Inventory, Monitoring, and Research Efforts for Natural Resource Management on DoD Installations and USACE Project Lands

U.S. Army Corps of Engineers

Engineer Research & Development Center - Environmental Laboratory

Dr. Michael Guilfoyle and Kevin Philley

U.S. Army Corps of Engineers - Engineer Research and Development Center (ERDC)

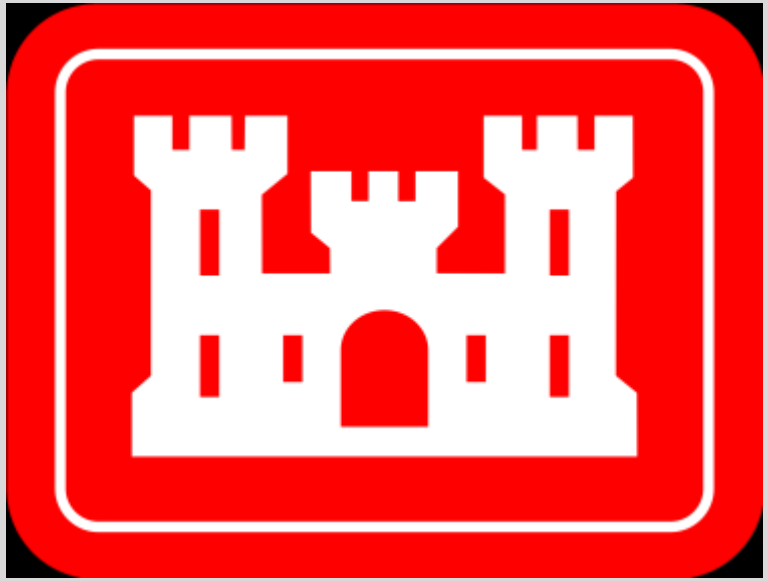
- What is ERDC? It is the premiere engineering and scientific research organizations in the world. Conducts R&D in support of the DoD and Civil Works Projects (water resources, environmental missions, etc.).

ERDC

INNOVATIVE SOLUTIONS
for a safer, better world

U.S. Army Corps of Engineers - Engineer Research and Development Center (ERDC)

- Staff of approximately 2,100 federal employees and contractors; 7 laboratories in 4 states:
  - Champaign, Illinois
    - Construction Engineering Research Laboratory
  - Alexandria, Virginia
    - Geospatial Research Laboratory
  - Hanover, New Hampshire
    - Cold Regions Research and Engineering Laboratory
  - Vicksburg, Mississippi:
    - 1) Coastal and Hydraulics Laboratory
    - 2) Environment Laboratory
    - 3) Geotechnical Laboratory
    - 4) Information Technology Laboratory
    - Champaign, Illinois



ERDC – Environmental Laboratory

- Dr. Michael Guilfoyle
  - B.S., Wildlife Management
  - M.S., Wildlife Management
  - Ph.D., Biology (Zoology)
    - Avian Ecology
      - Identification of North American Birds, Inventories/Long-term Monitoring
      - Impacts of Human Disturbance/Effects of Invasive Species
      - Avian Community Habitat Relationships/ Management of Imperiled Populations
    - Impacts of Coastal Engineering/ Beneficial Uses of Dredged material
      - Engineering With Nature: Designs to Benefit Birds
      - Sediment Management to Create Seasonal Habitats
    - Inventory and Management for Threatened, Endangered and At-Risk Species

ERDC – Environmental Laboratory

- Kevin Philley – Research Biologist
  - B.S., Forestry & Wildlife Management
  - M.S., Botany
  - Focus Area:
    - Wetlands
      - identification, delineation, and restoration
    - Plant communities
      - floristics
      - condition assessments
    - GIS
      - delineating/mapping community features

Level II Surveys

- Level II =“field-level” assessment
  - Ground-truth Level I Surveys (desktop assessments)
  - Higher resolution of data and classifications than Level I
  - Often triggered if Federally listed Threatened & Endangered species and/or their representative habitat may be present

Level II Wildlife Surveys & Research

- Bats
- Small Mammals
- Fish
- Birds
- Reptiles & Amphibians
- Mussels
- Insects (aquatic and terrestrial)
- Marine Mammals
- DNA – eDNA
- Threatened and Endangered Species

Level II Wildlife Surveys

Bat Inventories

- Inventory of Threatened and Endangered Species
- Monitoring and Management of Populations and Habitat
- Collaborate with Universities/ USFWS
- Bat Air Strike Hazards
- White-nose Syndrome Research

Small Mammal Inventories

- Inventory of Threatened and Endangered Species
- Monitoring and Management of Populations and Habitat
- Impacts of Invasive Trees (Russian olive)
- Collaborate with Universities/ USFWS/ USGS

Fisheries Inventories

- Research on Threatened and Endangered Species
- Monitoring and Management of Populations and Habitat
- Impacts of Dredging, Noise and Other Corps Activities
- Collaborate with Universities/ USFWS

Bird Community Inventories

- Research on Threatened and Endangered Species
- Monitoring and Management of Populations and Habitat
- Impacts of Dredging, Noise and Other Corps Activities
- Collaborate with Universities/ USFWS/ USGS/ USDA
- Partner’s in Flight; Coordinated Bird Monitoring

Reptile and Amphibian Inventories

- Research on Threatened and Endangered Species
- Monitoring and Management of Populations and Habitat
- Impacts of Dredging, Noise and Other Corps Activities
- Collaborate with Universities/ USFWS/ USGS/ NOAA and Others

Fresh Water Mussels Inventories

- Research on Threatened and Endangered Species
- Monitoring and Management of Populations and Habitat
- Impacts of Dredging, Noise and Other Corps Activities
- Collaborate with Universities/ USFWS/ USGS/ NOAA and Others

Aquatic and Terrestrial Insect Inventories

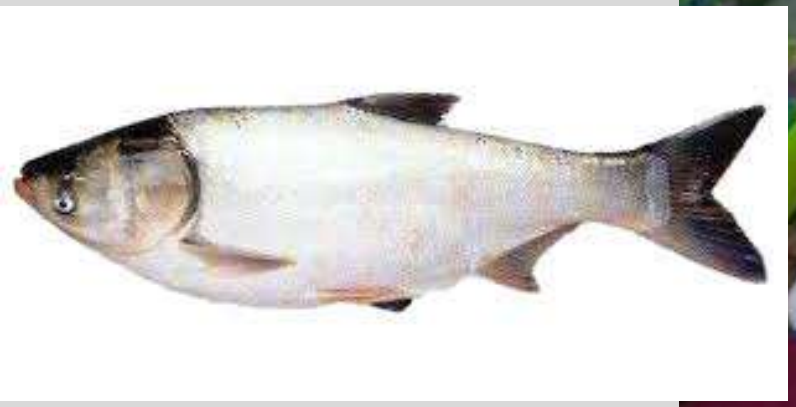
- Research on Threatened and Endangered Species
- Research on Pollinator Networks Populations and Habitat
- Impacts of Dredging, Land Management and Other Corps Activities
- Collaborate with Universities/ USFWS/ USGS and Others

Marine Mammal Inventories

- Research on Threatened and Endangered Species
- Research on Populations and Habitat
- Impacts of Dredging, Water and Recreational Activities and Other Corps Activities
- Collaborate with Universities/ USFWS/ NOAA and Others

DNA and eDNA Research

- Research on Threatened and Endangered Species
- Research on Invasive Species, eDNA monitoring
- Impacts of Land Management and Other Corps Activities
- Collaborate with Universities/ USFWS/ USGS/ NOAA, and Other Agencies, Non-Governmental Orgs.



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The contribution of double-crested cormorants (*Phalacrocorax auritus*) to silver carp (*Hypophthalmichthys molitrix*) DNA loads in the Chicago Area Waterway System

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U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS 39180, USA

ARTICLE INFO

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Fecal deposition
Nutrient loading model
Piscivorous birds
Silver carp

ABSTRACT

Waterfowl and colonial waterbirds can have significant impacts on water quality in lakes and reservoirs by d
positing feces that contribute to nitrogen and phosphorus loads. Piscivorous birds can also contribute the DN
of prey species to a water body. Here, we develop and apply a loading model to estimate the number of silv
carp (*Hypophthalmichthys molitrix*) DNA target marker copies that are potentially deposited by nesting doubl
crested cormorants (*Phalacrocorax auritus*) in the Chicago Area Waterway System (CAWS). The model assum
a conservative breeding population estimate ranging between 6000 and 8000 cormorants distributed amon
three large colonies in the Chicago metropolitan area. The model also assumes that cormorants are distributi
feces randomly throughout the CAWS in proportion to the amount of time spent at each location. Resul
show that cormorants may be contributing 2.6 to 113 target marker copies/m^2/day if birds are spending 22%
their time on open water and 6.4 to 291 target marker copies/m^2/day if birds are spending 56% of their tim
on open water. Over the entire CAWS, cormorants may contribute tens of millions to billions of silver ca
DNA copies each day. These target marker loads may be contributing to positive detections of silver carp enviro
mental DNA (eDNA) in the CAWS. This study does not address other potential sources of silver carp genetic m
terial in the CAWS, including live fish, and provides no indication as to whether or not the loads attributed
cormorants are large or small in relation to these other potential sources.

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Introduction

Fecal waste deposited by waterfowl and colonial waterbirds can have a significant impact on nutrient levels in lakes and reservoirs (Manny et al., 1994; Scherer et al., 1995; Hahn et al., 2007; Gwiazda et al., 2010; Klimaszyk et al., 2014). Birds may deposit feces directly into water bodies and accumulations of fecal material under communal roosts may leech into adjoining water bodies through runoff or erosion (Gwiazda et al., 2010; Klimaszyk and Rzymski, 2013). Researchers have developed nutrient loading models to analyze and understand the impact of waterfowl and waterbird populations on water quality (Manny et al., 1994; Scherer et al., 1995; Hahn et al., 2007). In most cases, the nutrient load contributed by birds through fecal deposition is considered minimal compared to other sources of nutrients entering the system (Murphy et al., 1984; Hoyer and Canfield, 1994; Scherer et al., 1995), or minimal at the landscape scale, with potential impacts at the local scale (Hahn et al., 2007). Nevertheless, in some situations, nutrient loading by birds may result in high nitrogen (N) and phosphorous (P) concentrations (Manny et al., 1994; Scherer et al., 1995; Hahn et al., 2007), contribute to associated algal blooms (Manny et al., 1994), exacerbate cadmium a
lead pollution (Mathis and Kevern, 1975) and increase coliform bacte
loadings (Klimaszyk and Rzymski, 2013).

Waterbird populations can contribute the genetic material of pre
species to waterbodies in the same way that they contribute nutrien
(Merkes et al., 2014; Guilfoyle et al., 2017a). The genetic material is a
lochthonous if it is transported from one water body to another b
means other than a live fish. Allochthonous DNA is a source of false po
itive error in environmental DNA monitoring studies, which attempt
document the presence of an aquatic species by detecting their genet
material in water samples (Darling and Mahon, 2011; Guilfoyle et a
2017a). It is important to understand sources of error in eDNA studi
because false positive errors can lead to faulty environmental manag
ment decisions that are costly and have negative environmental ou
comes (Merkes et al., 2014; Guilfoyle et al., 2017a).

Natural resource managers are conducting eDNA studies to monit
for the presence of two invasive species of carp in the Chicago Ar
Waterway System (CAWS). These two species, bighead ca
(*Hypophthalmichthys nobilis*) and silver carp (*H. molitrix*), have e
panded their ranges north in the Mississippi and Illinois Rivers and a
now approximately 115 km southwest of Lake Michigan (Unite
States Fish and Wildlife Service, 2015). The probability that these fi

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Threatened and Endangered Species Inventories

- Inventory of all Federal and State Listed Species, Plus Rare or Sensitive Species of Concern (TER-S) on DoD Installations and USACE Project Lands
- Research on USACE Activities on TER-S Populations and Habitat
- Assess Impacts of Dredging, Land Management and Other USACE Activities
- Collaborate with Universities/ USFWS/ USGS, and Other Government and Non-Governmental Organizations

Threatened and Endangered Species Team (TEST)

Richard A. Fischer, Ph.D.
Research Wildlife Biologist
USACE – ERDC
Environmental Laboratory

6 December 2016

Section 7(a)(1) of the Endangered Species Act—Supporting Agency Missions through Proactive Conservation Planning and Endangered Species Recovery






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THREATENED & ENDANGERED SPECIES TEAM

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Hoover/Killgore

Federal TES Expenditures

Agency/Land Ownership	Expenditure (2014)
NPS – 84 million acres	$ 13,000,617
FWS – 89 million acres	$159,368,673
BLM – 253 million acres	$ 22,398,174
USFS – 193 million acres	$ 45,983,888
DoD – 42 million acres	$337,383,601
U.S. Military	$111,760,850
USACE	$225,622,751

What is the Problem?

USACE TES Expenditures

- USACE TES conservation and compliance spending averages
  ~$230 million per year

FY14 Top Ten Costliest TES Species

	Common Name	Total
1	Salmon, chinook	$65,209,235
2	Sturgeon, pallid	$62,619,597
3	Steelhead	$31,828,548
4	Salmon, sockeye	$10,715,945
5	Tern, least	$8,431,784
6	Plover, piping	$8,307,257
7	Flycatcher, southwestern willow	$3,847,451
8	Salmon, coho	$3,270,107
9	Salmon, chum	$2,305,573
10	Trout, bull	$2,302,528
	Top 10 Total	**$198,838,025**
	Percent of FY14 Total	**87.57%**

What is the Problem?

- 85% of USACE expenditures are on fish
- 10% on birds

Salmon, chinook (9 Populations)	$73,851,410
Steelhead (11 populations)	$51,907,342
Sturgeon, pallid	$48,718,484
Salmon, sockeye (2 Populations)	$14,293,621
Flycatcher, southwestern willow	$7,668,176
Salmon, chum (2 Populations)	$6,102,995
Minnow, Rio Grande silvery	$5,787,904
Plover, piping (2 Populations)	$5,339,877
Tern, least	$4,467,906
Salmon, coho (4 Populations)	$3,404,322
Sturgeon, Atlantic	$2,248,191
Vireo, least Bell's	$2,229,661
Sturgeon, shortnose	$1,628,115
Sturgeon, North American green	$1,385,026
Woodpecker, red-cockaded	$1,058,791
Trout, bull	$979,656
Smelt, delta	$586,391
Bat, Indiana	$560,676
Sea turtle, loggerhead	$496,875
Manatee, West Indian	$469,134

FISH

BIRDS

MAMMALS

REPTILES/AMPHIBIANS

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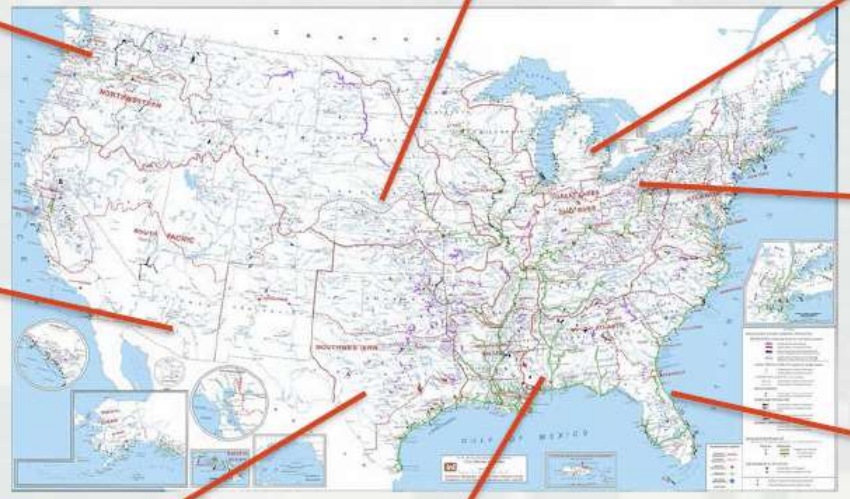
What is the Problem?

► TES conservation concerns currently exist at over 430 USACE projects, for over 300 different species

A piping plover incubates its eggs in a sandy hollow. Image courtesy of the U.S. Army Corps of Engineers.



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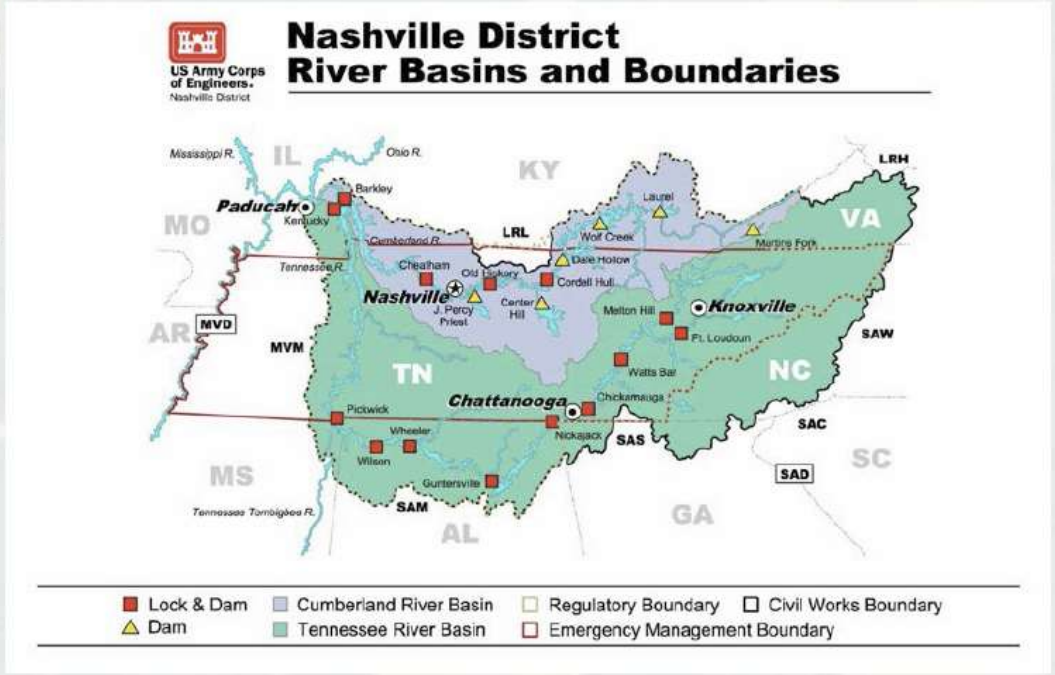
What is the Problem?

- An additional 200+ species listings or critical habitat designations are expected to occur by 2018



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THREATENED & ENDANGERED SPECIES TEAM

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USACE/USFWS 7(a)(1) Coordination

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

In Reply Refer To:
FWS/AES/DER/BCP/058968

JAN 09 2015

Memorandum

To: Regional Directors
Attn: Assistant Regional Directors, Ecological Services

From: Deputy Director

Subject: Working with the U.S. Army Corps of Engineers to Improve the Effectiveness of the Endangered Species Act (ESA) by expanding the use of Section 7(a)(1)

Section 7(a)(1) of the ESA requires all Federal agencies to use their authorities, in consultation with the Service, to carry out programs for the conservation of listed threatened and endangered species. Proactive and collaborative conservation using 7(a)(1) programs can improve outcomes for listed species and streamline Section 7(a)(2) consultation processes. In addition, larger scale, more integrated approaches to the conservation of these species should improve interagency communication, cooperation, and trust, as well as promote adaptive management, strategic habitat conservation, and operational flexibility.

Recently, USACE Mississippi Valley Division and the Service's Southeast Region broke new ground through collaborative development and implementation of a Section 7(a)(1) Conservation Plan for three species in the Lower Mississippi River as part of the Mississippi River and Tributaries Channel Improvement Program (see attached fact sheet). The USACE and Service believe this model can and should be replicated across the Nation.

By this memorandum, you are empowered and encouraged to work with your USACE counterparts to use creative solutions suitable to your Region to implement Section 7(a)(1). Major General John Peabody, Deputy Commanding General for Civil and Emergency Operations, USACE, recently transmitted a similar memorandum to USACE Divisional Leadership (attached).

For questions or comments regarding improving the effectiveness of the ESA through implementing Section 7(a)(1) please contact Mr. Craig Aubrey, our Ecological Services Division Chief for Environmental Review at 703-358-2442.

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO ATTENTION OF

CECW-ZA

30 June, 2015

MEMORANDUM FOR COMMANDERS, MAJOR SUBORDINATE COMMANDS, CHIEFS, OPERATIONS DIVISIONS

SUBJECT: Improving the Efficiency of Project Operations and Effectiveness of Endangered Species Act Compliance for U.S. Army Corps of Engineers Projects

1. References.

a. Endangered Species Act Section 7(a) Federal Agency Actions and Consultations. (1) The Secretary shall review other programs administered by him and utilize such programs in furtherance of the purposes of this Act. All other Federal agencies shall, in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species listed pursuant to Section 4 of this Act.

b. Endangered Species Act Section 7(a) Federal Agency actions and Consultations. (2) Section 7(a)(2) requires Federal agencies to consult with the Service to ensure that actions they fund, authorize, permit, or otherwise carry out will not jeopardize the continued existence of any listed species or adversely modify designated critical habitats.

c. Fact Sheet, USACE and Service Implement an Innovative Conservation Approach that Yields Success for Wildlife, U.S. Fish and Wildlife Service, September 2014.

d. Memorandum for all Counsel, HQ, Divisions, Districts, Centers, Labs & FOA offices, subject: ESA Guidance, dated 11 June 2013.

e. Memorandum for See Distribution, subject: Reissuance of the U.S. Army Corps of Engineers (Corps) Environmental Operating Principles, dated 7 August 2012.

2. Purpose. The purpose of this directive is to increase the environmental value of how the U.S. Army Corps of Engineers (USACE) operates existing Civil Works projects by conducting a holistic review of Endangered Species Act (ESA) Section 7(a)(1) and (2). Designing projects in ways that are compatible with the conservation needs of listed species and their ecosystems can be one of the most effective methods of ensuring an efficient Section 7 consultation process, as well as species' recovery.

3. Summary. The USACE operates, maintains, and manages a variety of projects throughout the Nation, often in a complex and inter-mixed natural and built environment that includes the potential to affect species listed as threatened or endangered under the ESA or to affect such species' habitats. The purposes of the ESA are to provide a means for conserving the ecosystems upon which endangered and threatened species depend by

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USACE Threatened & Endangered Species Team (TEST)

- Purpose

Accelerate the development of solutions to priority threatened and endangered species issues that will:

- *Improve operational flexibility*
- *Reduce future costs*
- *Improve budget planning capabilities*
- *Reduce adverse impacts to mission execution*
- *Improve species conservation outcomes (including Recovery)*

Endangered Species Team (TEST)?

- Develop a comprehensive long-term strategy for addressing TES within USACE
- Identify and document TES with biggest impacts to USACE mission (monetarily and operationally)
- Establish a prioritized TES list to better inform how we make investments (and subsequent ROI)
- Identify needed R&D that has high impact to TES recovery and/or decreased mission impact
- Identify opportunities for conservation planning using ESA Section 7(a)(1) authority
- Identify internal and external partnering opportunities to address high priority species
- Develop a proactive strategy addressing at-risk species likely to impact future missions

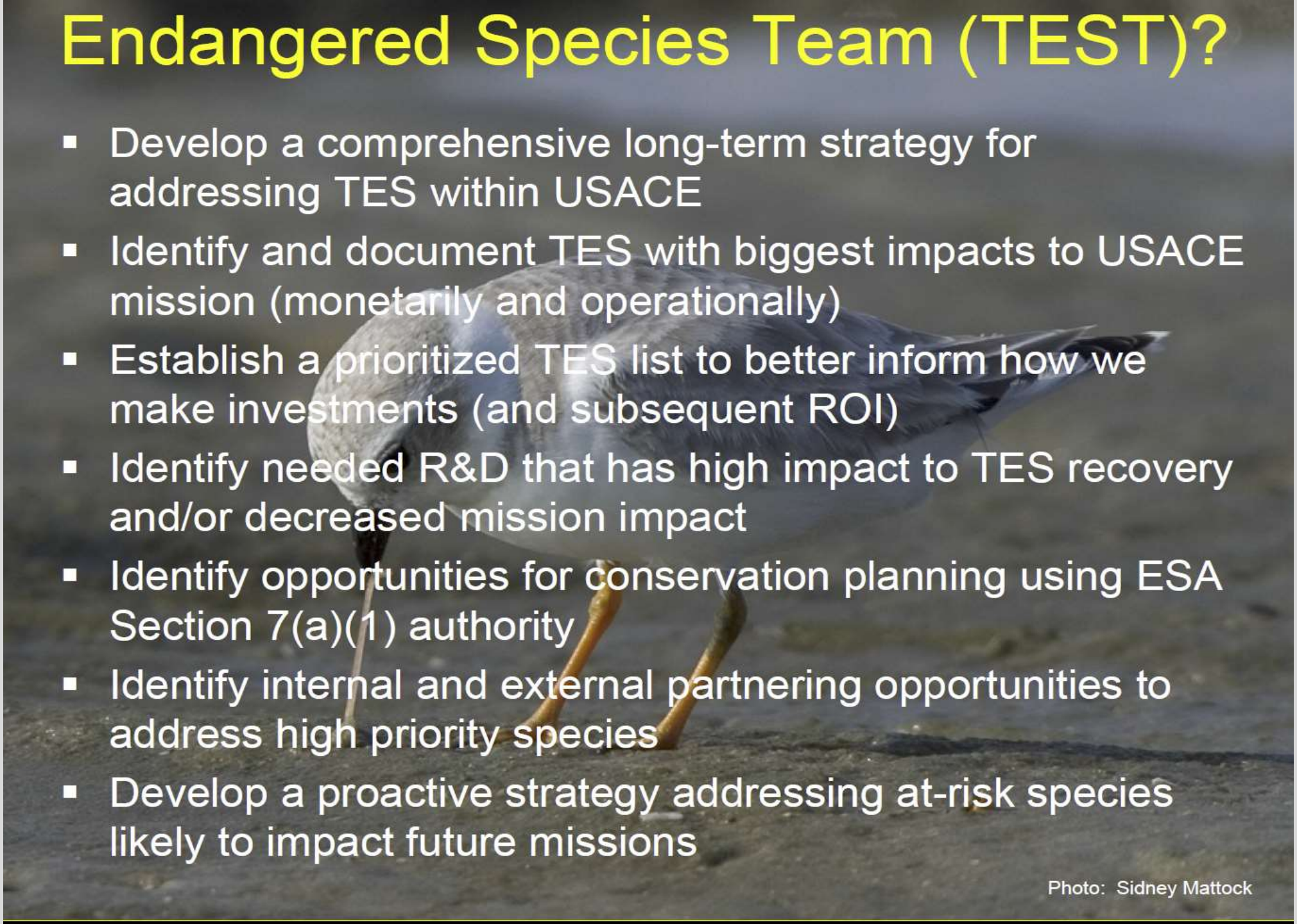


Photo: Sidney Mattock

Level II Vegetation/Habitat Surveys

- Why perform a vegetation inventory?
  - Know what vegetation types and/or species are present
  - Know where they are located
  - Know how much
    - Area (acres, hectares)
    - Number of populations/individuals
      - Rare/conservation value species
  - Know their condition
    - stable, declining, improving

Level II Vegetation/Habitat Surveys

- Why perform a vegetation inventory?
  - Tool for effective natural resource management
    - Detection and Monitoring of:
      - Priority species/assemblages
      - Species of Special Concern
        - T&E, state listed, vulnerable
      - Invasive species
    - Guide management decisions
      - Identify highest priorities
        - Develop management plans
          - best use of available funding
          - allocation of resources

Level II Vegetation/Habitat Surveys

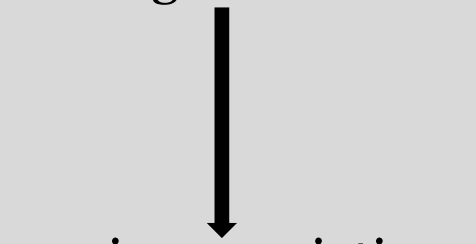
- How do we classify vegetation?
  - Dominant species?
  - Common names?
  - Local names?
- According to Engineer Regulation (ER) 1130-2-540:
  - Level I & II Inventories must be in accordance with the National Vegetation Classification System (NVCS).

Level II Vegetation/Habitat Surveys

- U.S. National Vegetation Classification System
  - Standardized methods
  - Common language and framework
    - Compatibility
      - State
      - Federal
      - International
      - Tool for “All lands Approach” to natural resource management
        - Know what you have + what is beyond your borders

Level II Vegetation/Habitat Surveys

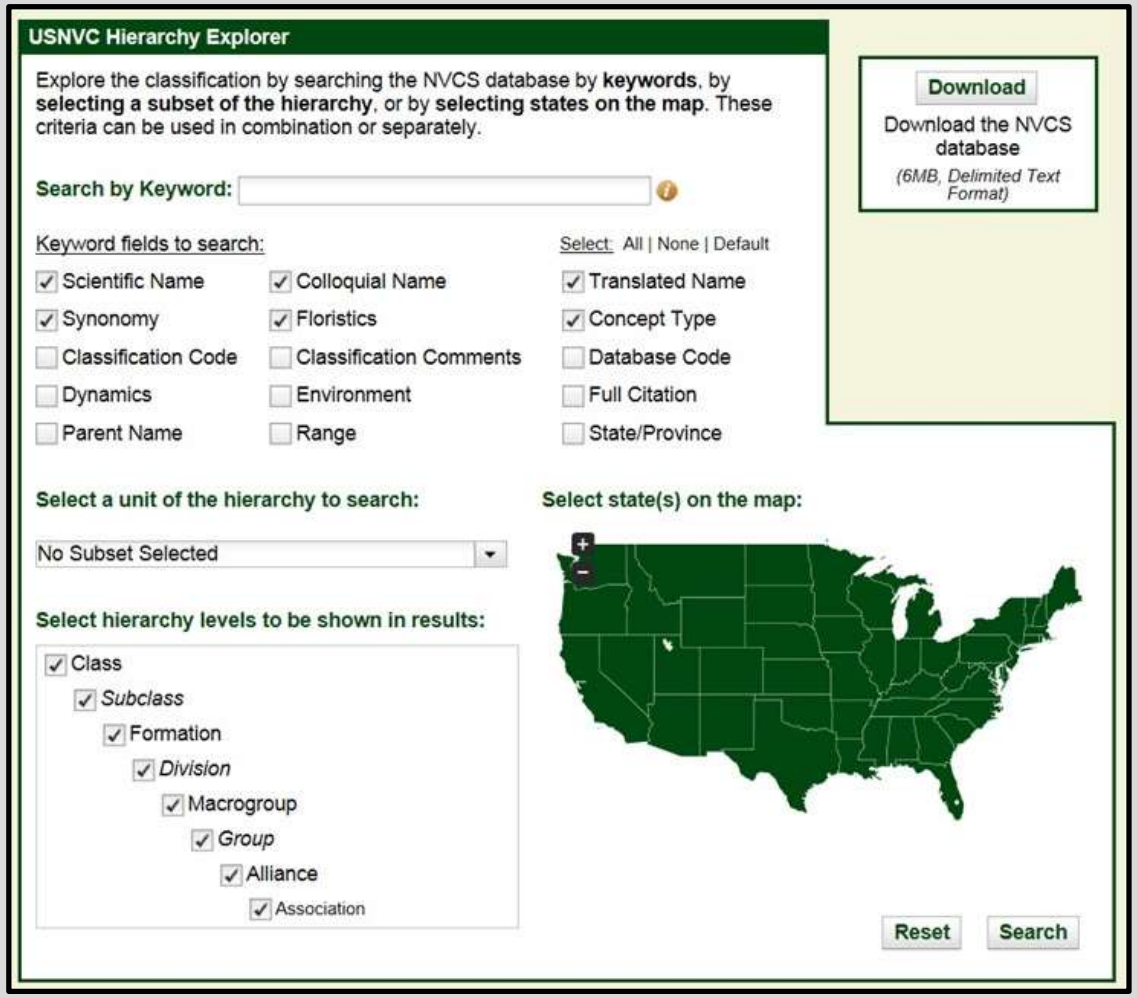
- U.S. National Vegetation Classification System
  - Peer reviewed
  - Periodic updates
  - Hierarchical System
    - Multi-tiered scales
    - broad global classes



species associations

Scale	U.S. NVCS
Broad	Formation Class
	Formation Sub-class
	Formation
Medium	Division
	Macro-group
	Group
Fine	Alliance
	Association

Level II Vegetation/Habitat Surveys



- U.S. National Vegetation Classification System
  - http://usnvc.org/
    - Explorer
      - Explore classifications
      - Filter Levels
      - Create lists
        - by Keyword search
        - by State

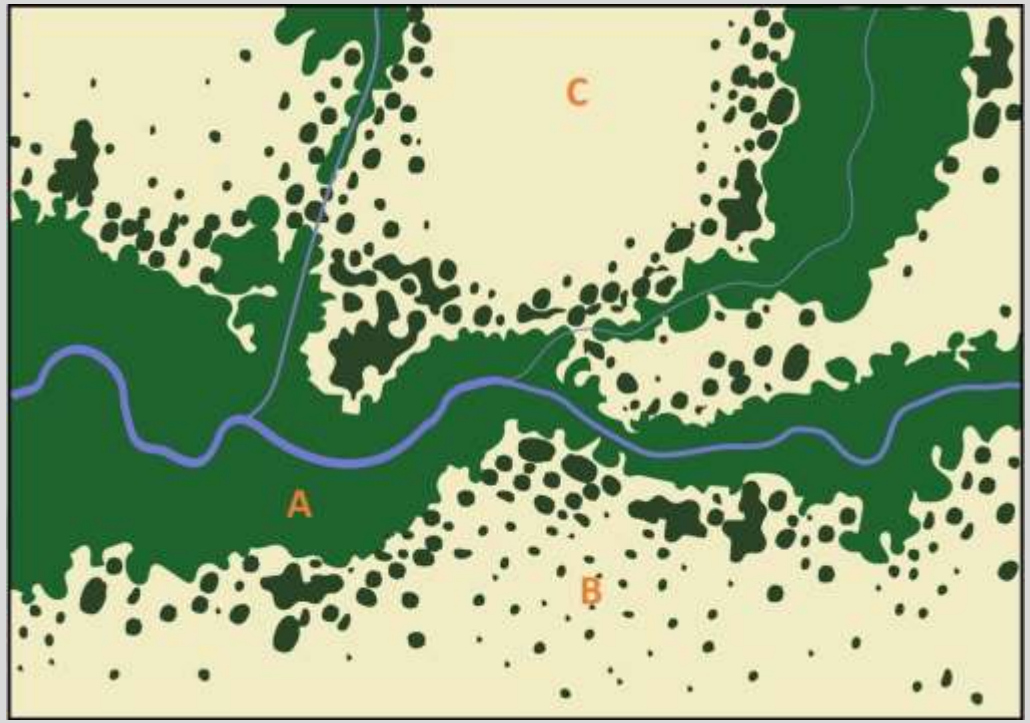
Level II Vegetation/Habitat Surveys


Sapindus marginatus

- Information incorporated into the survey report:
  - Vegetation
  - Soils
  - Geology
  - Land use
  - Herbaria
    - existing species records
  - Climate
    - rainfall patterns, temp.
  - Natural history of the region

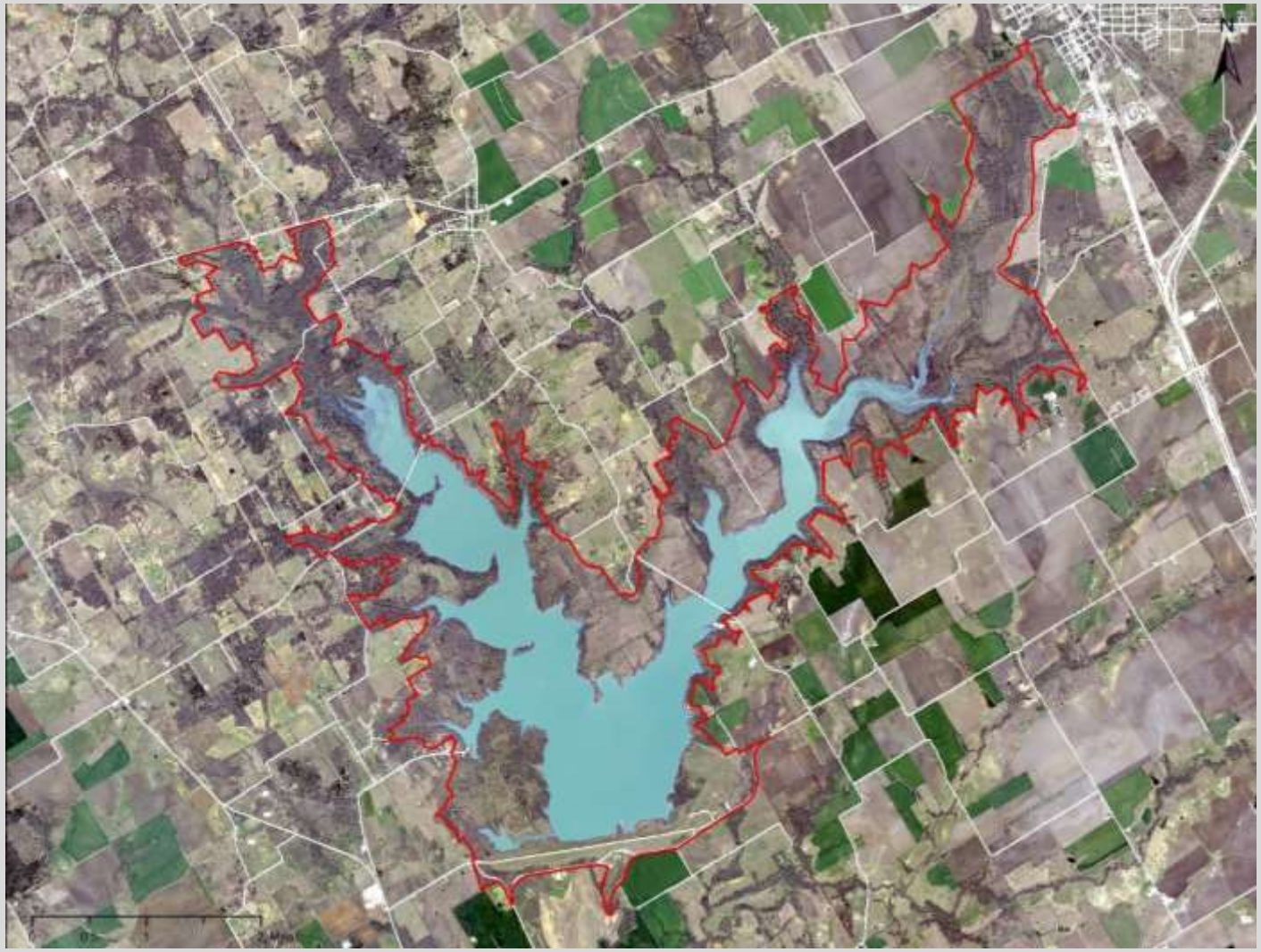
Level II Vegetation/Habitat Surveys

- Determine habitat suitability
- Make recommendations for achieving target conditions



Level II Vegetation/Habitat Surveys

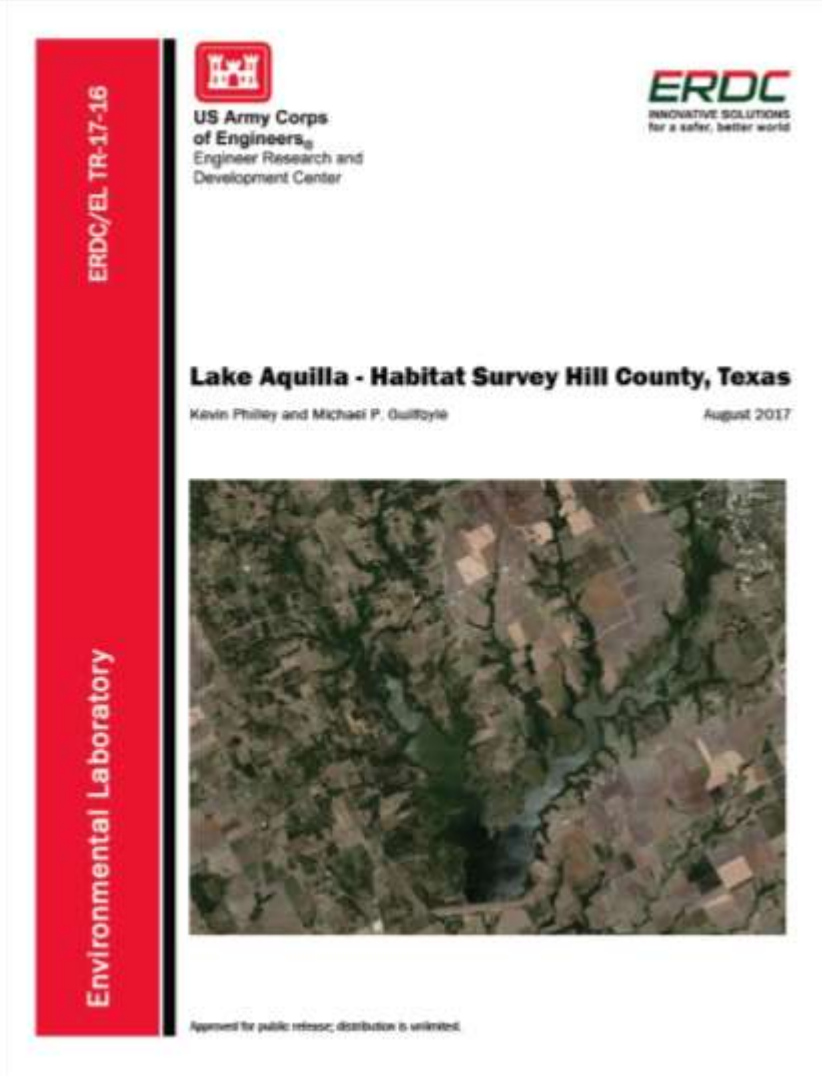
- Aquilla Lake, Hill County, Texas, Fort Worth District
  - Emphasis on locating/mapping:
    - potential blackland prairie remnants
      - ~99% have been lost
    - suitable habitat for the Golden-cheeked warbler
      - Oak-Juniper Woodlands
    - suitable habitat for the Black-capped vireo
      - shrublands



Level II Vegetation/Habitat Surveys

- Results:
  - Blackland Prairie remnants were detected and mapped.
  - Oak-Juniper woodlands and shrublands suitable for the Golden-cheeked warbler and the Black-capped vireo were not detected.
    - Features occurred as small, isolated inclusions.

Level II Vegetation/Habitat Surveys



A copy of this report can be downloaded from the ERDC Knowledge Core Digital Repository

- https://erdc-library.erdc.dren.mil/xmlui/handle/11681/22929

Level II Habitat Survey at Hords Creek Lake, Coleman County, Texas

A) Little bluestem grassland

B) Post oak woodland

Level II Habitat Survey at Hords Creek Lake, Coleman County, Texas

A) Mesquite invaded grassland

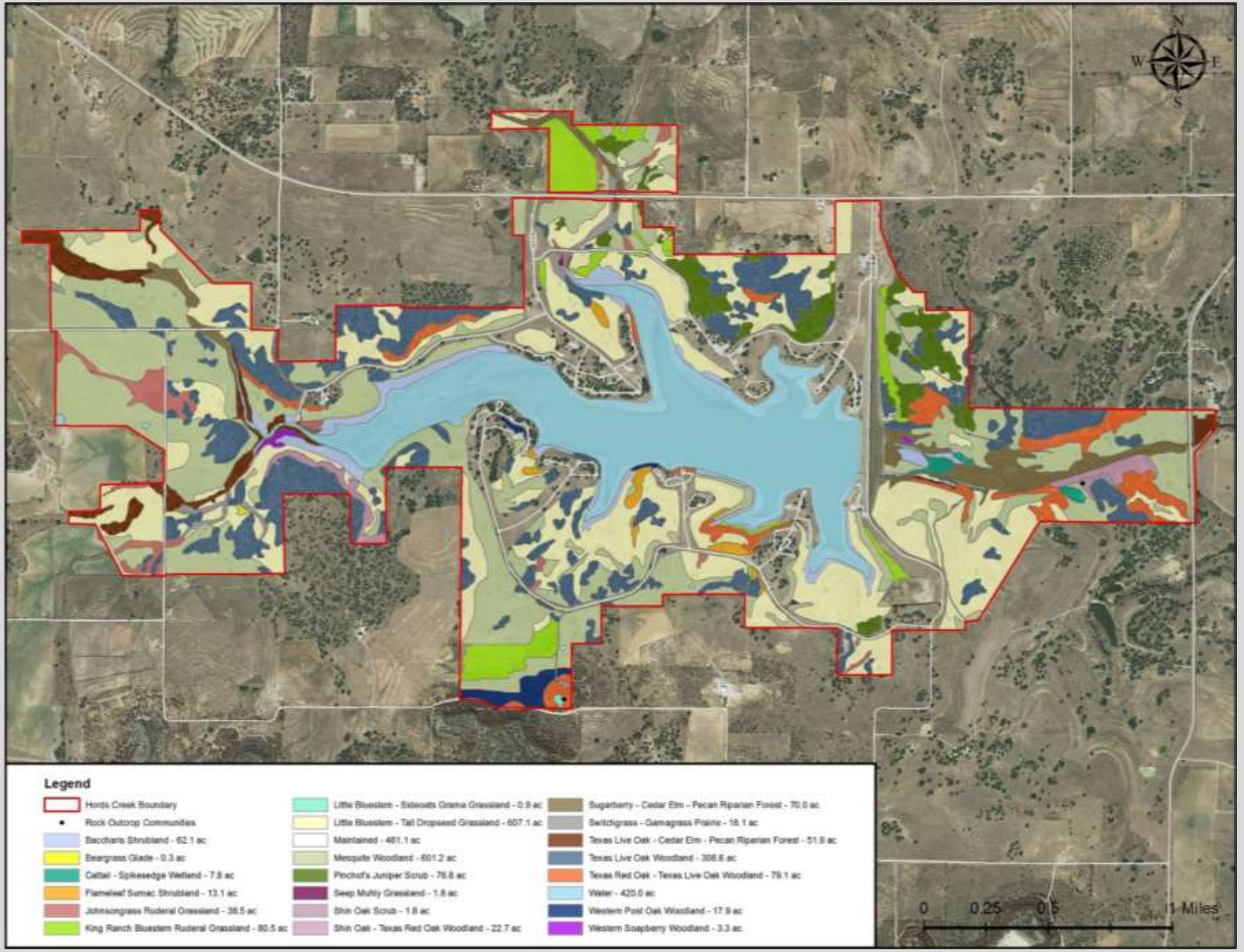
B) Treated area

Hords Creek Lake

Coleman County, TX

Fort Worth District, Southwest Division

Level II Survey – Habitat/Plant Community Classification



Additional Capabilities at ERDC

Invasive Species

- Inventories for non-native species
- Map and document occurrences of invasive plants
- Recommendations for control

Invasive Species

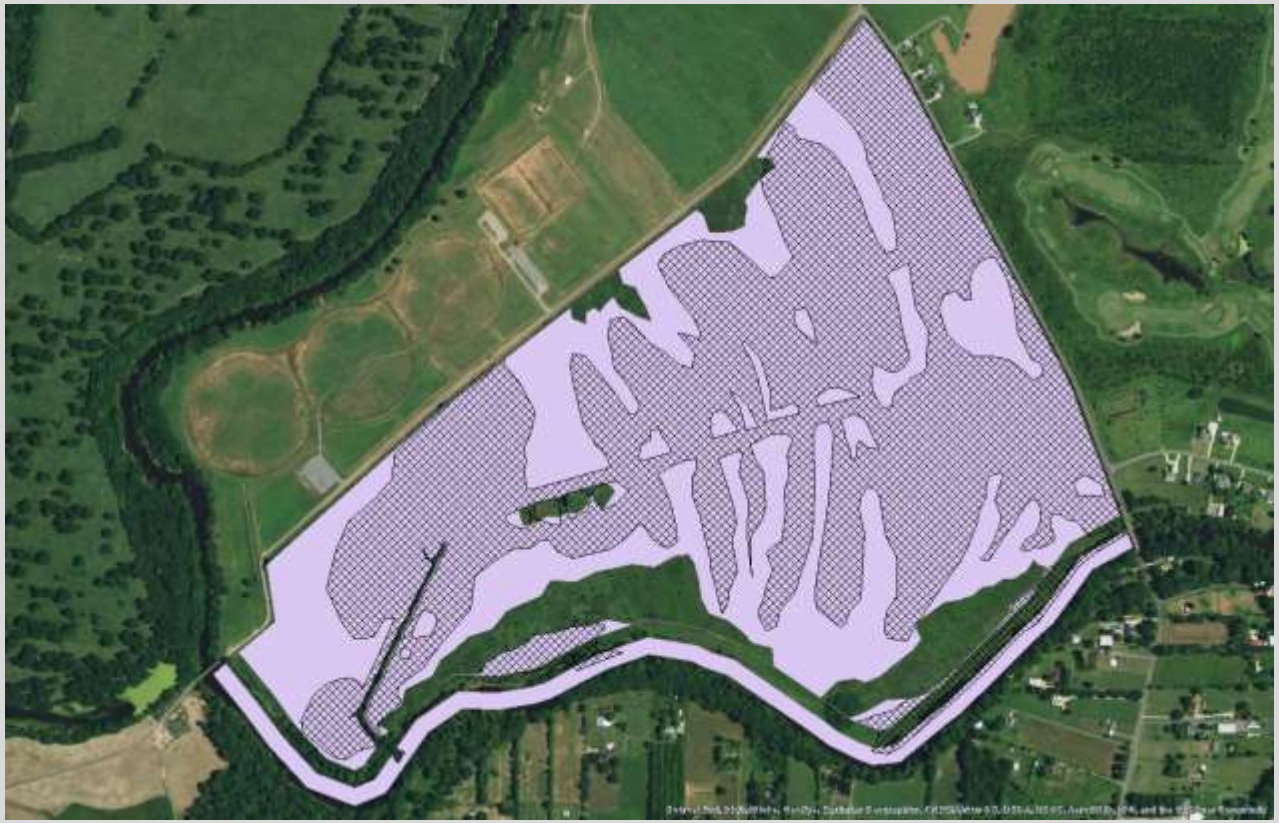
- GPS telemetry of feral hogs
  - Seasonal movement patterns and habitat use
  - Food availability/dietary studies
  - Information used to guide management and control efforts

Forest Inventory & Analysis

- Forest type/stand classification
- Volume and growth estimates
- Forest health
  - Ex. Emerald Ash borer
- Dendrochronology
  - Age
    - “Old-growth”
  - Past events “recorded” in the wood
    - Fire, climatic events

Wetland Delineations and Assessments

- Delineate wetlands and other waters of the U.S.
  - Three criteria approach
    - Vegetation, soils, hydrology
  - Ground water monitoring
- Application of various wetland assessment methodologies
  - HGM (Hydrogeomorphic approach)
  - Functional scores based on physical attributes

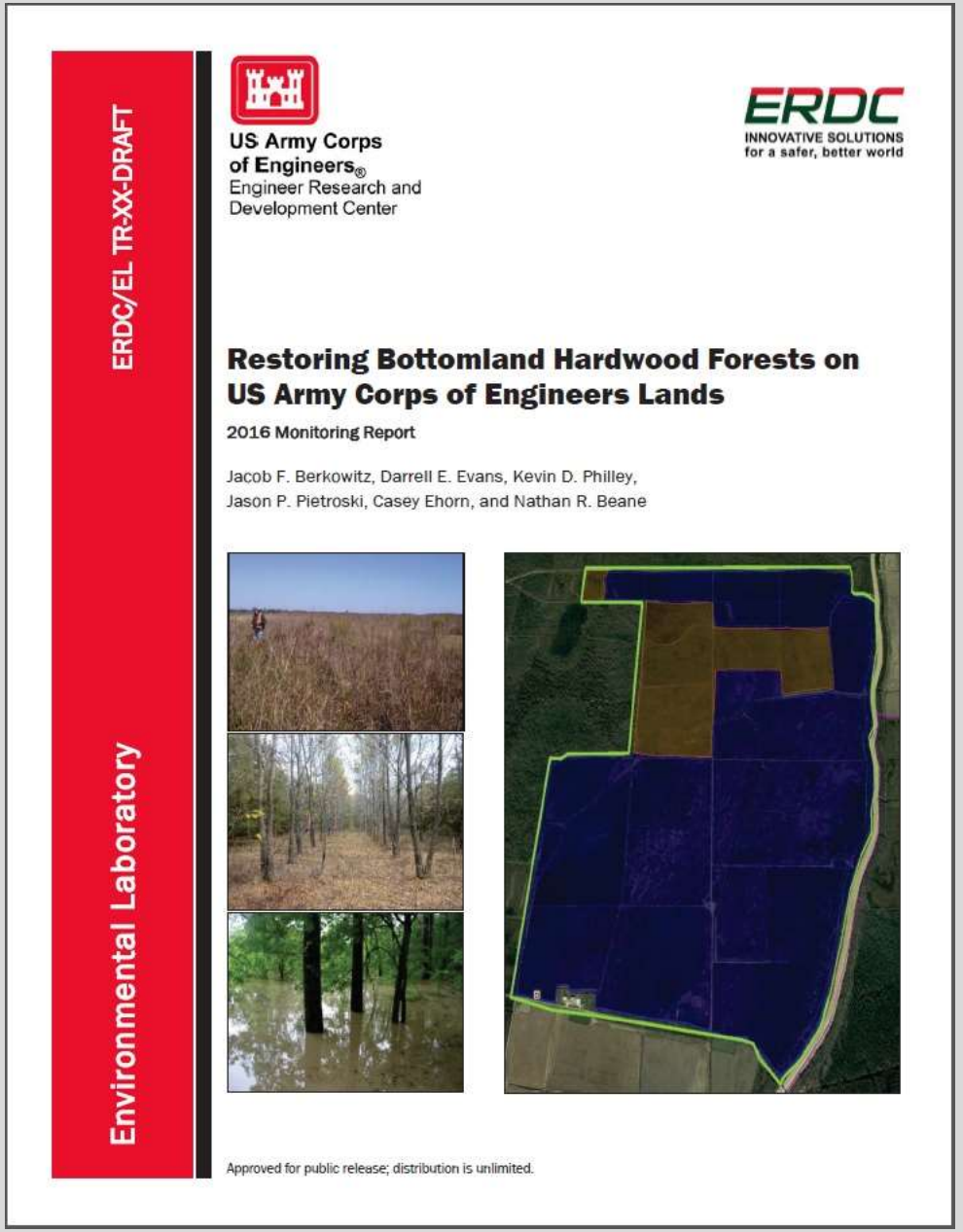


Wetland Delineations and Assessments

HGM Functional Assessment of restored wetlands in the Lower Mississippi River Alluvial Valley

Restoration Monitoring

- Develop Monitoring and Adaptive Management Plans
- Provide assistance with data analysis
- Management Recommendations

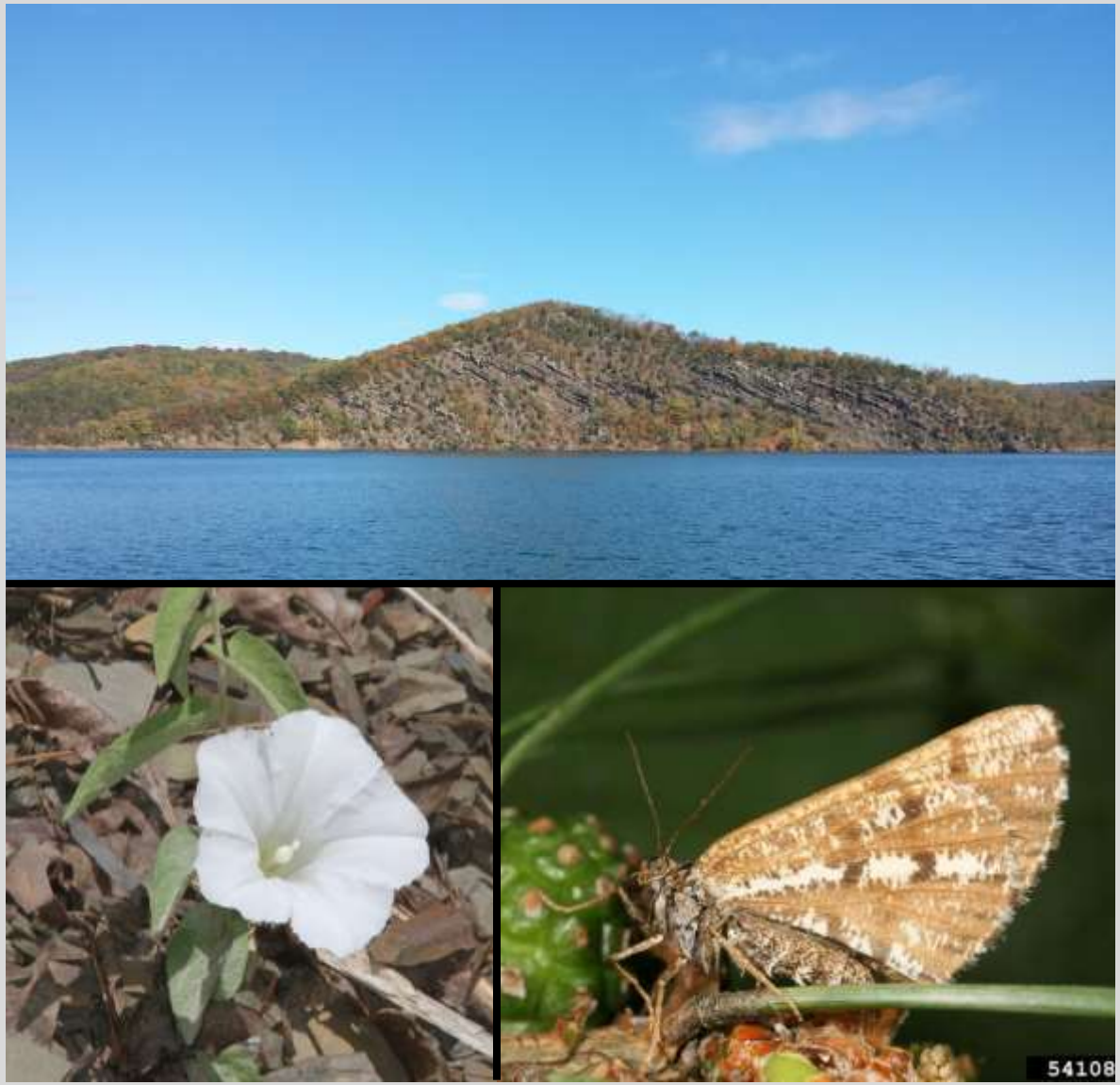


Restoration Monitoring

- Evaluation of marsh restoration
  - properties of sediments and soils
  - monitor plant community response

Upcoming projects

- Baltimore District
  - Surveying and mapping the endemic plants and invertebrates of mid-Appalachian Shale Barrens at Raystown Lake, PA
  - Some of these species have a global distribution of ≤5 U.S. counties



Upcoming projects

- Seattle District
  - Level II Surveys for Reptiles, Amphibians, and Vegetation at Mud Mountain and Howard Hanson Dams

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