broadcast (Ground)		
Non-selective, broadcast applications made from the ground (manual and mechanical) to treat an entire area, rather than individual	Herbicides can be liquid, granular, or powder and can be broadcast, giving this method some application flexibility. Involves less ground disturbance when applied at a distance, which minimizes	Applicators must be trained, follow applicable state guidelines for licensure and charter requirements. Applicators must also follow

Description	Advantages	Disadvantages
plants or small groupings of plants. Used to treat transmission ROWs that are heavily vegetated, and also are used to treat noxious weeds. Application techniques include: High-volume foliar treatments – herbicide is applied by truck, ATV, or tractor with a spray-gun, broadcast nozzle, or boom to spray foliage and stems of target vegetation. The herbicide mixture is pumped through hoses to either a hand-held nozzle or a boom. Cut-stubble treatment – herbicide is applied from a mobile boom over large swaths of freshly mechanically-cut areas to prevent resprout or regrowth of vegetation. This is the broadcast style of stump treatment. Broadcast granular treatment – granular forms of herbicide are dispersed by hand, belly grinder (a front-held container that disperses seeds by turning a hand crank), truck, or tractor. The herbicide is dispersed over a relatively large area, such as in an electric yard (substation) or around the tower legs of a transmission structure. Broadcast bare-ground treatments – herbicide is dispersed by ATV or tractor with a spray-gun by trucks with mounted booms, or can be hand disbursed. This application treats the ground to keep vegetation from growing, but covers a wider area than other broadcast application methods. Generally, this application technique is used in electric yards (substations) and other areas that need to be kept completely clear of vegetation for safety purposes (*i.e.*, prevention of worker electrocution due to vegetation creating a difference in the electrical potential).	damage to soils, archaeological resources, and nesting and tunneling wildlife.	manufacturer instructions and U.S. EPA guidelines. Application can require written permissions or permits. Multiple, specific restrictions on applications around waterbodies, agricultural areas, urban areas, federal and state parks and forests, and other sensitive areas. Herbicides must be prevented from reaching streams whether by direct application or through runoff (unless labeled for aquatic use). Timing of application is seasonally dependent.

Description	Advantages	Disadvantages
Herbicide, Broadcast (Aerial) - Aerial Sprayers		
Non-selective herbicide application made from a fixed wing or rotary aircraft.	Cost-effective because it can be used without disturbing the ROW. Can be cost effective and efficient for large, remote, or difficult-to-access sites. Herbicides can be liquid, granular, or powder and can be broadcast, giving this method some application flexibility. Involves less ground disturbance when applied at a distance, which minimizes damage to soils, archaeological resources, and nesting and tunneling wildlife.	Requires preflight walking or flying inspection 72 hours (hrs) prior to application (or as specific state statutes require). Aerial application of herbicides requires specific weather conditions (*e.g.*, wind speed, fog, temperatures) and involves risks associated with flying. Long-term decreases in diversity of native plants and degraded habitat for sensitive species. Aerial applications require buffers around sensitive resources. Threat to off-target vegetation from drift of herbicides. Applicators must be trained, follow applicable state guidelines for licensure and charter requirements. Applicators must also follow manufacturer instructions and U.S. EPA guidelines. Application can require written permissions or permits. Multiple, specific restrictions on applications around waterbodies, agricultural areas, urban areas, federal and state parks and forests, and other sensitive areas. Herbicides must be prevented from reaching streams whether by direct application or through runoff (unless labeled for aquatic use). Timing of application is seasonally dependent.

2.3. Debris Management

A second general TVA action category identified in section 2 routinely involves a need to manage debris. TVA is considering four methods of general debris management that can be used alone or in combination to manage debris within the TL ROW including:

- Manual, Debris Management;
- Mechanical, Debris Management;
- Burning, Debris Management;
- Landowner Use, Debris Management

These debris management methods, and the advantages and disadvantages of each method, are described in Table 2-3.

Table 2-3. Transmission Line Right-of-Way Debris Management Methods (source: BA Table 3-5).

Descriptions	Advantages	Disadvantages
Manual, Debris Management		
Cut and Leave (left in place) – chainsaws or other manual tools		
Trees may be cut and left in place in specified areas with approval from the appropriate regulatory agency. These areas may include sensitive areas where tree removal would cause excessive ground disturbance or very rugged terrain where windrowed trees are used as sediment barriers along the edge of the ROW. TVA prefers to leave vegetation in place in areas where removal is a significant risk to worker safety.	Eliminates off-site hauling costs. Can provide wildlife habitat under coarse-woody debris (depending on the species of interest). Can provide nutrient recycling (*i.e.*, organic soil matter). Can provide erosion control. Good for sensitive areas or very rugged terrain.	Requires prior approval from appropriate regulatory agency. Potential public backlash because of the initial aesthetics of felled logs and brush debris. Reduced access for subsequent vegetation maintenance activities. Cut vegetation might visually intrude on public or private landowner uses. Can create fuel for wildfires. Can harbor tree pests (e.g., emerald ash borer) and disease.
Cut & Leave (lopping and scattering) - ground crews, chainsaws, brush rakes, skidders		
Branches of trees are cut (lopped) and trunks are cut into 4 to 8 ft. lengths. Limbs and trunks are then scattered throughout the ROW, laid flat, and left to decompose. Debris can then be "crushed" by driving over with machinery (which can speed decomposition).	Eliminates off-site hauling costs. Some mechanical equipment also can mulch or lop and scatter vegetation debris as the equipment moves through an area. Can provide wildlife habitat (depending on the species of interest). Can provide erosion control and nutrient recycling.	Can be difficult, time consuming, and less safe. Cut vegetation might visually intrude in lands traditionally used by others. Can create more fuel for wildfires. Can harbor tree pests (*e.g.*, emerald ash borer), disease, and spread invasive species (*e.g.*, scatter seed). Limited use for certain tree species. For example, pine needles can reduce grass re-growth and there is a risk of poisoning to grazing livestock from pine needles and the wilted leaves of wild cherry. Not appropriate for sensitive areas.
Mechanical, Debris Management		
Chipping in Place – chippers, skidders, grapples, rakes		
Mechanical brush disposal cuts brush into chips (less than 4-inch diameter). Chips are then spread over the ROW. Trunks too large to chip are de-limbed then placed as windrows at the edge or scattered along the ROW, as the situation requires.	Eliminates off-site hauling costs. Can provide erosion control and nutrient recycling (*i.e.*, organic soil matter). Spread-out wood chips and mulch can create a visually appealing park-like look. Windrows can capture snow/precipitation and hold more moisture and provide some shade protection for seedling establishment. Potential benefits to wildlife and nutrient cycling.	Non-target plants can be damaged when debris is dispersed. Chipper machinery can have limited access. More labor intensive than mulching. Windrows allow tree saplings to sprout in places where mechanical equipment cannot reach during future vegetation control.
Mulching in Place – roller-choppers, mulchers, mowers		
Mulching falls between chip and lop-and-scatter methods.	Same as Chipping in Place	Not effective against noxious weeds (spread seed and leave roots).

Descriptions	Advantages	Disadvantages
Debris is cut into 4 inches to 2 ft lengths and scattered in the ROW to decompose and is best used when terrain or conditions do not allow use of mechanical chipping equipment.		Not appropriate for sensitive areas. Non-target plants can be damaged when mulching. Results in more coarse debris than chipping.
Offsite Debris Disposal (hauling) – loaders; truck and trailers		
Cut trees and brush are collected into piles and loaded onto trailers or debris trucks, regardless of debris size. Debris is then hauled by trucks to offsite locations.	Removing all debris can create a more visually appealing look. Creates safer conditions in the ROW for workers and the public. Reduces the fuel available for wildfires.	Trucks can have limited access. Rutting can damage non-target plants and compact soils from repeated truck-trips. May inadvertently spread invasive species by distributing seeds off the ROW. More labor intensive and expensive than Cut and Leave methods. Potential disposal costs at offsite locations.
Offsite Debris Disposal (chip and haul) – chippers; truck and trailers		
Brush is chipped and blown directly into a trailer. Trunks too large to chip are de-limbed then placed onto trailers. All debris is then hauled by trucks to offsite locations.	Removing all debris can create a more visually appealing look. Creates safer conditions in the ROW for workers and the public. Reduces the fuel available for wildfires. Chipping increases the amount of debris that can be loaded onto a single trailer, reducing number of truck-trips needed.	Same as above.
Burning, Debris Management		
Burning (pile) – ground crews, chainsaws, skidders, brush rakes, drip torches		
Debris is moved off the ROW and burned in small piles.	Reduces or eliminates hauling and debris processing costs. Reduces wildfire potential of remaining slash. Reduces transmission of insects and disease.	Reduces air quality, visibility, and public health due to the smoke created by burning woody biomass. Conditions can alter the effectiveness of this method and fire can spread if not managed properly. Workers conducting the burning can experience minor to severe burns, smoke irritation, and inhalation of toxic agents or particulates that can have acute effects. Burning is a hazard in the ROW and near substations where smoke can induce flashovers from electrified facilities. Will typically sterilize an area of the soil, making it susceptible to weeds. The soil in and around the burn should be stirred to re-inoculate the soil with beneficial micro-flora and fauna.

Descriptions	Advantages	Disadvantages
Burning (container) – air current incineration systems (*e.g.*, air current destructor, air curtain burner, trench burner)		
The main operating principle of air curtain incineration systems is high velocity air (curtain) that is blown across and into the upper portion of the combustion chamber. The high volume of air causes over-oxygenation of the fire, and secondly the high velocity airflow over the combustion chamber traps particulates (smoke). These types of burners can efficiently dispose of large quantities of forest waste products at very high temperatures with very little air emissions.	Produces lower smoke emissions compared to pile or broadcast burning. Burns a greater variety of materials (new and old) and turns 95 to 98% of debris into ash. Reduces fire risk and outbreak of insect problems. Operates with fewer restrictions on weather and burn conditions. Residents in urban interface areas are more willing to accept use and remove wood waste and slash fuel hazards around their homes if offered free disposal. The fire is contained and easily and quickly extinguished, if necessary.	Still produces smoke emissions and heat, which may make this option untenable in the ROW. May not be as cost competitive in areas where broadcast and pile burning are acceptable. Requires use of motors to add forced-air into the system which has risks (*e.g.*, fuel spills, emissions, noise). Requires purchase of the system which is an expensive upfront capital cost.
Landowner Use, Debris Management		
Landowner Use - feller-buncher, forwarders, skidders, chainsaws		
Wood that is large enough for firewood or sale by the owner can be cut to lengths upon request and left for the owner's use.	Benefits local landowners and can improve relations overall. Reduces need to remove large timber from the ROW.	Generally, only an option during initial ROW clearing and has limited application for existing ROW vegetation management. Requires prior communication and coordination with local landowners.

2.4. Avoidance and Minimization Measures (AMMs) to Protect Listed Plants

Information in this section was derived from Chapter 4 of the BA.

2.4.1. Office Level Sensitive Area Review (O-SAR)

The types of sensitive resources occurring in or near the transmission ROW vary widely and include threatened and endangered plant and animal species, caves, heron/osprey rookeries, natural areas, and wetlands. To protect sensitive resources on TL ROWs, TVA developed the Office Level Sensitive Area Review (O-SAR) process as an integral component of all of its vegetation management practices.

The O-SAR process is used to address routine vegetation maintenance activities. As part of the O-SAR process, qualified biologists perform reviews of the entire transmission system every three years. These desktop reviews use computer-based mapping programs and a wide array of digital data in lieu of field surveys to ascertain where sensitive resources may occur on TVA transmission ROWs. Field-verified data is added to the O-SAR data, if and when it becomes available. The common and widely available data sets used in office-level reviews include aerial photography, U.S. Geological Survey topographic maps, National Wetlands Inventory data, EPA Level 4 ecoregion maps, and Natural Resource Conservation Service (NRCS) soils maps.

Sensitive resources identified as part of the review process are grouped into five general categories: Plants, Aquatic Animals, Terrestrial Animals, Natural Areas, and Wetlands. Regarding plants, the data descriptions include documented or potential locations of federally or state-listed species or unique communities. Based on proposed vegetation management activities, and the requirements of sensitive resources present within areas to be managed, specific criteria are developed to guide project planning and work. These include limitations on the use of certain vegetation management practices (*e.g.*, broadcast herbicide application would be restricted around federally listed plant populations).

Each AMM is grouped into SAR "classes" for the respective categories. These classes define appropriate or inappropriate vegetation management practices, or impose additional review or coordination requirements prior to initiation of work.

TVA's approach is unique in that it uses specific data as part of the O-SAR review that includes both TL/structure locations coupled with TVA's extensive Regional Natural Heritage database. This is a "living" database that contains approximately 40,000 occurrence records for protected plants, animals, caves, heronries, eagle nests, and natural areas for the entire TVA operations area. TVA shares data with the USFWS, and most of the seven states within the TVA region to ensure the quality of data contained in the TVA Regional Natural Heritage database.

In the first phase of the O-SAR review process, data are added to the O-SAR database, primarily when TVA biologists conduct desktop reviews of portions of the transmission system. O-SAR reviews are conducted annually on approximately 1/3 of the transmission system in conjunction with planned vegetation maintenance activities. If during the review, data indicates a sensitive resource may be present, a polygon that defines the area of interest is created within the O-SAR database and overlaid on the segment of TL ROW under review. Each polygon is assigned an O-SAR class which identifies needed AMMs for the resource.

Sensitive areas may be defined based on information available on the various computer-based mapping sources described above. These also may be added to the O-SAR database because landscape features *(i.e.*, slope, soils, exposed bedrock) and proximity to previously documented resources could indicate that other sensitive resources may be present within or near the ROW easement.

In the second phase of the O-SAR review process, specific guidance governing transmission ROW vegetation management is appended to every identified sensitive resource polygon. This guidance results in the assignment of a "Class" level for each polygon, which is accompanied by specific guidance provided to TVA transmission ROW personnel to support further vegetation management planning efforts. The guidance may be informational or prescriptive and result in limitations of particular control measures, requirements for notification to TVA biologists, or the need for site-specific field surveys to be performed by TVA biologists prior to work activities. This guidance constitutes an important aspect of the implementation of BMPs to minimize environmental impact.

The guidance is particularly important to clearly define what vegetation maintenance activities are permissible within sensitive areas, taking into account the specific sensitive resources that

occur or might occur on a given section of transmission ROW. The guidance also seeks to give certainty and flexibility to TVA transmission ROW personnel, who develop vegetation control activities over large areas under schedule and budget constraints.

Resources are assigned to various classes from those that need less special treatment to those that include more sensitive species, which require greater precautions. Resource categories include plants, aquatic and terrestrial animals, natural areas, and wetlands. Because this consultation only addresses listed plants, we only discuss the classes into which plants are categorized and O-SAR guidance, specific to plants, including how the guidance types are assigned, below.

Plants, Class 1

This Class allows for selective herbicide application to woody plants and mechanical/hand-clearing of all vegetation without site-specific coordination with the TVA botanist, regardless of season. Broadcast herbicides are not permitted. This level of guidance is applied to protect rare species and habitats and is applied when federally or state-listed plants, or uniquely diverse plant communities, are somewhat likely to occur within a given section of transmission ROW based on the professional judgment of the TVA botanist when performing desktop O-SAR reviews.

Broadcast herbicide use is prohibited under this guidance because it is considered to be the most detrimental vegetation maintenance tool to rare plants and diverse, herbaceous plant habitats dominated by native plant species. Also, selective application of herbicide to woody plant species often promotes herbaceous habitat and is considered an appropriate tool for the large portions of the TVA transmission system that have not been field surveyed and could contain federally or state-listed plant species.

Currently, broadcast and aerial herbicide is restricted from use on approximately 17 percent (about 41,000 ac) of TVA TL ROWs likely to contain important habitat.

Plants, Class 2

Management of sensitive plant areas assigned as Class 2 requires active coordination between TVA operations' personnel and the TVA botanist. The guidance provided does not prescribe or prohibit any specific tool because each Class 2 area is handled on a case by case basis depending on the site, plant species in question, and the timing/type of vegetation clearing proposed.

This guidance is applied to sensitive areas where federally or state-listed (rank of S1 or S2) species are known to (or are highly likely to) occur. Often, areas covered under this classification are areas of regional conservation significance and contain unique species and habitat that are better represented within the early successional habitats perpetuated within the transmission ROW. Before scheduled vegetation maintenance, particularly herbicide application, TVA botanists regularly perform field surveys to assess the site.

Slightly less than one percent (about 2,000 ac) of TVA transmission ROW is known to contain populations of rare plant species; these areas are designated as Class 2 sites in the O-SAR database. When work is scheduled to occur at these locations, TVA botanists and transmission

ROW operations staff coordinate to ensure habitats are protected. Sometimes the proposed work would not affect listed plants found in the transmission ROW, but sometimes operations staff augment the timing or method of proposed work to protect sensitive resources. The following are representative examples of how O-SAR is used to avoid negative impacts to rare plants.

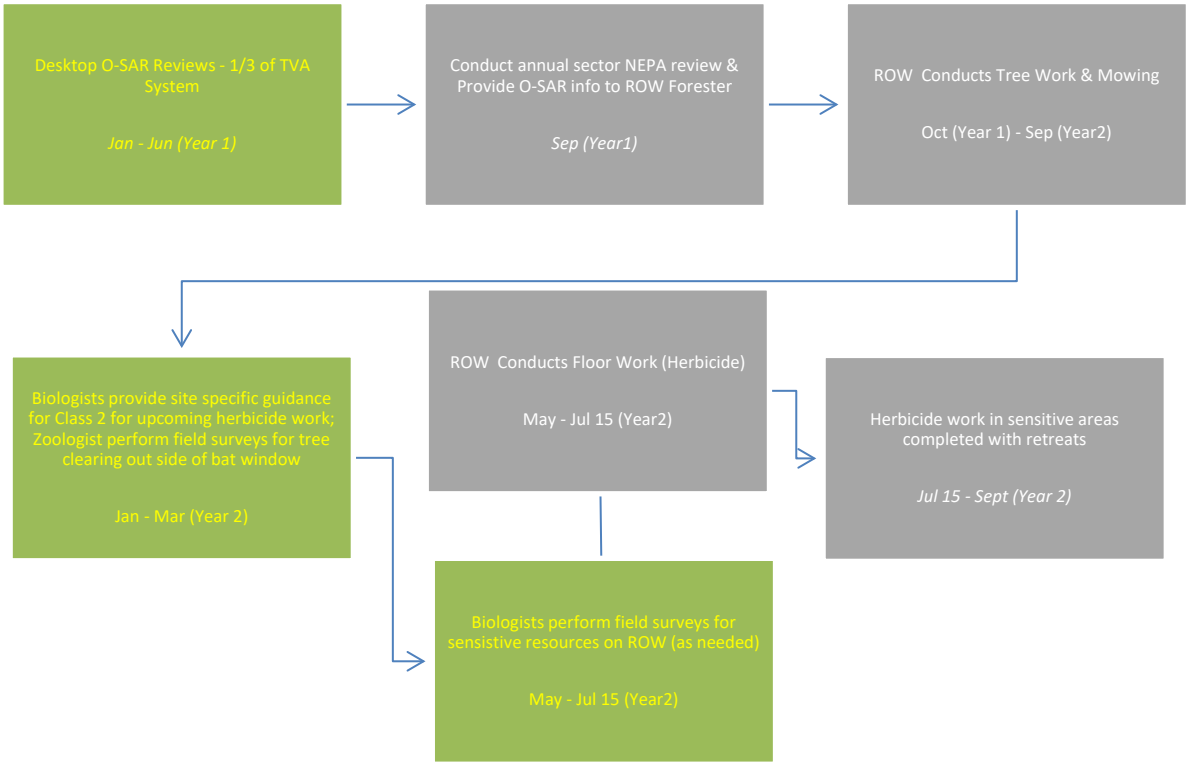
- *Timing* – TVA would avoid spraying herbicide in areas where federally listed plants may occur until after a species has completed its life cycle for the year (*i.e.*, after plants have bloomed and set seed).
- *Flagging* – Before localized herbicide application, typically low volume foliar application to woody plants, TVA botanists would perform field surveys to delineate specific areas where listed plants occur. Sites would be marked in the field with flagging tape and maps provided to the herbicide contractor, along with instructions on how work would be conducted in these areas. Typically, foliar herbicide would not be applied within flagged areas and any woody vegetation within those relatively small areas would be removed with machetes or spot application of herbicide.
- *Conservation Spray* – TVA documents sites where targeted, low-volume foliar application of herbicide to woody plants along the transmission ROW does not appear to negatively impact listed plant populations (*e.g.*, white fringeless orchid). This "conservation spray" differs from standard foliar application of herbicide because of extensive communication between TVA staff and herbicide applicators on the sensitive nature of the site. In addition, there is direct TVA oversight during the application, which leads to extra caution and large reductions in damage to non-target vegetation, such as the white fringeless orchid.
- *Natural Area Cooperation* – Where populations of listed plants occur on TVA TL ROW, TVA has worked with resource managers, who have coordinated with a third party to use herbicides to control woody plants in sensitive areas on ROW. Agreements with land management agencies are made on a case-by-case basis.

2.4.2. Implementation of O-SAR

The O-SAR process is fully integrated into the TVA vegetation management program. Figure 2-3 illustrates how the current iteration of this process fits in with other vegetation management activities and the National Environmental Policy Act (NEPA) reviews, which are conducted annually for each of the twelve ROW sectors that comprise the TVA transmission system. Specific attributes of O-SAR process may change over time, but integration of biology and ROW operations will continue into the future. In addition to ensuring NEPA compliance, these annual environmental reviews incorporate new O-SAR polygons and guidance, generated by TVA biologists, into the vegetation management planning process for the subsequent fiscal year (FY).

When all desktop O-SAR reviews have been completed for plants and all other disciplines (aquatic animals, terrestrial animals, natural areas, and wetlands), this data is then used for each sector specific NEPA review. The information is then passed on to the ROW Forester, who oversees vegetation management for each sector and uses it to inform on-the-ground vegetation management beginning the subsequent FY (i.e., beginning October 1 of each year).

Figure 2-3. Integration of O-SAR into the TVA Vegetation Management Program – Current Process (biologist actions are shown in green and ROW actions in gray) (source: BA Figure 4-3).



After providing updated O-SAR data via desktop review, there are several instances when biologists interact ROW operations staff. These include providing site specific guidance on Class 2 polygons (plants and aquatic animals) ahead of planned herbicide work (*i.e.*, low volume foliar treatment) and performing bat habitat surveys to support proposed tree work that must occur outside of the established clearing window. Botanists typically perform field surveys of Class 2 botany polygons during the growing season. These ROW are skipped during initial herbicide application. This allows botanists to perform field surveys at a seasonally appropriate time before application and prevents the surveys from holding up herbicide crews. The skipped Class 2 botany areas are then treated with other parts ROW in the TVA system that were inadvertently missed during the initial herbicide application (retreats). In these areas, AMMs, such as timing, flagging and conservation spray (See Plants, Class 1 and Class 2 under 2.4.1), are employed on a case-by-case basis according to the findings of the field survey.

2.5. Best Management Practices and Standard Operating Procedures

Information in this section was derived from Chapter 4 of the BA.

Several mechanisms govern how TVA performs ROW vegetation management activities on the ground. These range from formalized procedures and BMPs to indirect controls that serve to

limit adverse effects of vegetation work. The formalized processes and procedures outlined in three TVA documents are as follows.

- Guideline for Vegetation Maintenance, Site Specific Environmental Reviews & Permitting (TVA 2015a) – Appendix A of BA.
- A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Construction and Maintenance Activities, Revision 3 (TVA 2017a) – Appendix B of BA.[2]
- Transmission Environmental Protection Procedures, Right-Of-Way Vegetation Management Guidelines, Revision 8 (TVA 2017b) – Appendix C of BA.

Together, these practices, when paired with the planning and execution that takes place with O-SAR, allow TVA to avoid and minimize effects to listed plant species.

2.5.1. Streamside Management Zone Definition

Given the potential for herbicide application to negatively affect water quality and aquatic organisms, and the potential for soil disturbance to contribute to instream impacts, special restrictions are required when operating adjacent to intermittent or perennial waterbodies, including springs, streams, reservoirs, ponds, rivers, and other waterbodies. Measures are also taken to protect ephemeral streams (sometimes referred to as wet weather conveyances [WWCs]) even when they are not identified on project or topographic maps.

Streamside management zones (SMZs) are defined by TVA as, "an area or zone, covered with vegetation on both sides of perennial and intermittent streams and along the margins of bodies of open water, where extra precaution is used in carrying out activities (including vegetation management) to protect streambanks, instream aquatic habitat, and water quality". The width of SMZs may vary depending on the type of watercourse, primary use of the water resource, topography, existing features, land use, or the known or likely presence of listed animal species. A minimum 50-ft SMZ is established at ROW crossings. The width of the SMZ is increased as determined by conditions identified in Table 2-4.

Table 2-4. Recommended Minimum Width of Streamside Management Zones (source: BA Table 4-2).

Streamside Management Zone Category	**Percent Slope of Adjacent Lands**				
	1-10	11-20	21-30	31-40	41+
	Streamside Management Zone Width Each Side (Ft)				
A - Standard	50	70	90	110	130
B - Important	70	90	110	130	150
C - Unique	90	110	130	150	170

[2] Note - many techniques found in the BMP manual are designed for construction projects and do not apply to stand-alone vegetation clearing projects, however there are a number of practices that apply to both types of work.

A - Standard SMZ Protection
This is the standard (basic) level of protection for streams, springs, sinkholes, and the habitats around them.

B - Protection of Important Permanent Streams, Springs, and Sinkholes
This category will be used when there is one or more specific reason(s) why a permanent (always-flowing) stream, spring, or sinkhole requires protection beyond that provided by standard BMPs. Reasons for requiring this additional protection include high potential for occupancy by federally listed or significant state listed species, the presence of suitable habitat for federally listed or significant state listed species, CH, or areas designated as a special use classification (*e.g.*, trout waters). The purpose of these guidelines is to minimize the disturbance of the banks and water in the flowing stream(s) where this level of protection is required.

C - Protection of Unique Habitats
This category would be used when, for one or more specific reasons, a temporary or permanent aquatic habitat requires special protection. This relatively uncommon level of protection would be appropriate and required when a unique habitat requiring special protection is present (*e.g.*, the spawning area of a rare species), the stream is known to be occupied by a federally listed or significant state listed species, or when required as a special condition resulting from consultation with the USFWS to avoid project effects on a listed species or CH.

2.5.2. Site Specific Environmental Reviews

TVA uses prescriptive guidance within the O-SAR process to minimize and avoid effects to listed species. Most of this information is generated from desktop reviews. However, there are situations that would trigger a site-specific review by TVA environmental scientists should they arise during the course of vegetation management activities (TVA 2015a). Most of these situations rarely occur during vegetation management, but they include:

- O-SAR conditions and guidance cannot be met;
- Activities with the vicinity of large bird nests >2 ft in diameter;
- Activities in WWCs and SMZs including:
    - Culvert installations
    - Construction of stream crossing
    - Dredging/placing fill or riprap within a SMZ;
- Activities in wetlands including:
    - Equipment use cannot meet requirements laid out in TVA (2017a) for clearing in wetlands
    - Placing fill
    - Leaving brush, timber, tree limbs, debris, *etc*. in wetland area;
- Ground disturbing activities including:
    - Creating new access or clearing/regrading existing access
    - Leveling ground for equipment access
    - Other excavation/fill
    - Landowner requests (*e.g.*, repairing existing access, culvert repairs or installations, grading)

    - Use of bulldozer;
- Herbicide application cannot be applied in accordance with label use restrictions.

If these types of actions are needed during the course of ROW vegetation management, TVA would assess the potential impact of the work and enter into section 7 consultation if the proposed action may affect listed species.

2.5.3. Standard BMPs – Herbicide Use

Herbicides are an important tool in the integrated vegetation management approach utilized by TVA. While appropriate herbicide use benefits the ROW vegetation management program, there are some potential risks associated with their use. Some of these risks include contamination of waterways, over application that results in soil erosion, and unintended damage that could harm off-target plant and animal species. For these reasons, TVA employs a host of BMPs focused on avoiding and minimizing negative impacts of herbicide use. BMPs are reported comprehensively in TVA (2017a, 2017b) and summarized here.

- The sites to be treated are selected and application directed by the appropriate TVA official;
- Herbicide is only applied according to the label, by licensed applicators;
- Temperature, wind speed, and precipitation dictate application;
- Herbicides are not applied to surface water or wetlands unless specifically labeled for aquatic use. Generally, contractors are directed not to apply to waterbodies;
- Use of aerial or broadcast application of herbicides is not allowed within or adjacent to perennial streams, ponds, and other water sources;
- A pre-flight walking or flying inspection must be made within 72 hrs prior to applying herbicides aerially. This inspection should ensure that no land use changes have occurred, sensitive areas are clearly pointed out to the pilot, and proper buffer zones are maintained;
- Aerial application of liquid herbicides normally will not occur when surface wind speeds exceed five miles per hour (mph), in areas of fog, or during periods of temperature inversion or when other conditions exist that the label restricts;
- Pellet application normally will not occur when surface wind speeds exceed 10 mph or on frozen or water-saturated soils;
- Liquid application will cease when the temperature reaches 95 degrees (Fahrenheit) or above. Application during unstable, unpredictable, or changing weather patterns will be avoided. Equipment and techniques will be used that are designed to ensure maximum control of the spray swath with minimum drift; and
- Hand application of herbicides labeled for use within SMZs is used only selectively.

2.5.4. Standard BMPs – Tree Work

TVA employs many practices that encourage environmental stewardship during tree clearing activities. TVA (2017a) discusses how TVA clears vegetation in SMZ and wetlands. Specific BMPs used to minimize soil disturbance and erosion during tree clearing in SMZs and wetlands include:

- Stumps/roots are left in place;
- Hand cutting methods are used in SMZs; feller buncher use is permissible, but rarely used in SMZ for non-construction vegetation clearing; and
- Cut debris will be kept out of intermittent and perennial stream channels, wetlands, or groundwater infiltration zones. Should debris reach these areas, it would be promptly removed.

While not explicitly stated in TVA (2017a), the following practices are standard clearing procedures implemented throughout the ROW, not just in sensitive areas. These techniques limit the potential for erosion and include:

- Avoiding intentional soil disturbance during clearing – trees are hand cut with a chainsaw or cut above ground with machinery;
- Mechanical clearing equipment is not used on steep slopes exceeding 30 percent;
- Stumps and roots are left in place, allowing vegetation to quickly recover;
- Approximately 80 percent of chipping/mulching is completed <2 weeks from when trees are cut. Approximately 20 percent of chipping/mulching is completed >2 weeks from when trees are cut, usually because of weather constraints. In these situations, trees are cut and left in place until chipped or mulched; and
- TVA encourages contractors to adopt new technology as it becomes available. For example, TVA was an early adopter of the tracked chipper, which is a low ground pressure piece of equipment that results in very little soil disturbance.

Tree clearing practices designed to limit soil disturbance and erosion, resulting from clearing or rutting, is rarely problematic. If an aberrant erosion event occurred, the TVA ROW Forester would direct the contractor to immediately repair the damage resulting from TVA work. In this scenario, all work would be done according to the BMP manual (TVA 2017a). While not typically necessary, select practices used in these unusual situations could include:

- Mulch berms
- Silt fence
- Erosion control blankets
- Seeding temporary vegetation
- Seeding permanent vegetation.

2.5.5. Standard BMPs – Equipment Maintenance

All machinery requires petrochemicals in order to operate. TVA BMPs require all machinery to be in good working order (TVA 2017a). Examples of TVA BMPs designed to minimize discharge of pollutants to the environment include:

- All on-site vehicles must be monitored for leaks and receive regular preventative maintenance to reduce the chance of leakage;

- Heavy equipment may be serviced on the ROW except in designated sensitive areas. In that situation, proper ground cloths, matting, or plastic sheeting must be used to prevent releases of oil, fuel, or grease into the environment;
- Mobile and/or portable oil or fuel storage tanks should be positioned or located to prevent spilled oil from reaching watercourses; and
- Spill response equipment and sufficient absorbent material to contain and clean up fuel or chemical spills or leaks must be maintained on-site or be readily available.

2.5.6. Standard Operating Procedures

Indirect controls do not specifically direct how work is conducted, but do serve to incentivize behaviors that result in positive environmental outcomes, including reducing the potential for effects to listed species. Examples of indirect controls include direct ROW forester oversight, quality assurance/quality control (QA/QC) assessments, easement contract language, and property owner relationships. TVA also has a Condition Report/Corrective Action Plan (CR/CAP) process to identify and correct procedural and implementation issues related to its programs.

2.5.6.1. Direct Right-of-way (ROW) Forester Oversight

TVA ROW Foresters have direct day-to-day oversight over clearing contractors, who work on TVA ROW. A ROW Forester is assigned to each one of the twelve TVA ROW sectors (Figure 2-2) and has direct oversight of that particular sector. Before any work occurs in their sector, the TVA ROW Forester has a pre-job briefing with the tree clearing and herbicide contractors. During this meeting, TVA ensures that the scope of the project is clear, but also provides the clearing contractor with the TVA BMP manual and all environmental restrictions for the project area. This includes O-SAR guidance designed to protect caves, natural areas, SMZ, wetlands, and state and federally listed species. The contractor is encouraged to report issues, such as erosion events, as soon as they occur. While work is being conducted, ROW Foresters regularly visit the job site to ensure tasks are being properly conducted, including adherence to environmental standards. If issues are identified, the contractor must repair the damage immediately.

2.5.6.2. Quality Assurance/Quality Control Assessments

QA/QC assessments are a second tier of quality control that occurs at a broader scale than the direct ROW Forester oversight. The overall goal of the program is to ensure all contractors meet contract requirements in safety, vegetation management, and efficient use of resources. The inspection process provides an impartial and transparent feedback by using a third party who is not involved in the day to day activities of contractors. Specific inspection forms have been developed for each major type of inspection to be performed. Individual inspection forms are broken down into sub-categories defining specific requirements in the contract. A percentage compliant scale is used to score each type of inspection conducted. Each subcategory inspected receives a percent compliant score, which is compiled to achieve a percent compliant score for the overall completed inspection. Property damage, which includes soil disturbance and erosion,

is specifically assessed. If issues are identified, the contractor must repair the damage immediately. For tree clearing projects in previously unmaintained portions of the ROW:

- A random selection of 33 percent of all spans (a span is the area between consecutive structures on a TL) is assessed in the field; and
- If problems are found, additional spans are inspected to ensure the full extent of issues is identified.

2.5.6.3. Easement/Contract Language

ROW easement and contract language are indirect, but important, mechanisms for preventing erosion when TVA clears trees. As the holder of an easement and not the landowner, TVA is responsible for repairing any damage done to a property during the course of TVA operations on ROW. Similarly, contracts for a given tree clearing project typically contain language stating that contractors are responsible for repairing damage done during work. Example language is:

> "Contractor will be responsible for erosion damage and especially for creating soil conditions that would threaten the stability or compaction of the ROW soil, the structures, or access to either."

TVA also places language in contracts to incentivize positive behavior from the herbicide and clearing contractors employed to manage vegetation on TVA ROW. Examples of contract language that facilitate support of environmental protection measures include:

- "Contractor will be subject up to a $2,500 assessment per violation or occurrence for non-compliance with environmental guidance";
- "Contractor will be financially responsible for all environmental mitigation, including direct and indirect costs incurred by TVA, that is needed to repair damage from herbicide applications resulting from Contractor error or non-adherence to TVA guidelines"; and
- "In the event a violation occurs due to Contractor's negligence or the negligence of its subcontractors, Contractor will be required to perform a root cause analysis".

2.6. Project-Level Process

In Section 1, we discussed the scope of the Action, including the methods of TVA ROW vegetation management funded, authorized, or carried to rely on this programmatic consultation for ESA compliance with respect to the listed plants that such activities may affect. In Section 2, we indicated specific activities not covered by the programmatic Action.

In Section 1.8 of the BA, TVA describes situations where it would not tier from this programmatic ROW vegetation management consultation including:

1. TVA and USFWS determine that species are LAA in a manner not identified in this programmatic consultation.
2. TVA is unable to adhere to SOPs, BMPs, or the TVA O-SAR process during vegetation management.

If TVA cannot use the programmatic consultation to address affects to listed species expected to occur during vegetation management of a new TL, TVA would address vegetation management, along with construction and operation of the new TL, during a stand-alone section 7 consultation with the USFWS.

2.7. Interrelated and Interdependent Actions

A BO evaluates the effects of a proposed Federal action. For purposes of consultation under ESA §7, the effects of a Federal action on listed species or critical habitat include the direct and indirect effects of the action, plus the effects of interrelated or interdependent actions.

> "Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR §402.02).

The 12 methods addressed in this programmatic Action are routine components of projects that serve one or more of the three general action categories listed in section 2 of this BO. Projects authorized, funded, or carried out under these three action categories may or may not involve interrelated or interdependent actions. Section 1.8 of the BA indicates that "future ROW acquisitions and new TL construction would receive an independent review" and that, "TVA would enter into section 7 consultation with the USFWS for these projects if TVA determines that construction or operation of the new TL has the potential to affect listed species". Therefore, we believe that through TVA's independent O-SAR review process, potential interrelated or interdependent activities associated with one or more of the activities covered under this programmatic Action would be adequately addressed. Any assessment of interrelated and interdependent activities at the program level of this Action would be speculative, given its activity-level focus. Therefore, we do not further address the topic of interrelated or interdependent actions in this BO.

2.8. Cumulative Effects

For purposes of consultation under ESA §7(a)(2), cumulative effects are those caused by future state, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation.

The BA suggests that many types of non-federal actions may potentially occur within the 238,196-ac Action Area in the foreseeable future and have varying levels of impact on environmental resources. This is because TVA maintains only 47 percent (approximately 110,752 ac) of lands within the Action Area; approximately 52 percent of the transmission ROW is primarily maintained by landowners (Table 2-1). As examples, TVA lists state highway maintenance and improvement projects, airport operations and expansions, rail development projects, industrial/residential development, and mining operations. TVA further suggests that

other actions may include routine management and/or improvement of public lands by state and local agencies or an influx of new companies that leads to new infrastructure. Future routine operations and maintenance (O&M) activities undertaken by TVA also have the potential to trigger state, private and non-federal actions. Other actions may include routine management and/or improvement of public lands by state and local agencies or an influx of new companies that leads to new infrastructure.

Many of the threats identified for the 18 plant species covered under this consultation and identified in their recovery plans and 5-year reviews partially occur as a result of future state, local, or private actions that are reasonably certain to occur in the Action Area. These include indiscriminate application of herbicides, incompatible mowing regimes, and tree clearing activities for industrial forestry and ROW maintenance; introduction and encroachment of invasive exotic species and competitive herbaceous and woody vegetation; loss, alteration, and/or degradation of suitable habitat from residential, commercial, and/or industrial development (urbanization), cropland agriculture, livestock grazing, and trampling; illegal ORV use; relic hunting (at a single location known to support Cumberland sandwort) resulting in disturbance to plants via trampling and/or digging in a rock house; and poaching of plants for commercial resale purposes.

While we expect the non-federal actions discussed above to occur, we lack specific data about such actions and where the effects of such actions would occur in the Action Area. The USFWS is, therefore, unable to meaningfully assess the cumulative effects that may be relevant to this consultation, except as discussed in the Opinion sections for some of the affected species in the sections below.

3. PRICE'S POTATO-BEAN

3.1. Status of Price's Potato-Bean

This section summarizes best available data about the biology and current condition of Price's potato-bean (*Apios priceana*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the species as threatened on January 5, 1990 (55 FR 429-433).

3.1.1. Description of Price's Potato-Bean

The Price's potato-bean is a twining, herbaceous perennial vine in the pea family (Fabaceae). The species' climbing, yellow-green vines may grow up to 15 ft long and arise from stout, potato-like tubers that are about 7 inches (in) in diameter. The leaves are alternate and pinnately compound. The greenish-white to brownish-pink flowers are about 0.4-in long and tinged with magenta at the apex. The fruit is a legume about 5–6 inches long and 0.4-in wide that tapers at both ends. There are typically 4–10 seeds per legume. Fruits and seeds are olive-green when fresh, and mature fruits are brownish-red with tan lines, while the seeds are brown and glaucous when dry.

3.1.2. Life History of Price's Potato-Bean

Price's potato-bean typically flowers from mid-July through mid-August and produces fruit in August and September. Flowers are pollinated by various native arthropod species, such as the long-tailed skipper (*Urbanus proteus*) and bumble bees (*Bombus spp.*), and by non-native honeybees (*Apis mellifera*), although bees are reported to have some difficulty accessing the nectar (Robinson 1898). Flowers in the genus *Apios* have a tripping mechanism that causes the keel to coil when triggered by an insect. When the keel coils, it exposes the anthers and pistil, allowing pollination to occur (Bruneau and Anderson 1988). Price's potato-bean is the only species of *Apios* in which the keel bends backwards after tripping rather than coiling (Woods 1988). This tripping mechanism prevents self-pollination of the flowers. A single plant of Price's potato-bean growing in a private garden has been observed to set seed, indicating that the species is self-compatible (E. Croom, University of Mississippi, pers. comm., 1992).

Price's potato-bean plants have been observed to produce few seeds (Robinson 1898; Chester and Holt 1990; P. Olwell, Center for Plant Conservation, pers. comm., 1992). Shading of the plants by trees and shrubs (Medley 1980; Woods 1988; USFWS 1993), drought, and insect damage to flowers and fruits of Price's potato-bean (E. Chester, Austin Peay University, pers. comm., 1991) may all contribute to low seed set. Observations of a Mississippi population suggest that water availability may limit seed set; greater seed set has been observed in years with higher rainfall (E. Croom, pers. comm., 1992). Vegetative reproduction, if prevalent, would result in low genetic diversity that could reduce the success of sexual reproduction. Low fruit production also is seen in the American groundnut (*Apios americana*). Several populations of the species have been found to have a triploid chromosome number which precludes sexual reproduction (Bruneau and Anderson 1988). Bruneau and Anderson (1988) also found low fruit production (6 percent) in diploid populations of American groundnut and attributed low levels of fruit and seed production in these populations to limited resources and pollinators. A population of Price's potato-bean in Kentucky was found to be diploid with a somatic chromosome number of 22 (Seabrook and Dionne 1976). It is possible, however, that other populations are composed of sterile, triploid plants. More studies are needed to determine the reasons for low seed production in Price's potato-bean. When seeds are produced, they germinate readily with scarification (L. McCook, pers. comm., 1992; C. Baskin, University of Kentucky, pers. comm., 1991; Walter *et al*. 1986). In a small germination test, 18 of 20 seeds germinated after scarification (C. Baskin, pers. comm., 1991). Temperature fluctuations probably act to break the impermeable seed coat in the wild (C. Baskin, pers. comm., 1991). No information is available on when the seeds germinate in the wild.

This perennial species grows from a single large tuber, whereas American groundnut grows from several small tubers. Perhaps having a single tuber limits dispersal and vegetative reproduction of Price's potato-bean. Tubers of Price's potato-bean are dispersed when floods carry them to a new location (Seabrook and Dionne 1976). Tubers and seeds of American groundnut, frequently found near streams, may also be dispersed by water. No studies have investigated the dispersal mechanisms of the species. Plants do not flower during their first year of growth, but they can grow as much as 5–6 ft in their first season (C. Baskin, pers. comm., 1991). Observations also indicate that the tuber can remain dormant during a growing season and have vigorous growth the following year (L. McCook, pers. comm., 1992).

3.1.3. Numbers, Reproduction, and Distribution of Price's Potato-Bean

Price's potato-bean occurs in the southeastern United States in rocky, open woods and forest borders, often associated with mixed oak (*Quercus spp*.) woods, limestone, and drainage areas. When the Recovery Plan for Price's Potato-bean was published in 1993, there were 25 known extant populations distributed among 15 counties and four states: Autauga (2), Madison (1), and Marshall (1) counties, Alabama; Livingston (1), Lyon (1), and Trigg (2) counties, Kentucky; Clay (1), Lee (1), and Oktibbeha (2) counties, Mississippi; and DeKalb (1), Hickman (6), Marion (1), Maury (1), Montgomery (1), and Williamson (3) counties, Tennessee (USFWS 1993). There were 11 other populations considered extirpated in 1993 (2 in Illinois, 6 in Kentucky, and 3 in Tennessee), bringing the total number of known populations of the species at that time to 36. The species is considered extirpated from the State of Illinois (Ebinger *et al*. 2010), as no populations have been discovered in the state since the recovery plan was published.

Based on data in unpublished reports and from the Natural Heritage Programs in Alabama, Kentucky, Mississippi, and Tennessee, there are now 59 known extant populations, distributed among 26 counties in four states. Twenty-four of these populations are located entirely, or in part, on public lands or privately owned conservation lands; however, not all of these populations on protected lands receive adequate management to ensure they persist.

Alabama

There currently are 16 known extant populations of Price's potato-bean in Alabama, distributed among nine counties: Autauga (2), Butler (1), Dallas (2), Jackson (2), Lawrence (1), Madison (5), Marshall (1), Monroe (1), and Wilcox (1) (Alabama Natural Heritage Program [ANHP] 2014; Barger *et al*. 2014). Ten of these populations are located on publicly owned lands or private conservation lands (Table 3-1). Landowners of these sites include Alabama Department of Conservation and Natural Resources (ADCNR), Department of Defense (DOD), Land Trust of North Alabama (LTNA), U.S. Army Corps of Engineers (COE), and USFWS. The remaining populations are located on privately owned lands, including two on timberlands. These 15 extant populations totaled at least 2,266 Price's potato-bean plants, as reported by ANHP (2014). During a 2011 population census, a total of 2,158 plants were counted at Redstone Arsenal alone, half of which had stems 2 millimeters (mm) or less in diameter and were considered to be juveniles, providing evidence of recent successful recruitment (Boyd 2014).

Two extant Alabama populations that were included in the recovery plan have remained stable (Table3- 2). Based on available data, we are unable to determine the status of the other two Alabama populations that were included in the recovery plan.

Kentucky

There currently are seven known extant populations of Price's potato-bean in Kentucky, distributed among three counties: Livingston (2), Lyon (3), and Trigg (2) (Kentucky State Nature Preserves Commission [KSNPC] 2015). Of these seven populations, three were included in the species' recovery plan – one in Lyon County and the two in Trigg County (USFWS 1993). A fourth population, at the Carrsville Bluff site in Livingston County that was included in the recovery plan, has since been extirpated. Price's potato-bean has not been observed at this

Table 3-1. Price's potato-bean sites on protected lands (ANHP 2014; Boyd 2014; KSNPC 2015; USFS 2015; H. Sullivan pers. comm. 2016; TDEC 2018).

State	County	Site	Land Ownership	Last Observation
AL	Autauga	Jones Bluff	COE	21 vines – 2010
	Jackson	Little Coon Creek	ADCNR	5 vines – 2012
		Sauta Cave	USFWS	152 vines – 2011
	Madison	Blevins Gap	ADCNR, LTNA	32 vines – 2011
		Monte Sano State Park	ADCNR	27 vines – 2011
		Redstone Arsenal	DOD	2158 vines – 2011
		Rainbow Mountain	LTNA	42 vines – 2011
		Hale Mountain	ADCNR	6 vines – 2011
KY	Livingston	Corley Farm	Private	4 vines – 2014
		Livingston Co. WMA	Livingston County	41 vines – 2013
	Lyon	Mammoth Furnace	USFS	13 vines – 2018
		Pisgah Bay	USFS	1 vine – 2018
	Trigg	Hematite Lake	USFS	136 vines – 2018
		Laura Furnace	USFS	405 vines – 2018
MS	Chickasaw	Tombigbee NF	USFS	2 vines – 2015
	Lee	Coonewah & Chickasaw	NMLT	>500 vines – 2012 >50 vines – 2014
		Natchez Trace	NPS	53 vines – 2014
TN	DeKalb	Center Hill Bluffs	COE	>60 vines – 2015
	Franklin	Bear Hollow Mtn. WMA	TWRA	346 of vines – 2015
		Bear Hollow Mtn. WMA	TWRA	1 vine – 2011
	Hardin	Ross Forest SNA	Private	54 vines – 2015
	Montgomery	Barnett's Woods SNA	TDEC	18 vines – 2017
	Stewart	Neville Creek	USFS	44 vines – 2018
		Ft. Donelson NB	NPS	7 vines – 2017

location since 1992, despite several searches (most recently in 2008). However, American groundnut was found at this site in 1996, raising a question about the accuracy of the original record's identification as Price's potato-bean. The three extant populations that were included in the recovery plan have remained stable (Table 3-2).

Table 3-2. Status of extant Price's potato-bean populations in Alabama, Kentucky, Mississippi, and Tennessee (ANHP 2014; KSNPC 2015; TDEC 2018) that were included in the recovery plan (USFWS 1993).

State	County	Number of Vines – Date	
		Recovery Plan	**Last Observation**
AL	Autauga	6 – 1988	21 – 2010
	Marshall	5 or less – 1991	7 – 2010
KY	Lyon	7 – 1990	10 – 2013
	Trigg	<25 – 1989	23 – 2014
		30-50 – 1989	42 – 2014
MS	Lee	1,000 – 1983	>500 – 2012
	Oktibbeha	10-16 – 1988	11 – 2012
TN	DeKalb	25-50 – 1990	>60 – 2015
	Hickman	25 – 1990	>75 – 2015
		4 – 1991	1 – 2015
		7-10 – 1991	8 – 2015
		12 – 1991	2 – 2015
		6 – 1991	100 – 2015
		1-2 – 1991	1 – 2010 (No plants found in 2015)
	Marion	100-200 – 1990	231 – 2015
	Maury	24 – 1990	4 – 2015
	Montgomery	30-40 – 1990	61 – 2017
	Williamson	18 – 1990	47 – 2015
		45 – 1990	51 – 2015
		7 – 1990	22 – 2006 (No plants found in 2015)

The Lyon County population included in the species' recovery plan is on privately owned land. While the current landowner of this population cooperates with KSNPC (now, the Office of Kentucky Nature Preserves) conservation efforts for Price's potato-bean, there is no protection agreement in place and the landowner has expressed interest in selling this property. Two of the three populations in Lyon County are on U.S. Forest Service (USFS) property at Land Between the Lakes National Recreation Area (LBL), as are the two Trigg County populations included in the recovery plan (Table 3-1).

Both extant populations in Livingston County are protected. One population is located on the privately owned Corley Farm State Natural Area (SNA), which receives voluntary protection from the landowner under a natural area registry established in 2006. The second population is located on a site owned by Livingston County government. The Nature Conservancy (TNC) transferred ownership of this site to the local government and the KSNPC has entered into an agreement with Livingston County to assist in managing Price's potato-bean at the site (USFWS 2016a).

Mississippi

There are currently five known extant populations of Price's potato-bean in Mississippi, distributed among the following counties: Chickasaw (1), Kemper (1), Lee (2), and Oktibbeha (1) (H. Sullivan, Mississippi Department of Wildlife, Fisheries, and Parks, pers. comm. 2010, 2016; ANHP 2014; J. Burton, National Park Service [NPS], pers. comm. 2014).

Chickasaw County's population is located on the Tombigbee National Forest (NF) and consisted of two vines in 2015 (H. Sullivan pers. comm. 2016). One Lee County population is located in the North Mississippi Land Trust's (NMLT) Coonewah Nature Preserve (NP) and extends onto the neighboring Chickasaw Preserve (owned by The Archaeological Conservancy), while another population was discovered in 2014 on NPS lands along the Natchez Trace National Parkway. There were more than 500 plants estimated in the population at Coonewah NP in 2012 (ANHP 2014), over 50 plants at the Chickasaw Preserve in 2014 (Brady Davis, The Chickasaw Nation, pers. comm. 2016), and 53 plants at the Natchez Trace Parkway site (J. Burton pers. comm. 2014). The Kemper County population, consisting of only 6 plants as of 2012, and the Oktibbeha County population, with 11 plants in 2012, are both on privately owned lands (ANHP 2014). The Lee and Oktibbeha county populations were both included in the recovery plan, and based on numbers reported in the recovery plan and in ANHP (2014), appear to have remained stable (Table 3-2).

Two of the four populations that were known to exist in Mississippi at the time the recovery plan was completed have since been extirpated: the Rock Hill population in Oktibbeha County and the Clay County population. The Rock Hill population was extirpated due to incompatible land uses, including timber harvest and gravel mining. The Clay County population was apparently destroyed by a habitat improvement project funded by the NRCS (H. Sullivan pers. comm. 2010).

Tennessee

There currently are 31 known extant Price's potato-bean populations in Tennessee, distributed among 11 counties: DeKalb (1), Franklin (2), Giles (2), Hardin (3), Hickman (10), Marion (1), Maury (2), Montgomery (1), Stewart (2), Wayne (3), and Williamson (4) (Tennessee Department of Environment and Conservation [TDEC] 2018). Of these occurrences, 13 were included in the species' recovery plan – 1 each in DeKalb, Marion, Maury, and Montgomery counties, 6 in Hickman County, and 3 in Williamson County. Many of these occurrences included in the recovery plan have remained stable (Table 3-2).

There are seven populations on protected lands in Tennessee (Table 3-1). One Stewart County population is located at LBL and the other at Fort Donelson National Battlefield (NB), a NPS unit. The Montgomery County population is located at Barnett's Woods Designated SNA, owned by the TDEC, and one of the Hardin County populations discovered in 2009 is located on a privately owned, Registered SNA. The two Franklin County populations are located on Tennessee Wildlife Resources Agency's (TWRA) Bear Hollow Mountain Wildlife Management Area (WMA). In addition to these sites, there are reports of two sites on NPS lands along the Natchez Trace National Parkway, in Tennessee, supporting plants suspected to be Price's potato-bean, but positive identification of these plants has not been confirmed (Phillips 2006; Hatch and Kruse 2008).

3.1.4. Conservation Needs of and Threats to Price's Potato-Bean

Threats to Price's potato-bean include development, incompatible logging *(i.e.*, clearcutting or heavy logging), excessive shading by canopy trees, ROW maintenance for roads and utilities, and competition with non-native, invasive plants. Selective removal (hand thinning) of the canopy, if done carefully, may be beneficial to this species by increasing available light levels. It remains unknown whether excessive timber harvesting causes permanent destruction of the species; however, Kral (1983) asserts that occurrences exist in second growth forests and may recover after heavy logging.

Other threats affecting Price's potato-bean include small population size, low reproductive vigor, and potential for diminished genetic variation within the species. Despite the fact that 23 Price's potato-bean populations are on protected lands, recent observations indicate that low numbers of plants are present in most of these populations (ANHP 2014; KSNPC 2015; TDEC 2018; USFS 2015). Evidence of sufficient recruitment of seedlings into larger size classes capable of reproduction is generally lacking, with the exception of Redstone Arsenal's large population (Boyd 2014).

Davenport (2007) included Price's potato-bean in an analysis of potential effects of climate change on Alabama's plant life. The analysis was based on best professional judgment of how various habitat types and associated species may respond to climate changes that models predict Alabama will experience. Davenport (2007) concluded that "species demanding shady ravines and stream banks will constrict in distribution", including the hardwood forests inhabited by Price's potato-bean.

A previously unrecognized threat to Price's potato-bean occurred in the form of a 100-year flood event in middle Tennessee during May 2010, which severely disturbed habitat at nine populations in Hickman, Maury, and Williamson counties (TDEC 2012). Many of the affected populations occurred on steep slopes along the sides of roads that were severely damaged by the flooding due to their locations near streams in narrow valleys. As a result, further disturbance to the slopes where Price's potato-bean is located occurred at some of these sites during the process of clearing and grading the roadbeds for emergency repairs to restore traffic flow.

Conservation measures that have been implemented for Price's potato-bean include federal and state regulatory protection; research pertaining to the species' biology, ecology, and life history; establishment of seed banks; site protection and management; and surveys and monitoring. Similar conservation efforts should continue in the future.

3.2. Environmental Baseline for Price's Potato-Bean

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Price's potato-bean, its habitat, and ecosystem within the Action Area.

3.2.1. Action Area Numbers, Reproduction, and Distribution of Price's Potato-Bean

In the action area, the single known location of Price's potato-bean occurring on a TVA ROW is located in Stewart County, Tennessee, on the USFS's LBL. In cooperation with KSNPC, TDEC, and the USFWS's Kentucky FO, the USFS drafted a management plan in 2008 for sites where Price's potato-bean occurs at LBL (USFS 2009). This plan summarized management measures that TVA had taken at LBL during the mid-1990s, before transferring management authority to the USFS in 2004, and provides direction for future management and protection by USFS.

The population occurs on the lower-slopes of an east facing bluff on the left descending bank of the Cumberland River at approximately river mile (RM) 78.5. At this site, the Price's potato-bean population is found over approximately 5.5 ac and supported 54 individual plants as of 2015 (TVA 2018). Only a small part of the occupied habitat intersects the ROW, with less than five percent of the local population found within the ROW.

The most recent visit to the site by a TVA botanist was July 2013. The handful of plants observed in the ROW were located within 50 ft of the river downslope of a small limestone shelf that crosses the ROW along the contour of the slope, which runs parallel to the shoreline. Plants at this location occurred in deep shade, despite being in the ROW, because the population is located at the base of the steep slope and the TL conductor is high enough above the forest floor that trees in lower parts of the ROW do not need to be regularly maintained. Upslope of the limestone shelf in the ROW, the vegetation is thick young forest, dominated by black locust, and does not support Price's potato-bean. All plants occur in a portion of the ROW that is not currently maintained and is unlikely to be regularly maintained in the future.

Price's potato-bean's affinity for edge habitats suggests that it could be found along other transmission ROW sections in the PSA. TVA botanists have field surveyed about 4,900 ac (33 percent) of the estimated 15,000 ac of ROW in the counties where Price's potato-bean is known to occur and have not found new populations. TVA botanists have used the O-SAR process to designate about 10,250 and 400 ac of suitable habitat for Price's potato-bean in the Action Area as Class 1 and Class 2 plants, respectively. Given the limited area surveyed for the species and presence of suitable habitat in the Action Area, TVA is reasonably certain that additional Price's potato bean populations occur within the O-SAR polygons.

3.2.2. Action Area Conservation Needs of and Threats to Price's Potato-Bean

Populations of Price's potato bean on ROW and power line corridors are threatened by maintenance of the areas through indiscriminate application of herbicides, mowing, and tree clearing activities.

Conservation measures could include site protection (buffers), managing or eradicating competing vegetation, augmenting occurrences, and surveying for the species in undocumented areas.

3.3. Effects of Vegetation Management on Price's Potato-Bean

Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur. Our analyses are organized according to the description of the Action in section 2 of this BO[3].

This section analyzes the direct and indirect effects of the Action on Price's potato-bean. An effects analysis summary of the effects of various methods of vegetation management on Price's potato-bean and the other 17 listed LAA plant species from the BA has been included in Appendix II.

3.3.1. Effects of Manual Vegetation Clearing on Price's Potato-Bean

Manual vegetation clearing has the potential to adversely affect Price's potato-bean if trees need to be cleared on the lower slopes of the ROW where Price's potato-bean occurs. Direct injury or death of vines can occur during manual tree clearing activities. Indirectly, limited tree clearing activities resulting in increased light on sites where Price's potato-bean occurs will likely benefit the species by promoting growth and reproduction.

Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use of heavy equipment (to and from the site) that may result in soil disturbance.

3.3.2. Effects of Mechanical Clearing on Price's Potato-Bean

All mechanical vegetation control methods used by TVA have the potential to adversely affect Price's potato-bean. There is some chance vegetation removal could benefit the species and promote reproduction, by increasing light availability and reducing competing vegetation. However, all of the vegetation removal activities could result in loss of individuals by trampling, cutting, and soil disturbance from machinery.

As with manual tree clearing, adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use heavy equipment that may result in soil disturbance.

3.3.3. Effects of Herbicide Use on Price's Potato-Bean

Broadcast herbicide, either from the air or ground, will adversely affect Price's potato-bean plants growing on and near the ROW edge if used in occupied habitat. Of all the methods and tools available to TVA, broadcast herbicide has the greatest potential to result in impacts that extirpate plants from the ROW. The use of broadcast herbicide in a TVA ROW that contained Price's potato-bean could result in the death of individual plants and may even lead to the extirpation of entire populations.

[3] This text identifies the definitions of possible effects evaluated in a biological opinion and is applicable to all other plant species included in Section 3 of this biological opinion. This text is incorporated by reference for each subsequent Effects of Vegetation Management section in the biological opinion but has not been repeated in those sections to reduce redundancy in the document.

Spot treatment of herbicide is highly targeted and not likely to adversely affect Price's potato-bean at the population level, but could result in the death of individual plants if a broad spectrum herbicide is used in close proximity (direct contact) to individuals. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. If trees do not need to be cut immediately, but may threaten future TL reliability, spot treatments can be used to kill the trees without directly affecting Price's potato-bean, given appropriate buffers are established to protect from overspray. Even though localized herbicide application targets woody species within the ROW floor, the use of that tool would adversely affect the species. If individual Price's potato-bean plants occur within a few feet of a localized herbicide application, chances are high that the plant would experience some level of herbicide related damage which may rise to the level of individual plant death. These targeted applications may be less likely to damage Price's potato-bean plants beyond chemical burns or other limited effects (limiting or eliminating the application year's reproduction); however, the precise effects of such targeted herbicides on Price's potato-bean have not been studied, so they should still be used with caution.

In summary, all vegetation control methods that use herbicides may adversely affect Price's potato-bean if used in occupied habitat. Adverse effects from herbicide management activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, appropriate application and timing of herbicide treatment, conservation spraying, or another targeted herbicide application technique, such as spot application.

3.3.4. Effects of Debris Management on Price's Potato-Bean

All debris management techniques used by TVA have some potential to adversely affect Price's potato-bean. The aspect of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of debris. This disturbance could result from soil disturbance by machinery or dragging of debris over plants. At the requests of landowners, vegetation debris may be left for landowner's personal use under appropriate circumstances. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

Mechanical mulching is not expected to generate enough mulch to adversely affect Price's potato-bean. However, such mulching may cause physical disturbance to the plants or soil, resulting in damage or death of individuals.

In summary, all debris management activities are likely to adversely affect price's potato-bean. Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use of heavy equipment that may result in soil disturbance.

3.4. Conclusion for Price's Potato-Bean

The purpose of a BO under §7(a)(2) of the ESA is to determine whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated CH.

"Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).[4]

In this section, we interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) for the Prices's potato-bean relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action will have localized adverse effects to Price's potato-bean. If any plants are adversely affected, they will likely represent only a small portion of any given population within the Action Area. We anticipate no populations will be extirpated by proposed vegetation management activities, given that TVA follows its AMMs, BMPs and SOPs. Other non-federal actions in the Action Area that are reasonably certain to occur and that may affect Price's potato-bean include the use of broadcast herbicide on adjacent agricultural lands, use of broadcast herbicides at ROW intersections (*e.g.* railroad crossings, roads), and timber management activities on adjacent lands (cumulative effects; see Section 2.8). We also anticipate that the Action will result in beneficial effects to Price's potato-bean by removing competing vegetation, which will in turn increase light availability and promote reproduction.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of Price's potato-bean. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known, rangewide populations (one population out of a total of 59) exists within the Action Area, and less than five percent of that population (approximately two or three individuals, based on recent survey data) is found within the ROW; therefore, only a very small percentage of plants in the species range would be affected by the Action.

[4] This text identifies the purposes of a biological opinion and the definition of jeopardy and is applicable to all other plant species included in Section 3 of this biological opinion. This text is incorporated by reference for each subsequent Conclusion section in the biological opinion but has not been repeated in those sections to reduce redundancy in the document.

4. BRAUN'S ROCK-CRESS

4.1. Status of Braun's Rock-Cress

This section summarizes best available data about the biology and current condition of the Braun's rock-cress (*Arabis* [=*Boechera*] *perstellata*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the species as endangered on January 3, 1995 (60 FR 56-61).

4.1.1. Description of Braun's Rock-Cress

The Braun's rock-cress is a perennial herb that is distinguished from other members of the genus *Arabis* by the white, star-shaped hairs on stems and leaves that give the plant a grayish appearance. The fruit is a round, elongate, and densely, hairy silique. Flowers are produced from late March to early May; fruits mature from mid-May to early June (USFWS 1997).

4.1.2. Life History of Braun's Rock-Cress

Braun's rock-cress occurs on the slopes of calcareous mesophytic and sub-xeric forest types. The occurrence of this species does not appear to be limited to a particular slope aspect, elevation, or moisture regime within the slope forests. It is, however, sun intolerant and always occurs in at least partial shade. The largest and most vigorous populations occur on moist mid- to upper slope sites. Plants are often found around rock outcrops, protected sites on the downslope side of tree bases, and sites of natural disturbance, such as talus slopes and animal trails. It is rarely found growing among the leaf litter and herbaceous cover of the forest floor (USFWS 1997).

Braun's rock-cress is probably pollinated by insects, but the vector is not known nor is it clear whether it is self-fertile. It has no specific morphological mechanism for seed dispersal; it is likely that dispersal is occurring through wind or gravity, rather than animal movements. Seeds are probably most commonly dispersed downslope (USFWS 1997).

4.1.3. Numbers, Reproduction, and Distribution of Braun's Rock-Cress

Braun's rock-cress produces viable seeds, and plants can easily be grown from seeds under greenhouse conditions (USFWS 1997). It is not known, however, whether the plant depends on a seed bank to take advantage of opportunities for seed germination and establishment. Seedling survival may increase in years of high rainfall through the spring and early summer months. If suitable habitat is available, reproduction appears to be successful, but it is not clear whether it is successful at sufficient levels to maintain population viability (USFWS 1997).

The majority of Braun's rock-cress populations occur in Kentucky, and the last significant (rangewide) survey for Kentucky populations was conducted in 2012-2013 by the KSNPC, when 50 percent of populations were monitored. Within Kentucky, the species is currently restricted to 40 populations in three counties (Franklin, Henry, and Owen), all of which are associated with the Kentucky River or its tributaries (primarily Elkhorn Creek). Population trends in Kentucky

indicate that two occurrences are increasing, seven are stable, 13 are declining, and 18 are of unknown status (USFWS 2018a).

Within Tennessee, all occurrences are monitored by TDEC every three to five years, with the most recent comprehensive survey completed in 2018 (USFWS 2018a). The six extant Tennessee populations (12 occurrences) occupy portions of three counties, Rutherford, Smith, and Wilson, with the majority of these situated along the Stones River (USFWS 2018a). Population trends in Tennessee indicate that three occurrences are increasing, three are declining, and six are of unknown status (USFWS 2018a).

4.1.4. Conservation Needs of and Threats to Braun's Rock-Cress

At the time of listing, Braun's rock-cress was threatened primarily by destruction or adverse modification of its habitat (USFWS 1997). Specifically, these threats included residential, commercial, or industrial development; livestock grazing and trampling; timber harvesting; and competition with native and exotic weedy species, especially the European garlic mustard (*Alliaria petiolata*). These threats are on-going (USFWS 2018a). The species could benefit from additional survey efforts, including evaluations of associated forest quality (2019-2020), studies on garlic mustard management, increased seed banking efforts, and increased augmentation and introductions to high quality sites that contain fewer invasive plants.

4.2. Environmental Baseline for Braun's Rock-Cress

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Braun's rock-cress, its habitat, and ecosystem within the Action Area.

4.2.1. Action Area Numbers, Reproduction, and Distribution of Braun's Rock-Cress

No Kentucky Braun's rock-cress populations are known on TVA ROW. In Tennessee, however, Braun's rock-cress is known to occur in forests abutting three sections of TVA's TL ROW. One occurrence is on Scales Mountain in Rutherford County and the other two are associated with Walnut and Pilot knobs along the Wilson/Smith County line. Botanists from the Tennessee Natural Heritage Program (TNHP) surveyed the Scales Mountain population in 2015 and noted that 47 individual plants occurred on the site and that no plants were on the ROW. This data supports TVA's botanist's observations of the site from 2016 that noted no plants occurred on the ROW (or immediately adjacent to it) and that activities restricted to the cleared ROW (*i.e.*, ROW floor work) would not affect the species at this location.

TVA botanists first surveyed the ROW in Wilson County in 2013 and found about 200 - 250 individual plants at three areas located adjacent to the northern ROW. Most of these plants were near the edge of the ROW, in a previously unmaintained area that had been recently cleared of trees. The plants appeared healthy and vigorous at the time of the survey. A 2018 follow-up survey of the site found no plants in the ROW, but healthy plants were found on the ROW edge.

The site occurring on the southern ROW in Smith County was first identified in 2016. The 30-40 plants observed were all outside of the open ROW.

Additional undocumented occurrences of Braun's rock-cress may occur adjacent to the TVA ROWs. Approximately 2,600 ac of TVA ROW are situated in the three Tennessee counties where Braun's rock-cress is known to occur. While not all sections of TVA ROW are potential habitat for Braun's rock-cress, TVA botanists have used the O-SAR process to designate about 1,200 and 470 ac of ROW as Plants Class 1 and Plants Class 2, respectively. TVA believes that a small portion of the area covered by these O-SAR polygons likely contains Braun's rock-cress (TVA 2018).

4.2.2. Action Area Conservation Needs of and Threats to Braun's Rock-Cress

The conservation needs and threats of Braun's rock-cress within the Action Area have not been fully assessed; however, TVA ROW maintenance includes conservation measures to avoid and minimize effects to the species at known locations. In addition, removal of invasive species could improve habitat conditions at some sites.

4.3. Effects of Vegetation Management on Braun's Rock-Cress

This section analyzes the direct and indirect effects of the Action on Braun's rock-cress. An effects analysis summary of the effects of various methods of vegetation management on Braun's rock-cress and the other 17 listed LAA plant species from the BA has been included in Appendix II.

4.3.1. Effects of Manual Vegetation Clearing on Braun's Rock-Cress

Manual clearing is routinely used to avoid and minimize effects to listed plant species, including Braun's rock-cress. Use of hand tools in clearing activities is highly selective, used on relatively small scales, and, therefore, is unlikely to result in direct effects to Braun's rock-cress. Chainsaws may be used to remove individual trees from the transmission ROW floor, margins of the border zone, and danger trees within or adjacent to the ROW. Manual clearing of select trees in previously unmaintained parts of the ROW margin would have little direct effect on Braun's rock-cress if done to protect individual plants, but the resulting increase in sunlight could indirectly effect plants by exposing them to too much light.

4.3.2. Effects of Mechanical Clearing on Braun's Rock-Cress

Braun's rock-cress is normally found on steep slopes with rock outcrops that physically preclude the use of wheeled and tracked equipment. However, because the species is known to occur on the edges of ROWs, there is the potential that mechanical vegetation clearing activities could intersect habitat occupied by Braun's rock-cress. If Braun's rock-cress is present where bulldozers are being used, individual plants could be crushed by trees that are pushed over or damaged when plants or tree roots are dislodged. Sidewall trimming, either from the air or the ground, would directly affect trees being pruned, but would have few other effects, other than a marginal increase in light levels due to removal of individual limbs. Any soil disturbance from

ground-based sidewall trimming would be minimal and short-term. The species is restricted to forests and ecotones between the forest and ROW and does not occupy open portions of the ROW. Therefore, mowing, which is restricted to regularly maintained areas within the ROW floor, is not likely to adversely affect the species.

4.3.3. Effects of Herbicide Use on Braun's Rock-Cress

Vegetation control methods that utilize herbicides are likely to adversely affect Braun's rock-cress if used in occupied habitat. Spot treatment with herbicide is highly targeted and not likely to adversely affect Braun's rock-cress because localized herbicide application is restricted to the existing ROW (where Braun's rock-cress typically does not grow). However, spot treatment could potentially adversely affect individual plants via direct contact. Individual plants that occur at the edge of the ROW could be inadvertently exposed to localized herbicide application if they are growing adjacent to an undesirable tree seedling. Broadcast herbicide could affect plants growing on and near the ROW edge; however, the steep terrain where Braun's rock-cress typically occurs would prevent the use of ground-based, broadcast spray treatments, and the relatively dense population and mixed land use of areas where Braun's rock-cress occurs would make use of aerial application of herbicide unlikely.

4.3.4. Effects of Debris Management on Braun's Rock-Cress

Debris management techniques used by TVA could result in the physical disturbance of individual plants associated with manual or mechanized handling of material. This disturbance could result from dragging of debris over plants or minor soil disturbance from operating machinery in the area, but is not expected to result in the death of individual plants. Given the steep, rocky terrain in local areas supporting Braun's rock-cress, it is unlikely chipping and mulching would occur in areas supporting the species; however, if it did occur, plants could be crushed by machinery or buried by mulch/chips. Burning would occur in the open ROW and would not affect Braun's rock-cress. TVA's facilitation of landowner use of wood materials in the ROW would have a similar potential for minor impacts as the other debris management methods.

4.4. Conclusion for Braun's Rock-Cress

In this section, we interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) for the Braun's rock-cress relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to Braun's rock-cress. We do expect some damage or loss of individual plants that could result in local population declines; however, we expect those populations to persist. Additionally, canopy thinning and removal of invasive species could benefit the Braun's rock-cress in the future. Cumulative effects to Braun's rock-cress that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Braun's rock-cress. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) While 46 known populations of the species occur in portions of Kentucky and Tennessee, none of these occur within TVA's ROW. Three occurrences do abut separate, existing sections of TVA ROW in Tennessee, with only one of these occurrences containing more than 200 individuals and a high probability of viability.

5. PYNE'S GROUND-PLUM

5.1. Status of Pyne's Ground-Plum

This section summarizes best available data about the biology and current condition of Pyne's ground-plum (*Astragalus bibullatus*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Pyne's ground-plum as endangered on September 26, 1991 (56 FR 48748 48751).

5.1.1. Description of Pyne's Ground-Plum

Pyne's ground-plum is a rare member of the pea family (Fabaceae). The following description of Pyne's ground plum is adapted from Barneby and Bridges (1987) and Somers and Gunn (1990): a herbaceous perennial, stems simple, 5 to 15 centimeters (cm) (2 to 6 in) tall, loosely tufted and arising from a shallowly buried root-crown attached to a stout vertical taproot, glabrous and leafless at base, usually bearing five to ten leaves with petioles 2 cm (0.79-in), once-pinnate with 19 to 27 elliptic or ellipticobovate leaflet. The inflorescence is a raceme supporting 10 to 16 purple flowers. The fruits are fleshy pods that usually mature in May and June; at maturity, the pods are colored red above and yellow below (USFWS 2011a).

5.1.2. Life History of Pyne's Ground-Plum

Pyne's ground-plum flowers from late April through early May. Fruiting begins in early May with seed dispersal beginning around the first of June. As many as 26 above-ground stems and 50 fruits have been observed on one plant (USFWS 2011a). Dispersal mechanisms appear to be limited to abiotic factors including gravity and water (Morris *et al*. 2002). At a few sites, bush-hogging to control woody vegetation encroachment appears to have facilitated an increase in the number of plants, likely due to reduction of shade and enhanced seed dispersal (USFWS 2011a).

Characteristics of Pyne's ground-plum seeds and habitat favor the development of a large, persistent seed bank that is stratified by age (Morris *et al*. 2002). The seeds of Pyne's ground-

plum have a hard, impermeable seed coat that imposes a strong physical germination barrier. Soils in cedar glade habitats, where the species is found, contain an abundance of unconsolidated rock fragments in a soil matrix that is granular in structure (U.S. Department of Agriculture/Soil Conservation Service 1977); such soils, in combination with repeated frost-heaving and sedimentation processes, promote migration of Pyne's ground-plum seeds down through the soil column over time, likely stratifying seeds of different ages (Morris *et al*. 2002).

The pollinating agents for this plant are not known, but flying insects play a role in many other legumes. Factors relating to population structure and dynamics have not been researched. Population size seems to fluctuate dramatically in colonies from year to year, possibly in response to the amount of rainfall and the amount of disturbance (Somers and Gunn 1990).

5.1.3. Numbers, Reproduction, and Distribution of Pyne's Ground-Plum

Pyne's ground-plum is endemic to the limestone cedar glades in the Central Basin Section of the Interior Low Plateau in Tennessee (USFWS 2011a). The habitats of *Astragalus* species in the southeastern U.S. tend to be on rocky or sandy soils, providing a more arid contrast to the generally moist habitats found in the region (Weakley 2008), and this is true of native *Astragalus* in Tennessee. Pyne's ground-plum is known from eight extant occurrences, all occurring in the Stones River watershed in the vicinity of Murfreesboro, Rutherford County, Tennessee. Five of the eight occurrences are located on public lands. Four of these are designated SNAs, owned by TDEC. Three occurrences are located entirely on privately owned land (USFWS 2011a); the remaining occurrence is located on NPS lands. Table 5.1 provides a general summary of all extant and historic (extirpated) Pyne's ground-plum occurrences (USFWS 2011a).

Until 2006, the known occupied range of Pyne's ground-plum was restricted to an approximately 90 square kilometers (km2) (35 mi^2) area, and no occurrences were separated by a distance greater than approximately 18 kilometers (km) (11 mi). An occurrence that TVA biologists discovered during a 2007 survey of a power line ROW extended the known range approximately 16 km (10 mi) to the southwest and expanded the area encompassing the species' range to approximately 235 km2 (90 mi^2). TVA biologists discovered the occurrence in a small opening in an otherwise heavily wooded cedar forest, which would likely not have been recognized as suitable habitat for the species. This occurrence, in a small opening within a matrix of presumably unsuitable habitats, is located approximately 10 mi from the nearest historic or extant occurrence of Pyne's ground-plum (USFWS 2011a).

There are believed to be three extirpated wild occurrences of Pyne's ground-plum (Table 5.1), all from Rutherford County. The first was collected near the city of La Vergne by Augustin Gattinger, probably in 1881 (Barneby and Bridges 1987), and is represented by a specimen in the Smithsonian Institution [Gattinger s.n. (US-70229)] (Wurdack 2011). Vegetative material collected in June 1948 from a site near the Rutherford/Davidson County line by botanists from the University of Tennessee at Knoxville is represented in the University of Tennessee Herbarium (Wofford 2011); the site is now under Percy Priest Reservoir. Examinations of glades in both counties adjacent to the reservoir have failed to locate any additional Pyne's ground-plum. The third site occurred on private land that was commercially developed in the

Table 5.1. Summary of all extant and historic (denoted with a "*") occurrences of Pyne's ground-plum.[5]

EO Number	Ownership	Site Name	Population Data
1	TDEC	Flat Rock Cedar Glades and Barrens Designated SNA	1,000 – 2,800
2*	Private		<100
3	TDEC, Private	Flat Rock Cedar Glades and Barrens DSNA	50 - 200
4	TDEC	Overbridge Designated SNA	10 - 45
5	Private		20 - 200
6	Private		100 – rumored to have been planted
8*	Public		n/a
9	Public	Manus Road Cedar Glade Designated SNA	250 - 520
10*	Private		n/a
13	NPS	Stones River NB	110 individuals planted in 2001; 2 found in 2008
16*	TDEC	Sunnybell Cedar Glade Designated SNA	Failed introduction
18	Private		<300

mid-1990s. Recent surveys in this area have failed to locate any additional plants. Therefore, it is unlikely that this species still exists at these three sites. Occurrence number 16 is listed as extirpated in Table 5.1, but actually represents a failed attempt to establish a new occurrence on a designated SNA by transplanting nursery propagated plants into the habitat.

5.1.4. Conservation Needs of and Threats to Pyne's Ground-Plum

Pyne's ground-plum is extremely vulnerable because of its limited range and its specific use of limestone cedar glade habitat. The primary threat to the species is the loss, alteration, and/or degradation of habitat from residential, commercial, and/or industrial development from the nearby city of Murfreesboro; livestock grazing and trampling; encroachment of competing vegetation; and illegal ORV use. Only one of the eight known occurrences of Pyne's ground-plum is currently threatened by impacts from livestock grazing. All the known Pyne's ground-plum occurrences are threatened by the encroachment of more competitive herbaceous vegetation and/or woody plants, such as eastern red cedar (*Juniperus virginiana*), that produce shade and compete for limited water and nutrients. Habitat alteration and/or degradation due to invasive, encroaching exotic plant species also pose a threat to the species. Invasive exotic plants that currently are either being managed or have been noted as potential threats at Pyne's ground-plum occurrence sites include spotted knapweed (*Centaurea biebersteinii*), Japanese

[5] The column labeled "EO Number" refers to the element occurrence number assigned by TDEC. Site names are provided only for element occurrences on public lands. Population data are primarily from TDEC (2005) and represent approximate ranges from counts or estimates of abundance; where given, population data for extirpated occurrences are historic.

honeysuckle (*Lonicera japonica*), privet (*Ligustrum spp.*), and sericea lespedeza (*Lespedeza cuneata*), among others. Drought poses a potential threat to this species, as evidenced by the most severe drought in recorded history in middle Tennessee during summer 2007. It is possible that alterations in precipitation and drought frequency or severity that might accompany climate change could pose a growing threat to Pyne's ground-plum in the future (USFWS 2011b).

Due to the 2006 discovery of Pyne's ground-plum by TVA biologists approximately 10 mi from the nearest known occurrence of the species (see section 4.1.3), the cedar glade ecosystem of the Stones River Basin within Davidson, Rutherford, and Wilson counties should be considered the geographic range for recovering this species (USFWS 2011a). Conservation measures that have been implemented for Pyne's ground-plum include federal and state regulatory protection; investigating the species' biology, ecology, and life history; preserving germplasm and establishing or augmenting occurrences; site protection and management; and surveys and monitoring. Similar conservation approaches should continue in the future.

Five of the eight Pyne's ground-plum occurrences are located on public lands, providing them added protection. Four of these are designated SNAs, owned by TDEC, three of which were purchased using Recovery Land Acquisition grants funded through section 6 of the ESA. Of the remaining four occurrences, one was planted at the Stones River NB, one is located on private lands and managed under a SNA registry, and only three of the occurrences are on private lands and unprotected. TDEC manages and protects habitats at the occurrences on designated SNAs and at the site managed under a SNA registry.

5.2. Environmental Baseline for Pyne's Ground-Plum

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Pyne's ground-plum, its habitat, and ecosystem within the Action Area.

5.2.1. Action Area Numbers, Reproduction, and Distribution of Pyne's Ground-Plum

In the Action Area, the Pyne's ground-plum has been documented from one location in Rutherford County, Tennessee along a TVA ROW. This small population was found in 2007 by TVA botanists as part of an environmental review for a proposed new TL and exists immediately off the TVA ROW on private land (A. Datillo, TVA, pers. comm., April 19, 2019). The TL was initially designed to pass through the center of a very small glade opening that comprises the entirety of the habitat for the species. TVA realigned the ROW to the east, prior to construction, so that the species would not be affected. While the species is not currently in the TVA ROW easement, plants do occur 25 to 30 ft from the ROW edge.

Intact cedar glade habitats are not mutually exclusive with ROW vegetation management, and it is not inconceivable that other undocumented occurrences intersect the transmission system. TVA botanists have reviewed all TLs located in Rutherford County using the O-SAR process. Given the propensity for glades (and ROW near glades) to harbor listed plant species and the

ease which these habitats can be identified using aerial photos, TVA botanists have classified many areas as Class 2 Plants.

The vast majority of these areas, including one ROW just north of a more recently discovered population (2009) of Pyne's ground plum located near Flat Rock Cedar Glades and Barrens designated SNA, were subsequently field surveyed. These field surveys have resulted in discovery of multiple new populations of state and federally listed plant species on TVA ROW in Rutherford County, but no new occurrences of Pyne's ground plum. Few if any sizable, unsurveyed glades co-occurring on ROW remain in Rutherford County.

5.2.2. Action Area Conservation Needs of and Threats to Pyne's Ground-Plum

Few if any sizable, unsurveyed glades on TVA ROW remain in the Action Area. TVA botanists have conducted field surveys of nearly all of these sites and it is unlikely new populations of Pyne's ground-plum will be located on ROW. Threats to existing occurrences include loss, alteration, and/or degradation of habitat from residential, commercial, and/or industrial development; livestock grazing and trampling; encroachment of competing vegetation, including exotics; and illegal ORV use. Conservation measures could include managing or eradicating competing vegetation, augmenting occurrences and site protection.

5.3. Effects of Vegetation Management on Pyne's Ground-Plum

This section analyzes the direct and indirect effects of the Action on Pyne's ground-plum. An effects analysis summary of the effects of various methods of vegetation management on Pyne's ground-plum and the other 17 listed LAA plant species from the BA has been included in Appendix II.

5.3.1. Effects of Manual Vegetation Clearing on Pyne's Ground-Plum

Manual vegetation clearing has the potential to adversely affect Pyne's ground-plum. However, provided it does not intentionally disturb the soil, it is unlikely to result in the death of individual plants. Pyne's ground-plum is tolerant of sun, though it does not typically inhabit the interior of cedar glades. If tree clearing resulted in increased light on sites where it occurred, the effect would not likely be detrimental. The species would be susceptible to physical damage caused by clearing activities, but the shallow rocky soils characteristic of cedar glades do not rut easily and the species could resprout after the discrete widely-spaced instances of tree clearing.

Manually clearing vegetation on previously unmaintained ROW is a one-time event because these areas will subsequently be treated as ROW floor. Danger tree clearing occurs as needed. Danger tree clearing may never be needed in Pyne's ground-plum habitat near glades because the soils are not deep enough to support growth of trees tall enough to impact power lines.

5.3.2. Effects of Mechanical Clearing on Pyne's Ground-Plum

All mechanical vegetation control methods utilized by TVA have the potential to adversely affect Pyne's ground plum. However, as long as the method does not intentionally disturb the

soil it is unlikely to result in the death of individual plants. Mowers are generally set 10 to 12 inches off the ground and would likely miss low-growing Pyne's ground-plum; if damaged, all but the weakest plants would resprout.

5.3.3. Effects of Herbicide Use on Pyne's Ground-Plum

Vegetation control methods that utilize herbicides are likely to adversely affect Pyne's ground-plum. Spot treatment with herbicides is highly targeted and not likely to adversely affect Pyne's ground-plum, but could affect individual plants via direct contact. Cut stump and hack and squirt applications could be used when cutting larger trees to prevent resprouting and as an AMM to control smaller trees in occupied habitat within the ROW floor. Pyne's ground-plum could occupy the floor of ROW and, therefore, be affected by localized herbicide applications, which are commonly used to control woody species in the open ROW.

While off target herbicide damage could kill individual plants, it is unlikely that entire populations would be extirpated. This is because habitats where Pyne's ground-plum is most likely to occur do not have significant numbers of tree seedlings in the ROW. These dry, rocky areas do not support rapid tree growth, and woody plant species are typically widely-spaced. This increases the odds that Pyne's ground-plum plants, if undocumented populations occur on TVA ROW, would survive instances of localized application of herbicide. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW. However, it is unlikely that this tool would be used in relatively densely populated areas of Rutherford County, Tennessee, where this species is likely to occur.

5.3.4. Effects of Debris Management on Pyne's Ground-Plum

All debris management techniques used by TVA have a small potential to adversely affect Pyne's ground-plum. The aspect of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of debris. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be expected from use of machinery. The soil disturbance would be minimal because of the rocky habitats preferred by Pyne's ground-plum, which are well-drained and resistant to deep rutting. Neither form of disturbance would be likely to result in the death of individual plants. Pile burning could conceivably result in loss of individual plants, but the infrequent use of the tool, combined with the extreme rarity of the species, make the likelihood of this occurring very small. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

If mulching machines were used in Pyne's ground-plum habitat, it would not likely generate enough mulch to bury the species. This is because the amount of mulch or chips generated by the machine is directly proportional to the amount of vegetation the site supports. Dry glade margins stunt woody plant growth, and the layer of mulch left in these areas is often discontinuous and less than 1-in deep.

5.4. Conclusion for Pyne's Ground-Plum

In this section, we interpret the findings of the previous sections for the Pyne's ground-plum (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to Pyne's ground-plum and result in no more than a few individual plants within the Action Area being adversely affected. Some non-federal actions in the Action Area are reasonably certain to occur and may affect the Pyne's ground-plum. For example, a small population currently exists immediately off of the TVA ROW on private land (A. Datillo, TVA, pers. comm., April 19, 2019) that is at risk of potentially being affected by future management activities.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Pyne's ground-plum. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW (i.e., A small, single population, comprised of a few plants, is currently located 25 to 30 ft from the ROW edge.). (3) Only a fraction of known total populations (one out of a total of eight) occurs within the Action Area, and the single population is located off of the ROW, where individual plants would be less likely to be adversely affected.

6. MOREFIELD'S LEATHER-FLOWER

6.1. Status of Morefield's Leather-Flower

This section summarizes best available data about the biology and current condition of the Morefield's leather-flower (*Clematis morefieldii*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the species as endangered on May 20, 1992 (57 FR 2156-21564).

6.1.1. Description of Morefield's Leather-Flower

Morefield's leather-flower is a perennial vine in the buttercup family (Ranunculaceae) that can grow up to 16 ft (5 meters [m]) long. This species has compound leaves, reaching lengths of 8 inches (2 decimeters [dm]), arranged in 9–11 leaflets, with terminal leaflets (one-three) forming tendrils. The flowers, which are present from May to July, are pinkish in color and 20–25 mm (0.8–1.0 in.) long. Fruits are clusters of hairy achenes (a type of simple, dry fruit containing only

one seed). This species is a member of the *Viornae* subsection of *Clematis*, which is noted for its narrow endemics (Kral 1987). *Clematis* in this subsection are distinguished by urnshaped flowers which occur singly, or in few-flowered groups, in leaf axils. Their primary flower stalks (peduncles) are subtended by leafy bracts. Morefield's leather-flower is closely related to vasevine (*Clematis viorna*), a more variable species, but Morefield's leather-flower is distinguished from this species by the dense, white hairs on shoots, velvety lower leaf surfaces, and stouter, usually shorter (15–25 mm or 0.6–1.0 inches long) peduncles with sessile to nearly sessile bracts at the base (Kral 1987).

6.1.2. Life History of Morefield's Leather-Flower

Morefield's leather-flower blooms from May to July. Pollinated flowers are capable of producing abundant (15 or more per flower) achenes (Crabtree 2014). Little information on effective pollinators is available, but Crabtree (2011) observed bumblebees (*Bombus* spp.) visiting flowers of Morefield's leather-flower. Various studies and observations indicate that flower and fruit production are positively correlated with precipitation (Emanuel 2000; Boyd and Paris 2013; Crabtree 2014; Paris *et al*. 2015, 2016). Herbivory by vertebrates and insects is apparently common for Morefield's leather-flower (Boyd and Paris 2013; Paris *et al*. 2015, 2016) and can reduce a plants' flower and fruit production (Paris *et al*. 2015). Small flower buds are particularly vulnerable to herbivory by Lepidopteran larvae (Paris *et al*. 2016). A study by Paris *et al*. (2015) indicated that insecticide use could be an effective management tool to increase sexual reproduction of Morefield's leather-flower.

Seeds may remain dormant during their first year after dispersal, with many seeds germinating in the second year post-dispersal (Paris *et al*. 2016). Paris *et al*. (2016) noted that post-dispersal predation of achenes was generally low during a multi-year study. Crabtree (2011) repeatedly observed Morefield's leather-flower seedlings along deer trails, suggesting that white-tailed deer (*Odocoileus virginianus*) may be potential dispersal agents of the species' seeds, but additional research is needed to elucidate this putative relationship.

6.1.3. Numbers, Reproduction, and Distribution of Morefield's Leather-Flower

Morefield's leather-flower is endemic to limestone drains and outcrops on the Cumberland Plateau escarpments in northeast Alabama, northwest Georgia, and south-central Tennessee. This species occupies a narrow range, spanning fewer than 70 mi east to west and under 50 mi north to south, and is restricted to areas underlain by calcareous bedrocks (such as limestone) along south to southwest facing slopes within the Plateau Escarpment ecoregion. Plants occur at elevations of 700 - 1700 ft and are often found near seeps and springs in red cedar-hardwood forests, particularly within transitional zones between dry calcareous forests and mesic forests (Kral 1987; Weber 1991; Cook 2018; T. Crabtree, TDEC 2018; USFWS 1994a, 2018b).

Populations were not explicitly defined in the listing rule (57 FR 21562-21564), recovery plan (USFWS 1994a), or 2010 5-year review (USFWS 2010) for Morefield's leather-flower. In the most recent 5-year review for Morefield's leather-flower (USFWS 2018b), a provisional population definition of 1 km (0.6-mi) is used to delimit individual populations, which is in line with both the TNHP (2018) and the ANHP (2018) EOs. As such, individuals or groups of

Morefield's leather-flower that are separated by at least 1 km from their nearest known neighbors are considered to be a distinct population. Alternatively, Crabtree (2011) suggested that a separation distance of 500 m (1640 ft), based on flight distances of bumblebees (*Bombus spp.*) as potential pollinators, might be appropriate. However, this may underestimate flight distances, as recent studies have shown that maximum distances for various bumblebee species can range from 450 m (1476 ft) to 2.5 km (1.5 mi) (Knight *et al.* 2005; Osborne *et al.* 2008; Hagen *et al.* 2011). Indeed, Georgia Department of Natural Resources (GDNR) (2018) staff have suggested a 1.5-km separation distance may be appropriate. However, the region's rugged terrain and development (*e.g*., roads) may limit potential pollinator movement between sites (Bhattacharya *et al*. 2003). Given this and the consistency between two of the three responsible state natural heritage programs (SNHPs), using a 1-km separation distance to delineate populations is appropriate at this time. Revisions to the current provisional population definition based on pollinator flight distances, and associated potential pollen and gene flow, or based on genetic studies and/or other factors (*e.g.*, topography) will likely alter the number of discrete populations and should be adopted if determined to be appropriate upon further evaluation (USFWS 2018b).

Under the 1-km provisional population definition, there are 34 known populations of Morefield's leather-flower across three states (Alabama, Tennessee, and Georgia), with 32 populations considered extant and two considered extirpated. With 20 extant populations in two counties, Franklin (18) and Grundy (2), Tennessee is home to nearly two-thirds of known populations (TNHP 2018). Six of Tennessee's populations, Franklin County (5) and Grundy County (1), have been discovered since 2010 (TNHP 2018). Alabama has 11 extant populations in two counties, Jackson (2) and Madison (9) (ANHP 2018). A previously unknown population was discovered in Walker County, Georgia in 2015 (GDNR 2018), which represents an extension of the species' known range into Georgia. No other occurrences from Georgia are known.

SNHPs in Alabama, Georgia, and Tennessee have tracked and ranked a combined 34 populations of Morefield's leather-flower in their states (ANHP 2018; GDNR 2018; TNHP 2018). Two of these tracked populations are thought to be extirpated; one population in Alabama was destroyed by a residential development in the 1980s (ANHP 2018), and one of Tennessee's populations was not found during surveys in 2009 and is presumed extirpated due to earlier road widening (T. Crabtree pers. comm. 2010; TNHP 2018). Another population in Alabama has been damaged by residential development in the state (Weber 1994). Of the remaining 32 presumed extant Morefield's leather-flower populations, four are considered to have excellent viability (ranked as "A"), while nine have been ranked as having good ("B") or good to fair ("BC") viability. Most (19) populations have been ranked as having fair ("C") or poor ("D") viability, 16 of which occur in Tennessee. However, over half (20) of extant populations have not been visited and assessed in more than five years and their current status may be different from their available ranked status.

As reported in the latest 5-year review (USFWS 2018b), current population size data are limited, and no systematic population monitoring and survey protocols are known for Morefield's leather-flower. The only known monitoring program for the species occurs in Tennessee, which is funded by the USFWS's ESA section 6 cooperative grant program and is conducted by TNHP (Bailey 2005; Crabtree 2011, 2014). While population size data are available for 31 of the 32 extant populations (no population size data are available for Georgia's only known population),

only 20 populations have data available that were collected since the 2010 5-year review, 11 of which have data that are five years old or less. Available population data for the remaining 11 populations were collected between 1990 and 2009. Together, these data, ranging from one to 28 years old, indicate that the total population size of Morefield's leather-flower may be potentially as large as 16,000 individuals (Boyd and Paris 2013; Paris 2013; ANHP 2018; T. Cook, Huntsville Botanical Garden, pers. comm. 2018; TNHP 2018). Based on these latest available observations, one population supports over 7,000 individuals, two populations are greater than 1,000 individuals, 17 populations (over half of all extant populations) have fewer than 100 individuals, and 11 populations have 20 individuals or less. The lack of recent (less than five years), systematic survey and monitoring data for many populations increases the uncertainty of our assessment of individual population sizes, the species' total population size, and population trends.

Sixteen populations of Morefield's leather-flower occur entirely, or partially, on conservation lands. Of these 16 populations, six are ranked as having excellent or good viability (four in Alabama and two in Tennessee) by their respective SNHPs (ANHP 2018; TNHP 2018), while one, Georgia's only population, is ranked as having good to fair viability (GDNR 2018). Nine populations are ranked as having fair or poor viability (eight in Tennessee [TNHP 2018]; one in Alabama [ANHP 2018]). Nine populations occur on state-owned lands (one in Alabama; one in Georgia; seven in Tennessee), three populations are found on lands owned by the University of the South (Sewanee) in Tennessee, two populations are on TNC lands in Alabama, and one Alabama population occurs on lands of mixed public (City of Huntsville) and private conservation organization (LTNA) ownership (Paris 2013; ANHP 2018; Cook 2018; GDNR 2018; TNHP 2018). Populations occurring on conservation lands are not uniformly protected, however, with most lands managed primarily for wildlife, recreation, and/or mixed uses (*i.e.*, few of these conservation lands are apparently managed primarily for their biodiversity values and/or rare species). While at least some state-owned sites periodically receive management to improve Morefield's leather-flower habitat, such as clearing encroaching woody species (*e.g.*, T. Crabtree pers. comms. 2015, 2018), specific management and monitoring regimes for Morefield's leather flower are not known for many populations on conservation lands. As such, much of Morefield's leather-flower habitat management is likely ancillary to management for other conservation and land use priorities. However, it is likely that these populations are protected from outright habitat destruction and conversion.

6.1.4. Conservation Needs of and Threats to Morefield's Leather-Flower

Threats to Morefield's leather-flower include habitat destruction or modification due to urban development, timber management, roadside maintenance, and other activities. These activities have caused the loss or decline of populations and remain persistent threats to populations that are not under secure ownership by public or private conservation agencies and organizations. Conservation needs for Morefield's leather-flower include continued surveying and monitoring across the species' range; site protection and management; and additional research pertaining to the species' biology, ecology and life history. While periodic monitoring is ongoing for some populations, overall, it has been inconsistently implemented across all populations. Additionally, the discovery of new populations of Morefield's leather-flower in Tennessee and Georgia indicate the continued need for additional surveys throughout the species' range and,

particularly, expansion of these surveys into Georgia (USFWS 2018b). Some former privately-owned sites in Tennessee have recently been acquired by the state. Continued work to protect and manage remaining privately-owned sites is needed. Limited studies have begun to elucidate some of the habitat parameters necessary for the species' survival and to assist with identifying additional survey areas. Management plans that specifically address the needs of Morefield's leather-flower and its habitat are not known for many sites; however, management activities to specifically benefit this species have been implemented. Expanding habitat management activities, such as implementation of prescribed fire and canopy thinning, are expected to improve the species' overall status.

6.2. Environmental Baseline for Morefield's Leather-Flower

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Morefield's leather-flower, its habitat, and ecosystem within the Action Area.

6.2.1. Action Area Numbers, Reproduction, and Distribution of Morefield's Leather-Flower

While Morefield's leather-flower has not yet been observed in field surveys of TVA ROW, TVA is reasonably certain this species is present within the Action Area, given the TVA transmission system occurs on the Cumberland Plateau Escarpment slope in northeast Alabama and south-central Tennessee, where this species is known to occur. Additionally, only one-third of the roughly 5,300 ac of TVA ROW found within the counties where Morefield's leather-flower is known to occur have been surveyed, leaving much of the Action Area unsurveyed. While not all sections of TVA ROW are potential habitat for Morefield's leather-flower, TVA botanists have used the O-SAR process to designate about 3,200 and 250 ac of suitable habitat for Morefield's leather-flower in the Action Area as Plants Class 1 and Class 2, respectively. TVA botanists have field surveyed about 1,800 ac of ROW in the counties where Morefield's leather-flower is known to occur and have not found new populations. However, given the limited area surveyed for the species and presence of suitable habitat in the Action Area, TVA is reasonably certain that Morefield's leather-flower occurs within some of the O-SAR polygons.

Since field surveys have been conducted on about one-third of the ROW in those counties, and no new populations have been recorded, TVA believes that ROW are unlikely to provide primary habitat for the species. While Morefield's leather-flower has not been observed on TL ROW, it does do well (at least temporarily, data are limited) in gaps exposed to light within closed canopy forest. This suggests it could potentially persist along ROW edges, though ROW would not comprise the core habitat for this species. The ability of Morefield's leather-flower to exploit light gaps suggests the species may occupy edge habitats found along TVA TL ROW. As such, it is unlikely that undocumented populations would be confined to the ROW. Most plants in undocumented populations that intersect TVA ROW probably extend well off the ROW. As such, it is likely that only small portions of any individual population would intersect ROW vegetation management activities.

6.2.2. Action Area Conservation Needs of and Threats to Morefield's Leather-Flower

Populations of this species on ROW and power line corridors are threatened by maintenance of the areas through application of herbicides, mowing, tree clearing and debris management activities. Conservation measures for Morefield's leather flower in the Action Area include site protection (buffers, flagging), avoiding the use heavy equipment that may result in soil disturbance, and recognition of the species occurrence in undocumented areas.

6.3. Effects of Vegetation Management on Morefield's Leather-Flower

This section analyzes the direct and indirect effects of the Action on Morefield's leather-flower. An effects analysis summary of the effects of various methods of vegetation management on Morefield's leather-flower and the other 17 listed LAA plant species from the BA has been included in Appendix II.

6.3.1. Effects of Manual Vegetation Clearing on Morefield's Leather-Flower

Manual vegetation clearing has the potential to adversely affect Morefield's leather-flower. While tree clearing would increase light levels on site, potentially resulting in a benefit to Morefield's leather-flower, direct physical disturbance of the species is likely to occur. The disturbance could result from trampling, cutting, or soil disturbance. Increased light could benefit the species by spurring growth and reproduction, or it could favor more aggressive species like Japanese honeysuckle (*Lonicera japonica*) to the detriment of Morefield's leather-flower (USFWS 2010). Manual removal of single danger trees may have a positive effect on the species by providing a boost in light levels that could increase productivity and reproduction without fundamentally changing the vegetation structure and light regime in the immediate vicinity of the plant.

In summary, manual vegetation clearing is likely to adversely affect Morefield's leather-flower if conducted in occupied habitat. Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use of heavy equipment (to and from the site) that may result in soil disturbance.

6.3.2. Effects of Mechanical Clearing on Morefield's Leather-Flower

If mechanical vegetation control methods utilized by the TVA ROW program intersect habitat occupied by Morefield's leather-flower, the species could be adversely affected. Morefield's leather-flower typically occurs in rocky, calcareous forests and is most likely to be found on the edge of a ROW; it is unlikely to inhabit the open portions of the ROW floor. Therefore, mowing, which is restricted to regularly maintained areas within the ROW floor, is not likely to adversely affect the species. Mechanical clearing and side-wall trimming could all adversely affect Morefield's leather-flower, though some of these methods have more potential to adversely affect than others. Mechanical clearing would adversely affect Morefield's leather-flower, if used in habitats where the species occurs, but the likelihood of using this type of

equipment where the species occurs is small, given this species is found on steep slopes with rock outcrops that physically preclude the use of wheeled and tracked equipment.

In summary, mechanical tree clearing and side-wall trimming are likely to adversely affect Morefield's leather-flower. Mechanical mowing is unlikely to adversely affect Morefield's leather-flower. Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use of heavy equipment that may result in soil disturbance.

6.3.3. Effects of Herbicide Use on Morefield's Leather-Flower

Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW edge if it were used in occupied habitat; however, all areas of the Cumberland Plateau Escarpment slope within the range of Morefield's leather-flower have either been field surveyed or are designated as Class 1 or 2 Plants in O-SAR. This O-SAR restriction prohibits the use of broadcast herbicide either from the air or ground. Therefore, the potential for broadcast herbicide to adversely affect Morefield's leather-flower is discountable.

Spot treatment of herbicide is highly targeted and unlikely to affect Morefield's leather-flower at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. These methods could also be used as an AMM to control smaller trees in occupied habitat. If the trees did not need to be cut immediately, but would present a threat to TL reliability in the future, spot treatment could be used to kill the trees while minimizing direct effects to Morefield's leather-flower. Localized herbicide is likely to adversely affect Morehead's leather-flower particularly at the ROW edge. In this area, individual plants growing adjacent to tree seedlings could be inadvertently affected by overspray.

In summary, all methods of herbicide use, except for broadcast herbicide application, would likely adversely affect Morefield's leather-flower. Adverse effects from herbicide management activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, appropriate application and timing of herbicide treatment, conservation spraying, or another targeted herbicide application technique such as spot application.

6.3.4. Effects of Debris Management on Morefield's Leather-Flower

Debris management techniques used by TVA may affect Morefield's leather-flower, particularly any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge. Effects from manual clearing are more likely to occur, given the rocky terrain where the species occurs would preclude the use machinery. These effects would include physical damage resulting from cutting or dragging trees, but would not likely result in death of individuals. The terrain would also likely prevent chipping and mulching from occurring due to equipment access limitations. If mulching/chipping did occur, the species could be directly affected by crushing from machinery and burial/smothering by mulch/chips. Burning would occur in the open ROW away from suitable habitat for Morefield's leather-flower and would not likely affect the species, but debris handling by machinery during burning operations could affect

individual plants on the ROW edge. On landowner request, vegetation debris may be left for landowner use. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

In summary, all debris management activities are likely to adversely affect Morefield's leather-flower. Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, appropriate timing of debris management, and avoiding the use of heavy equipment that may result in soil disturbance.

6.4. Conclusion for Morefield's Leather-Flower

In this section, we interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) for the Morefield's leather-flower relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would, at most, have localized adverse effects to Morefield's leather-flower and result in only a few individual plants within the Action Area being adversely affected, if any. Although closed canopy forests comprise the primary habitat for the species, data suggests that the species does well when exposed to light gaps, such as those resulting from ROW edges. Other non-federal actions in the Action Area that are reasonably certain to occur and that may affect Morefield's leather-flower include the use of broadcast herbicide on adjacent agricultural lands, use of broadcast herbicides at ROW intersections (*e.g.* railroad crossings, roads), and timber management activities on adjacent lands (cumulative effects; see Section 2.8).

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Morefield's leather-flower. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a small fraction of rangewide populations could potentially occur within the limited amount of suitable habitat in the action area; 32 known extant populations of the species occur in Alabama, Georgia, and Tennessee, but no occurrences have yet been observed on TVA ROW. All documented populations are located well off of the ROW.

7. ALABAMA LEATHER-FLOWER

7.1. Status of Alabama Leather-Flower

This section summarizes best available data about the biology and current condition of the Alabama leather-flower (*Clematis socialis*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the Alabama leather-flower as endangered on September 26, 1986 (51 FR 34420-34422).

7.1.1. Description of Alabama Leather-Flower

The Alabama leather-flower is a small, perennial herb in the buttercup family (Ranunculaceae), found in the Coosa River Valley in damp, silty-clay neutral soils, generally in sunny, open, herb-dominated locations. Fire or other natural disturbances may be necessary to limit competition from tall woody plants, such as trees and shrubs.

The genus *Clematis* is composed of mostly vigorous, woody, climbing vines/lianas. Alabama leather-flower, in contrast, forms clumps of small, upright stems that reach only about 1-ft in height, rising from an underground network of rhizomes. Stems from a single rhizome are genetically identical clones of the original stem. The rhizomes branch out over time, producing large patches of above-ground stems that emerge from the ground, generally in March, as temperatures begin to rise. Leaves form on the stems in pairs and vary in shape. Lower leaves are often simple (with a single, entire blade), whereas upper leaves are composed of multiple leaflets. The thick, leathery sepals (the structures that encase the flower buds prior to opening) are the source of the species' common name (Boyd 2015).

7.1.2. Life History of Alabama Leather-Flower

Alabama leather-flower blooms in late April to May, produce fruits by June, and die back to underground rhizomes in late summer. The distinctive bell-shaped flowers are produced singly at the top of above-ground stems. When pollinated, the flower produces a cluster of hairy single-seeded fruits, or achenes, each about 1-in long. Plants are hard to see in tall grasses, but fruits are distinctive all summer (Chaffin 2008, Boyd 2015). Scientists have not observed new plants growing from seed. Survival of the species over time depends mainly on the long-lived rhizomes. Genetic sampling of populations in Alabama revealed that genetically-distinct individuals can be quite large, spreading to at least 36 ft via underground rhizomes (Goertzen *et al.* 2011). These data, coupled with earlier estimates that Alabama leather-flower's rhizomes grow approximately 4 inches per year (Goertzen and Boyd 2007), indicate that the species is relatively long-lived and can live at least 55 years.

7.1.3. Numbers, Reproduction, and Distribution of Alabama Leather-Flower

The plant first was discovered on a highway ROW in 1980 in St. Clair County, Alabama. It was known only from the type locality until 1985, when a second population was discovered 40 mi away on a highway ROW in Cherokee County, Alabama. A total of eight natural populations have been located in northeastern Alabama (Cherokee, Etowah, and St. Clair counties) and

northwestern Georgia (Floyd County), but only six are extant. The species' entire known range spans less than 90 mi, with individual populations typically separated by 30 or more miles from their nearest neighbors (plants or groups of plants that are separated by at least 1-mi are considered to be distinct populations). All known populations occur within the Ridge and Valley physiographic province. Transplant efforts to establish a second Georgia population on land held under conservation easement by TNC have had limited success, and the population is not currently viable (USFWS 2017).

The Georgia population is owned by the Georgia Department of Transportation and managed by the Georgia Department of Natural Resources. A population in St. Clair County, Alabama, is owned by TNC. Most extant populations are small, occupying substantially less than 1 ac of habitat (USFWS 2017), and all populations continue to require active management to control competing vegetation and maintain suitable, open habitat conditions (Boyd 2015, USFWS 2017).

7.1.4. Conservation Needs of and Threats to Alabama Leather-Flower

Habitat for this species has been reduced through development, logging operations, and conversion to agriculture and pine (*Pinus spp*.) plantations (Boyd 2015). Remaining populations are threatened by inadequate management, particularly a lack of mowing, prescribed fire, and/or hand clearing. Alabama leather-flower is apparently a poor competitor; it is most vigorous in open areas with little competing vegetation and open canopies. The species benefits from occasional, limited disturbance (such as periodic mowing or prescribed fire), which reduces encroachment of competing vegetation, but individuals and/or populations may be affected by incompatible mowing regimes and errant herbicide application (USFWS 2017).

Alabama leather-flower's limited number of extant populations and relatively small, local population sizes increase the species' vulnerability to anthropogenic impacts and stochastic events. Small population sizes also increase the risks posed by inbreeding and genetic drift, which may limit the species' adaptive capacity and ability to cope with future stressors (Ellstrand and Elam 1993). However, the unexpectedly high level of genetic diversity maintained within Alabama leather-flower populations studied thus far (Goertzen and Boyd 2007, Goertzen *et al.* 2011), may limit some of the genetic threats posed by the species' small number of populations and overall small population size.

Climate change has potential to affect distribution and abundance of plants by influencing seasonal weather patterns, frequency and timing of severe weather events, and myriad plant physiological responses. Davenport (2007) suggested that Alabama leather-flower may be adversely affected by climate change if available habitat is reduced under drier conditions. Climate change may disrupt plant-pollinator interactions, shifting the timing of flowering and/or pollinator activity (Memmott *et al.* 2007, Hawkins *et al.* 2008) and reducing the already-low rate of sexual reproduction of Alabama leather-flower.

7.2. Environmental Baseline for Alabama Leather-Flower

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is

an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Alabama leather-flower, its habitat, and ecosystem within the Action Area.

7.2.1. Action Area Numbers, Reproduction, and Distribution of Alabama Leather-Flower

Alabama leather-flower has not been observed on TVA ROW. However, sections of the ROW overlap with the range of the species and not all ROW has been surveyed. Given the known range of the species, the only plausible overlap of Alabama leather-flower and the TVA transmission system is along ROW near Centre, Alabama, within a few miles of Weiss Lake in the Coosa River valley. This area is along the southern edge of the TVA transmission system and less than 20 mi of ROW intersect places on the landscape that could support habitat for the plant. Much of the ROW in this area now supports highly disturbed habitats like agricultural, industrial, or residential land uses, but there are ROW within the range of Alabama leather-flower that do support natural vegetation. Field surveys for Alabama leather-flower and other rare plants have been conducted over more about 90 percent of these areas, but the plant has not been found. There is a reasonable likelihood that undocumented occurrences of Alabama leather-flower exist on TVA ROW, but it is unlikely that more than a handful of undocumented occurrences occur on TVA ROW.

7.2.2. Action Area Conservation Needs of and Threats to Alabama Leather-Flower

The primary threats to Alabama leather-flower in the Action Area include potential herbicide affects and competition from aggressive, competing vegetation.

The species benefits from occasional, limited disturbance, such as periodic mowing or prescribed fire, which reduces shading and encroachment of competing vegetation.

7.3. Effects of Vegetation Management on Alabama Leather-Flower

This section analyzes the direct and indirect effects of the Action on Alabama leather-flower. An effects analysis summary of the effects of various methods of vegetation management on Alabama leather-flower and the other 17 listed LAA plant species from the BA has been included in Appendix II.

7.3.1. Effects of Manual Vegetation Clearing on Alabama Leather-Flower

Manual clearing could adversely affect individual Alabama leather-flower plants, although the magnitude of the negative effect would likely be small. Clearing trees would increase light levels, potentially resulting in a benefit to Alabama leather-flower. However, there is potential for direct physical disturbance as a result of trampling, cutting, or minor soil disturbance.

7.3.2. Effects of Mechanical Clearing on Alabama Leather-Flower

Effects to Alabama leather-flower from mechanical clearing would be similar to those described under 7.3.1 for manual clearing. In addition, if mechanical vegetation control methods utilized

by the TVA ROW program intersect habitat occupied by Alabama leather-flower, there is the potential that the species could be affected. The species occurs in areas disturbed by human activities and prospers in open conditions like those found along TL ROW. Alabama leather-flower could occur within the open floor of the ROW or along the relatively shady edges. Therefore, mowing, which is restricted to regularly maintained areas within the ROW floor could adversely affect individual plants, especially if the mowing was conducted during the flowering period or before fertilized plants could disperse seed. Although mowing can temporarily reduce woody species concentration, repeated mowing in wetter habitats, which are most likely to support Alabama leather-flower, would shatter the stumps of individual trees and shrubs located within the ROW. This would promote sprouting and the proliferation of woody species within the ROW over time, and, therefore, could be detrimental to Alabama leather-flower. However, given the dependence of Alabama leather-flower on asexual reproduction from underground rhizomes, it is unlikely mechanical vegetation control measures implemented by TVA for ROW vegetation management would remove the species from a site.

7.3.3. Effects of Herbicide Use on Alabama Leather-Flower

Vegetation control methods that utilize herbicides are likely to adversely affect Alabama leather-flower if used in occupied habitat, though the magnitude of effect would not likely be large enough to remove the species from a site. Spot treatment of herbicide is highly targeted and unlikely to adversely affect Alabama leather-flower at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. These methods could also be used as an AMM to control smaller trees in occupied habitat. If the trees did not need to be cut immediately, but would present a threat to TL reliability in the future, spot treatment could be used to kill the trees while minimizing direct effects to Alabama leather-flower.

Even though localized herbicide application targets woody species within the ROW floor, the use of that tool could have some level of adverse effects on the species. If individual Alabama leather-flower plants occur within a few feet of a tree seeding treated with localized herbicide application, chances are high that the plant would experience some level of herbicide related damage. This damage may rise to the level of individual plant death. Broadcast herbicide, either from the air or ground, could adversely affect plants growing on and near the ROW edge if it were used in occupied habitat. However, all areas of the ROW near Centre, Alabama, within the range of Alabama leather-flower have either been field surveyed or are designated as Plants Class 1 and 2 in O-SAR. This O-SAR restriction prohibits the use of broadcast herbicide either from the air or ground. Therefore, the potential for broadcast herbicide to adversely affect Alabama leather-flower is discountable.

7.3.4. Effects of Debris Management on Alabama Leather-Flower

Debris management techniques used by TVA have a small potential to adversely affect Alabama leather-flower. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. These effects would include physical damage resulting from cutting or dragging trees and would not likely result in death of individuals. If mulching/chipping did occur, the species could be directly affected by

crushing from machinery and burial by mulch/chips. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool combined with the extreme rarity of the species make the likelihood of this occurring small. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

7.4. Conclusion for Alabama Leather-Flower

In this section, we interpret the findings of the previous sections for the Alabama leather-flower (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects on Alabama leather flower and result in no more than a few individual plants within the Action Area being adversely affected. The species could also benefit from occasional, limited disturbance, such as periodic mowing or prescribed fire, which reduces shading and encroachment of competing vegetation. Cumulative effects to Alabama leather-flower that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Alabama leather-flower. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations would potentially occur on the TVA ROW because less than 20 mi of unsurveyed ROW intersect places on the landscape that could support habitat for the plant, and much of that remaining unsurveyed area is highly disturbed.

8. LEAFY PRAIRIE-CLOVER

8.1. Status of Leafy Prairie-Clover

This section summarizes best available data about the biology and current condition of leafy prairie-clover (*Dalea foliosa*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list leafy prairie-clover as endangered on May 1, 1991 (56 FR 19953-19959).

8.1.1. Description of Leafy Prairie-Clover

Leafy prairie-clover is a member of the legume family or Fabaceae. Leafy prairie-clover is easily distinguished from most other species of the genus *Dalea* east of the Mississippi River on the basis of the leaflet number, which ranges from nine (Barneby 1977) to 31 (Gleason and Cronquist 1963), but typically is between 20 and 27 (Fernald 1950). Leafy prairie-clover is a glabrous, stout perennial herb, with one to several stems 2 to 8 dm (8 to 31 in) long arising from a hardened root crown. The dense conic to cylindric flowering heads are between 0.4 and 8.9 cm (0.15 to 3.5 in) long and 0.6 to 1.0 cm (0.24 to 0.4 in) wide (DeMauro and Riddle, unpublished data) on short peduncles, 0 to 2 mm (0 to 0.08 in) long, with lance-ovate, long acuminate bracts which surpass the small (up to 5 mm [0.2 in] long) lavender-purple calyx that has five petals and five strongly exerted anthers with orange pollen (Fernald 1950, Gleason and Cronquist 1963, Wemple 1970, Barneby 1977).

8.1.2. Life History of Leafy Prairie-Clover

Leafy prairie-clover is a short-lived, herbaceous perennial forb that has no capacity for vegetative spread (Baskin and Baskin 1973; Schwegman and Glass, unpublished data). In March, new ramets (stems) begin to grow from buds on the root crown just below the soil surface. By July, these ramets are 40 to 65 cm (15.7 to 25.6 in) tall (Baskin and Baskin 1973). Non-flowering plants have from one to four ramets, and flowering plants have from one to 20 ramets. A single ramet will develop one or more inflorescence buds in late June (USFWS 1996a).

Flowering begins in late July, peaks in mid-August, and can continue until late August. Plants may take up to three years to flower (Baskin and Baskin 1989). Mature plants may have from one to ten (or more) flowering ramets. The average number of flowering ramets per plant varies from 0.58 to nearly three in extant leafy prairie-clover populations throughout the species' range (USFWS 1996a). The number of flowers per inflorescence varies from 40 to 495 (mean of 158.95 + 97.04 standard deviation) (DeMauro and Riddle, unpublished data). Leafy prairie-clover seeds ripen by early October and disperse from the erect dead ramets from late fall to early spring (Baskin and Baskin 1973). Potential dispersal vectors include wind, gravity, birds, and small mammals. Dormant seeds are capable of forming a persistent seed bank. Under natural conditions, several years are required to soften the hard seed coat, although mechanical scarification yields high germination rates in fresh seeds (Baskin and Baskin 1973, 1989). Germination occurs in April and, by late May, the seedlings have several leaves (Baskin and Baskin 1973).

Seedlings are killed by summer drought and frost heave and very few survive to maturity (Baskin and Baskin 1973; Schwegman and Glass, unpublished data). The oldest living plants monitored to date have reached seven to eight years of age (Schwegman and Glass, unpublished data). Dormancy has been observed in mature plants; some plants have been dormant for two consecutive years. Mature plants may not flower every year and may show decreased vegetative growth following a year of exceptionally vigorous growth (USFWS 1996a).

8.1.3. Numbers, Reproduction, and Distribution of Leafy Prairie-Clover

Leafy prairie-clover is currently known from north-central Alabama, northeastern Illinois, and central Tennessee. The plant occurs only in open habitats with thin, calcareous soils. In Tennessee and Alabama, the preferred habitat is limestone or dolomite glades, while in Illinois, this plant is restricted to very rare dolomite prairie habitat (USFS 2018).

Alabama

In Alabama, there are three known extant populations, one in Franklin County and two in Lawrence County (Schotz 2011; Adam Dattilo pers. comm. 2019). There are four occurrences of uncertain status, located in Franklin, Jefferson, and Morgan counties. No other occurrences are known to have been extirpated from Alabama besides those reported in the recovery plan (USFWS 1996a), all within these same counties.

According to the most recent survey data included in the BA, biologists from TVA observed 52 plants in one Lawrence County population in 2018 (this is a well-documented population that was first observed in 1989); this population was estimated to consist of 30 to 40 plants in 1989. The second Lawrence County population was first observed by TVA in 2012 and supported 65 plants; more recent 2018 survey data, included in the BA, indicates that there are 336 plants now at this site. There were 72 plants at the Franklin County site as of 2011 (Schotz 2011).

Illinois

There currently are 14 known extant populations in Illinois, ranging in size from a few hundred to several thousand individuals (Redmer and Lah 2008, J. Armstrong pers. comm. 2012, C. Pollack pers. comm. 2015). One population is located in Cook County, four in DuPage County, and the others are in Will County. A population at Midewin National Tallgrass Prairie in Will County was discovered in 1997 (Molano-Flores 2004). The Cook County population was first observed in 2002 (Illinois Department of Natural Resources 2008). Contrary to the statement in the recovery plan that the population at Lockport Prairie East was extirpated, we have concluded based on information in our records that this population is represented by the Will County population that was discovered in 2001 at Dellwood Park West (Barbers and Wilhelm 2005). The leafy prairie-clover was extirpated from Kane, Kankakee, and LaSalle counties in the late 1800s (USFWS 1996a).

Monitoring data for the population at Lockwood Prairie NP in Will County display considerable interannual variability with respect to abundance in each of three stages: seedling/juvenile, non-flowering adult, and flowering adult. Between 1990 and 2004, 11 leafy prairie-clover censuses were conducted at this site. Total number of plants ranged from a high of 5,636 in 1990, to a low of 1,056 in 2000. The total number rebounded to 5,022 in 2004 (Key 2004). This population increased to a total of 13,345 total individuals in 2006 (J. Armstrong pers. comm. 2012).

Monitoring was conducted in 2002 and 2004 at the Dellwood Park West site in Lockport, where a leafy prairie-clover population was discovered in 2001. The total number of plants increased over this period from 154 to 1,289, apparently in response to removal of invasive woody plants and subsequent fire management (Barbers and Wilhelm 2005). In 2014, there were 1,410 plants at this site, 1,002 of which were flowering or fruiting (C. Pollack pers. comm. 2015).

The total number of plants at Romeoville Prairie NP in Will County, inclusive of all life history stages, peaked at 2006, the last year during which a population census was conducted.

Considerable variability has also been observed in the population at Midewin National Tallgrass Prairie in Will County from 2002 through 2014, during which time the total number of plants ranged from a low of 92 in 2002, to a high of 839 in 2014, 375 of which were flowering or fruiting (USFS no date; C. Pollack pers. comm. 2015).

The Illinois Natural History Survey began monitoring a population of leafy prairie-clover at Keepataw Forest Preserve in Will County in 2005, under contract with the Illinois Toll Highway Authority (Taft *et al*. 2010). There are five colonies at this site, from which census data are collected for four life history stages: seedlings, juveniles, non-flowering adults, and flowering adults. The data from 2005-2006 display an increase, followed by a decrease in total numbers of plants from 2006-2010. Despite the fact that the total number of plants recorded was lowest in 2010, both the number of flowering adults and inflorescence spikes per adult reached their recorded peak, yielding the greatest potential reproductive output in 2010 compared to the five prior years (Taft *et al*. 2010).

Tennessee

There currently are 55 known extant occurrences in Tennessee in the following counties: Bedford (1), Davidson (7), Marshall (2), Maury (14), Rutherford (15), Williamson (1), and Wilson (15). Ten of these occurrences were found in surveys conducted during 2001 through 2003, mostly on public lands or private conservation lands (TDEC 2004a). In addition to the 55 sites reported by TDEC (2004a), two occurrences have been found in TVA ROW (TDEC 2015). There are 11 occurrences that are considered either historic or extirpated, distributed among the following counties: Davidson (2), Maury (1), Rutherford (5), Sumner (1), Williamson (1), and Wilson (1) (TDEC 2004a). No occurrences are known to have been extirpated from Tennessee besides those reported in the recovery plan (USFWS 1996a).

From 1996 through 2001, TVA monitored six leafy prairie-clover occurrences that are located within the Yanahli WMA and Duck River Complex Designated SNA. The TVA monitored no more than two of these occurrences per year, and TDEC assumed responsibility for monitoring these occurrences in 2003 (TDEC 2004b). Because of the inconsistencies among occurrences with respect to the years that monitoring occurred and sampling design used, we only discuss here the general trends reported by TDEC (2004b). Site names and element occurrence (EO) numbers, in parentheses, for the monitored occurrences include:

- Blue Springs (049)
- Columbia Glade (005)
- Columbia Glade East (054)
- Sowell Mill North Glade (028)
- Sowell Mill North Glade A.T.&T. ROW(068)
- Nancy Branch (047).

TDEC (2004b) reported a general decline during the period 1996 through 2003 in numbers of plants, stems, flowering stems, and flowering heads at all of these occurrences besides 005 and

068. Increases were observed in numbers of flowering stems and flowering heads at 005, despite a decrease in total number of plants, and in all leafy prairie-clover metrics at 068. The most notable decline was observed at 047, where total numbers of plants declined from 1,589 plants in 2000 to 32 plants in 2003. Given the considerable inter-annual fluctuation that has been observed at locations that have been monitored more consistently in Illinois, inferring trends from the data for these six occurrences is difficult due to inconsistency among monitoring years and methods. Monitoring data has demonstrated the importance of monitoring populations at a sufficient frequency, ideally annually, for detecting trends and cyclical variation in leafy prairie-clover populations (USFWS 2015b).

TDEC conducted general surveys of 18 leafy prairie-clover occurrences during 2004, to provide current data on numbers of plants (Table 8.1) (TDEC 2005). Beginning in 2009, TDEC began annual monitoring using permanent plots at 16 protected sites in Tennessee (TDEC 2014). This monitoring approach does not allow for tracking changes within entire populations present at each protected site, but does provide a means for examining variability in density over the full range of monitored sites. Data are recorded for the following variables in each plot: flowering plants, flowering stems, non-flowering plants (excluding seedlings), non-flowering stems, seedlings, and browsed stems (USFWS 2015b).

As is the case for monitoring data collected from Illinois, preliminary analysis of these monitoring data, conducted for this status review, demonstrate considerable variability both among sites and among years for all sites combined. The mean number of plants per square meter (m^2) for all stages combined decreased from 2009 through 2012, but peaked at 23.9 during 2014. The number of flowering plants/m^2 peaked at 13.17 in 2010, but was less than 4 in all other years. Non-flowering plants, excluding seedlings, were most abundant in 2009 (16.27/m^2), decreased through 2012, but increased during 2013 and 2014. The mean number of seedlings/m^2 has remained low throughout all years, with a high in 2013 of 2.27. Based on these preliminary analyses, these 16 protected leafy prairie-clover have fluctuated considerably, and mean numbers of flowering and non-flowering plants per m^2 suggest some decline since 2009. However, assessment of the species' overall status require additional years of data and more careful analysis before reaching firm conclusions (USFWS 2015b).

As noted above, analyzing data for trends across all 16 monitored populations does not effectively examine trends within individual sites or groups of sites. In the future, these data will be analyzed to provide insight into trends at individual sites. This will be necessary due to the variability in leafy prairie-clover abundance among the sites and differences in threats affecting them, as well as varying levels of management to address those threats (USFWS 2015b).

8.1.4. Conservation Needs of and Threats to Leafy Prairie-Clover

There currently are 44 occurrences on protected lands throughout the species' range. Nonetheless, several of the threats to leafy prairie-clover habitat identified in the recovery plan still have the potential to negatively affect this species even in protected sites, namely, degradation due to invasive exotic or native species encroachment, illegal ORV use, and incompatible management of utility ROW. The main threat to protected sites comes from the

Table 8.1. Results from general surveys of 18 *D. foliosa* occurrences conducted in Tennessee in 2004 ("- -" indicates data not collected) (TDEC 2005).

Site Name	EO Number	Non-flowering	Flowering	Total Plants
Flat Rock/Adams #3 Glade	011	--	544	544+
Couchville South	014	23	6	29
Cedars of Lebanon – S. of Cedar Forest Road	018	3	6	9
Cedars of Lebanon – Richmond Shop Barren	024	0	5	5
Long Hunter State Park – Wet Barren	031	--	--	37
Hall Farms Glades	032	--	559	559+
Cedars of Lebanon – Rowland Barren	033	--	187	187+
Jones Mill Glade / Campbell Road	037	--	--	70
Hamilton Creek Glade	040	--	--	442
Cedars of Lebanon State Forest – Quarry Creek	044	--	14	14
Cedars of Lebanon – Cedars Natural Area, Moccasin Road	052	0	0	0
Rocky Hill Glade	057	--	28	28
Cedars of Lebanon – Cedar Forest Road West 8	059	--	244	244
Long Hunter State Park	060	--	--	51
Cedars of Lebanon State Forest	064	--	80	80+
Flat Rock / Adams #2 Glades, Roadside, Trailside	065	0	0	0
Couchville North	066	0	1	1
Hall Farm Glades	067	--	824	824+
TOTALS		26+	2934+	3118+

potential for either exotic or native, invasive plant species to displace leafy prairie-clover from otherwise suitable habitat. The final listing rule for leafy prairie-clover (56 FR 19953) stated that all known populations were threatened by encroachment from competing herbaceous vegetation and/or woody plants, and this remains largely true today (USFWS 2015b). In addition to the threat of habitat degradation, the combined threats of small population size, low genetic variability, and accelerated climate change could increase the risk of localized extinction facing many leafy prairie-clover populations (Barrett and Kohn 1991; Molano-Flores and Bell 2012).

Conservation needs for leafy prairie-clover include: 1) increased use of prescribed fire, or other techniques to maintain open conditions with limited competing vegetation in areas with sufficient soil depth to support the plant, 2) continued efforts to reintroduce/augment Illinois populations, 3) development of a population viability analysis for the species across its entire range to provide a better estimation of the extinction risk faced by individual populations and the

species as a whole, and 4) increasing the frequency of monitoring in Tennessee and Alabama populations.

8.2. Environmental Baseline for Leafy Prairie-Clover

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the leafy prairie-clover, its habitat, and ecosystem within the Action Area.

8.2.1. Action Area Numbers, Reproduction, and Distribution of Leafy Prairie-Clover

In the Action Area, leafy prairie-clover has been documented from active TVA ROW in three discrete areas in Tennessee and two sites in Alabama. One of the Tennessee populations is located just north of Cedars of Lebanon State Forest and was first observed by TVA botanists in 2008. While there are cedar glades occurring with 500 ft of known locations of leafy prairie-clover, there is no off-ROW habitat immediately adjacent to this population.

Without the existence of the ROW, the plants would not occur on-site because the adjacent forest is unsuitable for the species. The small population was comprised of seven individual plants in 2008. During the most recent visit of the site in 2014, TVA botanists noted the population had increased to approximately 20 individual plants. The shallow soils found on the site retard invasion of woody species and result in a relatively low woody stem count and a diverse herbaceous plant community.

The other two Tennessee populations were both first observed several miles southeast of the city of Columbia in 2009 during field surveys for a proposed new TL. At both sites, the proposed new TL was sited parallel to an existing TVA TL that crossed through a natural cedar glade complex. The majority of leafy prairie-clover plants found at both locations were situated on the existing ROW. The initial observation of one population noted that about 125 individual plants occurred in the existing ROW, while an additional 20 plants occurred adjacent to a cedar glade off the ROW. After construction of the new TL, all leafy prairie-clover plants at this site remained in an open ROW. Subsequent surveys in 2018 noted that 52 plants remained on the site. Approximately 23 individual leafy prairie-clover plants were initially observed at the second site. The area was heavily grazed by horses, to the extent that it was surprising to find the plants present on the site. Leafy prairie-clover was restricted to small, wet portions of the glade. Subsequent surveys in 2018 found no plants extant in this population. The cause of the apparent declines at these sites is difficult to ascertain and could be the result of action taken by the private landowner (grazing), TVA vegetation management, or some combination of the two.

The two leafy prairie clover sites in Alabama lie on the northern edge of the William Bankhead NF. One of the sites is a well-documented site that was first observed in 1989 by botanist, David Webb. The TL ROW intersects a limestone cedar glade complex that supports a number of state and globally rare plant species. On this site, leafy prairie clover inhabits dry ROW and has never been observed outside of the TL easement. The site has not been systematically monitored, but botanists have made detailed observations multiple times since the site was first discovered.

Population counts have fluctuated over time, but appear relatively stable. Individual plant counts of this population include: 30-40 (1989); 100-200 (1993); 21 (2008); 40 (2012); 56 (2014); 31 (2016); and 52 (2018). The recent increase in the frequency of monitoring efforts is linked to TVA's ROW floor vegetation management, which occurs every third year. TVA botanists survey the site before work takes place.

The second population was first observed by TVA botanists in 2012. This occurrence is comprised of three sub-sites that span about 4,000 ft of ROW. This population is situated on the same TL ROW as the other population, but about 1-mi to the southeast. At this site, there are no open cedar glades adjacent to the ROW and no off-ROW habitat for leafy prairie-clover. The population appears stable based on available plant count data: 65 (2012), 290 (2014), 200 (2016), and 336 (2018). The low value in 2012 may be the result of the timing of survey, which was the third week in May. This is too early in the season to effectively monitor leafy prairie-clover, but late enough in the season for TVA botanists to find small plants growing in the ROW.

8.2.2. Action Area Conservation Needs of and Threats to Leafy Prairie-Clover

In Tennessee, the primary threats to leafy prairie-clover in the Action Area are encroachment by competitive herbaceous and woody vegetation into suitable habitat for the species and adverse land use activities by private landowners *(e.g.*, grazing suitable habitat). In Alabama, TVA vegetation management, primarily localized herbicide applications used to control woody vegetation in ROW, is the primary threat and may result in limited inadvertent adverse effects to the leafy prairie-clover. Reducing these threats may be best addressed by continued coordination with TVA regarding maintenance of ROW.

8.3. Effects of Vegetation Management on Leafy Prairie-Clover

This section analyzes the direct and indirect effects of the Action on leafy prairie-clover. An effects analysis summary of the effects of various methods of vegetation management on leafy prairie-clover and the other 17 listed LAA plant species from the BA has been included in Appendix II.

8.3.1. Effects of Manual Vegetation Clearing on Leafy Prairie-Clover

Manual vegetation clearing, when utilized by TVA, has the potential to adversely affect leafy prairie-clover. However, provided clearing does not intentionally disturb the soil, it is unlikely to result in the death of individual plants. Leafy prairie-clover prefers sunny conditions, though it does not typically inhabit the interior of cedar glades. Plants frequently inhabit ROW edges. If tree clearing resulted in increased light on ROW edges where leafy prairie-clover occurred, the effect would not likely be detrimental. The species would be susceptible to physical damage from clearing activities, but the shallow rocky soils, characteristic of cedar glades, do not rut easily, and the species could resprout after tree clearing.

Clearing previously unmaintained ROW is a one-time event because these areas would subsequently be treated as ROW floor. Danger tree clearing occurs as needed. Danger tree

clearing may never be needed in leafy prairie-clover habitat near glades because the soils are not sufficiently deep to support growth of taller trees.

8.3.2. Effects of Mechanical Clearing on Leafy Prairie-Clover

All of TVA's mechanical vegetation control methods have the potential to adversely affect leafy prairie-clover. Mowers are generally set 10 to 12 inches off the ground and would likely miss leafy prairie-clover if mowing occurred before June. If damaged during mowing, all but the weakest plants would resprout because TVA mowing would not be employed more frequently than once every three years.

8.3.3. Effects of Herbicide Use on Leafy Prairie-Clover

Vegetation control methods that utilize herbicides are likely to adversely affect leafy prairie-clover. Spot treatment of herbicide is highly targeted and unlikely to adversely affect leafy prairie-clover at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting larger tree to prevent resprouting and as an AMM to control smaller trees in occupied habitat within the ROW floor. Leafy prairie-clover often occurs on the floor of ROW and could, therefore, be affected by localized herbicide applications, which are commonly used to control woody species in the open ROW.

While off target herbicide damage could kill individual plants, it is unlikely that whole populations would be extirpated. This is because habitats where leafy prairie-clover is most likely to occur do not have significant stringers of tree seedlings in the ROW. These dry, rocky areas do not support rapid tree growth, and woody plant species are typically widely-spaced. This increases the odds that leafy prairie-clover plants, if any undocumented populations occur on TVA ROW, would survive instances of localized application of herbicide. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW. However, it is unlikely that this tool would be used in areas that might support leafy prairie-clover because nearly all glade and barrens habitat that could potentially support the species has been field surveyed by TVA botanists or is restricted with a Class 1 or 2 Plants O-SAR polygon, which restricts use of broadcast herbicide.

8.3.4. Effects of Debris Management on Leafy Prairie-Clover

All debris management techniques used by TVA have a small potential to adversely affect leafy prairie-clover. The aspect of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of debris. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be expected from use of machinery. The soil disturbance would be minimal because of the rocky habitats preferred by leafy prairie-clover, which are usually well-drained and resistant to deep rutting. Neither form of disturbance would likely result in death of individual plants. Pile burning could conceivably result in loss of individual plants, but the infrequent use of the tool, combined with the extreme rarity of the species, make the likelihood of this occurring slight.

TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

If mulching machines were used in leafy prairie-clover habitat, it would not likely generate enough mulch to bury the species. This is because the amount of mulch or chips generated by the machine is directly proportional to the amount of vegetation the site supports. Dry glade and barrens margins stunt woody plant growth, and the layer of mulch left in these areas is often discontinuous and less than 1-in deep.

8.4. Conclusion for Leafy Prairie-Clover

In this section, we interpret the findings of the previous sections for the leafy prairie-clover (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to leafy prairie-clover and result in only a few individual plants within the Action Area being adversely affected. The species only occurs on TVA ROW because of the existence of the ROW; the open conditions of the ROW provide suitable habitat, whereas the plants do not occur in adjacent forested areas because such habitat is unsuitable for leafy prairie-clover. Cumulative effects to leafy prairie-clover that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the leafy prairie-clover. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) The ROW provides suitable cedar glade habitat conditions for the five populations in the Action Area, thus supporting the conservation of the species. (4) Only a fraction of the known rangewide population (five small populations out of a total of 71) exists within the Action Area; therefore, only a small percentage of plants in the species range would be adversely affected by the Action.

9. WHORLED SUNFLOWER

9.1. Status of Whorled Sunflower

This section summarizes best available data about the biology and current condition of whorled sunflower (*Helianthus verticillatus*) throughout its range that are relevant to formulating an

opinion about the Action. The USFWS published its decision to list whorled sunflower as endangered on August 1, 2014 (79 FR 44712- 44718).

9.1.1. Description of Whorled Sunflower

A member of the aster family (Asteraceae), whorled sunflower is a perennial herb arising from horizontal, tuberous-thickened roots with slender rhizomes, producing stems that can reach 4 m (13 ft) or more in height (Matthews *et al*. 2002). The leaves are opposite on the lower stem, verticillate (whorled) in groups of three to four at the mid-stem, and alternate or opposite in the inflorescence (flower-bearing portion of a plant). Individual leaves are firm in texture and have a prominent mid-vein, but lack the prominent lateral veins found in many members of the genus. The leaves are linear-lanceolate in shape, narrowing at the tip to a point, and 7.5 to 18.5 cm (3 to 7.2 in) long and 0.7 to 2.0 cm (0.3- to 0.8 in) wide. The flowers are arranged in a branched inflorescence, typically consisting of three to seven heads, each with deep yellow ray flowers and lighter yellow disk flowers. Achenes are 0.4 to 0.5 cm (0.16 to 0.2 in) long.

9.1.2. Life History of Whorled Sunflower

Whorled sunflower is found in moist-soiled areas ranging from degraded sites along roadsides, railroads, and agricultural fields to higher integrity prairie remnants in openings in woodlands and adjacent to creeks. Creation and maintenance of whorled sunflower habitat requires managing for open conditions by controlling invasive plants and competing woody vegetation with careful herbicide application, prescribed fire, and/or properly-timed mechanical thinning.

Whorled sunflower appears to be a habitat specialist, occurring in natural wet meadows or prairies and calcareous barrens. Despite the commonly degraded condition of these habitats, the list of associated species in these areas indicates a community with strong prairie affinities as specified in Schotz (2001); Matthews *et al*. (2002); Tennessee Division of Natural Areas (TDNA) (2008a).

9.1.3. Numbers, Reproduction, and Distribution of Whorled Sunflower

Whorled sunflower is endemic to the Loess Plains, Northern Hilly Gulf Coastal Plain, and Southern Shale Valleys ecoregions. There are five known extant whorled sunflower populations found in four states including Alabama (1), Georgia (1), Mississippi (1), and Tennessee (2) and one known historical population in Tennessee. A general summary of all extant whorled sunflower occurrences can be found in Table 9.1. The Georgia population is located in Floyd County and composed of four subpopulations. The Alabama population is located in Cherokee County and composed of two subpopulations. The populations in Georgia and Alabama are less than 2 km (1.2 mi) apart. In Tennessee, there is one population composed of six subpopulations in McNairy County and the second population composed of four subpopulations in Madison County. A small, roadside population was found in Marshall County, Mississippi, in 2017 (Collection Manager, University of Memphis Herbarium, pers. comm., August 12, 2017). Follow-up searches in 2018 discovered more plants growing upstream of the original site within a forested riparian corridor between agricultural fields (D. Brandon pers. comm., August 29, 2018). Table 9.1 lists these populations and subpopulations, and relates them to EO numbers

used by state conservation agencies to track their status. Given this recent discovery, expansion of surveys may discover more whorled sunflower populations in northern Mississippi and/or southwestern Tennessee.

Table 9-1. Summary of extant whorled sunflower populations and subpopulations by state and county, with corresponding site names and EO numbers from state conservation agency databases in Alabama, Georgia, and Tennessee.[6]

Population (County, State)	Site Name	EO Number	Subpopulation Number(s)
Cherokee, AL	Kanady Creek Prairie	AL 1	1
	Locust Branch Prairie	AL 2	2
Floyd, GA	Jefferson Road Wet Prairie	GA 1	1
	Kanady Creek Wet Prairie	GA 4	2
	Upper Mud Creek Wet Prairies	GA 5	3
	Sunnybell Prairie	GA 7	4
Marshall, MS	Clear Creek	n/a	n/a
Madison, TN	Turk Creek	TN 2	1–6
McNairy, TN	Prairie Branch	TN 3	1–4

Whorled sunflower is a self-incompatible, clonal perennial and flowers from August–October (Matthews *et al*. 2002; Ellis and McCauley 2009). Self-incompatibility is a common strategy of flowering plants to promote outcrossing and prevent inbreeding (Silva and Goring 2001). Whorled sunflower propagates clonally via rhizomes, as well as by sexual reproduction (*i.e.*, flowering and seed production); thus, many stems that appear to be individual plants are genetically identical to their neighbors, resulting in a clumped distribution (Ellis *et al*. 2006; Mandel 2010). Clumped distribution combined with the species' self-incompatibility and short flight distances of potential pollinators (*e.g.*, two-spotted long-horned bees [*Mellisodes bimaculatus*] and honeybees [*Apis mellifera*] have been observed visiting flowers of the species) increase the likelihood of geitonogamous self-pollination (transfer of pollen between flowers of this same genetic individual) that will result in unsuccessful pollination (Ellis 2008; Mandel 2010). Whorled sunflower lacks adaptations for wind pollination, so pollinating invertebrates are likely required for successful reproduction, although studies to determine effective pollinators of this species have not been conducted.

The species is easily cultivated and seed germination is high in the laboratory. Upon transplanting, this species has been shown to reproduce rapidly from rhizomes, creating dense colonies of stems that can reach over 4 m (13 ft.) in height (Matthews *et al*. 2002). However, Ellis and McCauley (2009) reported lower germination rates in seeds produced from crosses between plants from the Madison County, Tennessee, population compared to plants from the larger Alabama population. Lower rates of seed viability were also observed in second-

[6] Due to its recent discovery, some data was not available for the Mississippi population.

generation (F2) crosses of the Tennessee versus Alabama plants. These results suggest a possible influence of population size on individual fitness in whorled sunflower populations.

9.1.4. Conservation Needs of and Threats to Whorled Sunflower

Loss and degradation of habitat represent the greatest threats to whorled sunflower. Past and ongoing risks of adverse effects from mechanical or chemical vegetation management for industrial forestry, ROW maintenance, or agriculture threaten three of the five extant populations of this species. Degradation of the species' remnant prairie habitats, due to shading and competition resulting from vegetation succession, also threatens these three populations, limiting growth and reproductive output of whorled sunflower. Whorled sunflower is vulnerable to localized extinction because of its extremely restricted distribution and small population sizes at most known locations. Small population size may affect reproductive fitness of whorled sunflower by limiting availability of compatible mates and/or by causing higher rates of inbreeding among closely related individuals. Extant populations vary in size, but are relatively small and isolated, making it more difficult for the species to withstand and recover from stochastic or catastrophic events. Furthermore, the species is likely suffering genetic isolation and reduced adaptive capacity. These threats are expected to continue into the foreseeable future absent conservation efforts to intervene.

9.2. Environmental Baseline for Whorled Sunflower

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the whorled sunflower, its habitat, and ecosystem within the Action Area.

9.2.1. Action Area Numbers, Reproduction, and Distribution of Whorled Sunflower

In the Action Area, whorled sunflower has been previously reported in close proximity to one small section of a TVA ROW in McNairy County, Tennessee, associated with Prairie Creek. Plants were originally observed by TDNA biologists in 2006. Individuals were recorded from multiple locations along the railroad easement, creek banks, agricultural field edges, and roadsides. No whorled sunflower plants have been documented in the TVA ROW near the Prairie Creek population, which was last visited by TVA botanists in 2013. The nearest plants to the ROW were located about 700 ft to the south along the margins of a soybean field. The initial discovery of whorled sunflower in Mississippi in 2017 (D. Brandon pers. comm., August 12, 2017) was along the U.S. Highway 72 ROW at Clear Creek, and surveys conducted since then have discovered several additional plants growing along Clear Creek in the same general vicinity. This known location is also within 0.5-mi of an existing TVA ROW.

The ability of whorled sunflower to occupy disturbed, open habitat suggests that the species could occupy other sites on TVA TL ROW. TVA botanists have surveyed 480 ac (46 percent) of the 1,100 ac of TVA ROW area situated in counties where whorled sunflower is known to occur. While not all sections of TVA ROW contain suitable habitat for whorled sunflower, TVA botanists have used the O-SAR process to designate about 560 and 70 ac of ROW as Plants Class

1 and Class 2, respectively. It is impossible to quantify with certainty, but given the limited area surveyed for the species and presence of suitable habitat in the Action Area, TVA is reasonably certain that whorled sunflower occurs within the O-SAR polygons.

9.2.2. Action Area Conservation Needs of and Threats to Whorled Sunflower

Threats to this species in the Action Area include mechanical and chemical vegetation management for industrial forestry, ROW maintenance (*i.e.*, incompatible mowing regimes, indiscriminate herbicide application); agriculture; shading and competition resulting from vegetation succession; and limited distribution and small population sizes.

Management of whorled sunflower habitat requires maintaining open conditions by controlling invasive plants and woody vegetation with careful herbicide application, prescribed fire, and/or properly timed mechanical thinning (*e.g.*, mowing).

9.3. Effects of Vegetation Management on Whorled Sunflower

This section analyzes the direct and indirect effects of the Action on whorled sunflower. An effects analysis summary of the effects of various methods of vegetation management on whorled sunflower and the other 17 listed LAA plant species from the BA has been included in Appendix II.

9.3.1. Effects of Manual Vegetation Clearing on Whorled Sunflower

Manual vegetation clearing has the potential to adversely affect whorled sunflower. While tree clearing would increase light levels on-site, potentially resulting in a benefit to whorled sunflower, direct physical disturbance of the species is likely to occur. The disturbance could result from trampling, cutting, or soil disturbance. Given the ability of whorled sunflower to reproduce asexually from underground rhizomes, it is unlikely manual vegetation clearing would completely remove the species from a site. Likewise, the presence, if any, of a soil seed bank of whorled sunflower may limit the effects of such activities on local populations.

In summary, manual vegetation clearing is likely to adversely affect whorled sunflower if conducted in occupied habitat. Adverse effects from manual clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, and avoiding the use of heavy equipment (to and from the site) that may result in soil disturbance.

9.3.2. Effects of Mechanical Clearing on Whorled Sunflower

All mechanical vegetation control methods used by TVA have the potential to adversely affect whorled sunflower. Whorled sunflower occurs in areas disturbed by human activities and thrives in open conditions like those found along TL ROWs. Whorled sunflower could occur within the open floor of the ROW or along the relatively shady edges. The effects caused by mechanical clearing are similar to those from manual vegetation clearing. In addition, mowing, which is restricted to regularly maintained areas within the ROW floor, could adversely affect individual

plants, especially if the mowing was conducted during the flowering period or before fertilized plants could disperse seed. Even though mowing can temporarily reduce woody species concentration, repeated mowing in moist-soil habitats, most likely to support whorled sunflower, would shatter the stumps of individual trees and shrub, thereby promoting sprouting and the proliferation of woody species. Allowing a woody canopy to develop within the ROW may be detrimental to whorled sunflower over time.

Mechanical clearing and side-wall trimming will increase light levels on-site, potentially resulting in a benefit to whorled sunflower. However, there is a potential for direct physical disturbance with all methods. The disturbance could result from trampling, cutting, or soil disturbance resulting from machinery (*e.g.*, rutting from tires, and tracked equipment/vehicles).

In summary, all mechanical vegetation control methods used by TVA are likely to adversely affect whorled sunflower. Adverse effects from mechanical clearing activities can be minimized by implementing the same BMPs (TVA 2017) and AMMs described under 9.3.1.

9.3.3. Effects of Herbicide Use on Whorled Sunflower

Broadcast herbicide, either from the air or ground, will adversely affect plants growing on and near the ROW edge if used in occupied habitat. Broadcast herbicide used in an agricultural setting and for vegetation management along the nearby railroad have been detrimental to whorled sunflower in the Prairie Creek population. Many TVA ROWs in west Tennessee that have non-native, naturalized vegetation have been assigned a Class 1 Plants O-SAR polygon, but the fairly ubiquitous nature of whorled sunflower habitat makes it difficult to effectively identify areas that might harbor the species using the O-SAR process. In addition, while not currently used, broadcast herbicide could be used in the future in the isolated parts of the TVA study area, such as west Tennessee. If broadcast herbicide would be used in a TVA ROW that contained whorled sunflower, the population could be severely damaged.

Spot treatment with herbicide is highly targeted and unlikely to adversely affect whorled sunflower at the population level, but could result in isolated, direct adverse effects on individual plants if a broad spectrum herbicide is used in close proximity to individuals. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. These methods could also be used as an AMM to control smaller trees in occupied habitat. If trees do not need to be cut immediately, but may threaten future TL reliability, spot treatments can be used to kill the trees without directly affecting whorled sunflower. Although localized herbicide application targets woody species within the ROW floor, the use of that tool would have some level of adverse effects on the species. If individual whorled sunflower plants occur within a few feet of a of a localized herbicide application, chances are high that the plant would experience some level of herbicide related damage. This damage may rise to the level of individual plant death. These targeted applications may be less likely to damage whorled sunflower plants beyond chemical burns or other limited effects (limiting or eliminating the application year's reproduction); however, the precise effects of such targeted herbicides on whorled sunflower have not been studied, so they should still be used with an abundance of caution.

In summary, all vegetation control methods that use herbicides are likely to adversely affect whorled sunflower if used in occupied habitat. Adverse effects from herbicide management activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, appropriate application and timing of herbicide treatment, conservation spraying, or another targeted herbicide application technique such as spot application.

9.3.4. Effects of Debris Management on Whorled Sunflower

Debris management techniques used by TVA are likely to adversely affect whorled sunflower. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. These effects include physical damage resulting from cutting or dragging trees and would not likely result in death of individuals. If mulching/chipping is used, the species could be directly affected by crushing and grinding from machinery and smothering by mulch/chips. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool, combined with the extreme rarity of the species, make the likelihood of this occurring small. At the requests of landowners, vegetation debris may be left for landowner's personal use under appropriate circumstances. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

In summary, all debris management activities are likely to adversely affect whorled sunflower. Adverse effects from mechanical clearing activities can be minimized by implementing BMPs (TVA 2017) and AMMs including flagging occupied habitat, appropriate timing of debris management, and avoiding the use heavy equipment that may result in soil disturbance.

9.4. Conclusion for Whorled Sunflower

In this section, we interpret the findings of the previous sections for the whorled sunflower (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects on whorled sunflower and result in a few individual plants, if any, within the Action Area being damaged or destroyed. Other non-federal actions in the Action Area, that are reasonably certain to occur and that may affect whorled sunflower, include the use of broadcast herbicide on adjacent agricultural lands, use of broadcast herbicides at ROW intersections (*e.g.*, railroad crossings, roads), and other timber management activities on adjacent lands (cumulative effects; see Section 2.8).

After reviewing the current status of whorled sunflower, the environmental baseline for the Action Area, the effects of the proposed Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the whorled sunflower. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations

of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations (one population out of six) exists within the Action Area, and this population is located 700 ft from the ROW, where individual plants would likely not be affected by the Action. (4) The species has the ability to occupy disturbed, open habitat; therefore, the plant would likely persist following removal of vegetation in the Action Area.

10. SMALL WHORLED POGONIA

10.1. Status of Small Whorled Pogonia

This section summarizes best available data about the biology and current condition of small whorled pogonia (*Isotria medeoloides*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the small whorled pogonia as endangered on September 9, 1982 (53 FR 39827-39831). On October 6, 1994, the USFWS reclassified the species from endangered to threatened (59 FR 50852-50857).

10.1.1. Description of Small Whorled Pogonia

Small whorled pogonia is a perennial herb in the orchid family with long, pubescent roots and a smooth, hollow stem, 3.7 to 9.8 inches tall, terminating in a whorl of five or six light green, elliptical leaves that are somewhat pointed and measure up to 3.1 x 1.6 inches. A flower, or occasionally two flowers, is produced at the top of the stem. Small whorled pogonia's nearest relative is the purple five-leaf orchid (*Isotria verticillata*), which is similar looking, but can be distinguished by its purplish stem and by differences in the flower structure. The purple five-leaf orchid is much more common and widespread than the small whorled pogonia. When not in flower, young plants of Indian cucumber-root (*Medeola virginiana*) also resemble small whorled pogonia. However, the hollow stout stem of the small whorled pogonia will separate it from the genus *Medeola*, which has a solid, more slender stem (USFWS 1992).

10.1.2. Life History of Small Whorled Pogonia

Small whorled pogonia is a forest species and is often found in colonies. The species tends to occupy mesic, second-growth deciduous or deciduous coniferous forest with a robust herb layer (NatureServe Explorer 2018a). It prefers areas with a layer of leaf litter and decaying material, but it can sometimes occupy edges and disturbed successional forests, such as those that may be found along a ROW margin. Flowering typically occurs May-June, although some individuals within a colony may remain underground in a dormant state for several years, making it difficult to determine population size and viability.

10.1.3. Numbers, Reproduction, and Distribution of Small Whorled Pogonia

Small whorled pogonia is a small orchid that is wide ranging, occurring in 22 states from Georgia to Maine. There are about 150 populations of small whorled pogonia throughout its range. Rangewide, the status of the species is considered to be stable. There are approximately 61 populations of small whorled pogonia in the states containing TVA TL ROW including: seven in North Carolina, 33 in Virginia, 19 in Georgia, and two in Tennessee. Most southeastern populations number less than 25 plants, although Georgia has two populations numbering about 100 plants each. In the Southeast, North Carolina has two protected sites, both of which are viable; and Georgia has seven protected sites, four of which are viable (USFWS 2008). Recent data is sparse and many populations have not been monitored. The most recent report (from a small whorled pogonia workshop in 2016) indicated that Georgia had five extant populations ranging in size from 1 to 30 plants and only one population had more than five individuals. The patterns for North Carolina were reported to be similar. Of the 18 populations found in North Carolina between 1978 and 2013, nine populations were extirpated or had not been found since 2004 and the population size ranged from one to 15 plants. Six populations in North Carolina were reported to be stable, and three populations were declining (Isotria Workshop 2016).

10.1.4. Conservation Needs of and Threats to Small Whorled Pogonia

Of the known populations of small whorled pogonia in the southeast, few are provided long-term protection. Primarily, protection of small whorled pogonia populations in the southeast has transpired as a result of surveys documenting populations on state and federal lands (USFWS 2008). Also, because the species can remain dormant for years, monitoring and collection of data to assess the health of populations is difficult. The limitations, associated with monitoring of small whorled pogonia, create data gaps and difficulty in assessing population density and viability. Additional research and monitoring of known populations, rangewide surveys to locate previously unknown populations, and mechanisms to ensure long-term protection and management of populations are needed to aid in recovery of this species.

The primary threat to small whorled pogonia is the loss of populations and degradation of habitat from urban development. Forestry practices have also been known to degrade or eliminate suitable habitat for the species. Other lesser threats that can lead to habitat degradation or loss of individual plants are recreational activities and trampling.

10.2. Environmental Baseline for Small Whorled Pogonia

The environmental baseline is a “snapshot” of the species’ health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the small whorled pogonia, its habitat, and ecosystem within the Action Area.

10.2.1. Action Area Numbers, Reproduction, and Distribution of Small Whorled Pogonia

Small whorled pogonia is an interior forest species and is very unlikely to occur on the floor of a TL ROW. Although there are no known occurrences of small whorled pogonia in the Action

Area, there are a number of populations in the TVA PSA and within proximity of TVA ROWs. Most known occurrences of small whorled pogonia in the PSA inhabit mountain slopes and are at least 5 mi distance from the nearest TVA TL ROW. The nearest documented location for small whorled pogonia in North Carolina is 12 mi from the eastern edge of the PSA; the other occurrences are more than 20 mi distance. Similarly, the Lee County, Virginia record for the species is more than 20 mi north of the nearest TVA ROW. In Georgia, where the majority of occurrences of small whorled pogonia occur in the TVA PSA, all records are more than 5 mi away from the nearest TV TL. Tennessee records of the species are generally closer to the TVA ROW with the Hamilton, Washington, and Marion county records being about 4, 1, and 0.15-mi away, respectively, but these populations are small, averaging about four plants per population.

10.2.2. Action Area Conservation Needs of and Threats to Small Whorled Pogonia

Because small whorled pogonia is restricted to forests and ecotones between the forest and ROW and does not occupy open portions of ROW floor, mowing in regularly maintained areas within the ROW is not likely to adversely affect the species. However, other vegetation management activities, such as manual and mechanical tree clearing and trimming, and herbicide use in and adjacent to areas of suitable habitat, could affect small whorled pogonia. Debris management techniques (*e.g.*, piling, chipping, and burning of brush) also have the potential to affect small whorled pogonia when utilized adjacent in the ROW edges.

Although there are no known populations of small whorled pogonia adjacent to TVA ROWs, suitable habitat does occur adjacent to TVA ROW. For this reason, it is likely small whorled pogonia populations could occur where vegetation management actions will take place. Though the probability is low, there is the possibility that vegetation management and debris management activities could affect small whorled pogonia.

10.3. Effects of Vegetation Management on Small Whorled Pogonia

This section analyzes the direct and indirect effects of the Action on small whorled pogonia. An effects analysis summary of the effects of various methods of vegetation management on small whorled pogonia and the other 17 listed LAA plant species from the BA has been included in Appendix II.

10.3.1. Effects of Manual Vegetation Clearing on Small Whorled Pogonia

Manual vegetation management activities, such as tree clearing, have the potential to affect small whorled pogonia by crushing or cutting individual plants, disturbing the soil profile, and/or changing lighting regimes. Large increases in sunlight from canopy removal could result in adverse effects to plants occurring in the area; however, some canopy clearing in densely vegetated areas could result in increased light levels that could increase productivity and reproduction without fundamentally changing the vegetation structure and light regime in the immediate vicinity of the plant, but this is unclear (NatureServe Explorer 2018a).

10.3.2. Effects of Mechanical Clearing on Small Whorled Pogonia

Mechanical vegetation management activities, such as ROW sidewall trimming, also have the potential to affect small whorled pogonia by crushing or cutting individual plants, disturbing the soil profile, and/or changing lighting regimes. Effects and potential benefits to small whorled pogonia from mechanical vegetation management are similar to those described in section 10.3.1.

10.3.3. Effects of Herbicide Use on Small Whorled Pogonia

Vegetation control methods that use herbicides are likely to adversely affect small whorled pogonia if used in occupied habitat, though the probability of herbicides intersecting the species is small. Spot treatment with herbicides is highly targeted and unlikely to adversely affect small whorled pogonia at the population level, but could result in isolated, direct adverse effects on individual plants. Because it is restricted to the ROW floor where small whorled pogonia does not grow, localized herbicide application is not likely to intersect the species. There is a potential nexus with localized herbicide application and small whorled pogonia at the ROW edge. In this area, individual plants growing adjacent to tree seedlings could be inadvertently affected by overspray. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW edge. The chances of broadcast herbicide being used adjacent to small whorled pogonia are very small because areas in Tennessee and Georgia most likely to support the species have been given a Class 1 Plants designation in the O-SAR database, which prohibits the use of broadcast spray. These restricted areas include TVA ROW that bisects higher elevation, natural forests within counties where small whorled pogonia is known to occur.

10.3.4. Effects of Debris Management on Small Whorled Pogonia

Debris management techniques used by TVA have a small potential to adversely affect small whorled pogonia. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants, but the removal of trees preceding debris management activities could ultimately result in plants occurring there dying over time. If chipping and mulching did occur, the effect could be direct affected by crushing from machinery and burial by mulch/chips. Burning would occur in the open ROW and would not affect small whorled pogonia, but debris handling by machinery could affect individual plants on the ROW edge. TVA's facilitation of landowner use of wood have similarly low potential for effects as other debris management methods.

10.4. Conclusion for Small Whorled Pogonia

In this section, we interpret the findings of the previous sections for the small whorled pogonia (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would at most have localized adverse effects to small whorled pogonia and result in only a few individual plants within the Action Area being adversely affected. Cumulative effects to small whorled pogonia that may be relevant to this consultation are unknown.
After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the small whorled pogonia. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The species is currently unknown to occur on the TVA ROW (i.e., Because the species inhabits interior forests, it is unlikely that it would occur on the ROW.). (3) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near the TVA ROW. (4) Rangewide, there are 150 populations in 22 states, including 61 known populations in four of the states within TVA's PSA; the nearest known populations to the TVA ROW occur about 4.1 and 0.15-mi from the ROW in Tennessee, averaging only four plants per population, and, therefore, any adverse effects would occur to only a small proportion of the rangewide population.

11. FLESHY-FRUIT GLADECRESS

11.1. Status of Fleshy-Fruit Gladecress

This section summarizes best available data about the biology and current condition of fleshy-fruit gladecress (*Leavenworthia crassa*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list fleshy-fruit gladecress as endangered on August 1, 2014 (79 FR 44712-44718).

11.1.1. Description of Fleshy-Fruit Gladecress

Fleshy-fruit gladecress (Family: Brassicaceae) is a glabrous, having no trichomes (bristles or hair-like structures), winter annual known from Lawrence and Morgan counties, Alabama. It usually grows 10 to 30 cm (4 to 12 in) tall. The leaves are mostly basal, forming a rosette, and entire to very deeply, pinnately (multiple leaflets attached in rows along a central stem) lobed or divided, to 8 cm (3.1 in) long. Flowers are on elongating stems, and the petals are approximately 0.8 to 1.5 cm (0.3- to 0.6 in) long, obovate to spatulate, and emarginate (notched at the tip). Flower color is either yellow with orange or white with yellow, usually with both color forms intermixed in a single population. The fruit is globe-shaped or slightly more elongate and about 1.2 cm (0.5-in) long with a slender beak at the tip, which is 0.25 to 0.60 cm (0.1- to 0.24 in) in length. Seeds are dark brown, nearly round in shape, and winged.

11.1.2. Life History of Fleshy-Fruit Gladecress

Fleshy-fruit gladecress is an annual, spring-flowering member of the mustard family (Brassicaceae). As an annual, the seeds germinate in the fall, overwinter as rosettes, and commence a month-long flowering period beginning in mid-March. The first seeds mature in late April, and during most years the plants dry and drop seed by the end of May. It is unlikely that all seeds produced in spring germinate the next fall, but the length of dormancy in the soil is not known (McDaniel and Lyons 1987), and we do not know whether the species is capable of forming a seed bank. Native bees in the families Andrenidae and Halictidae (sweat bees), including the species *Halictus ligatus*, were observed carrying pollen from fleshy-fruit gladecress and Alabama gladecress (*Leavenworthia alabamica*) in northern Alabama (Lloyd 1965).

Fleshy-fruit gladecress was described by Rollins (1963) from material collected in 1959 in Morgan County, Alabama. Rollins (1963) delineated the species into two varieties (var. *crassa* and var. *elongata*) based on differences in fruit length. However, herbarium and field studies have shown var. *elongata* to have variation in fruit length within the range of fruit lengths for var. *crassa* (McDaniel and Lyons 1987). Thus, the species is treated as one taxon.

11.1.3. Numbers, Reproduction, and Distribution of Fleshy-Fruit Gladecress

Fleshy-fruit gladecress is endemic to a 21-km (13-mi) radius area in north central Alabama within Lawrence and Morgan counties (Rollins 1963). A 1961 record from Lauderdale County, Alabama has never been confirmed (McDaniel and Lyons 1987). Surveys by Lyons (*in litt.* 1981 to R. Sutter), McDaniel and Lyons (1987), and Hilton (1997) were unsuccessful at locating a number of historical sites for fleshy-fruit gladecress. McDaniel and Lyons (1987) failed to locate eight sites previously reported by Rollins (1963), and Lloyd (1965) and Hilton (1997) were unsuccessful at locating seven sites listed in McDaniel and Lyons (1987).

Currently, there are seven known extant occurrences of fleshy-fruit gladecress documented, three in Morgan County and four in Lawrence County, Alabama (Table 11-1). One of these occurs on USFS lands. The majority of other sites are actively grazed, a practice that has, for the most part, maintained favorable growing conditions for the species. However, adjusting grazing patterns to take place during the species' dormant cycle would greatly reduce potential mortality of reproducing plants, while maintaining ideal habitat conditions.

Table 11-1 lists these populations and subpopulations, and relates them to EO rank used by state conservation agencies to track their status. The EO final rank is a summary of ranking criteria that includes quality, condition, viability, and defensibility of the population. The ranking is given based on a scale from A to D, with A meaning excellent, B meaning good, C meaning marginal, and D meaning poor.

Table 11-1. List of fleshy-fruit gladecress populations by county, with corresponding site names and EO rank from state conservation agency databases in Alabama.

County	Designation	EO Rank	Land Ownership
Lawrence	Bluebird Glades	D	Private & State ROW Stover Branch Glades
	Glades	C	Private
	Indian Tomb Hollow	A	Federal--USFS Glade
	Hillsboro Glade	*	Private
Morgan	Cedar Plains South	C	Private
	Cedar Plains North	B	Private
	Massey Glade	C	Private

*Recently discovered population.

11.1.4. Conservation Needs of and Threats to Fleshy-Fruit Gladecress

Fleshy-fruit gladecress is endemic to cedar glade areas in north-central Alabama that have been significantly altered from their original condition. More than a 50 percent loss in glade habitat has occurred since European settlement (Hilton 1997), with resulting glade habitats reduced to remnants fragmented by agriculture and development. Hilton (1997) conducted a thorough survey of cedar glade communities in northern Alabama using historical records, soil maps, topographic maps, geology, and aerial photography; 22 high priority glades were identified. However, field surveys found only five of these to be in good condition and restorable, and only two of these were considered high quality sites. Threats to fleshy-fruit gladecress from habitat destruction and modification are occurring throughout the entire range of the species. These threats include agricultural conversion or incompatible practices, maintenance of transportation ROW, residential and industrial development, and shading and competition. The conservation efforts of the USFS have removed threats associated with ORV use and encroachment of invasive species at one site; however, maintenance of transportation ROW and use of ORV could adversely affect the remaining six extant populations. The population-level effects from these activities are expected to continue into the future. State and federal regulations that might help conserve rare species on state highway ROW, including avoidance or minimization of habitat destruction, as well as regulations that protect plants from herbicide applications, can help protect this species. However, no existing regulations protect the species on privately owned land, where most of the remnant gladecress populations are found.

Fleshy-fruit gladecress is vulnerable to localized extinction because of the small number of occurrences and the small population sizes within the species' limited range. Small population sizes decrease the resilience of individual fleshy-fruit gladecress occurrences to recover from effects of other threats affecting the species' habitat. There are only seven remaining fleshy-fruit gladecress occurrences, and only one of these is protected. The loss of any occurrence would significantly affect the species' viability by reducing its redundancy on the landscape, which would increase its vulnerability to stochastic environmental stressors and reduce the species' resilience to recover from effects of threats. Three of the seven populations of fleshy-fruit gladecress are small in size as a result of effects of habitat loss. The loss of populations and reductions in population sizes have resulted in spatial isolation between these remnant

populations. These isolated populations are vulnerable to extinction by reductions in genetic variation among the populations (Klank *et al.* 2012; Schotz, pers. comm., 2013). Genetic variation is low in self-compatible populations of fleshy-fruit gladecress (Koelling *et al.,* 2011), which could limit their adaptive potential to respond to environmental change (Primack 1998). Habitat disturbance or unintentional human movement resulting in contact between populations of fleshy-fruit gladecress and Alabama gladecress could also increase the threat of hybridization, but, at this time, these species do not occur together in the wild and the potential for hybridization is reduced by incompatibility between them (Koelling and Mauricio 2010).

Based on this information, we conclude that the small number of populations and the small size of populations within the species' limited range are significant threats to fleshy-fruit gladecress.

11.2. Environmental Baseline for Fleshy-Fruit Gladecress

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the fleshy-fruit gladecress, its habitat, and ecosystem within the Action Area.

11.2.1. Action Area Numbers, Reproduction, and Distribution of Fleshy-Fruit Gladecress

Fleshy-fruit gladecress has been documented from one location on TVA ROW about 2.5 mi south of the town of Hillsboro in Lawrence County, Alabama. This site was first identified by TVA botanists during desktop O-SAR reviews while examining aerial photos, topographic maps, and TVA Natural Heritage data. This site was subsequently surveyed in the field, which resulted in the discovery of seven state-listed plant species, as well as the population of fleshy-fruit gladecress. No population estimate was made during the initial observation, but a 2018 field survey noted that thousands of flowering fleshy-fruit gladecress occur within the ROW. The population may sound large, but the species is less than 5 cm tall and viable habitat within the ROW only covers a few thousand square feet.

No high quality habitat occurs adjacent to the ROW; most habitat off-ROW is closed canopy forest or agricultural fields and pasture. Fleshy-fruit gladecress can be found in these suboptimal open habitats, but populations in these situations are often ephemeral due to the dynamic nature of plant communities found there. Intact cedar glade habitats are not mutually exclusive with ROW vegetation management and it is not inconceivable that other undocumented occurrences of fleshy-fruit gladecress intersect the transmission system in Alabama. However, TVA botanists have reviewed all TL located in northern Alabama using the O-SAR process. Given the propensity for glades (and ROW near glades) to harbor listed plant species and the ease which these habitats can be identified using aerial photos, TVA botanists have classified many areas as Class 2 Plants in O-SAR. The vast majority of these areas have been subsequently field surveyed. Multiple new populations of state and federally listed species have been found on TVA ROW in this part of Alabama, including other rare gladecress species, but no new occurrences of fleshy-fruit gladecress. Few, if any, sizable, unsurveyed glades co-occurring on ROW remain in northern Alabama.

11.2.2. Action Area Conservation Needs of and Threats to Fleshy-Fruit Gladecress

Conservation efforts involve using hand removal of invasive plants to maintain the open, well-lit conditions fleshy-fruit gladecress favors. The population at Hillsboro glade along the power line ROW seems to respond well to management that maintains open, well-lit conditions.

ROW floor work would use timing restrictions, and other AMMs, as discussed in Section 2.4 to eliminate the risk of herbicide applications inadvertently affect the population. If new populations of fleshy-fruit gladecress are documented from TVA ROW, the location would be added to the O-SAR database and subsequent vegetation management would seek to avoid impacts using AMMs.

11.3. Effects of Vegetation Management on Fleshy-Fruit Gladecress

This section analyzes the direct and indirect effects of the Action on fleshy-fruit gladecress. An effects analysis summary of the effects of various methods of vegetation management on fleshy-fruit gladecress and the other 17 listed LAA plant species from the BA has been included in Appendix II.

11.3.1. Effects of Manual Vegetation Clearing on Fleshy-Fruit Gladecress

Manual vegetation clearing, when utilized by TVA, has the potential to adversely affect fleshy-fruit gladecress. However, provided clearing does not intentionally disturb the soil, it is unlikely to result in the death of individual plants. Fleshy-fruit gladecress prefers sunny conditions; and typically inhabits the interior of cedar glades. If tree clearing resulted in increased light on ROW edges where fleshy-fruit gladecress occurred, the effect would not likely be detrimental. The species is susceptible to physical damage from clearing activities, but the shallow rocky soils, characteristic of cedar glades, do not rut easily, and the species could resprout after tree clearing.

Clearing previously unmaintained ROW is a one-time event because these areas would subsequently be treated as ROW floor. Danger tree clearing occurs as needed. Danger tree clearing may never be needed in fleshy-fruit gladecress habitat near glades because the soils are not sufficiently deep to support growth of taller trees.

11.3.2. Effects of Mechanical Clearing on Fleshy-Fruit Gladecress

All mechanical vegetation control methods utilized by TVA have the potential to adversely affect fleshy-fruit gladecress. Effects to the species from mechanical clearing are similar to those described under manual clearing. As long as the clearing method would not intentionally disturb the soil, it is unlikely to result in death of individual plants.

Mowers are generally set 10 to 12 inches off the ground and would likely miss the low-growing fleshy-fruit gladecress.

11.3.3. Effects of Herbicide Use on Fleshy-Fruit Gladecress

Vegetation control methods that utilize herbicides are not likely to affect fleshy-fruit gladecress, but an adverse effect resulting from this control technique is not impossible. The low probability of herbicide adversely affecting fleshy-fruit gladecress is related to two factors: seasonality of herbicide application in relation to species life cycle and habitat preferences of the plant. Fleshy-fruit gladecress is a winter annual, which means that seeds germinate in the fall, overwinter as a rosette, flower in the spring, and die by June of any given year. TVA cannot spray herbicide until tree species growing in the ROW have leafed out sufficiently. This is because without enough leaf area on any given tree, foliar herbicides will not be taken up by an individual plant, which would result in low efficacy of the application. Therefore, herbicide treatments often do not start until mid-May in many parts of the TVA system. Fleshy-fruit gladecress would be setting seed and nearing the end of its life cycle at this time. In addition, fleshy-fruit gladecress grows in flat, limestone outcrops that often have soil depths of less than 1 cm. These areas are dry in summer and typically do not support tree growth characteristics that are targeted for herbicide application.

Even if ROW containing undocumented locations for fleshy-fruit gladecress were sprayed using low-volume foliar application of herbicide, the chemical would be unlikely to intersect the species because few trees would be present. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW, if applications were made early in the season. However, it is unlikely that this tool would be used in areas where fleshy-fruit gladecress might occur because the region is characterized by a patchwork of land uses, making broadcast spray a less desirable option.

11.3.4. Effects of Debris Management on Fleshy-Fruit Gladecress

All debris management techniques used by TVA have a small potential to adversely affect fleshy-fruit gladecress. The characteristic of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of material. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be expected from use of machinery. The soil disturbance would be minimal because of the rocky habitats preferred by fleshy-fruit gladecress, which are well drained and resistant to deep rutting. Neither form of disturbance would be likely to result in the death of individual plants. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool, combined with the extreme rarity of the species, make the likelihood of this occurring very small. TVA's facilitation of landowner use of wood has similar potential for small impacts as other debris management methods.

If mulching machines were used in fleshy-fruit gladecress habitat, it would not likely generate enough mulch to bury the species. This is because the amount of mulch or chips generated by the machine is directly proportional to the amount of vegetation a site supports. Dry glade margins stunt woody plant growth and the layer of mulch left in these areas is often discontinuous and less than 1-in deep.

11.4. Conclusion for Fleshy-Fruit Gladecress

In this section, we interpret the findings of the previous sections for the fleshy-fruit gladecress (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to fleshy-fruit gladecress and result in only a few individual plants within the Action Area being adversely affected. The plant responds well to vegetation clearing because suitable habitat for the species includes open, well-lit conditions. Cumulative effects to fleshy-fruit gladecress that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the fleshy-fruit gladecress. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) We do not expect to lose the single population on the ROW due to benefits (increased light conditions) provided by TVA's ongoing maintenance, which offsets the likelihood of adverse effects on the species. (4) While the population on TVA's ROW is substantial (i.e., several thousand plants), it is only one of seven populations, and the loss of this population is not expected as discussed in #3 above.

12. LYRATE BLADDERPOD

12.1. Status of Lyrate Bladderpod

This section summarizes best available data about the biology and current condition of lyrate bladderpod (*Lesquerella* [=*Paysonia*] *lyrata*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list lyrate bladderpod as threatened on September 28, 1990 (55 FR 39864-39868).

12.1.1. Description of Lyrate Bladderpod

Lyrate bladderpod, an annual, herbaceous member of the mustard family (Brassieaceae), is 10 to 30 cm (4 to 12 in) tall. The plants are shortly pubescent and usually branched at the base. The stem leaves are alternate, ovate to elliptic in shape, smoothed or toothed on the margins, with prominent ear-like projections at the bases. The flowers are ascending, on the stalks 10 to 15 mm (0.4 to 0.6 in) long, with yellow petals 5 to 7 mm (0.2 to 0.3 in) in length. The fruits are

silques, globose in shape 2.5 to 3.5 mm (0.1 in) long and 3 to 4 mm (0.1 to 0.2 in) wide (USFWS 1990). The species resembles the Duck River Bladderpod (*Lesquerella densipila,*), which has fruits and styles that are pubescent, but the lyrate bladderpod has glabrous fruits and styles.

12.1.2. Life History of Lyrate Bladderpod

The lyrate bladderpod is endemic to cedar glade areas in northern Alabama. The species appears to be an early successional species that historically colonized shallow soils on or adjacent to cedar glade habitats. The lyrate bladderpod slowly disappears as the soil layer develops and other competing plants establish themselves (USFWS 1996b). Lyrate bladderpod has an annual dormancy/non-dormancy cycle, with dormancy loss occurring in the summer and dormancy induction in late autumn/winter. Seeds are dormant at maturity in May and have a high temperature requirement to break dormancy; whereas, low temperatures cause non-dormant seeds to reenter dormancy (Baskin and Baskin 2000). After germination and initial growth, young plants overwinter as rosettes (USFWS 1990). The growth period for the lyrate bladderpod is from September/October into May. Flowering takes place usually from mid-March to April, and seed dispersal generally occurs from the end of flowering until mid-May (USFWS 1990).

12.1.3. Numbers, Reproduction, and Distribution of Lyrate Bladderpod

Populations of lyrate bladderpod in Franklin and Colbert counties are located near growing urban areas (Schotz 2008). At the time of this species' listing in 1990, a large number of individual plants were observed in cultivated fields; however, these areas are no longer cultivated, and plants today are located in pasturelands. The population in Lawrence County is located in pastureland that is lightly-grazed outside of the growing season and is thriving; however, remaining populations have shown declines in numbers due to field abandonment (Webb and Kral 1986; USFWS 1990, 1996b).

12.1.4. Conservation Needs of and Threats to Lyrate Bladderpod

Most cedar glades have been unable to escape human disturbances, including those glades that naturally supported populations of the lyrate bladderpod (Webb and Kral 1986; McDaniel 1987; USFWS 1990, 1996b; Hilton 1996). Shading causes decreased vigor and death and decreases the number of seeds at the site (Baskin and Baskin 1998, 2000). In typical glade habitats, the shallow, droughty soils inhibit the establishment of competing plants. Cedar glades have been fragmented by agriculture and development and mostly exist as remnants today.

Housing development, trash dumping, adverse agricultural practices, and road building have destroyed or negatively impacted a number of cedar glade systems, including those associated with the lyrate bladderpod (USFWS 1990, 1996b). Urban and residential development poses a threat to populations in Franklin and Colbert counties (Schotz 2008). Plants extend onto roadsides at several sites, and mowing or herbicide application prior to seed set would negatively affect these populations (USFWS 1990, 1996b). Certain agricultural practices are compatible with the survival of this species. Plowing associated with row crop farming and grazing on pasturelands, provides the needed disturbance to arrest succession in these populations. Row

crop farming incompatibility comes into play when plowing takes place prior to seed set and when pre-emergent herbicides are used.

12.2. Environmental Baseline for Lyrate Bladderpod

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the lyrate bladderpod, its habitat, and ecosystem within the Action Area.

12.2.1. Action Area Numbers, Reproduction, and Distribution of Lyrate Bladderpod

Within the Action Area, the lyrate bladderpod has not been documented in the TVA ROW. Multiple TVA TLs occur within Colbert, Franklin, and Lawrence counties, Alabama, but the vast majority of these ROW do not possess suitable habitat for the species. Cedar glade habitat is easily identifiable during O-SAR desktop reviews, and all sections of TVA ROW that have significant potential to contain lyrate bladderpod have already been identified in O-SAR and field surveyed. One section of TVA ROW, located about 2.5 mi southeast of the Prairie Grove Glades population of lyrate bladderpod, possesses extensive suitable cedar glade habitat within the ROW. Field surveys of the site documented ten state-listed plant species in the ROW, but lyrate bladderpod was not present. Few, if any, sizable, unsurveyed glades are co-occurring on ROW in northern Alabama.

12.2.2. Action Area Conservation Needs of and Threats to Lyrate Bladderpod

TVA should make every effort to locate and protect all remaining cedar glade habitat in TVA ROW that could potentially support lyrate bladderpod. Loss and disturbance of these areas is the one threat to lyrate bladderpod in the Action Area.

12.3. Effects of Vegetation Management on Lyrate Bladderpod

This section analyzes the direct and indirect effects of the Action on lyrate bladderpod. An effects analysis summary of the effects of various methods of vegetation management on lyrate bladderpod and the other 17 listed LAA plant species from the BA has been included in Appendix II.

12.3.1. Effects of Manual Vegetation Clearing on Lyrate Bladderpod

All manual vegetation control methods utilized by TVA have the potential to adversely affect lyrate bladderpod if they occurred in undocumented habitat for the species. However, as long as manual clearing does not intentionally disturb the soil, it is unlikely to result in death of individual plants. Lyrate bladderpod requires sunny conditions and typically inhabits the interior of cedar glades away from the shade cast by trees. If tree clearing resulted in increased light on sites where it occurred, the effects would not likely be detrimental. The species would be susceptible to physical damage caused by clearing activities, but the shallow rocky soils, characteristic of cedar glades, do not rut easily.

Danger tree clearing occurs as needed. Danger tree clearing may never be needed in lyrate bladderpod habitat near glades because the soils are not sufficiently deep to support growth of taller trees.

12.3.2. Effects of Mechanical Clearing on Lyrate Bladderpod

Similar to manual vegetation clearing, all mechanical vegetation control methods utilized by TVA would have the potential to adversely affect lyrate bladderpod. Mowers are generally set 10 to 12 inches off the ground and would likely miss the low-growing lyrate bladderpod.

12.3.3. Effects of Herbicide Use on Lyrate Bladderpod

Vegetation control methods that utilize herbicides in occupied lyrate bladderpod habitat could result in adverse effects, but the probability of that occurring is low. The low probability of herbicides affecting lyrate bladderpod is related to two factors: seasonality of herbicide application in relation to species life cycle and habitat preferences of the plant. Lyrate bladderpod is a winter annual, which means that seeds germinate in the fall, overwinter as a rosette, flower in the spring, and die by June of any given year. TVA cannot spray herbicides until tree species growing in the ROW have leafed out sufficiently. This is because without enough leaf area on any given tree, foliar herbicides will not be taken up by an individual plant, which would result in low efficacy of the application. Therefore, herbicide treatments often do not start until mid-May in many parts of the TVA system. Lyrate bladderpod would be setting seed and nearing the end of its life cycle at this time.

In addition, lyrate bladderpod grows in flat, limestone outcrops that often have soil depths of less than 1 cm. These areas are dry in summer and typically do not support tree growth characteristics that are targeted for herbicide application. Even if ROW containing undocumented locations for lyrate bladderpod were sprayed using low-volume foliar application of herbicide, the chemical would be unlikely to intersect the species because few trees would be present. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW if applications were made early in the season. However, it is unlikely that this tool would be used in areas where lyrate bladderpod might occur because the region is characterized by a patchwork of land uses, making broadcast spray a less desirable option.

12.3.4. Effects of Debris Management on Lyrate Bladderpod

All debris management techniques used by TVA have a small potential to adversely affect lyrate bladderpod. The aspect of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of material. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be expected from use of machinery. The soil disturbance would be minimal because of the rocky habitats preferred by lyrate bladderpod, which are well drained and resistant to deep rutting. Neither form of disturbance would be likely to result in death of individual plants.

If mulching machines were used in lyrate bladderpod habitat it would not likely generate enough mulch to bury the species. This is because the amount of mulch or chips generated by the machine is directly proportional to the amount of vegetation the site supports. Dry glade margins stunt woody plant growth, and the layer of mulch left in these areas is often discontinuous and less than 1-in deep.

Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool combined with the extreme rarity of the species make the likelihood of this occurring very small. TVA's facilitation of landowner use of wood have similarly low potential for impacts as other debris management methods.

12.4. Conclusion for Lyrate Bladderpod

In this section, we interpret the findings of the previous sections for the lyrate bladderpod (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to lyrate bladderpod, resulting in only a small percentage of undocumented, individual plants within the Action Area being affected, if any; no populations would be extirpated by TVA ROW vegetation management activities. Cumulative effects to lyrate bladderpod that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the lyrate bladderpod. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) The species' range is restricted to three counties in northern Alabama, and several areas on TVA ROW in one of these counties possess suitable cedar glade habitat; the species has not been observed at these sites during surveys, so the potential for adverse effects is limited.

13. SPRING CREEK BLADDERPOD

13.1. Status of Spring Creek Bladderpod

This section summarizes best available data about the biology and current condition of Spring Creek bladderpod (*Lesquerella* [=*Paysonia*] *perforata*) throughout its range that are relevant to

formulating an opinion about the Action. The USFWS published its decision to list Spring Creek bladderpod as endangered on December 23, 1996 (61 FR 67493-67497).

13.1.1. Description of Spring Creek Bladderpod

The following description of Spring Creek bladderpod is adapted from Kral (1983) and Rollins (1955): a herbaceous annual, stems several to many, outer ones usually decumbent at base, inner ones erect, simple or branched, 10 to 15 cm (3.9 to 5.9 in) tall, stems and leaves are covered with fine or coarse hairs. The stem leaves are sessile, articulate, oblong to obovate, with few to many teeth on the margins. The cross-shaped flowers are arranged in a raceme, have white to pale lavender petals with a yellow base, and are 7 to 9 mm (0.28- to 0.35-in) long. The fruits are broadly obovoid to pear-shaped, very inflated, 4 to 7 mm (0.16- to 0.28-in) long, and divided into two halves (USFWS 2006).

13.1.2. Life History of Spring Creek Bladderpod

Spring Creek bladderpod is a winter annual that germinates between September and early October, over-winters as a small rosette of leaves, and fully develops and flowers the following spring. Full sun is a requirement for optimum growth. Flowering usually occurs in March and April. The fruit splits open upon maturity in late April and early May, and the enclosed seeds are dispersed and lie dormant until autumn (USFWS 2006). The plant dies back soon after the fruits mature. Germination can only occur when the correct temperature coincides with adequate moisture (Pearson 1967). Upon germination, the cycle starts over again.

The life history and the seed dispersal mechanism of Spring Creek bladderpod result in many seeds, continuous turnover, and easy movement to new sites. Each of these characteristics favor the ability to persist as long as habitat is available and competing vegetation does not crowd it out (USFWS 2006).

13.1.3. Numbers, Reproduction, and Distribution of Spring Creek Bladderpod

While Spring Creek bladderpod habitat does occur in cedar glades, it is more often found in scour zones and dynamic riparian areas associated with Spring Creek and Bartons Creek in Wilson County, Tennessee. When the Recovery Plan for Spring Creek bladderpod was published in 2006 (USFWS 2006), there were 21 known occurrences of the species, all in the vicinity of the City of Lebanon. Of those 21 occurrences, six were located along Spring Creek, 11 along Bartons Creek and its tributaries, and four along Cedar Creek. All sites occurred on private or municipally owned land, which remains the case today. Based on information in USFWS files and data provided to USFWS by TDEC (2011a), there currently are 22 extant occurrences of Spring Creek bladderpod. The current distribution of Spring Creek bladderpod includes:

<u>Barton's Creek</u>
There currently are 11 occurrences considered extant in the Barton's Creek drainage (TDEC 2011a). One occurrence (EO 34) in this drainage, estimated to contain greater than 1,000 plants,

was discovered during 2008. Only three occurrences have management agreements, but those agreements are non-binding, and occur in the Barton's Creek drainage (EOs 4, 11 and 21).

Cedar Creek
There currently are four occurrences considered extant in the Cedar Creek drainage (TDEC 2011a). One occurrence (EO 28) was thought to have been extirpated by excavation that was first noted during 2004. The site was visited again during 2006, at which time no plants were observed, but plants were observed there in 2011. No other historic or extirpated occurrences are known from this drainage.

Spring Creek
There currently are seven occurrences considered extant in the Spring Creek drainage (TDEC 2011a). EO 24 has not been observed since 1997, thus its status is questionable. One new occurrence (EO 32) was discovered in 2006 following publication of the recovery plan.

13.1.4. Conservation Needs of and Threats to Spring Creek Bladderpod

Habitat destruction or modification from development, cattle grazing, and cropland farming practices (*i.e.*, soil disturbances from tillage and lack of conservation practices) are the primary threats to the Spring Creek bladderpod. Private lands in the City of Lebanon, primarily in Barton's Creek drainage, remain at high risk of loss to urbanization. Increased cattle grazing has transpired across all three drainages in the species' range. Ground disturbance, largely as a result of cropland cultivation between September 15 and May 15, has adversely affected seed bank maintenance for the species (TDNA 2008b; USFWS 2011c).

Based on knowledge of the species' seed ecology and life cycle, Fitch *et al*. (2007) proposed that cropland management for Spring Creek be conducted as follows:

- Planting, field preparation, or other soil disturbance for cultivation should occur after mid-May when seeds disperse, but before seeds are photostimulated. Once seeds are photostimulated, by about mid-July under current climatic conditions, they would be prone to higher germination rates than if they were buried during cultivation prior to this time. While higher germination rates might seem desirable, excessive germination rates could result in seed bank depletion over time.
- Crops should be harvested before seeds germinate in early September to minimize disturbance to newly germinated plants.
- Fields should not be disturbed from September until completion of the above-ground life cycle of the plant, in May.

Additional Spring Creek bladderpod sites need to be enrolled in cooperative management agreements to assist in protection and recovery of the species. Currently, only three sites are enrolled in cooperative management agreements, and inconsistencies in management at these sites have contributed to fluctuations in habitat condition and Spring Creek bladderpod abundance over time. The remaining sites are all located on private lands, primarily under agricultural uses. Additional coordination with landowners and refinement of cropland management practices will be necessary to manage the threat of habitat loss or decline on

agricultural lands. Sites on private lands in the City of Lebanon also need to be protected from urbanization (USFWS 2011c).

13.2. Environmental Baseline for Spring Creek Bladderpod

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Spring Creek bladderpod, its habitat, and ecosystem within the Action Area.

13.2.1. Action Area Numbers, Reproduction, and Distribution of Spring Creek Bladderpod

In the Action Area, the Spring Creek bladderpod has been documented from two areas within TVA ROW. The first site is located in the floodplain of Bartons Creek, and the species was first observed at this location in 1992. That area is now dominated by cool season grasses and used as a hayfield. During a 2009 site visit by TVA botanists, three flowering plants were observed within a portion of riparian area regularly scoured by high flows where there was bare soil and little competition from other species. The second site is within an urban area near downtown Lebanon and is under significant development pressure. The TVA ROW runs adjacent to a railroad bed and is very disturbed. In 2009, about 20 flowering plants were observed in the TVA ROW at this site. Searches were not systematically conducted off the TVA ROW, but several hundred plants were seen outside of the ROW that could be adversely affected by the TVA ROW vegetation management program.

13.2.2. Action Area Conservation Needs of and Threats to Spring Creek Bladderpod

Consistent with the threats described in Section 13.1.4., disturbances to the Spring Creek bladderpod in the Action Area include cropland agriculture and development associated with urbanization. Reducing these threats is best addressed by working with private landowners and the City of Lebanon to promote conservation and recovery of the species.

13.3. Effects of Vegetation Management on Spring Creek Bladderpod

This section analyzes the direct and indirect effects of the Action on Spring Creek bladderpod. An effects analysis summary of the effects of various methods of vegetation management on Spring Creek bladderpod and the other 17 listed LAA plant species from the BA has been included in Appendix II.

13.3.1. Effects of Manual Vegetation Clearing on Spring Creek Bladderpod

All manual vegetation control methods utilized by TVA have the potential to adversely affect Spring Creek bladderpod if they are carried out in habitat occupied by the species. The most likely effects would be from trampling or crushing individual plants, either from foot traffic or handling cut vegetation. While direct physical disturbances could result in adverse effects, the

removal of overstory and consequential increases in light levels would result in future benefits to the affected population.

13.3.2. Effects of Mechanical Clearing on Spring Creek Bladderpod

Similar to manual vegetation clearing, all mechanical vegetation control methods utilized by TVA would have the potential to adversely affect Spring Creek bladderpod. The effects would result from trampling or crushing, handling cut vegetation, and machinery traffic. Mechanical clearing would also result in increased light levels, potentially benefitting future Spring Creek bladderpod populations. Mowers are generally set 10 to 12 inches off the ground and would likely miss the low-growing Spring Creek bladderpod.

13.3.3. Effects of Herbicide Use on Spring Creek Bladderpod

Herbicide use that adversely affects Spring Creek bladderpod is not probable, but adverse effects from herbicide application is possible. The low probability of herbicides adversely affecting Spring Creek bladderpod is related to two factors: (1) seasonality of herbicide application in relation to the species life cycle and (2) habitat preferences of the plant. Spring Creek bladderpod is a winter annual, which means that seeds germinate in the fall, overwinter as a rosette, flower in the spring, and die by June of the following year. TVA cannot spray herbicide until tree species growing in the ROW have leafed out sufficiently, because without enough leaf area on a tree, foliar herbicides will not be taken up by the tree. Therefore, herbicide treatments often do not start until mid-May in many parts of the TVA system. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW if applications were made early in the season. However, it is unlikely that this tool would be used in areas where Spring Creek bladderpod might occur, because the region is characterized by a patchwork of land uses, making broadcast spray a less desirable option.

13.3.4. Effects of Debris Management on Spring Creek Bladderpod

All debris management techniques used by TVA have a small potential to adversely affect Spring Creek bladderpod. The debris removal phase most likely to affect the species is physical disturbance associated with manual or mechanized handling of material. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be expected from use of machinery. The soil disturbance would be minimal because of the rocky habitats preferred by Spring Creek bladderpod, which are well drained and resistant to deep rutting. Neither form of disturbance would be likely to result in the death of individual plants. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool combined with the extreme rarity of the species make the likelihood of this occurring very small. TVA's facilitation of landowner use of wood has similar potential for small impacts as other debris management methods.

If mulching machines were used in occupied Spring Creek bladderpod habitat it would likely generate enough mulch to bury, or partially bury, individual plants. This immediate effect would adversely affect the species, but Spring Creek bladderpod seed can remain viable for many years and the long-term increase in open habitat could benefit a population.

13.4. Conclusion for Spring Creek Bladderpod

In this section, we interpret the findings of the previous sections for the Spring Creek bladderpod (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to Spring Creek bladderpod and result in very few individual plants within the Action Area being adversely affected. Cumulative effects to Spring Creek bladderpod that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Spring Creek bladderpod. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only two of the known 22 rangewide extant populations occur in the Action Area on TVA ROW, and these two populations total no more than 23 plants based on the most recent survey data, so only a very small percentage of plants in the species' range would be affected by the Action on the ROW. (4) Several hundred plants have been observed outside of the TVA ROW that could be adversely affected by the Action, but this risk is diminished due to the distance from ROW vegetation management activities, and no more than a few plants could be adversely affected.

14. MOHR'S BARBARA'S BUTTONS

14.1. Status of Mohr's Barbara's Buttons

This section summarizes best available data about the biology and current condition of Mohr's Barbara's buttons (*Marshallia mohrii*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Mohr's Barbara's buttons as threatened on September 7, 1988 (53 FR 34698-34701).

14.1.1. Description of Mohr's Barbara's Buttons

Mohr's Barbara's buttons is a herbaceous perennial in the Aster family (Asteraceae) that occurs in the Cumberland Plateau and Ridge and Valley physiographic provinces from north central Alabama to northwestern Georgia. It is native to seasonally-wet, sandy-clay soils in prairie-like meadows, along margins of shale-bedded streams, on public utility/highway ROW, and in

habitats with widely spaced trees (barrens or glades). Leaves form a basal rosette, with leaves decreasing in size and number upward on the stem. The leaves are elliptic to spathulate in outline, entire, slightly pubescent, and have three prominent veins (Chafin 2008; Alabama Herbarium Consortium 2019).

14.1.2. Life History of Mohr's Barbara's Buttons

Mohr's Barbara's button flowers mid-May to June (Patrick *et al.* 1995). Flowers are pollinated by beetles, butterflies, and other small insects and must be cross-pollinated to set viable fruit. To avoid self-pollination, flowers on a given plant produce pollen before that plant's stigmas become receptive (Chafin 2008). Flowers are produced in heads, with 1-10 in number held at the tip of the branches on long peduncles. Each head is composed of numerous five-lobed disc flowers. Buds and newly opened flowers are pink, while older flowers are white. The fruit is about 1/8-in long, seed-like, oblong, ribbed, and hidden among bracts of the flower head (Chafin 2008; Alabama Herbarium Consortium 2019). Seeds likely are dispersed by birds and other small animals (Chafin 2008).

14.1.3. Numbers, Reproduction, and Distribution of Mohr's Barbara's Buttons

Mohr's Barbara's buttons first was collected by Charles Mohr in Cullman County, Alabama, in 1882. It historically was known from 28 populations (22 in Alabama, 5 in Georgia, and 1 shared by both states); 19 of these populations are extant (Bibb, Calhoun, Cherokee, Jefferson, and Walker Counties, Alabama, and Floyd County, Georgia); 8 have not been found in recent years and are considered historical; and 1 is confirmed extirpated (USFWS 2016b). Current rangewide Mohr's Barbara's buttons population size may approach 10,000 plants (Schotz 2014; Alabama Army National Guard 2015; M. Hodges pers. comm. 2015; TVA 2015b). Individual sites may range from fewer than 20 plants to well over 1,000 (Schotz 2014; Alabama Army National Guard 2015; TVA 2015b); although, most (27 [79%]) of the 34 extant sites surveyed by Schotz support 200 or fewer plants. At this time, only eight of the extant populations and portions of populations receive some protection from habitat loss or lack of habitat management.

14.1.4. Conservation Needs of and Threats to Mohr's Barbara's Buttons

Primary anthropomorphic threats affecting the species include (as summarized in USFWS 2016):

- Timber harvest and conversion to pine plantation or agriculture;
- Damage associated with recreational uses, such as ATV use;
- Development and associated habitat destruction;
- Fire suppression that promotes vegetation succession and encroachment of invasive species (particularly Chinese privet), which can out-compete Mohr's Barbara's buttons for resources (*e.g.*, moisture, nutrients, light, and recruitment sites); and
- Herbicide use and incompatible mowing regimes on highway and utility ROW.

Most extant populations are small and vulnerable to anthropogenic impacts and stochastic events. Small population size increases the risks posed by inbreeding and genetic drift, which may limit the species' adaptive capacity and ability to cope with future stressors (Ellstrand and

Elam 1993). Climate change also has potential to affect distribution and abundance of plants by influencing seasonal weather patterns, frequency and timing of severe weather events, and myriad plant physiological responses. Davenport (2007) suggested that Mohr's Barbara's buttons may be adversely affected by climate change if available habitat is reduced under drier conditions. Climate change may disrupt plant-pollinator interactions, shifting the timing of flowering and/or pollinator activity (Memmott *et al*. 2007) and reducing the Barbara's buttons' sexual reproduction.

14.2. Environmental Baseline for Mohr's Barbara's Buttons

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Mohr's Barbara's buttons, its habitat, and ecosystem within the Action Area.

14.2.1. Action Area Numbers, Reproduction, and Distribution of Mohr's Barbara's Buttons

TVA scientists located Mohr's Barbara's buttons in 2014 at three sites on a TVA ROW in Jefferson County, Alabama. There is currently no off-ROW habitat for the species near these populations and, given the age of the surrounding forest, there has not been for many years. This suggests that ROW vegetation management is, overall, beneficial to the species. Absent the disturbance necessary to keep ROW free of woody species, Mohr's Barbara's buttons likely would not exist at these locations.

In 2014, Population 1 contained a large population that was reported to contain "many hundreds to 1000+ plants" (TVA 2018). The clonal nature of the species makes precise counts of plants difficult without intensive, consistent monitoring, but the cited numbers suggest the species was common over an approximate 2.5-ac area within the ROW where it occurred. The site was comprised of largely native and herbaceous species. Population 2 consists of "many hundreds of plants, many beginning to flower". Plants in this area were continuous in areas and formed extensive colonies over approximately 1.3 ac. Population 3 extended over about 0.5-mi of ROW (approximately 7.5 ac) and contained hundreds of plants. The number of woody stems in the ROW containing Mohr's Barbara's buttons was low.

There is a reasonable likelihood that undocumented occurrences of Mohr's Barbara's buttons occur elsewhere on TVA ROW. The most likely place the species would be found is on other portions of the Jefferson County ROW that is known to support the species. About 50 percent of the potential habitat for this species on TVA ROW in Jefferson County has been surveyed. All of the un-surveyed areas that could support the species have at least a Class 1 Plants polygon in the O-SAR database.

14.2.2. Action Area Conservation Needs of and Threats to Mohr's Barbara's Buttons

The TL has been in service since 1939, and previous ROW management included mowing, low-volume foliar herbicide application, and possibly broadcast aerial herbicide. As indicated under

Section 14.2.1, there currently is no off-ROW habitat for the species near these populations; this suggests that TVA ROW vegetation management is, overall, beneficial to the species, since it maintains the ROW free of woody species.

14.3. Effects of Vegetation Management on Mohr's Barbara's Buttons

This section analyzes the direct and indirect effects of the Action on Mohr's Barbara's buttons. An effects analysis summary of the effects of various methods of vegetation management on Mohr's Barbara's buttons and the other 17 listed LAA plant species from the BA has been included in Appendix II.

14.3.1. Effects of Manual Vegetation Clearing on Mohr's Barbara's Buttons

Manual vegetation clearing could adversely affect individual Mohr's Barbara's buttons plants, though the magnitude of the negative effect would likely be small. Clearing of trees would increase light levels on-site and potentially result in a benefit to Mohr's Barbara's buttons. However, there would also be a potential for direct physical disturbance. The disturbance could result from trampling or cutting. It is unlikely manual clearing implemented by TVA for ROW vegetation management would remove the species from a site.

14.3.2. Effects of Mechanical Clearing on Mohr's Barbara's Buttons

Mohr's Barbara's buttons could be adversely affected if mowing operations are conducted during the flowering period or before fertilized plants could disperse seed. The magnitude of the negative effect would likely be small, since mowing creates and maintains the open habitats required by the plant. Such negative effects could include disturbance due to trampling, cutting, or minor soil disturbance resulting from machinery. Repeated mowing, particularly in wetter situations, also can shatter the stumps of individual trees and shrubs located within the ROW, promoting sprouting and the proliferation of woody species. Promotion of this woody canopy within the ROW may be detrimental to Mohr's Barbara's buttons over time.

14.3.3 Effects of Herbicide Use on Mohr's Barbara's Buttons

Vegetation control methods that utilize herbicides are likely to adversely affect Mohr's Barbara's buttons if used in occupied habitat, though the magnitude of effect would not likely be large enough to remove the species from a site. Spot treatment of herbicide is highly targeted and unlikely to adversely affect Mohr's Barbara's buttons at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. These methods could also be used as an AMM to control smaller trees in occupied habitat. Even though localized herbicide application targets woody species within the ROW floor, the use of that tool could have some adverse effects, including death, on individuals near a tree treated with localized herbicide application.

Broadcast herbicide, either from the air or ground, would affect plants growing on and near the ROW edge if it were used in occupied habitat. This would most likely degrade the overall quality of the habitat, as well as populations of Mohr's Barbara's buttons over time. Areas of potential habitat along un-surveyed portions of the TL known to contain the species have all been designated as Class 1 Plant areas in the O-SAR database. This prevents the use of broadcast spray at these locations.

14.3.4. Effects of Debris Management on Mohr's Barbara's Buttons

Debris management techniques used by TVA have a small potential to adversely affect Mohr's Barbara's buttons. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. These effects would include physical damage resulting from cutting or dragging of trees and would not likely result in death of individuals. If mulching/chipping did occur, the species could be directly affected by crushing from machinery and burial by mulch/chips. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool combined with the extreme rarity of the species make the likelihood of this occurring small. TVA's facilitation of landowner use of wood has similar potential for small impacts as other debris management methods.

14.4. Conclusion for Mohr's Barbara's Buttons

In this section, we interpret the findings of the previous sections for the Mohr's Barbara's buttons (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects on Mohr's Barbara's buttons and result in no more than a few individual plants within the Action Area being adversely affected. The TL has been in service since 1939 at the three sites in Jefferson County, Alabama, where the species is known to occur. Suitable habitat for the species includes open, disturbed sites, lacking woody vegetation. Off-ROW areas adjacent to these three populations are forested and unsuitable for the species. Therefore, the species is not found off-ROW. Mohr's Barbara's buttons would not exist in the ROW absent the disturbance necessary to keep the ROW free of woody species. TVA's vegetation management activities appear to have increased light levels and benefitted Mohr's Barbara's buttons, allowing it to persist on the ROW. Cumulative effects to Mohr's Barbara's buttons that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of Mohr's Barbara's buttons. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of

invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Relative to the rangewide population (19 individual populations believed to approach 10,000 plants), the three known ROW populations are comprised of several hundred plants each, so only a fraction of plants in the species' range would be affected by the Action.

15. CUMBERLAND SANDWORT

15.1. Status of Cumberland Sandwort

This section summarizes best available data about the biology and current condition of Cumberland sandwort (*Minuartia* [=*Arenaria*] *cumberlandensis*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Cumberland sandwort as endangered on June 23, 1988 (53 FR 23745-23748).

15.1.1. Description of Cumberland Sandwort

Cumberland sandwort, a perennial, herbaceous member of the Pink family (Caryophyllaceae), is 4 to 6 inches (10 to 15 cm) tall, and has small white-petaled flowers and relatively long narrow leaves (USFWS 1996c). The species resembles the mountain sandwort (*Minuartia* [=*Arenaria*] *groenlandica*) and glabrous mountain sandwort (*Minuartia* [=*Arenaria*] *glabra*), but Kral (1983) states that it can be distinguished by "its longer, broader, thinner, veinier leaves, leafier upper stems, which produce fewer flowers as a rule, and by its distinctive seed sculpture."

15.1.2. Life History of Cumberland Sandwort

Cumberland sandwort generally occurs in several noncontiguous patches in one or more sandstone rock houses or cliff faces which are located in a linear or vertical pattern with no barriers present (USFWS 2013). The species flowers May through August and develops fruit September through November. The plants are probably self-incompatible, and dispersal is highly localized, as seedlings are typically distributed adjacent to previously reproductive adults (Winder 2004). Seed viability appears to be high in natural populations (Winder 2004). The plant has a narrow ecological niche requiring cool temperatures, perpetually moist sand, and deep shade. Associated species include: roundleaf catchfly (*Silene rotundifolia*), mountain meadow-rue (*Thalictrum clavatum*), littleflower alumroot (*Heuchera parviflora*), and Lucy Braun's snakeroot (*Ageratina luciae-brauniae*) (USFWS 1996c).

15.1.3. Numbers, Reproduction, and Distribution of Cumberland Sandwort

The species is currently known from the Cumberland Plateau of south-central Kentucky (McCreary County) and north-central Tennessee (Fentress, Pickett and Scott counties). Historically, the plant also occurred in Morgan County, Tennessee, but is now believed to be extirpated (USFWS 2013).

In order to evaluate the species' status in relation to recovery criteria, TDEC (2011b) developed specifications for delineating EOs of Cumberland sandwort. An EO is a fundamental unit of information in the NatureServe Natural Heritage methodology, and is defined as "an area of land and/or water in which a species or natural community is, or was present" (USFWS 2013).

There are 64 extant EOs of Cumberland sandwort, 34 of which TDEC and KYNPC consider viable, indicating that they likely are self-sustaining. Three of the viable EOs are located on privately owned lands in Fentress County, Tennessee. The remaining 31 are located on conservation lands, owned and managed by the NPS, TDNA, Tennessee State Parks, and Tennessee Division of Forestry. The county distribution of these occurrence sites is as follows: Fentress County, Tennessee (eight), McCreary County, Kentucky (one), Pickett County, Tennessee (21), and Scott County, Tennessee (one). Thus, there are only ten protected and presumably, self-sustaining occurrences located outside of Pickett County (USFWS 2013).

Monitoring data collected by TDEC provide a basis for assessing the persistence of EOs over time and documenting coarse changes in the area they occupy, but they do not provide insight into demographic processes, such as reproductive output, germination and recruitment, and mortality rates that influence population growth rates (USFWS 2013). The only data currently available concerning seed production and germination in the species are anecdotal observations by Winder (2004), who noted that populations he sampled for an investigation of genetic diversity in Cumberland sandwort produced copious viable seed during the years he observed them and that young seedlings were present frequently in most populations. Additional monitoring measures to understand demographic processes could become necessary at monitoring sites where declining trends become apparent from sustained decreases in estimates of area occupied by Cumberland sandwort. Conducting monitoring late in the growing season for Cumberland sandwort, rather than during the winter as it often occurs, would allow for an assessment of whether seed production and seedling germination are occurring at monitoring sites (USFWS 2013).

Winder (2004) found reduced levels of heterozygosity in individual populations of Cumberland sandwort, with some containing little or no heterozygosity despite having considerable haplotype diversity, and noted that this pattern is consistent with the effects of inbreeding. Winder (2004) suggested investigation factors that could influence breeding patterns in Cumberland sandwort, specifically suggesting two factors: (1) determining whether movement of pollen and seeds is highly restricted, potentially even within a single rock house population, and (2) conducting breeding system studies to determine whether there could be high rates of self-fertilization in populations of Cumberland sandwort.

15.1.4. Conservation Needs of and Threats to Cumberland Sandwort

Cumberland sandwort plants growing on rock house floors are vulnerable to trampling by hikers, campers, and picnickers on public lands where the species occurs. Trampling by persons who are rappelling poses a threat to plants growing on ledges or solution pockets on sandstone rock faces (USFWS 2013). Relic digging is one of the most destructive threats facing these habitats (Bailey and Shea 2000), despite the fact that the activity is illegal on public lands. In some rock houses, fire pits are present from historic or recent recreational use. In addition to these threats

resulting from recreational activities, feral hogs have caused intensive soil disturbance at a few Cumberland sandwort sites (USFWS 2013).

Measures to prevent or reduce threats related to recreational activities have been installed in eight rock houses, located along trails at Big South Fork National Scenic River and Recreation Area (BISO), Pickett State Forest (PSF) and Pickett State Park (PSP). While these threats remain at many sites, they do not currently place Cumberland sandwort at imminent risk of extinction; therefore, the FWS consider them to continue to be moderate (USFWS 2013). Coordination with land managers at BISO, PSF, and PSP is encouraged to maintain existing and install additional protective measures to reduce or eliminate threats from recreational activities.

15.2. Environmental Baseline for Cumberland Sandwort

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Cumberland sandwort, its habitat, and ecosystem within the Action Area.

15.2.1. Action Area Numbers, Reproduction, and Distribution of Cumberland Sandwort

In the Action Area, the Cumberland sandwort has been recorded from a single location on a TVA ROW. This site is located on PSF at a location where an existing TL intersects a large rock house. Cumberland sandwort were first discovered at this site in 1979, but the population was not estimated until a March 2000 survey noted that, "100's of plants" were observed in the rock house (TVA 2018). A subsequent visit in 2007 noted, "1000 plants concentrated in 4 areas" at the site. However, during a 2012 site visit, one of the four areas, which had supported the largest number of Cumberland sandwort, no longer appeared to support the plants.

The TVA TL that intersects the rock house was first placed into service in 1951. While there is uncertainty about population trends at this site, the dispersal mechanism and the narrow habitat preferences of Cumberland sandwort suggest that the species has persisted with TVA ROW vegetation management for nearly 70 years. It is unlikely that other rock houses containing this species intersect TVA ROW because of the very restricted range of the species. Only one other TVA TL is located in the vicinity of a documented occurrence of Cumberland sandwort and that occurrence is within 4 mi of the TL.

15.2.2. Action Area Conservation Needs of and Threats to Cumberland Sandwort

Consistent with the threats described in Section 15.1.4., relic hunting has been noted in the Action Area at the single location known to support Cumberland sandwort; relic hunting can result in disturbance to plants via trampling and/or digging in the rock house. Reducing these threats is best addressed by coordination with PSF land managers to maintain existing and install additional protective measures to reduce or eliminate threats from relic hunting.

15.3. Effects of Vegetation Management on Cumberland Sandwort

This section analyzes the direct and indirect effects of the Action on Cumberland sandwort. An effects analysis summary of the effects of various methods of vegetation management on Cumberland sandwort and the other 17 listed LAA plant species from the BA has been included in Appendix II.

15.3.1. Effects of Manual Vegetation Clearing on Cumberland Sandwort

TVA has identified approximately 2,500 areas of transmission ROW, using their O-SAR database with habitat to support, or potentially could support, federally or state-listed plant species. The rock house habitat most frequently associated with the Cumberland sandwort does not support tree growth, but trees are found just outside of this habitat. Manual tree clearing would be unlikely to directly affect Cumberland sandwort, but tree removal adjacent to a rock house containing the species could result in increased light levels that may change soil moisture levels or result in increased competition. These affects could put Cumberland sandwort at a disadvantage compared to other plant species.

One occurrence, totaling several hundred Cumberland sandwort plants (< 1,000) over three areas, was last observed in a rock house; therefore, manual tree clearing could cause the permanent loss of some Cumberland sandwort due to increased light levels.

15.3.2. Effects of Mechanical Clearing on Cumberland Sandwort

Mechanical clearing could adversely affect Cumberland sandwort if used in habitats where the species occurs, but the likelihood of using this type of equipment where the species occurs is small. This is because rock hoses supporting the species are typically located in steep rocky areas that are inaccessible to this type of machinery. Similarly, mowing, which is restricted to regularly maintained areas within the ROW floor, is not likely to adversely affect the species. Side-wall trimming, if it were to occur adjacent to occupied habitat would have similar potential affects to manual tree clearing.

In summary, side-wall trimming could result in the permanent loss of some Cumberland sandwort due to increased light levels, but other types of mechanical clearing would not likely adversely affect the species.

15.3.3. Effects of Herbicide Use on Cumberland Sandwort

Vegetation control methods that utilize herbicides are likely to adversely affect Cumberland sandwort if used in occupied habitat, though the probability of herbicide intersecting the species is small. Spot treatment with herbicides is highly targeted and unlikely to adversely affect Cumberland sandwort at the population level, but could result in isolated, direct adverse effects on individual plants. These methods could be used as an AMM to control smaller trees adjacent to occupied habitat. Trees do not grow in rock houses where Cumberland sandwort occurs. Therefore, localized herbicide application, which targets woody species, would be unlikely to adversely affect Cumberland sandwort.

Broadcast herbicide, either from the air or ground, could affect plants growing in a rock house within a TVA ROW, but is not likely. All areas of potential habitat adjacent to the single TVA TL, located near documented locations for Cumberland sandwort have either been field surveyed or are designated as Class 1 or 2 Plants in O-SAR. This O-SAR restriction prohibits the use of broadcast herbicide either from the air or ground.

In summary, while the probability of effects would be low due to no additional occurrences of Cumberland sandwort being known in the Action Area and an O-SAR restriction prohibiting broadcast herbicide in areas designated as Class 1 or 2 Plants, Cumberland sandwort could be adversely affected by all types of herbicide application, but it would unlikely based on the rationale provided above.

15.3.4. Effects of Debris Management on Cumberland Sandwort

Debris management techniques used by TVA have a small potential to adversely affect Cumberland sandwort. Any physical disturbance associated with manual or mechanized handling of debris could directly affect plants, but the likelihood of any disturbance resulting from debris management negatively affecting Cumberland sandwort is negligible. The rock houses most likely to support the species do not support tree growth. Any handling of downed trees adjacent to a rock house would be at a sufficient distance from Cumberland sandwort to have no measurable effect on the plants. The terrain would also prevent chipping and mulching from occurring because equipment could not maneuver on the site. Burning would occur in the open ROW and would not affect Cumberland sandwort. TVA's facilitation of landowner use of wood would have similar small potential for impacts as the above debris management methods.

In summary, debris management techniques, including manual, mechanical, burning and landowner use, would not likely adversely affect the Cumberland sandwort.

15.4. Conclusion for Cumberland Sandwort

In this section, we interpret the findings of the previous sections for the Cumberland sandwort (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would at most have localized adverse effects to Cumberland sandwort and result in only a few individual plants within the Action Area being adversely affected. Cumulative effects to Cumberland sandwort that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Cumberland sandwort. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which,

collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations (four populations out of 64 extant populations) have existed on TVA ROW within the Action Area, and no plants have been observed at the site of the largest of the four populations since 2012; therefore, very few plants would be affected by the Action. (4) Due to the location and rugged nature of the habitat, plants would largely be protected and away from TVA's vegetation management activities, minimizing their exposure to the Action.

16. SHORT'S BLADDERPOD

16.1. Status of Short's Bladderpod

This section summarizes best available data about the biology and current condition of Short's bladderpod (*Physaria globosa*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Short's bladderpod as endangered on August 1, 2014 (79 FR 44712-44718).

16.1.1. Description of Short's Bladderpod

Short's bladderpod is an upright biennial or perennial plant in the mustard family (*Brassicaceae*) (79 FR 44712-44718). It grows up to 20 in tall. Clusters of small, yellow flowers top single and sometimes, multiple stems from April to early June. The scientific name of the plant is derived from the globe-shaped fruits it produces (USFWS 2018c).

16.1.2. Life History of Short's Bladderpod

Short's bladderpod typically grows on steep, rocky, wooded slopes and talus slopes and along tops, bases, and ledges of bluffs, often near rivers or streams and on south- to west-facing slopes. Most populations are closely associated with calcareous outcrops (Shea 1993).

Short's bladderpod lives for two years or longer. Preliminary results from research at the Missouri Botanical Garden indicate that seed viability is high in one of the Tennessee populations they studied and that seeds germinated at higher rates under greenhouse conditions approximating mean diurnal temperatures that occur during late spring/early autumn and summer, versus those approximating conditions that occur during early spring/late autumn (79 FR 44712-44718).

16.1.3. Numbers, Reproduction, and Distribution of Short's Bladderpod

Short's bladderpod is known to occur in Posey County, Indiana; Clark, Franklin, and Woodford counties, Kentucky; and Cheatham, Davidson, Dickson, Jackson, Montgomery, Smith, and Trousdale counties, Tennessee (79 FR 44712-44718). Populations of Short's bladderpod vary in

size from two to about 1,500 individuals, with most populations containing fewer than 50 plants. In a 1992 status survey for Short's bladderpod, Shea (1993) observed the species at only 26 of 50 historical sites: one in Indiana, 14 in Kentucky, and 11 in Tennessee. The remaining 24 records were of sites from which the species had been extirpated or lacked sufficient location information to be relocated during the survey. Later surveys in Tennessee found Short's bladderpod extant at two of these sites, Tennessee EO numbers 8 and 12, which correspond to Shea's population numbers 34 and 29, respectively (Table 16.1) (78 FR 47109-47134).

Based on data provided by conservation agencies (Indiana Natural Heritage Data Center [INHDC]) 2012, Kentucky Natural Heritage Program [KNHP] 2012, Tennessee (Tennessee Natural Heritage Inventory Database [TNHID] 2012) in the states where the species occurs, the USFWS determined the current distribution and status of Short's bladderpod (78 FR 47109-47134). Difficulty in relating the species' distribution at the time of Shea's (1993) status survey to its current distribution was a result of state conservation agencies revising the mapping of some EOs in these databases. In two instances, pairs of occurrences that Shea (1993) considered distinct were combined into single EOs (Table 16.1). Conversely, TNHID (2012) treats as two distinct EOs the two locations that Shea (1993) mapped together as population number 23. One of these occurrences (TN EO number 22) was extant as of 2012 (Table 16.1), while the other

(TN EO number 2) is extirpated (Table 16.2). Based on current mapping, state conservation agencies now recognize 24 EOs that correspond to populations that Shea (1993) found extant in 1992. Of these 24 occurrences, 18 were extant in 2012. Accounting for rediscovery of the two Tennessee occurrences that Shea (1993) did not find during 1992, and recent changes in EO mapping, a total of 20 occurrences that were documented by Shea (1993) were still considered extant as of 2012 (Table 16.1). The approximate range of abundance shown in Table 16.1 is primarily based on individual plants. As a result of location, it was impossible to enumerate individual plants. This resulted in are two instances where TNHID surveyed these populations from a boat and reported the approximate range in clusters (78 FR 47109-47134).

There are now eight known extant occurrences in Kentucky, 17 in Tennessee, and one in Posey County, Indiana (Table 16.1). Extant occurrences in Kentucky are distributed among Clark (1), Franklin (6), and Woodford (1) counties, and in Tennessee among Cheatham (5), Davidson (2), Dickson (1), Jackson (2), Montgomery (3), Smith (1), and Trousdale (2) counties. One Tennessee occurrence straddles the county line between Cheatham and Davidson counties. There are 19 occurrences in Kentucky and ten in Tennessee that have either been extirpated or for which inadequate information exists to relocate them. Adding the seven populations that Shea (1993) treated as either historical or lacking complete locality information, and which are not represented in state-maintained databases used to create Tables 16.1 and 16.2, these numbers rise to 20 for Kentucky and 16 for Tennessee. Thus, there is a total of 62 occurrences that have been reported for Short's bladderpod. However, when reporting percentages of all known occurrences that are now or historically were in the case of extirpated occurrences, affected by various threats, we only use the 55 records that have been verified and are currently tracked in state-maintained databases (78 FR 47109-47134).

Table 16.1. List of known extant Short's bladderpod occurrences by state and county, with E.O. numbers assigned by state natural heritage programs (INHDC (2012), KNHP (2012), TNHID (2012)), numbers assigned to populations reported in Shea (1993), and first and last years of known observations.

State	County	EO Number (Shea Population Number)	First Observed	Last Observed	Approximate Range of Abundance	Land Ownership
Indiana	Posey	1 (1)	1941	2012	3–1000s	IDNR
Kentucky	Clark	1 (3	1957	2009	2	Private
	Franklin	4 (11, 12)	1979	2011	100–500	Private
		7 (10)	1981	2004	1-100	Private
		11 (13)	1983	2003	1–52	Private
		18 (4)	1992	2012	20-350	City of Frankfort
		22 (9)	1990	2012	2-200	Private; KSNPC
		23 (14)	1990	2011	60-500	Private
	Woodford	28	2005	2010	few	Private
Tennessee	Cheatham	1 (18)	1956	2008	100s–1000s	COE; Private
		15 (17)	1955	2008	few–20	COE
		17 (16)	1953	2012	20– ~1500	Town of Ashland City; Private
		29	1998	2008	~50	COE; Private
		30	1998	2008	10–25	COE; Private
	Davidson; Cheatham	10 (21,22)	1935	2012	10s–1000s	Private
	Davidson	4 (19)	1971	2012	100s–1000s	Private; COE easement
		8 (34)	1886	2008	~50	Private; COE easement
	Dickson	32	2008	2008	~7 clusters	COE
	Jackson	26	1998	2008	3 clusters	COE
		27	1998	2008	~50	COE
	Montgomery	12 (29)	1946	2008	~50	Private; COE easement
		22 (23a)	1969	2008	20–50	Private; COE easement
		28	1998	2008	~300	Private; COE easement
	Smith	24	1998	2008	~10	COE
	Trousdale	3 (25)	1969	2008	40–500	COE; Private
		21 (26)	1992	2008	100–250	COE; Private

Table 16.2. List of extirpated Short's bladderpod occurrences by state and county, with EO numbers assigned by state natural heritage programs (INHDC (2012), KNHP (2012), TNHID (2012)), numbers assigned to populations reported in Shea (1993), and first and last years of known observations.

State	County	EO Number (Shea Population Number)	First Observed	Last Observed	Abundance	Land Ownership
Kentucky	Bourbon	* 19 (2)	1963	2005	10–120	Private
	Fayette	12 (38)	1931	1931	n/a	Private
		16 (37)	1892	1900	n/a	Private
	Franklin	* 2 (6)	1979	1992	11	Private
		* 3 (8)	1979	1994	4	Private
		5 (39)	1880	1880	n/a	Private
		8 (27)	1981	1981	-40	Private
		14 (40)	1856	1856	n/a	Private
		* 20 (5)	1992	1992	21	Private
		* 21 (7)	1992	1992	7	Private
	Jessamine	6 (42)	1942	1942	n/a	Private
		13 (32)	1939	1939	n/a	Private
		17 (28)	1991	2019	n/a	Private
		+ 27	1990	1993	1-7	Private
	Madison	10 (43)	1903	1903	n/a	Private
	Mercer	24 (44)	1916	1916	1-7	Private
	Nelson	25	1935	2019	n/a	Private
	Powell	15 (45)	1923	1923	n/a	Private
	Scott	* 9 (15)	1930	1992	2	Private
Tennessee	Cheatham	14 (33)	1969	1969	n/a	Private
	Davidson	* 9 (20)	1974	1998	20-29	Private; COE easement
		+ 23	1997	1997	-200	Private
	Jackson	+ 25	1998	1998	5	COE
	Maury	7 (31)	1955	1955	n/a	Private
	Montgomery	2 (23b	1968	1992	1	Private
		13 (30)	1975	1975	n/a	Private
		18 (35)	1967	1967	n/a	Private
		31	1979	1979	n/a	Private
	Smith	20 (24)	1992	1998	30	Private; COE easement

* Occurrences observed by Shea (1993), but which are now considered extirpated.
+Occurrences not documented in Shea (1993) that have been observed since 1992, but which are now considered extirpated.

Despite the rediscovery of the two Tennessee occurrences and the discovery of ten additional occurrences since the 1992 status survey, only 26 extant occurrences of Short's bladderpod are known to remain due to the loss of ten occurrences during the last 20 years (Table 16.2). Seven of the occurrences that Shea (1993) observed in 1992, and three others (Kentucky EO number 27 and Tennessee EO numbers 23 and 25) that were seen after 1992, have since been extirpated (Table 16.2). This constitutes a loss of 27 percent of all occurrences that were extant during 1992 or later (78 FR 47109-47134).

There are 19 extant Short's bladderpod occurrences that are located on city, state, or federal lands. The Indiana occurrence is on lands owned by the State of Indiana and managed by the Indiana Department of Natural Resources (IDNR). A portion of one occurrence in Kentucky is located in a state NP, owned and managed by the KSNPC, and another occurs in a park owned by the City of Frankfort, where access is limited, but no specific management is provided for the species or its habitat. In Tennessee, there are 15 occurrences that are entirely or partially located on lands owned or leased by the COE adjacent to the Cumberland River. Some of these COE lands are WMAs, cooperatively managed by TWRA. The plants at EO numbers 29 and 32 are located in TWRA's Cheatham WMA, and those at EO numbers 24 through 27 are located in TWRA's Cordell Hull WMA. Part of one occurrence in Tennessee is located on lands owned by Ashland City (78 FR 47109-47134).

Dr. Carol Baskin (Professor, University of Kentucky) observed low fruit set in the Indiana population and, based on lack of seed production from plants in a greenhouse from which pollinators were excluded, she concluded that the species likely is self-incompatible. Self-incompatibility has been reported in other species of Physaria (Bateman 1955; Claerbout et al. 2007; Edens-Meier et al. 2011; Tepedino et al. 2012), and the molecular mechanisms underlying self-recognition between pollen and stigma and subsequent pollen rejection have been well studied in the Brassicaceae (Takayama and Isogai 2005). Dr. Baskin also observed that seeds produced by Short's bladderpod apparently are capable of forming a seed bank, as seeds that were planted in a greenhouse were observed to germinate and produce seedlings over several years, rather than all germinating in the year they were planted (78 FR 47109-47134).

16.1.4. Conservation Needs of and Threats to Short's Bladderpod

The most significant threats to Short's bladderpod are the loss and degradation of its habitat. The main causes for habitat loss and degradation are potential future construction and ongoing maintenance of transportation ROW; prolonged inundation and soil erosion due to flooding and water level manipulation; and overstory shading due to forest succession and shading and competition from invasive, nonnative plant species (78 FR 47109-47134).

Conservation of Short's bladderpod should include continuation of monitoring known populations for status of threats, site condition, and abundance of plants, and surveying potential habitat for new populations. This species requires open areas, so manual removal of shrubs would help open up habitat, where it is declining due to being shaded. Controlled burning could also be beneficial in this situation. Mechanical disturbance of the area should be limited or avoided because the soils are thin where this species occurs (Pyne *et al.* 1995); soil compaction

and damage to the seed bank could occur. Non-native plants should be controlled, so that they do not dominate the vegetation where this species grows (NatureServe Explorer 2018b).

16.2. Environmental Baseline for Short's Bladderpod

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Short's bladderpod, its habitat, and ecosystem within the Action Area.

16.2.1. Action Area Numbers, Reproduction, and Distribution of Short's Bladderpod

The TVA transmission system does not intersect habitat for Short's bladderpod in Kentucky or Indiana, but it does overlap the species range in Tennessee. In the Tennessee portion of the Action Area, Short's bladderpod occurs primarily in association with bluffs along the Cumberland River between RM 134 in Montgomery County in the vicinity of Clarksville upstream to RM 344 in Jackson County in the vicinity of White's Bend. There are 17 TVA TL crossings within this reach of the river. Topographic maps and aerial photos suggest that nine of the ROW crossings have no potential to support Short's bladderpod. These sections of ROW are flat, lacking prominent rock outcrops or bluff features, which typically serve as suitable habitat for the species. The remaining eight ROW crossings intersect potentially suitable habitat as evidenced by the presence of steep south and west facing slopes, broken canopied forest adjacent to the ROW, and the presence of exposed rock at the soil surface.

Field surveys have been performed at three of the Cumberland River locations where Short's bladderpod has been previously observed within a 1,000 ft of a TVA ROW; the species was not found in or adjacent to the TVA ROW at any of these locations. If an undocumented site for Short's bladderpod does occur at a TVA ROW Cumberland River crossing, the species would most likely occur in a spanned section of forest where the conductor is high enough above mature trees that clearing is unnecessary. This often occurs where TL cross large rivers because structures are usually placed on high points to allow conductors to span long crossings.

Some Tennessee populations of Short's bladderpod do not occur along bluffs and are found at more disturbed sites, such as road medians, eroding river banks, and riprap slopes. Therefore, it is difficult to predict where the species might occur in disturbed habitat in the Action Area.

16.2.2. Action Area Conservation Needs of and Threats to Short's Bladderpod

In the Action Area, the most likely threats to Short's bladderpod are habitat loss and degradation from overstory shading due to forest succession and shading and competition from invasive, nonnative plant species. These threats can be reduced by monitoring site conditions of known populations and manually removing shrubs, burning, and controlling invasive, non-native plants to open up habitat that is being shaded.

16.3. Effects of Vegetation Management on Short's Bladderpod

This section analyzes the direct and indirect effects of the Action on Short's bladderpod. An effects analysis summary of the effects of various methods of vegetation management on Short's bladderpod and the other 17 listed LAA plant species from the BA has been included in Appendix II.

16.3.1. Effects of Manual Vegetation Clearing on Short's Bladderpod

Direct physical disturbance associated with manual tree removal could adversely affect Short's bladderpod, but the increased sunlight associated with canopy removal has the potential to benefit plants suppressed by a dense forest canopy.

16.3.2. Effects of Mechanical Clearing on Short's Bladderpod

If mechanical vegetation control methods utilized by the TVA ROW program intersect habitat occupied by Short's bladderpod, there is the potential the species could be adversely affected. The species most often occurs in open, rocky calcareous forests, but it also tolerates higher light conditions and could theoretically occur, both, on the ROW floor and in adjacent forests. Mowing could adversely affect Short's bladderpod if implemented in occupied habitat in the ROW, but the species usually inhabits areas that are far too steep to allow the use of mowers. The likelihood of Short's bladderpod being adversely affected by TVA ROW mowing is very small. Similarly, mechanical clearing and side-wall trimming require equipment access, which would most likely be precluded by the steep slopes and rock outcrops. Therefore, though these tools could adversely affect Short's bladderpod if used in occupied habitat, the chances of these tools intersecting the species is very low because the terrain would likely prevent their application. Aerial side-wall trimming would result in more light reaching the herbaceous layer of vegetation, with no physical ground disturbance. This would most likely have beneficial effects if used in the vicinity of Short's bladderpod, but could result in small adverse effects depending on the situation.

16.3.3. Effects of Herbicide Use on Short's Bladderpod

Vegetation control methods that utilize herbicides are likely to adversely affect Short's bladderpod if used in occupied habitat. Spot treatment with herbicide is highly targeted and unlikely to adversely affect Short's bladderpod at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting and as an AMM to control smaller trees in occupied habitat. Localized herbicide application could affect plants in, both, the open ROW floor and along the edge of the ROW, especially if Short's bladderpod plants grow adjacent to woody plants targeted for removal. Broadcast herbicide, either from the air or ground, could affect plants growing on and in the vicinity of the ROW edge if this method were used in occupied habitat. However, all TVA ROW crossings of the Cumberland River that could potentially support Short's bladderpod have Class 1 or 2 Plants in O-SAR. This O-SAR restriction prohibits the use of broadcast herbicide either from the air or ground.

16.3.4. Effects of Debris Management on Short's Bladderpod

Debris management techniques used by TVA have a small potential to adversely affect Short's bladderpod. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. Effects from manual clearing are more likely because the rocky terrain where the species occurs would preclude the use of machinery. These effects would include physical damage resulting from cutting or dragging trees and would not likely result in death of individuals. The terrain would also likely prevent chipping and mulching from occurring because equipment could not maneuver on the site. If mulching/chipping did occur, the species could be directly affected by crushing from machinery and burial by mulch/chips. Burning is very unlikely to occur in the steep sections of ROW that could potentially support Short's bladderpod, but debris handling by machinery could theoretically affect individual plants on the ROW edge. TVA's facilitation of landowner use of wood has the similar potential for small impacts as manual debris management methods.

16.4. Conclusion for Short's Bladderpod

In this section, we interpret the findings of the previous sections for the Short's bladderpod (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to Short's bladderpod and result in very few individual plants within the Action Area being adversely affected, if any. Cumulative effects to Short's bladderpod that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the Short's bladderpod. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Rangewide, there are 26 known extant populations, and, in the Action Area, there are eight TVA ROW crossings supporting suitable habitat where the species may occur; therefore, only a very small percentage of plants (if present) in the species' range could potentially be affected by the Action. (4) The species would likely occur in a spanned section of forest, where the TVA conductor would be high above mature trees and vegetation clearing unnecessary, reducing the probability of the action adversely affecting plants.

17. WHITE FRINGELESS ORCHID

17.1. Status of White Fringeless Orchid

This section summarizes best available data about the biology and current condition of white fringeless orchid (*Plantanthera integrilabia*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list white fringeless orchid as threatened on September 13, 2016 (81 FR 62826-62833).

17.1.1. Description of White Fringeless Orchid

White fringeless orchid is a perennial herb with a light green, 60 cm long stem that arises from a tuber. The leaves are alternate with entire margins and are narrowly elliptic to lanceolate in shape. The white flowers are borne in a loose cluster at the end of the stem. The plants flower from late July through September, and the small narrow fruiting capsule matures in October (Shea 1992).

17.1.2. Life History of White Fringeless Orchid

White fringeless orchid typically inhabits wetlands that occur on mineral soils and do not accumulate peat. They often are located at stream heads and connected to ephemeral streams via dispersed sheet flow or concentrated surface flow in incipient channels. However, further study is needed to characterize the range of variation in soils, hydrology, physicochemistry, and origin of wetlands throughout the range of white fringeless orchid. Most sites where white fringeless orchid populations exist are on soils formed over sandstone bedrock, which usually are low in fertility and organic matter content and are acidic (Shea 1992). The species often occurs in swamps dominated by red maple (*Acer rubrum*) and blackgum (*Nyssa sylvatica*).

Like most terrestrial orchids, white fringeless orchid depends on a symbiotic relationship with mycorrhizal fungi to enhance seed germination and promote seedling development and establishment (Rasmussen and Whigham 1993). In addition to providing a carbon source for seedling development, mycorrhizal fungi enhance germination by promoting increased water uptake by orchid seeds (Yoder *et al*. 2000). Their small size permits dispersal of orchid seeds to new environments via wind currents; however, very few of the seeds likely encounter suitable habitats where host fungi are present (Yoder *et al*. 2010). This likelihood is further reduced in the case of species such as white fringeless orchid, which may rely on a single fungal host species, *Epulorhiza inquilina,* to complete its life cycle (Currah *et al.* 1997).

Known pollinators for white fringeless orchid include three diurnal species from two families of butterflies (Lepidoptera): silver spotted skipper (Hesperiidae: *Epargyreus clarus*), spicebush swallowtail (Papilionidae: *Papilio troilus*), and eastern tiger swallowtail (Papilionidae: *Papilio glaucus*) (Zettler *et al.* 1996). Based on floral characteristics, it is likely that more effective pollinators for white fringeless orchid exist in the nocturnal sphingid moth family (Zettler *et al.* 1996); however, this has not been confirmed.

17.1.3. Numbers, Reproduction, and Distribution of White Fringeless Orchid

White fringeless orchid has a self-compatible breeding system, allowing individuals to produce seed using their own pollen; however, the proportions of fruits produced through self-pollination versus cross-pollination are not known (Zettler and Fairey 1990). Zettler and McInnis (1992) speculated that higher rates of fruit set were probably more typical, historically, when larger populations provided greater opportunities for cross-pollination to occur.

The white fringeless orchid's distribution is concentrated in the Cumberland Plateau section of the Appalachian Plateaus physiographic province, with isolated populations scattered across the Blue Ridge, Piedmont, and Coastal Plain provinces (Fenneman 1938). The species' current distribution includes 35 counties where extant and uncertain occurrences exist in Kentucky, Alabama, Tennessee, Mississippi, South Carolina, and Georgia. More occurrences are included in the species' current distribution than were historically known to exist, likely as a result of increased survey effort; however, low numbers of flowering plants have been observed at most sites (80 FR 55304 - 55321). For example, fewer than 50 flowering plants have ever been observed at one time at 45 (64 percent) of the 70 extant and uncertain occurrences for which data are available. At 26 (37 percent) of these occurrences, fewer than 10 flowering plants have ever been recorded (81 FR 62826 - 62833).

17.1.4 Conservation Needs of and Threats to White Fringeless Orchid

Habitat modification caused by development, silvicultural practices, invasive plant species, disturbance by feral hogs, shading due to understory and canopy closure, altered hydrology, and ROW maintenance have impacted the range and abundance of white fringeless orchid. While the species is present in a number of sites on conservation lands, few conservation actions have been undertaken to address these threats to the species' habitat, and those that have been implemented, have been met with limited success (80 FR 55304 - 55321).

17.2. Environmental Baseline for White Fringeless Orchid

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the white fringeless orchid, its habitat, and ecosystem within the Action Area.

17.2.1. Action Area Numbers, Reproduction, and Distribution of White Fringeless Orchid

White fringeless orchid has been documented from TVA ROWs at five locations on the Cumberland Plateau near Spencer, Tennessee and at one location on Lookout Mountain near Fort Payne, Alabama. Population information is detailed in the BA and summarized below.

> Population 1: Population 1 was first observed by TVA botanists in 2009 as part of an environmental review for a minor TL infrastructure repair project. At that time, about 20 flowering plants were observed in a small ROW swale. Less than five plants occurred in

the adjacent forest. Counts of flowering stems from Population 1 are 20 (2009), 37 (2011), 369 (2013), 950 (2014), 1537 (2015), 761 (2016), and 991 (2017).

Population 2: Population 2 is located in a narrow strip of suitable habitat that straddles Simmons Creek, where it crosses the TVA ROW. There is no suitable habitat immediately adjacent to the ROW. In this area, the ROW bisects a loblolly pine (*Pinus taeda*) plantation. The site was only visited once by TVA botanists; nine flowering plants were seen in 2013.

Population 3: Population 3 was located by TVA botanists during a 2010 field survey for a new distribution line that was sited adjacent to an existing TVA TL. This small population grows in what could likely be considered marginal habitat. During all surveys of the site, white fringeless orchid was difficult to discern because of dense growth of competing vegetation. Counts of flowering stems from Population 3 are 7 (2010), 25 (2011), 0 (2014), 28 (2015), and 9 (2016).

Population 4: Population 4 covers more than 2.25 ac of ROW and was first observed in 1983. This relatively large occurrence persists as part of a diverse, herbaceous plant community within the ROW. The data available for the site suggests that the population is stable. Counts from Population 4 are about 40-50 plants (1984-1990), 487 (1997), 111 (2000), 7 (2008), 16 (2011), 205 (2014), 687 (2015), 883 (2016), and 920 (2017).

Population 5: Population 5 was discovered in August of 2018. About 50 flowering plants were observed within the TVA ROW, and no plants were seen outside of the ROW.

Population 6: Population 6 was discovered in 2013 and is the first occurrence of the species in DeKalb County, Alabama. This populations occurs near a sandstone complex with several other globally rare species, including sun-facing coneflower (*Rudbeckia heliopsidis*), woodland tickseed (*Coreopsis pulchra*), and longleaf sunflower (*Helianthus longifolius*). Plants were observed in July 2018, but no count was conducted.

It is likely additional undocumented populations of white fringeless orchid occur on TVA ROW, particularly on the Cumberland Plateau of Tennessee. About 11,500 ac of TVA ROW are situated in counties where white fringeless orchid is known to occur. While not all sections of these TVA ROWs are potential habitat for white fringeless orchid, TVA botanists have used the O-SAR process to designate about 8,300 and 500 ac of ROW as Plants Class 1 and Class 2, respectively. TVA botanists have field surveyed about 2,700 ac of ROW in the counties where white fringeless orchid is known to occur, and have found five of the populations listed above.

17.2.2. Action Area Conservation Needs of and Threats to White Fringeless Orchid

Consistent with the threats described in Section 17.1.4., disturbances to the white fringeless orchid have not been fully assessed in the Action Area, but observations during surveys indicate that invasive plant species, shading due to understory and canopy closure and ROW maintenance have resulted in declines to the species. However, TVA ROW maintenance is being tailored to

minimize effects to the species at known locations. In addition, removal of invasive species and thinning of the canopy could improve habitat conditions at some locations.

17.3. Effects of Vegetation Management on White Fringeless Orchid

This section analyzes the direct and indirect effects of the Action on white fringeless orchid. An effects analysis summary of the effects of various methods of vegetation management on white fringeless orchid and the other 17 listed LAA plant species from the BA has been included in Appendix II.

17.3.1. Effects of Manual Vegetation Clearing on White Fringeless Orchid

All manual vegetation control methods utilized by TVA have the potential to adversely affect white fringeless orchid if they are carried out in habitat occupied by the species. The most likely effects would be from trampling or crushing individual plants from foot traffic or handling cut vegetation. While direct physical disturbances could result in adverse effects, the removal of overstory and resultant increases in light levels could benefit affected populations.

17.3.2. Effects of Mechanical Clearing on White Fringeless Orchid

All mechanical vegetation control methods utilized by TVA have the potential to adversely affect white fringeless orchid as a result of trampling or crushing from machinery traffic, in addition to foot traffic. Mechanical clearing could also result in increased light levels, benefitting future white fringeless orchid populations. In addition, given the propensity of white fringeless orchid to reproduce asexually from underground shoots, it is unlikely that mechanical vegetation control measures implemented by TVA would remove the species from a site.

17.3.3. Effects of Herbicide Use on White Fringeless Orchid

Vegetation control methods that utilize herbicides are likely to adversely affect white fringeless orchid; however, spot treatment with herbicide is highly targeted and unlikely to adversely affect white fringeless orchid at the population level, but could result in isolated, direct adverse effects on individual plants. Even though localized herbicide application typically targets woody species within the ROW floor, it is likely that white fringeless orchid plants that occur nearby would experience some level of herbicide related damage or death. Broadcast herbicide, from either the air or ground, could affect plants growing on and near the ROW edge if it were used in occupied habitat. However, most sections of TVA ROW, with naturalized vegetation and situated on the Cumberland Plateau, have either been field surveyed or are designated as Class 1 or 2 Plants in O-SAR, which prohibits the use of broadcast herbicide either from the air or ground making exposure unlikely.

17.3.4. Effects of Debris Management on White Fringeless Orchid

All debris management techniques used by TVA have a small potential to adversely affect white fringeless orchid. The debris removal phase most likely to affect the species is physical disturbance associated with manual or mechanized handling of material. This disturbance could result from dragging of debris over plants or the marginal soil disturbance that would be

expected from use of machinery, but is not anticipated to result in the death of individual plants. If mulching/chipping occurs, the species could be directly affected by crushing from machinery and burial by mulch/chips. Pile burning could conceivably result in the loss of individual plants, but infrequent use, combined with the rarity of the species, makes the likelihood of this occurring small. TVA's facilitation of landowner use of wood materials in the ROW would have a similar potential for minor impacts as the other debris management methods.

17.4. Conclusion for White Fringeless Orchid

In this section, we interpret the findings of the previous sections for the white fringeless orchid (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to white fringeless orchid. Although some damage to plants is expected and individual plants could be adversely affected, we do not expect the extent of adverse effects to result in declines at the population level. Additionally, canopy thinning and removal of invasive species could benefit the white fringeless orchid in the future at some sites. Cumulative effects to white fringeless orchid that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the white fringeless orchid. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations (six populations out of a total of 70 extant populations) occurs on ROW within the Action Area, and only a small percentage of the plants in the species range would be adversely affected by the Action. (4) Two of the six populations on TVA ROW have increased to nearly 1,000 plants per population, while the other, much smaller populations have fluctuated, but persisted, suggesting ROW vegetation management is not adversely affecting the species.

18. GREEN PITCHER PLANT

18.1. Status of Green Pitcher Plant

This section summarizes best available data about the biology and current condition of the green pitcher plant (*Sarracenia oreophila*) throughout its range that are relevant to formulating an

opinion about the Action. The USFWS published its decision to list the green pitcher plant as endangered on September 21, 1979 (44 FR 54922-54923).

18.1.1. Description of Green Pitcher Plant

Green pitcher plant is a carnivorous, perennial herb in the pitcher plant family (Sarraceniaceae). Green pitcher plant grows from moderately branched rhizomes that are 1 to 1.5 cm (0.4- to 0.6 in) in diameter. The leaves are of two types. One type, the hollow leaves (the pitcher), appear in spring, are 20 to 75 cm (8 to 30 in) long, 6 to 10 cm (2.4 to 4 in) in circumference at the orifice (top opening), and gradually narrow toward the base. The pitchers are green to yellow-green with some being maroon suffused, maroon veined externally, or rarely with a purple blotch at the orifice. At the top of the pitcher, a similarly colored hood arches over the opening. Pitchers wither by mid- to late-summer, depending on soil moisture. The second type of leaves appear after flowering or when the plant is stressed, forming a rosette of flat leaves that are erect and then strongly curved downward and are approximately 5 to 18 cm (2 to 7 in) long. Flowers have five yellow petals, five yellow-green sepals, and an inverted, yellow-green, umbrella-shaped central disc. The flowers occur singly on a leafless flower stalk that is approximately 45 to 70 cm (18 to 28 in) long. The fruit is a tuberculate capsule 1.5 to 1.8 cm (0.6- to 0.7 in) wide. All of these descriptive features can be variable in this species. This description of green pitcher plant was summarized from a more thorough description found in Troup and McDaniel (1980); Catalani (2004); Chafin (2007); and Weakley (2015).

18.1.2. Life History of Green Pitcher Plant

The green pitcher plant is classified as an obligate wetland species, meaning that the species almost always occurs in wetlands (Lichvar *et al.* 2016). Green pitcher plant habitats can be generally grouped into two types: streambanks and upland bogs (Troup and McDaniel 1980; USFWS 1994b, 2014a; Sutter and Rudd 1997). These sites occur in a range of open to forested conditions and are thought to be underlain by semi-impervious clay layers that help maintain the relatively moist soil conditions (USFWS 2014a). Further characterizations of habitats by Carter *et al.* (2006) of several Alabama populations described habitats as poorly draining oak-pine flatwoods and red maple-blackgum swamps and seepage bogs with limited canopy cover. Control of competing vegetation through periodic scouring or fire may help maintain appropriate habitat conditions for green pitcher plant (USFWS 2014a). Plants found along streambanks may be more susceptible to extirpation caused by excessive scouring of the habitat during periodic extreme flood events (USFWS 2014a).

Green pitcher plant populations grow and spread by both sexual reproduction (production of seeds and recruitment of seedlings) and asexual, vegetative clones (via underground rhizomes) (Folkerts 1992; USFW 1994b). Sexual reproduction and genetic variability of populations of this species may be limited by the availability and movements of their pollinators. Queen bumblebees (*Bombus* spp.) are considered the primary pollinator of green pitcher plants (Folkerts 1992; Folkerts 1999). The movement distance for typical queen bumblebees is less than 1-mi (Folkerts 1992); therefore, pollen flow (and consequent gene flow) is restricted by the inability of pollinators to traverse this distance (Folkerts 1999). Dispersal of plants to new locations and recolonization of extirpated populations rely on the seed dispersal through insect or water movement (USFWS 2014a).

18.1.3. Numbers, Reproduction, and Distribution of Green Pitcher Plant

Green pitcher plant is found in the Cumberland Plateau and the Ridge and Valley provinces of Alabama, and the Blue Ridge physiographic province of Georgia and North Carolina. Within green pitcher plant's extant range, the species' distribution can be broadly divided into four geographic areas: Coosa Valley, Lake Chatuge, Lookout Mountain, and Sand Mountain (Dennis 1980; USFWS 1994b). Lake Chatuge green pitcher plant colonies are restricted to Georgia and North Carolina, whereas Coosa Valley, Lookout Mountain, and Sand Mountain green pitcher plant distribution is restricted to Alabama (USFWS 2014a).

Because of the limits of primary pollinators, populations of green pitcher plant are defined as plants that are separated from their nearest neighbors by at least 1-mi (USFWS 2014a). As of 2013, there were 15 known populations of green pitcher plant rangewide. The colonies in North Carolina and Georgia represent a single population, and the 28 colonies in Alabama represent an additional 14 populations (USFWS 2014a). Rangewide, ten green pitcher plant populations (20 colonies/sites) are protected. Three populations are protected by TNC in Alabama, Georgia, and North Carolina; two populations are protected by the State of Alabama; and five populations are protected by the NPS. Of the five populations protected by the NPS, the current status of three is currently unknown, but these populations are considered to have poor viability by the ANHP (USFWS 2014a). Populations occurring along streambanks have an unknown future, because flooding could scour and destroy those populations.

18.1.4. Conservation Needs of and Threats to Green Pitcher Plant

The primary threats identified in the Final Rule listing the green pitcher plant as endangered included a reduction in range from over-collecting, changes in land use (*e.g.*, residential, agricultural, and silvicultural development), inundation from construction of reservoirs, mining, road construction, and succession of bog and wetland communities caused by removal of fire from the landscape (44 FR 54922-54923). Additional threats addressed in the latest 5-year review include cattle grazing, logging, and pollinator limitations (USFWS 2014a).

Although many populations of this species occur on protected lands, these plants are still vulnerable to poaching, changes to soil moisture from surrounding hydrologic alterations, and from succession of the landscape, which degrades the species' habitat (USFWS 2014a).

Research has identified that the small, isolated populations of this species are likely pollinator limited (Folkerts 1999). Any activities that reduce pollinator numbers or effectiveness may adversely affect the extant populations of green pitcher plant. This limitation has also likely resulted in low genetic diversity of existing populations and increased genetic isolation of populations (USFWS 2014a). Continued land use changes throughout the southeast coupled with pollinator declines will continue to threaten and isolate extant populations.

18.2. Environmental Baseline for Green Pitcher Plant

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is

an analysis of the effects of past and ongoing human and natural factors leading to the current status of the green pitcher plant, its habitat, and ecosystem within the Action Area.

18.2.1. Action Area Numbers, Reproduction, and Distribution of Green Pitcher Plant

In the Action Area, green pitcher plant is known to occur at one site on the TVA ROW at Little River Canyon National Preserve (LRCNP) in DeKalb County, Alabama. Green pitcher plants in this location were first observed in 1985 and extend off the ROW in many areas throughout this section of the park. TVA has deferred to the NPS on vegetation management on this section of ROW and has not used herbicide to manage vegetation on this TL for many years. The NPS uses mowing to control woody plant growth within the ROW and prescribed fire to maintain habitats, both within and outside of the ROW.

18.2.2. Action Area Conservation Needs of and Threats to Green Pitcher Plant

Few, if any, sizable, unsurveyed upland seepage bogs or streambank habitats that could host significant populations or colonies of green pitcher plant on TVA ROW remain in the Action Area. TVA botanists have used desktop reviews to identify areas that are likely to support green pitcher plant near Weiss Lake in the Coosa River valley, as well as on Lookout and Sand mountains. Since 2013, TVA botanists have field surveyed over 120 discrete sections of the Action Area in Alabama that were identified as having potential habitat, but no new populations of green pitcher plant were observed.

Threats to existing occurrences of green pitcher plant include loss, alteration, and/or degradation of habitat from residential, commercial, and/or industrial development, livestock grazing and trampling, encroachment of competing vegetation (including exotics), poaching, and ORV use. The population that occurs in the TVA ROW is threatened by woody vegetation encroachment and lack of fire, which promotes encroachment of shortleaf pine (*Pinus echinata)*, blackberry (*Rubus spp*.), and sparkleberry (*Vaccinium arboreum*) (Emanuel 1998).

Conservation measures could include managing or eradicating competing vegetation through prescribed fire, manual mowing and removal of woody vegetation, augmenting occurrences, support of safeguarding efforts, and the development of a management plan with the NPS for the population at LRCNP. The hydrology of this pitcher plant bog has already been impacted by activities associated with the power line ROW, as noted in Emanuel's 1998 management plan for the species at this location: "The hydrologic flow in this seepage bog has been interrupted by the woods road alongside the power line. Deep ruts have been created by vehicles driving across the seepage area. Three lanes of ruts have been created by avoidance of an existing rut that was muddy and impassable. The topographical gradient should be repaired to the original level and an alternative means of traversing the seepage area or avoiding it completely should be investigated. The interrupted hydrologic flow is detrimental to the southern portion of the seepage bog where other green pitcher plants exist." (Emanuel 1998).

18.3. Effects of Vegetation Management on Green Pitcher Plant

This section analyzes the direct and indirect effects of the Action on green pitcher plant. An effects analysis summary of the effects of various methods of vegetation management on green pitcher plant and the other 17 listed LAA plant species from the BA has been included in Appendix II.

18.3.1. Effects of Manual Vegetation Clearing on Green Pitcher Plant

Manual vegetation clearing has the potential to adversely affect green pitcher plant; however, provided such clearing does not excessively disturb the soil, it is unlikely to result in the death of individual plants. Green pitcher plant populations decline as succession of their habitats increases and clearing of woody vegetation will help maintain increased light levels and the appropriate hydrology the populations need. The plants are susceptible to physical damage caused by clearing activities, but the species could resprout if soils in the area are not excessively compacted by heavy equipment. The soil disturbance should be minimal because of BMPs designed for activities in wetlands.

Manually clearing trees on previously unmaintained ROW is a one-time event because these areas will subsequently be treated as ROW floor. Danger tree clearing occurs as needed and may not be needed in areas where green pitcher plant occur, because those populations are maintained as early successional habitats and have minimal overstory structure.

18.3.2. Effects of Mechanical Clearing on Green Pitcher Plant

All mechanical vegetation control methods used by TVA have the potential to adversely affect green pitcher plant. However, as long as the method does not excessively disturb the soil, it is unlikely to result in the death of individual plants. Mowers are generally set 10 to 12 inches off the ground and would likely miss much of the vegetative growth of this species; if damaged, however, this species would likely resprout. As previously stated, opening of the canopy through this type of clearing could benefit green pitcher plant populations.

18.3.3. Effects of Herbicide Use on Green Pitcher Plant

Vegetation control methods that use herbicides are likely to adversely affect green pitcher plant. Spot treatment with herbicides is highly targeted and unlikely to adversely affect green pitcher plant at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting larger woody material in and near the ROW to prevent resprouting and as an AMM to control smaller trees in occupied habitat within the ROW floor. Green pitcher plants occupy the ROW floor, and, therefore, are likely to be adversely affected by localized herbicide applications in those areas.

If individual green pitcher plants occur within a few feet of a tree treated with localized herbicide application, chances are high that the plant would experience some level of herbicide related damage. This damage may rise to the level of individual plant death especially if areas supporting the species were mowed for many years before application of herbicide, which would

result in a proliferation of woody plant stems that would form a low tree canopy within the ROW. Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW edge if it were used in occupied habitat. Most, but not all, sections of TVA ROW with naturalized vegetation located near green pitcher plant occurrences have either been field surveyed or are designated as Plants Class 1 and 2 in O-SAR. This O-SAR restriction prohibits the use of broadcast herbicide from the air or ground.

According to TVA's BA, herbicide use is not to occur on NPS or USFS lands without the written permission of government officials; this should ensure herbicide use on the population of green pitcher plant at LRCNP has been reviewed and complies with the management plan for the LRCNP. Because TVA does not use herbicide to manage this population of green pitcher plant and the NPS uses mowing and prescribed fire to maintain this population, there should be no effect from herbicide use on the population.

18.3.4. Effects of Debris Management on Green Pitcher Plant

All debris management techniques (manual or mechanized handling of debris, mulching or chipping, and pile burning) used by TVA have some potential to adversely affect green pitcher plant. The characteristic of debris removal most likely to affect the species is physical disturbance associated with manual or mechanized handling of debris. This disturbance could result from dragging of debris over plants or soil disturbance that is expected from use of machinery. Wetland BMPs should minimize soil disturbance from these activities. Pile burning could result in loss of some plants if piles are located directly on top of or immediately adjacent to plants, but the infrequent use of the tool, the extreme rarity of the species, and the unlikely possibility of using a wetland habitat for burning make the likelihood of this technique adversely affecting green pitcher plant improbable. These effects can be avoided by marking known populations prior to these activities to ensure that piles are not located on the plants. TVA's facilitation of landowner use of vegetation debris (*e.g.*, fire wood) has similar potential for effects as manual debris management methods. Impacts from this activity can be reduced by ensuring wood placement and landowner access is not in an area with green pitcher plants.

18.4. Conclusion for Green Pitcher Plant

In this section, we interpret the findings of the previous sections for the green pitcher plant (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action will have localized adverse effects to green pitcher plant and result in no more than a few individual plants within the Action Area being adversely affected. Cumulative effects to green pitcher plant that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the green pitcher plant. We

reached this determination based on the fact that the single population on TVA ROW is located on lands owned and managed by the NPS, which uses mowing and prescribed fire to maintain this population and prohibits herbicide use. Since TVA vegetation management activities likely will not be implemented at this site due to NPS management there, the Action could not affect plants at this site, and NPS's interrelated action to manage the ROW (i.e., in-lieu of TVA ROW management) does not appear to adversely affect the species.

If the NPS were to cease managing the population and if TVA began managing the ROW, it is also the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the green pitcher plant based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations (one population out of a total of 15 extant populations) occurs on ROW within the Action Area; therefore, only a small percentage of the plants in the species range potentially would be adversely affected by the Action.

19. LARGE-FLOWERED SKULLCAP

19.1. Status of Large-Flowered Skullcap

This section summarizes best available data about the biology and current condition of large-flowered skullcap (*Scutellaria montana*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list large-flowered skullcap as endangered on June 20, 1986 (51 FR 22521-22524) and its decision to reclassify the species from endangered to threatened on January 14, 2002 (67 FR 1662-1668).

19.1.1. Description of Large-Flowered Skullcap

Large-flowered skullcap is a perennial herb with solitary, erect, square stems, usually from 30 to 50 cm (11.8 to19.7 in) tall. The leaves are lanceolate to ovate, on 1 to 2 cm (0.4- to 0.8-in) petioles, with blades 5 to 8 cm (2 to 3.2 in) long and 3 to 5 cm (1.2 to 2 in) wide, crenate to serrate margins, and hairy on both surfaces. The inflorescence is a terminal, leafy-bracted raceme, with or without paired lateral racemes at the base. The calyx is two-lobed (characteristic of the genus *Scutellaria*). The corolla is relatively large, 2.6 to 3.5 cm (1 to 1.4 in) long, blue and white, and lacking a fleshy ridge (annulus) within the corolla tube near the top of the calyx. Flowering occurs from mid-May to early June and fruits mature in June and early July (USFWS 1996d).

19.1.2. Life History of Large-Flowered Skullcap

Bridges (1984) described the habitat of large-flowered skullcap as rocky, submesic to xeric, well-drained, slightly acidic slope, ravine and stream bottom forests in the Ridge and Valley and Cumberland Plateau provinces of Northwestern Georgia, and adjacent southeastern Tennessee. TDEC (2008) reported that large-flowered skullcap can apparently live eight or more years.

Nutlets are released from mid-June to mid-July, overwinter, and apparently germinate in late March. Mature individuals that have perenneated as root stocks begin shoot growth in late March. By early April, plants are 5 to 10 cm (2 to 3.9 in) tall and are pushing through leaf litter. Anthesis typically begins during mid-May and continues through early June. Pollination is principally exclusively by Hymenoptera of the superfamily Apoideae (bees). The corolla shrivels somewhat and falls from the calyx one or two days after pollination, presumably within 24 hrs of fertilization. The calyx closes around the developing fruit immediately after corolla abscission. During the next two to four weeks, the calyx and the enclosed nutlets enlarge and mature. The calyx then dehisces by the loss of the upper lip and the nutlets are released (USFWS 1996d).

A different course is followed if fertilization does not occur. The corolla shrivels markedly and may or may not remain united to the calyx. The entire calyx, still open at the mouth, falls leaving the pedicel bare (USFWS 1996d).

Long distance seed dispersal appears to be limited for the large-flowered skullcap; dispersal distance is not known to exceed 2 mi (USFWS 1996d). Cruzan (2001) observed that large, gravity-dispersed seeds likely constrain the species' dispersal ability and cited unpublished data that indicated a persistent seed bank is likely in large-flowered skullcap because cold treatments failed to break seed dormancy in this species; whereas, the same treatments resulted in fairly high germination rates for closely related falseteeth skullcap (*Scutellaria pseudoserrata*).

19.1.3. Numbers, Reproduction, and Distribution of Large-Flowered Skullcap

The large-flowered skullcap has been found in Bledsoe, Hamilton, Marion, and Sequatchie counties in Tennessee; and Catoosa, Dade, Floyd, Gordon and Walker counties in Georgia (51 FR 22521-22524). According to TDEC (2014), there are currently 164 extant large-flowered skullcap EOs in Tennessee, distributed among 28 extant populations. Of the 28 extant populations in Tennessee, 22 have at least 100 plants and are located, in whole or part, on protected land (*i.e.*, they meet the criteria for viability) (USFWS 2015a). In Georgia, there are 52 extant EOs, but their distribution among populations has not been evaluated (USFWS 2015a).

In completing a status survey of large-flowered skullcap in Tennessee, TDEC (2014) applied the following criteria for delineating populations among the 164 extant occurrences:

1. Populations are defined as groups of EOs that are located in a major drainage within a HUC-12 watershed and have topographic continuity (*e.g.*, in some cases populations are delineated between groups of occurrences on top of the Cumberland Plateau and those on the escarpment within the same HUC-12).

2. Subpopulations are defined as groups of EOs within a population that occur in continuous habitat with no apparent physical barriers to gene flow.

Based on these criteria, there are 30 populations distributed among 16 HUC-12 watersheds in Tennessee, 28 of which are extant (*i.e.*, not F- or X-ranked as discussed below and reported in Table 19.1). Within eight of these populations, 22 subpopulations have been delineated because of significant discontinuity in habitat between some groups of occurrences included within those populations (TDEC 2014).

Using available data on large-flowered skullcap abundance and threats for each EO, TDEC (2014) assessed the viability of the 30 populations in Tennessee (Table 19.1). The viability ranks are based on criteria in the recovery plan that a population will be considered self-sustaining if monitoring data support the conclusion that it is reproducing successfully and is stable or increasing in size and if the minimum number of individuals is at least 100 (67 FR 1662-1668). The rank specifications that follow are based on the most recent information taking into account habitat quality, including invasive plant species and expert opinion:

> **A-rank (Excellent Viability)**: population of large-flowered skullcap contains greater than 1,000 plants with the number of plants in each occurrence that makes up a population. A smaller population with the number of plants in each occurrence having 500-1,000 plants with minimal habitat disturbance and no or few invasive exotic plant species.
>
> **B-rank (Good Viability)**: population of large-flowered skullcap with 500 -1,000 plants with the number of plants in each occurrence that makes up a population with some habitat disturbance, or smaller population with the number of plants in each occurrence having 100-500 plants in sites with minimal habitat disturbance and no or few invasive exotic plant species. Site may be restorable to an A rank.
>
> **C-rank (Fair Viability)**: population of large-flowered skullcap with 100 -500 plants with the number of plants in each occurrence that makes up a population with some habitat disturbance and some invasive exotic species.
>
> **D-rank (Poor Viability)**: population of large-flowered skullcap with less than 100 plants with the number of plants in each occurrence that makes up a population. Restoration of disturbed or degraded sites would be unlikely.
>
> **E-rank**: Extant but no data available, habitat does exist at the site.
>
> **F-rank**: Failed to find during survey period.
>
> **H-rank**: Historic, not seen in 25 years.
>
> **X-rank**: Extirpated.

Using these rank specifications and available data on minimum abundance recorded at each EO, TDEC (2014) determined that there are 22 viable populations (Table 19.1) in Tennessee. In many cases, recent counts of plants beyond those in permanent monitoring plots were not available, and the evaluation was based on plants in the plots alone. In other cases, no recent data were available. Of the 22 viable populations, 11 occur completely on protected lands and the other 11 are partially protected. In most cases, the majority of the EOs within the partially protected populations are located on protected lands (USFWS 2015a).

Table 19.1. Population ranks and protection status for *Scutellaria montana* in Tennessee (TDEC 2014).

	A-rank	B-rank	C-rank	D-rank	F-rank	X-rank
Total	8	2	12	6	1	1
Protected	5	1	5	3	1	0
Partially-protected	3	1	7	3	0	0

19.1.4. Conservation Needs of and Threats to Large-Flowered Skullcap

A recent status survey for large-flowered skullcap in Tennessee identified the following potential threats to the species and its habitat (USFWS 2015a):

- ORV traffic on undesignated trails
- Invasive exotic plants
- Trail construction and maintenance on public and conservation lands
- Power line maintenance including the use of herbicide, manual, and mechanical treatments for vegetation management
- Wildfire suppression involving construction of large fire lines
- Recreational impacts including unauthorized hiking, camping and picnicking on public and conservation lands
- Mineral mining and quarrying
- Removal of mature forest by logging or development on private lands.

While these threats to habitat remain on the landscape and potentially could affect large-flowered skullcap, the large number of populations and the protected status of many populations likely provides the redundancy and resilience needed for the species' conservation. Based on available data, no known threats to habitat are both widespread and severe enough to place the species at risk of extinction, nor are they likely to cause the species to become at risk of extinction in the foreseeable future given the fact that all viable populations are either partially or completely protected.

The proposed rule to reclassify large-flowered skullcap from endangered to threatened maintained that wildfire poses a threat to the species (65 FR 42976). However, a recent study demonstrated that large-flowered skullcap transplanted into a previously burned site had greater

survival rates than a control plot and plots that had been either canopy-thinned or burned and canopy-thinned (Kile *et al*. 2013). This study did not examine effects of fire on individuals that were present at the time of the treatments. Anecdotal data from eight monitoring plots in the Tennessee River gorge, half of which burned in a 2007 wildfire, reveal no detectable difference in stage-specific or overall abundance of large-flowered skullcap between burned and unburned plots, and large-flowered skull cap abundance was greater in burned than unburned plots in preliminary results from a study in TNC's Marshall Forest Preserve in Georgia (S. Monteleone, Associate Professor of Biology, Shorter University, unpublished data). Based on the results of these studies, we no longer consider wildfire to be a threat to large-flowered skullcap. However, the potential exists for plants and habitat to be damaged during suppression operations that involve mechanical construction of fire lines (TDEC 2014).

Conservation needs for the species include continued monitoring across the species' range to infer general trends, collection of census data from populations for which recent data are lacking to evaluate viability ranks assigned by TDEC (2014) and to establish viability ranks for populations in Georgia, and development of management agreements for protected sites to ensure that conservation of the species would continue into the future if the species is delisted. The USFWS is working with partners via an informal recovery working group, coordinated by TVA, to develop a strategy for completing these actions within three to five years (USFWS 2015a).

19.2. Environmental Baseline for Large-Flowered Skullcap

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Large-Flowered Skullcap, its habitat, and ecosystem within the Action Area.

19.2.1. Action Area Numbers, Reproduction, and Distribution of Large-Flowered Skullcap

In the Action Area, large-flowered skullcap is known to occur on the only two TVA ROW crossing the Cumberland Plateau within the range of the species. Field surveys of these two TL, L6103-CH and L6068, were originally conducted by TVA botanists because both ROW crossed forest with multiple EO records for the species. In addition, one flowering plant was observed in 2002 along the open ROW of L6068. Large-flowered skullcap occurs primarily in forested habitats (USFWS 2015a), but the confirmed presence of the species within the open ROW suggested the possibility that plants might occur in larger numbers within the open ROW.

In May 2013, during the flowering period for the species, TVA botanists surveyed all potentially suitable ROW on L6068 east of the Sequatchie Valley and west of the Ridge and Valley. Along this 12+ mi of ROW within potentially suitable habitat, 16 patches with 313 total plants were recorded from on or adjacent to the ROW. No attempt was made to survey areas off the ROW. Some plants were observed on the open ROW floor, but most favored the edge of the ROW where the individuals received relatively more sunlight than the adjacent closed-canopy forest. Many plants occurring on the ROW edge were situated in a thin band along the ROW margin

that had been recently cleared of trees, so it is possible that these individuals established in a closed-canopy forest even though they were observed in more open conditions.

On the L6103-CH TL ROW, about half of the 9 mi of potentially suitable habitat on the Cumberland Plateau were surveyed in July of 2013. Only two flowering and two vegetative large-flowered skullcap plants were observed at a single location during this survey.

Large-flowered skullcap plants have not been observed on open TL ROW within the Ridge and Valley physiographic province. TVA botanists have not visited all ROW within Georgia and Tennessee that bisect forest that may support the species.

TVA ROW on the Cumberland Plateau regularly contain relatively intact herbaceous plant communities; this is uncommon on ROW situated in the Ridge and Valley near Chattanooga, Tennessee. Large-flowered skullcap could occur on TVA ROW in the Ridge and Valley in this small section of Georgia and Tennessee, but the individuals on the ROW would likely be few and comprise only a small part of the population in the surrounding forest.

19.2.2. Action Area Conservation Needs of and Threats to Large-Flowered Skullcap

The potential exists for habitat encroachment from invasive exotic plants and vegetation management (herbicide applications and manual, and mechanical treatments) to threaten large-flowered skullcap in the Action Area. Reducing these threats is best addressed by continued coordination with TVA regarding maintenance of ROW.

19.3. Effects of Vegetation Management on Large-Flowered Skullcap

This section analyzes the direct and indirect effects of the Action on large-flowered skullcap. An effects analysis summary of the effects of various methods of vegetation management on large-flowered skullcap and the other 17 listed LAA plant species from the BA has been included in Appendix II.

19.3.1. Effects of Manual Vegetation Clearing on Large-Flowered Skullcap

Large-flowered skullcap can occupy ecotones between the forest and ROW. Manual clearing in these habitats would most likely affect individuals growing along the edge of the ROW. Manual removal of single danger trees may have a positive effect on the species by providing a boost in light levels that could increase productivity and reproduction without fundamentally changing the vegetation structure and light regime in the immediate vicinity of the plant. Manual removal of swaths of previously unmaintained trees along a ROW margin may have beneficial or adverse effects depending on the situation. Large-flowered skullcap seems to favor ecotones as evidenced by the surveys of L6068 in 2013, but many of these plants likely established in shadier conditions and may not survive in the long-term. However, plants observed in higher light conditions were generally more vigorous than plants in the adjacent, shaded forest, so there may be some advantage to individuals that occur in habitats situated along the edge of the closed canopy forest.

Manual clearing would have the potential to directly affect individual plants by trampling, cutting, and crushing, but it is unlikely this disturbance would result in the death of individual plants.

In summary, all methods of manual vegetation clearing would likely adversely affect the species to varying degrees, but not always result in permanent loss of plants. Beneficial effects could result from manual clearing in instances where light levels were increased.

19.3.2. Effects of Mechanical Clearing on Large-Flowered Skullcap

If mechanical vegetation control methods utilized by the TVA ROW program intersect habitat occupied by large-flowered skullcap, the species could be adversely affected. As described above under Section 2.3.1., as with manual clearing, mechanical clearing also has the potential to provide beneficial or adverse effects via removal of swaths of previously unmaintained trees along a ROW margin, depending on the situation, and to directly affect individual plants individual plants by trampling, cutting, and crushing, but likely would not result in the death of individual plants.

Side wall trimming may have some minor direct or indirect effect on large-flowered skullcap plants if that tool were used, but the physical disturbance or change in light levels would be unlikely to result in the loss of plants from a given area.

In summary, all methods of mechanical clearing would likely adversely affect the species to varying degrees, but not always result in permanent loss of plants. Beneficial effects could result from mechanical clearing in instances where light levels were increased.

19.3.3. Effects of Herbicide Use on Large-Flowered Skullcap

Vegetation control methods that utilize herbicides are likely to adversely affect large-flowered skullcap if used in occupied habitat, although the tool would likely only effect relatively small parts of populations that occur on ROW. Plants occurring off the ROW would not be affected. Spot treatment of herbicide is highly targeted and unlikely to adversely affect large-flowered skullcap at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting or as an AMM to control smaller trees in occupied habitat. Localized herbicide application has the potential to adversely affect plants occurring on the open ROW floor where that tool is used. Individual plants would likely be killed if located adjacent to woody species targeted for removal. This process of targeting woody species for removal would also favor herbaceous species over woody species, which could result in more habitat for large-flowered skullcap in the long-term.

Broadcast herbicide, either from the air or ground, could affect plants growing on and near the ROW edge. This tool is non-selective and would injure or kill large-flowered skullcap if used in occupied habitat, but all ROW along the Cumberland Plateau within the known range of the species has either been field surveyed or is designated as Class 1 or 2 Plants in the O-SAR database. This designation prohibits the use of broadcast herbicide.

In summary, all methods of herbicide use would likely adversely affect the species.

19.3.4. Effects of Debris Management on Large-Flowered Skullcap

Debris management techniques used by TVA have potential to adversely affect large-flowered skullcap. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. Leaving debris in place typically has little direct effect on vegetation, but the subsequent vegetation control efforts can be hindered by larger debris piles. Specifically, low-volume foliar herbicide applications can be less targeted around piles because applicators have a difficult time moving amongst the downed branches. This problem has been observed on the L6068 ROW. Large-flowered skullcap was observed growing through piles of cut trees along with other small tree seedlings along the recently re-cleared ROW margin. TVA did not apply herbicide directly adjacent to plants, because the location was known. However, localized herbicide application would be more likely to produce off-target damage to surrounding vegetation amongst slash piles, which could affect undocumented rare plant occurrences that occur on ROW across the system. This potential negative effect would diminish over time as the woody material decomposes.

Mulching and chipping in occupied habitat could result in burial of individual plants. This could result in death of some plants occurring in the work area; however, during the 2013 survey of L6068 ROW, vigorous large-flowered skullcap plants were observed growing through mulch along the ROW edge. The limited evidence available suggests that it is unlikely that mulching or chipping in occupied habitat would result in the loss of all plants present. Mulching or chipping debris could also result in crushing from machinery.

Burning would occur in the open ROW and would not affect large-flowered skullcap, but debris handling by machinery could adversely affect individual plants on the ROW edge. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

In summary, all methods of debris management (manual, mechanical, burning, and landowner use) would likely adversely affect the species.

19.4. Conclusion for Large-flowered Skullcap

In this section, we interpret the findings of the previous sections for the large-flowered skullcap (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to large-flowered skullcap and result in only a few individual plants within the Action Area being adversely affected. Manual and mechanical clearing may provide some beneficial effects to the species because plants observed in higher light conditions were generally more vigorous than plants in the adjacent forest. Therefore, those

individuals in habitats situated along the edge of closed canopy forest could benefit from the Action. Cumulative effects to large-flowered skullcap that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of the large-flowered skullcap. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Only a fraction of the known rangewide populations (two populations, comprised of over 300 plants, out of a total of 80 extant populations, comprised of several thousand plants) occurs on TVA ROW in the Action Area; therefore, only a small percentage of plants in the species range would be affected by the Action.

20. TENNESSEE YELLOW-EYED GRASS

20.1. Status of Tennessee Yellow-Eyed Grass

This section summarizes best available data about the biology and current condition of Tennessee yellow-eyed grass (*Xyris tennesseensis*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list Tennessee yellow-eyed grass as endangered on July 26, 1991 (56 FR 34151 34154).

20.1.1. Description of Tennessee Yellow-Eyed Grass

Tennessee yellow-eyed grass is a rare perennial monocot that is an obligate wetland plant that prefers relatively high pH seeps and streambanks. The plant ranges from 7 to 10 dm (2.3 to 3.3 ft) in height. Plants typically occur in clumps where they arise from fleshy bulbous bases. Leaves are basal, the outermost scale-like, the larger one linear, twisted, deep green and 14 to 45 cm (5.5 to 17.7 in) in length. The inflorescence consists of brown conelike spikes, 1 to 1.5 cm (0.4- to 0.6 in) in length, which occur singly at the tips of long slender stalks from 30 to 70 cm (12 to 28 in) long. The flowers, which are pale yellow in color and 4.5 mm (0.2 in) long, unfold in the late morning and wither by mid-afternoon. Fruits are thin-walled capsules containing numerous seeds 0.5 to 0.6 mm (0.02-in) in length. Flowering occurs from August through September.

20.1.2. Life History of Tennessee Yellow-Eyed Grass

Tennessee yellow-eyed grass is restricted to calcareous seeps, fens, and spring runs in Alabama, Georgia, and Tennessee. The species is not only at risk as a wetland plant, but is also extremely rare due to its unusual habitat requirement among North American xyrids for circumneutral pH

soils overlying calcareous substrates. In addition, it has been shown to be a poor competitor and quickly succumbs to ecological succession without periodic disturbance.

20.1.3. Numbers, Reproduction, and Distribution of Tennessee Yellow-Eyed Grass

The known current and historic distribution of Tennessee yellow-eyed grass is restricted to the states of Alabama, Georgia, and Tennessee almost exclusively within the Interior Plateau and Ridge and Valley ecoregions. Tennessee yellow-eyed grass was known from only seven sites, five in Tennessee, one in Georgia, and one in Alabama, at the time of listing in 1991 (56 FR 34151-34154). However, surveys since its listing have resulted in the location of 16 additional populations. Currently, a total of 22 populations are known to be extant including three in Bibb County, four in Calhoun County, and one each in Shelby and Franklin Counties, Alabama; four in Bartow County, one in Floyd County, and one in Whitfield County, Georgia; and seven in Lewis County, Tennessee. Status surveys conducted in 1998-1999 listed 17 sites with plants (Moffett 2008). A resurvey of several of these sites in the summer and fall of 2008 revealed a decline in populations following several years of drought (Boyd and Moffett 2010). A population survey conducted in the summer and fall of 2009 by Auburn University concluded that the known population size has been relatively stable during the past decade. The 2009 study (Boyd and Moffett 2010) found known occurrences from 23 sites, an increase from the 17 known sites from the 1998-1999 surveys. A population survey conducted across the species three-state range in the summer and fall of 2009 by Auburn University found occurrences at 23 sites. Three of the sites in the 2009 surveys were new occurrences, all discovered in Georgia.

Seedlings appear to need relatively moist soils with significant sun exposure to become established and grow to maturity. Further, this species tends to be disturbance dependent and needs active management to maintain populations for long-term survival (Boyd and Moffett 2010). Current research on Tennessee yellow-eyed grass indicates that flower production and (perhaps) seedling recruitment are most extensive in locations that are relatively sunny and lack an overstory of shrub or tree canopies. The species does best in relatively open moist sites. According to Moffett (2008), woody competition that shades out the species and herbaceous competition that shades and competes with the species can suppress its growth and reproduction. This management strategy reveals that conservation of the species requires a more hands-on management approach than some endangered plant species.

20.1.4. Conservation Needs of and Threats to Tennessee Yellow-Eyed Grass

Because this species depends on open, sunny sites for establishment, modification of habitat through natural succession or lack of disturbance is considered a major threat to the success of Tennessee yellow-eyed grass. Due to the level of destruction and degradation of habitat associated with human population growth in the southeastern U.S., active conservation and management for this species are critical to its continued existence. In situ efforts focus on habitat protection, acquisition, and/or restoration and management of CH for rare taxa. This species continues to be threatened by habitat destruction, including stream impoundment, habitat conversion for agriculture and residential development, and poor management practices of the few remaining populations (Johnson *et al*. 2012).

20.2. Environmental Baseline for Tennessee Yellow-Eyed Grass

The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of Tennessee yellow-eyed grass, its habitat, and ecosystem within the Action Area.

20.2.1. Action Area Numbers, Reproduction, and Distribution of Tennessee Yellow-Eyed Grass

Tennessee yellow-eyed grass has not been documented on TVA ROW, but the species may be found in unsurveyed ROW. The species prefers open, moist conditions, which are not necessarily mutually exclusive with a TL ROW (UFWS 2014b). However, for the species to be present, a ROW would have to intersect a calcareous seep or other similar feature, which are rare on the landscape. Known populations from Alabama, Georgia, and Tennessee all occur with 1.5 mi of one or more TVA TL. Portions of these and other nearby TVA TL segments with naturalized vegetation and wetland features have been designated as Class 1 Plants in O-SAR, but the rarity of the species reduces the likelihood that it occurs within TVA ROW.

20.2.2. Action Area Conservation Needs of and Threats to Tennessee Yellow-Eyed Grass

Tennessee yellow-eyed grass prefers higher light levels than those found in closed canopy forest. The species can thrive in canopy gaps within forested situations and can occur in open habitats, such as the "roadside ditch" in Franklin County, Alabama, that is referenced in the BA. Disturbance associated with TVA ROW vegetation management could adversely affect individual plants, but since the program is focused on removing woody vegetation, there would be a disproportionally larger impact on woody species. This focus on woody species removal on ROW can favor light-loving herbaceous species such as Tennessee yellow-eyed grass and result in beneficial effects to entire populations, even if individual plants are adversely affected. In addition, methods such as broadcast herbicide that can produce entire, ROW-wide changes to vegetation composition would not be used in areas near known populations of the species because of restrictions in the O-SAR database.

20.3. Effects of Vegetation Management on Tennessee Yellow-Eyed Grass

This section analyzes the direct and indirect effects of the Action on Tennessee yellow-eyed grass. An effects analysis summary of the effects of various methods of vegetation management on Tennessee yellow-eyed grass and the other 17 listed LAA plant species from the BA has been included in Appendix II.

20.3.1. Effects of Manual Vegetation Clearing on Tennessee Yellow-Eyed Grass

Tennessee yellow-eyed grass could occur within the open ROW floor or along the ROW edge if the TL intersects appropriate habitat. Since Tennessee yellow-eyed grass would occur in a wetland or SMZ, manual vegetation control techniques would be used to remove trees. This

could result in direct adverse effects resulting from physical disturbance, but could also increase light levels on-site that could benefit the population.

In summary, manual vegetation clearing would likely adversely affect the species. Beneficial effects could also potentially be realized by manual clearing in instances where light levels were increased to plants.

20.3.2. Effects of Mechanical Clearing on Tennessee Yellow-Eyed Grass

If mechanical vegetation control methods utilized by the TVA ROW program intersect habitat occupied by Tennessee yellow-eyed grass, there is the potential the species could be adversely affected. Extensive rutting throughout a seep could also result in local changes to hydrology that may affect the long-term viability of the population, if present. Side-wall trimming may result in a very small amount disturbance that could adversely affect Tennessee yellow-eyed grass, but the resulting increase in light reaching the forest floor may be beneficial to the species if that tool were used in occupied habitat.

In summary, all methods of mechanical clearing have the potential to adversely affect the species (if present) in varying degrees, but not always resulting in permanent loss of plants. Beneficial effects could also potentially be realized by mechanical clearing in instances where light levels were increased to the plants.

20.3.3. Effects of Herbicide Use on Tennessee Yellow-Eyed Grass

Vegetation control methods that utilize herbicides are likely to adversely affect Tennessee yellow-eyed grass if used in occupied habitat. Spot treatment of herbicide is highly targeted and unlikely to adversely affect Tennessee yellow-eyed grass at the population level, but could result in isolated, direct adverse effects on individual plants. Cut stump and hack and squirt applications could be used when cutting trees to prevent resprouting. These methods could also be used as an AMM to control smaller trees in occupied habitat. Even though localized herbicide application targets woody species within the ROW floor, the use of that tool would have some level of effects on the species. If individual Tennessee yellow-eyed grass plants occur within a few feet of a tree seeding treated with localized herbicide application, chances are high that the plant would experience some level of herbicide related damage. This damage may rise to the level of individual plant death. However, removal of competing woody species may benefit populations of Tennessee yellow-eyed grass over the long-term.

Broadcast herbicide, either from the air or ground, could adversely affect plants growing on and near the ROW. However, all ROW situated near populations of Tennessee yellow-eyed grass have been reviewed using the O-SAR process, and areas with naturalized vegetation and wetlands features have been designated as Class 1 Plants. This O-SAR restriction prohibits the use of broadcast herbicide either from the air or ground.

In summary, all methods of herbicide use would likely adversely affect the species.

20.3.4. Effects of Debris Management on Tennessee Yellow-Eyed Grass

Debris management techniques used by TVA have a small potential to adversely affect Tennessee yellow-eyed grass. Any physical disturbance associated with manual or mechanized handling of debris occurring on the open ROW edge could directly affect plants. These effects would include physical damage resulting from cutting or dragging trees and would not likely result in death of individuals. If mulching/chipping did occur, the species could be directly affected by crushing from machinery and burial by mulch/chips. Pile burning could conceivably result in the loss of individual plants, but the infrequent use of the tool combined with the extreme rarity of the species make the likelihood of this occurring discountable. TVA's facilitation of landowner use of wood has similar potential for small impacts as manual debris management methods.

In summary, all methods of debris management (manual, mechanical, burning, and landowner use) would likely adversely affect the species if present.

20.4. Conclusion for Tennessee Yellow-Eyed Grass

In this section, we interpret the findings of the previous sections for Tennessee yellow-eyed grass (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA.

Opinion

The Action would have localized adverse effects to Tennessee yellow-eyed grass, resulting in only a small percentage of undocumented, individual plants within the Action Area being affected, if any; no populations would be extirpated by TVA ROW vegetation management activities. Cumulative effects to Tennessee yellow-eyed grass that may be relevant to this consultation are unknown.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the USFWS's biological opinion that the Action is not likely to jeopardize the continued existence of Tennessee yellow-eyed grass. We reached this determination based on the following factors: (1) The likelihood of the species being adversely affected is low with TVA's adherence to the AMMs, BMPs and SOPs, which, collectively, limit the probability that known and unknown populations of the species will be affected. (2) The Action would result in a mix of adverse and beneficial effects to the species. During proposed herbicide applications in particular, the incidental, localized removal of invasive species may provide some beneficial effects in circumstances where such invasive removal would reduce competition with the species and/or allow the species to expand into new habitat near or within the TVA ROW. (3) Of the 22 extant populations that are known rangewide, none of those populations currently occur within the Action Area. (4) For the species to occur on a ROW, it would have to intersect a calcareous seep or other similar feature, which are inherently rare habitats on the landscape.

21. REPORTING REQUIREMENTS

This section provides the specific instructions for reporting. As necessary and appropriate to fulfill this responsibility, the TVA must require any permittee, contractor, or grantee to accomplish the reporting through enforceable terms that are added to the permit, contract, or grant document.

1. Annual Reporting. Each year from 2020–2041, TVA will file a report not later than December 31 covering the preceding fiscal year ending September 30. The report will:

    a. Summarize system-wide vegetation management activities that complied with ESA §7(a)(2) by relying on the programmatic consultation;
    b. Identify total acreage of floor work and tree work, including a summary of the use of each vegetation control method considered in the consultation during the reporting period; enumerate known sites of federally listed plants that were intersected by the TVA vegetation management program during the reporting period and identify the vegetation control and debris and debris management methods used on those sites;
    c. Provide the results of any surveys for known and newly discovered populations of federally listed plants associated with TVA ROW vegetation management projects during the survey period;
    d. Identify the number of listed plants adversely affected to the extent practicable, if any, and, when possible, the number of listed plants beneficially affected;
    e. Summarize the outcome of any coordination with USFWS Field Offices; and
    f. Be provided to the U.S. Fish and Wildlife Service, Tennessee Field Office, 446 Neal Street, Cookeville, Tennessee 38501.

2. Annual Coordination. After the receipt of the final report, TVA and the USFWS Tennessee Field Office will determine if a follow-up meeting is necessary to discuss the annual report, review the progress of the Action, or review any new information relevant to the Action and its effects on the plant species considered in this consultation. If one or both parties determines a meeting is needed, TVA and the USFWS will meet on a mutually agreeable date between February 1 and May 1.

22. CONSERVATION RECOMMENDATIONS

ESA §7(a)(1) directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The USFWS offers the following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the TVA. In general, our recommendations are to continue and expand the various programs that TVA already undertakes to contribute to rare plant conservation.

1. Protect listed plants from clearing, development, and use of herbicides.
2. Avoid mowing during the growing season on sites where listed plants may be present.
3. Use hand-clearing or prescribed fire to control competing woody plants and to create sunny openings for listed plant species that prefer increased sunlight exposure.
4. Eradicate invasive exotic plant species from TVA ROWs, especially areas in close proximity to known locations of listed plants.
5. Promote (fund and allow) research on these listed plant species within the TVA PSA.

23. REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the TVA retains discretionary involvement or control over the Action (or is authorized by law) when:

a. new information reveals that the Action may affect listed species or designated CH in a manner or to an extent not considered in this opinion;
b. the Action is modified in a manner that causes effects to listed species or designated CH not considered in this opinion; or
c. a new species is listed or CH designated that the Action may affect.

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25. APPENDIX I - NOT LIKELY TO ADVERSELY AFFECT SPECIES

Listed species (LE=listed as endangered; LT=listed as threatened) and designated critical habitats (CH) that TVA has determined the proposed Action is not likely to adversely affect (NLAA).

Scientific Name	Common Name	Federal Status	CH (Y=Yes)	TVA Species Determination	TVA CH Determination
Mammals					
Glaucomys sabrinus coloratus	Carolina Northern Flying Squirrel	LE	-	NLAA	-
Birds					
Charadrius melodus	Piping Plover	LT	-	NLAA	-
Grus americana	Whooping Crane	LE	-	NLAA	-
Mycteria americana	Wood Stork	LT	-	NLAA	-
Picoides borealis	Red-cockaded Woodpecker	LE	-	NLAA	-
Sterna antillarum athalassos	Interior Least Tern	LE	-	NLAA	-
Reptiles					
Graptemys oculifera	Ringed Map Turtle	LT	-	NLAA	-
Sternotherus depressus	Flattened Musk Turtle	LT	-	NLAA	-
Amphibians					
Gyrinophilus gulolineatus	Berry Cave Salamander	C	-	NLAA	-
Necturus alabamensis	Black Warrior Waterdog	LE	Y	NLAA	NLAA
Fishes					
Acipenser oxyrinchus desotoi	Gulf Sturgeon	LT	-	NLAA	-
Chrosomus saylori	Laurel Dace	LE	Y	NLAA	NLAA
Cottus paulus (pygmaeus)	Pygmy Sculpin	LT	Proposed	NLAA	NE*
Crystallaria cincotta	Diamond Darter	LE	Y	NLAA	NLAA
Cyprinella caerulea	Blue Shiner	LT	-	NLAA	-
Elassoma alabamae	Spring Pygmy Sunfish	LT	Proposed	NLAA	NLAA
Erimonax monachus	Spotfin Chub	LT	Y	NLAA	NLAA
Erimystax cahni	Slender Chub	LT	Y	NLAA	NLAA
Etheostoma akatulo	Bluemask Darter	LE	-	NLAA	-
Etheostoma boschungi	Slackwater Darter	LT	Y	NLAA	NLAA
Etheostoma chermocki	Vermilion Darter	LE	Y	NLAA	NE*
Etheostoma chienense	Relict Darter	LE	-	NLAA	-

Scientific Name	Common Name	Federal Status	CH (Y=Yes)	TVA Species Determination	TVA CH Determination
Etheostoma nuchale	Watercress darter	LE	-	NLAA	-
Etheostoma percnurum	Duskytail Darter	LE	-	NLAA	-
Etheostoma phytophilum	Rush Darter	LE	Y	NLAA	NE*
Etheostoma rubrum	Bayou Darter	LT	-	NLAA	-
Etheostoma spilotum	Kentucky Arrow Darter	LT	-	NLAA	-
Etheostoma susanae	Cumberland Darter	LE	Y	NLAA	NLAA
Etheostoma trisella	Trispot Darter	PT	-	NLAA	-
Etheostoma wapiti	Boulder Darter	LE	-	NLAA	-
Moxostoma sp. 2	Sicklefin Redhorse	Under Review	-	NLAA	-
Notropis albizonatus	Palezone Shiner	LE	-	NLAA	-
Notropis cahabae	Cahaba Shiner	LE	Proposed	NLAA	NE*
Noturus baileyi	Smoky Madtom	LE	Y	NLAA	NE*
Noturus crypticus	Chucky Madtom	LE	Y	NLAA	NE*
Noturus flavipinnis	Yellowfin Madtom	LT	Y	NLAA	NE*
Noturus stanauli	Pygmy Madtom	LE	-	NLAA	-
Percina antesella	Amber Darter	LE	Y	NLAA	NLAA
Percina aurolineata	Goldline Darter	LT	Proposed	NLAA	NE*
Percina aurora	Pearl Darter	LT	-	NLAA	-
Percina jenkinsi	Conasauga Logperch	LE	Y	NLAA	NLAA
Percina tanasi	Snail Darter	LT	-	NLAA	-
Phoxinus cumberlandensis	Blackside Dace	LT	-	NLAA	-
Scaphirhynchus albus	Pallid Sturgeon	LE	-	NLAA	NLAA
Scaphirhynchus suttkusi	Alabama Sturgeon	LE	-	NLAA	-
Speoplatyrhinus poulsoni	Alabama Cavefish	LE	Y	NLAA	NE*
Freshwater mussels					
Alasmidonta atropurpurea	Cumberland Elktoe	LE	Y	NLAA	NLAA
Alasmidonta raveneliana	Appalachian Elktoe	LE	Y	NLAA	NE*
Cumberlandia monodonta	Spectaclecase	LE	-	NLAA	-
Cyprogenia stegaria	Fanshell	LE	-	NLAA	-

Scientific Name	Common Name	Federal Status	CH (Y=Yes)	TVA Species Determination	TVA CH Determination
Dromus dromas	Dromedary Pearlymussel	LE	-	NLAA	-
Epioblasma brevidens	Cumberlandian Combshell	LE	Y	NLAA	NLAA
Epioblasma capsaeformis	Oyster Mussel	LE	Y	NLAA	NLAA
Epioblasma florentina florentina	Yellow-blossom Pearlymussel	LE	-	NLAA	-
Epioblasma florentina walkeri	Tan Riffleshell	LE	-	NLAA	-
Epioblasma metastriata	Upland Combshell	LE	Y	NLAA	NLAA
Epioblasma obliquata obliquata	Purple Catspaw	LE	-	NLAA	-
Epioblasma othcaloogensis	Southern Acornshell	LE	Y	NLAA	NLAA
Epioblasma penita	Southern Combshell	LE	-	NLAA	-
Epioblasma torulosa gubernaculum	Green Blossom Pearlymussel	LE	-	NLAA	-
Epioblasma torulosa rangiana	Northern Riffleshell	LE	-	NLAA	-
Epioblasma torulosa torulosa	Tuberculed Blossom Pearlymussel	LE	-	NLAA	-
Epioblasma triquetra	Snuffbox	LE	-	NLAA	-
Epioblasma turgidula	Turgid Blossom Pearlymussel	LE	-	NLAA	-
Fusconaia cor	Shiny Pigtoe Pearlymussel	LE	-	NLAA	-
Fusconaia cuneolus	Fine-rayed Pigtoe	LE	-	NLAA	-
Hemistena lata	Cracking Pearlymussel	LE	-	NLAA	-
Lampsilis abrupta	Pink Mucket	LE	-	NLAA	-
Lampsilis altilis	Fine-lined Pocketbook	LT	Y	NLAA	NLAA
Lampsilis perovalis	Orange-nacre Mucket	LT	Y	NLAA	NLAA
Lampsilis virescens	Alabama Lampmussel	LE	-	NLAA	-
Lemiox rimosus	Birdwing Pearlymussel	LE	-	NLAA	-
Leptodea leptodon	Scaleshell	LE	-	NLAA	-
Medionidus acutissimus	Alabama Moccasinshell	LT	Y	NLAA	NLAA
Medionidus parvulus	Coosa Moccasinshell	LE	Y	NLAA	NLAA
Obovaria retusa	Ring Pink	LE	-	NLAA	-
Pegias fabula	Little-wing Pearlymussel	LE	-	NLAA	-
Plethobasus cicatricosus	White Wartyback	LE	-	NLAA	-

Scientific Name	Common Name	Federal Status	CH (Y=Yes)	TVA Species Determination	TVA CH Determination
Plethobasus cooperianus	Orange-foot Pimpleback	LE	-	NLAA	-
Plethobasus cyphyus	Sheepnose	LE	-	NLAA	-
Pleurobema clava	Clubshell	LE	-	NLAA	-
Pleurobema curtum	Black Clubshell	LE	-	NLAA	-
Pleurobema decisum	Southern Clubshell	LE	Y	NLAA	NLAA
Pleurobema furvum	Dark Pigtoe	LE	Y	NLAA	NLAA
Pleurobema georgianum	Southern Pigtoe	LE	-	NLAA	-
Pleurobema gibberum	Cumberland Pigtoe	LE	-	NLAA	-
Pleurobema hanleyianum	Georgia Pigtoe	LE	-	NLAA	-
Pleurobema marshalli	Flat Pigtoe	LE	-	NLAA	-
Pleurobema perovatum	Ovate Clubshell	LE	Y	NLAA	NLAA
Pleurobema plenum	Rough Pigtoe	LE	-	NLAA	-
Pleurobema taitianum	Heavy Pigtoe	LE	-	NLAA	-
Pleuronaia dolabelloides	Slabside Pearlymussel	LE	Y	NLAA	NLAA
Potamilus capax	Fat Pocketbook	LE	-	NLAA	-
Potamilus inflatus	Alamabama (inflated) Heelsplitter	LT	-	NLAA	-
Ptychobranchus greenii	Triangular Kidneyshell	LE	Y	NLAA	NLAA
Ptychobranchus subtentum	Fluted Kidneyshell	LE	Y	NLAA	NLAA
Quadrula cylindrica	Rabbitsfoot	LT	Y	NLAA	NLAA
Quadrula cylindrica strigillata	Rough Rabbitsfoot	LE	Y	NLAA	NLAA
Quadrula fragosa	Winged Mapleleaf	LE	-	NLAA	-
Quadrula intermedia	Cumberland Monkeyface	LE	-	NLAA	-
Quadrula sparsa	Appalachian Monkeyface	LE	-	NLAA	-
Quadrula stapes	Stirrupshell	LE	-	NLAA	-
Toxolasma cylindrellus	Pale Lilliput	LE	-	NLAA	-
Villosa fabalis	Rayed Bean	LE	-	NLAA	-
Villosa perpurpurea	Purple Bean	LE	Y	NLAA	NLAA
Villosa trabalis	Cumberland Bean	LE	-	NLAA	-
Snails					

Scientific Name	Common Name	Federal Status	CH (Y=Yes)	TVA Species Determination	TVA CH Determination
Anguispira picta	Painted Snake Coiled Forest Snail	LT	-	NLAA	-
Athearnia anthonyi	Anthony's River Snail	LE	-	NLAA	-
Campeloma decampi	Slender Campeloma	LE	-	NLAA	-
Leptoxis ampla	Round Rocksnail	LT	-	NLAA	-
Leptoxis foremani	Interrupted Rocksnail	LE	Y	NLAA	NLAA
Leptoxis plicata	Plicate Rocksnail	LE	-	NLAA	-
Leptoxis taeniata	Painted Rocksnail	LT	-	NLAA	-
Lioplax cyclostomaformis	Cylindrical Lioplax	LE	-	NLAA	-
Pleurocera foremani	Rough Hornsnail	LE	-	NLAA	-
Pyrgulopsis ogmorhaphe	Royal Marstonia	LE	-	NLAA	-
Pyrgulopsis pachyta	Armored Marstonia	LE	-	NLAA	-
Insects					
Neonympha mitchellii	Mitchell's Satyr	LE	-	NLAA	-
Crustaceans					
Orconectes shoupi	Nashville Crayfish	LE	-	NLAA	-
Flowering Plants					
Arabis georgiana	Georgia Rock-cress	LT	Y	NLAA	NE*
Conradina verticillata	Cumberland Rosemary	LT	-	NLAA	-
Liatris helleri	Heller's Blazing Star	LT	-	NLAA	-
Lindera melissifolia	Pondberry	LE	-	NLAA	-
Ptilimnium nodosum	Harperella	LE	-	NLAA	-
Sagittaria secundifolia	Kral’s Water-plantain	LT	-	NLAA	-
Spigelia gentianoides	Gentian Pinkroot	LE	-	NLAA	-
Spiraea virginiana	Virginia Spiraea	LT	-	NLAA	-

*NE = No Effect

26. APPENDIX II - SUMMARY OF EFFECTS ANALYSIS FOR LIKELY TO ADVERSELY AFFECT PLANT SPECIES

(source: BA Table 6-1)

Summary of Effects Analysis for all LAA Plant Species

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Vegetation Control	Manual	Cutting or pulling using hand tools or chainsaws	Most likely to occur on ROW edges while clearing danger trees, in other unmaintained parts of ROW, or in areas where herbicide is not permitted	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response of listed species	Known sites recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = LAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Vegetation Control	Mechanical - Clearing	Clearing of trees and shrubs where previous vegetation maintenance has been infrequent and woody plants have encroached into ROW or removal of vegetation in areas where trees were never cleared. Can also be used to safely remove off-ROW danger trees	Most likely to occur on ROW edges while clearing danger trees or in other unmaintained parts of ROW; One-time event on ROW as cleared areas will be subsequently treated as ROW floor; Exposure to chips/mulch is on-going	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response of listed species; mulch/chips could impede the growth of listed species or competing vegetation	Known sites recorded in O-SAR as Class 2 Plants Bulldozer use requires site specific review	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = LAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Vegetation Control	Mechanical - Mowing	Mowing of herbaceous plants and seedlings to maintain vegetation within the floor area of the ROW	Periodic, once every three years maximum on open ROW	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response of listed species	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = NLAA ASBI = LAA CLMO = NLAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = NLAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Vegetation Control	Mechanical – Side-Wall Trimming	Tree trimming, from ground or air, on ROW edge	Periodic as needed depending on tree growth. Temporary change in light conditions	Change to vegetation structure on-site resulting in positive or negative response of listed species	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = LAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Vegetation Control	Herbicide - Spot	Highly targeted herbicide application like stump treatment or hack and squirt	Direct contact with herbicide, which is unlikely given targeted nature. Every three years on the ROW floor, as trees are cut if used to treat stumps after tree clearing	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = LAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Vegetation Control	Herbicide - Localized	Low volume foliar most common. Basal treatment, localized granular application, and bareground treatments also included	Direct contact with herbicide. Every three years on the ROW floor.	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = LAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Vegetation Control	Herbicide – Broadcast (ground)	Non-selective herbicide application made from the ground	Direct contact with herbicide	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response	Known site recorded in O-SAR as Class 2 Plants Undocumented sites would be protected by O-SAR Class 1 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = NLAA CLSO = NLAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Vegetation Control	Herbicide – Broadcast (aerial)	Non-selective herbicide application made from the ground	Direct contact with herbicide	Physical damage up to death; Change to vegetation structure on-site resulting in positive or negative response	Known site recorded in O-SAR as Class 2 Plants Undocumented sites would be protected by O-SAR Class 1 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = NLAA CLSO = NLAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Debris Management	Manual	Cut and leave trees. Material may be cut into smaller pieces to facilitate decomposition	Physical disturbance during cutting of debris; Subsequent vegetation control efforts may be less precise due to large dead trees left on ROW edge	Physical damage from debris management; indirect negative effects up to death of individual if debris left in place hinders future herbicide applications	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Debris Management	Mechanical	Chipping, mulching, and off-site hauling of debris	Physical disturbance during debris handing; Exposure to chips/mulch is on-going	Physical damage up to death; mulch/chips could impede the growth of listed species or competing vegetation	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

Category	METHODS[1]	EXPLANATION	EXPOSURE[2]	STRESSOR AND RESPONSE[2]	AVOIDANCE MEASURES[3]	EFFECT[4]
Debris Management	Burning	Burning in piles or containers	Physical disturbance during debris or container handling; heat from burning	Physical damage up to death resulting from crushing or effects of fire	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA
Debris Management	Landowner Use	Debris can be provided to the landowner in the form of firewood or mulch	Physical disturbance during debris handling	Physical damage up to death resulting from crushing	Known site recorded in O-SAR as Class 2 Plants	APPR = LAA ARPE = LAA ASBI = LAA CLMO = LAA CLSO = LAA DAFO = LAA HEVE = LAA ISME = LAA LECR = LAA LELY = LAA LEPE = LAA MAMO = LAA MICU = NLAA PHGL = LAA PLIN = LAA SAOR= LAA SCMO = LAA XYTE= LAA

[1] Methods are described in detail in Chapter 3 Description of Proposed Actions.

[2] *Stressor* resulting from the activity; *exposure* (*e.g.*, life stage, activity intensity, duration) of species to potential stressors resulting from actions; *response* (*e.g.*, growth, flowering incidence, death) by the species that results from exposure.

[3] Conservation measures are discussed in Chapter 4 Right-of-Way Processes and Procedures

[4] Effects: NE = No effect, NLAA = Not likely to adversely affect, LAA = Likely to adversely affect
Species: APPR =*Apios priceana*, ARPE = *Arabis perstellata*, ASBI = *Astragalus bibullatus*, CLMO = *Clematis morefieldii*, CLSO = *Clematis socialis*, DAFO = *Dalea foliosa*, HEVE = *Helianthus verticillatus*, ISME = *Isotria medeoloides*, LECR = *Lesquerella crassa*, LELY = *Leavenworthia lyrata*, LEPE = *Lesquerella perforata*, MAMO = *Marshallia mohrii*, MICU = *Minuartia cumberlandensis*, PHGL = *Physaria globosa*, PLIN = *Platanthera integrilabia*, SAOR = *Sarracenia oreophila*, SCMO = *Scutellaria montana*; XYTE = *Xyris tennesseensis*