

A RISK ANALYSIS TO ASSESS THE POTENTIAL TO SPREAD AQUATIC INVASIVE SPECIES VIA THE SEAPLANE PATHWAY RECOMMENDATIONS TO ENHANCE U.S. AIS-SEAPLANE PREVENTION EFFORTS

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PROJECT GOALS



- Build on existing pathway knowledge.
- Conduct risk assessment.
- Survey seaplane pilots.
- Develop recommendations to enhance seaplane AIS prevention efforts via regional remote focus groups and survey.
- Host a “Think Tank” summit with seaplane and float manufacturers.



Elodea on a float plane
in Alexander Lake, AK.
Image by Kristine
Dunker with ADF&G.



PROJECT PHASES

Phase 1	Phase 2	Phase 3	Phase 4
3 Months 	6 Months 	4-6 Months	2 Months
<ul style="list-style-type: none"> • Literature review. • Identify, quantify, and map U.S. waterbodies used by seaplanes. • Project website. • Impacts of AIS and the potential effects of climate change. 	<ul style="list-style-type: none"> • Seaplane instructor survey. • Seaplane pilot operations in the lower 48 and Alaska. • The most likely high-risk AIS to be transported by seaplanes in 8 different regions of the country. • Develop 8 case studies. 	<ul style="list-style-type: none"> • Survey Draft BMPs. • Survey to seaplane operators that shares the proposed final BMPs to obtain feedback. • “Think Tank” summit to explore and discuss potential for redesign of equipment. 	<ul style="list-style-type: none"> • Final report and recommendations via the website. • Present recommendations to the U.S. Fish and Wildlife Service and ANS Task Force.

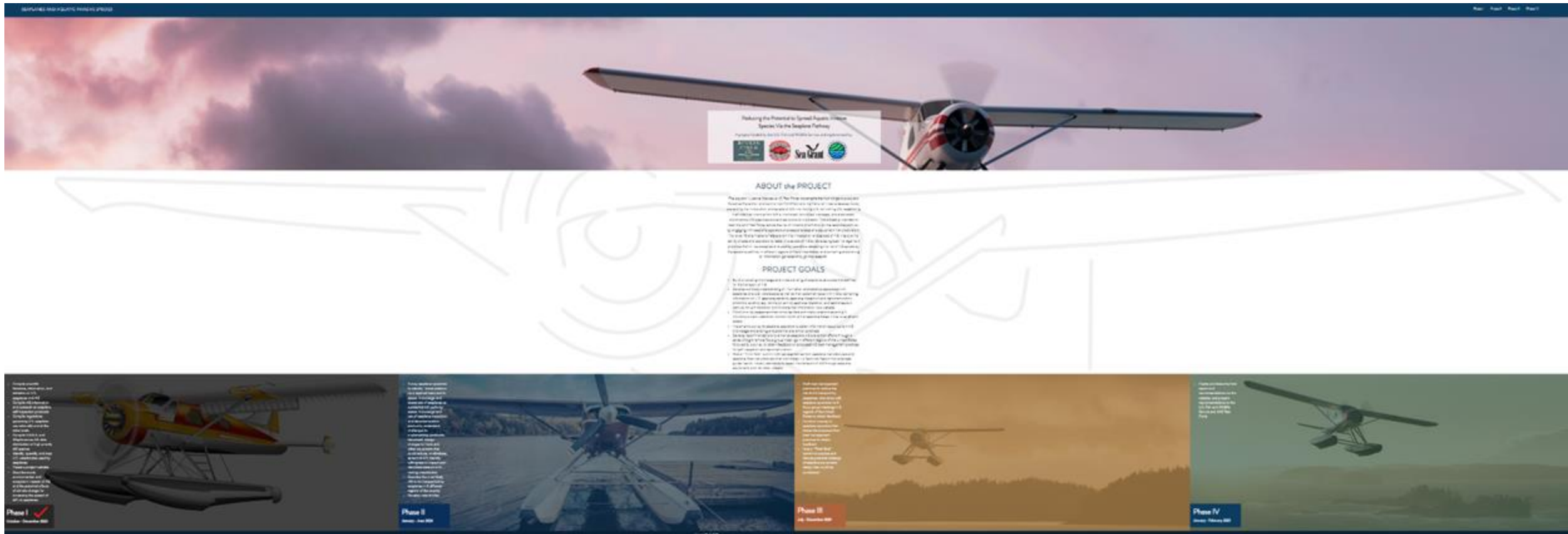


PHASE ONE

Website
Literature Review
Alaska Case Study
Risk Assessment Frameworks
Federal and State Laws
Seaplane Schools
Seaplanes and Pilots
The Seaplane Pathway
Mitigating the Risks

PROJECT WEBSITE

<https://www.seaplanesandais.com/>



A Risk Analysis to Assess the Potential to Spread Aquatic Invasive Species via the Seaplane Pathway: Recommendations to Enhance U.S. Aquatic Invasive Species—Seaplane Prevention Efforts

Phase 1: Literature Review and Statistics on Seaplanes and Aquatic Invasive Species in the United States

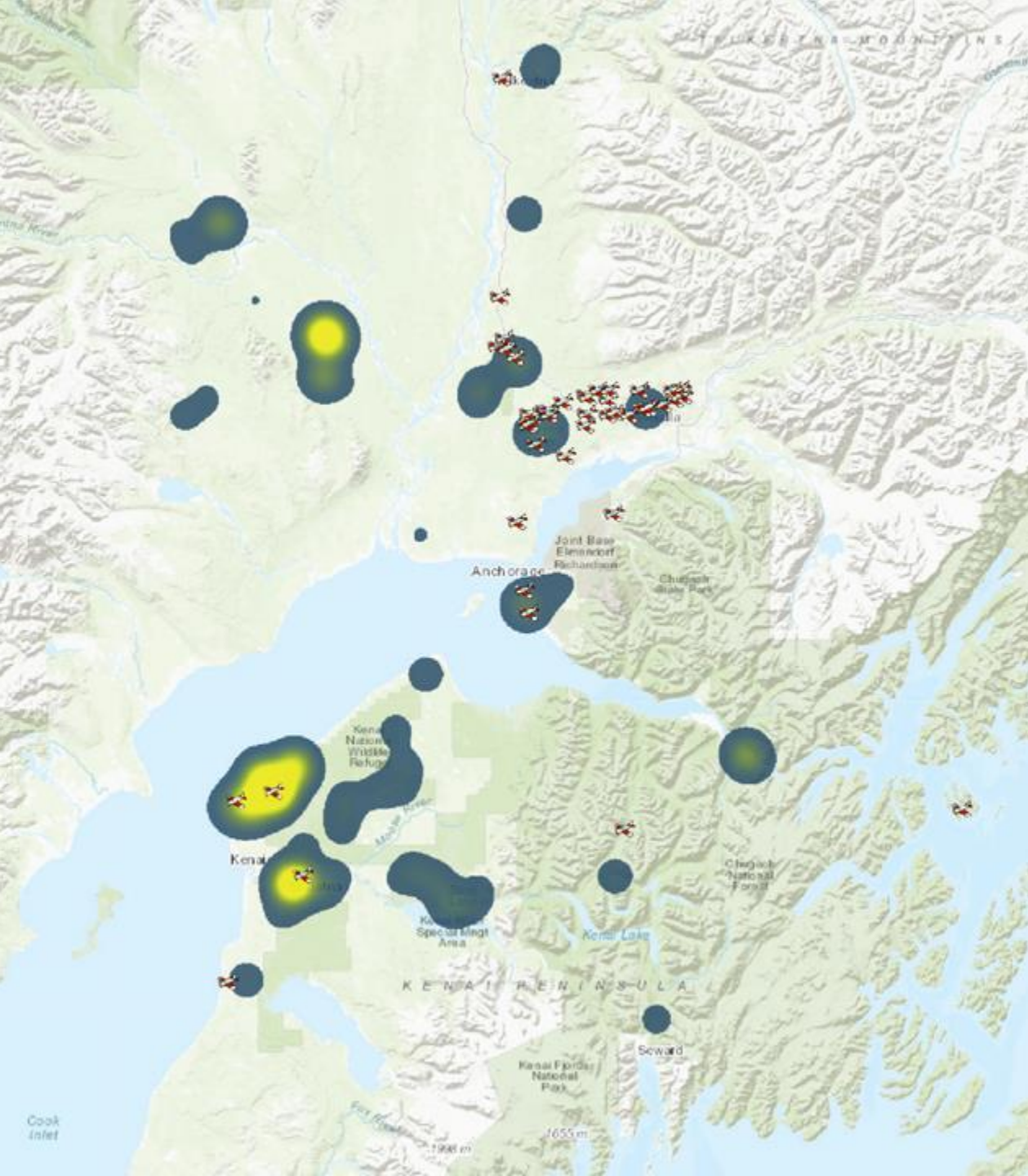


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ALASKA CASE STUDY

Elodea spp.



RISK ASSESSMENT COMPONENTS

SPECIES

Description

INVASION/ ESTABLISHMENT POTENTIAL

Likelihood of
invasion
Distribution, spread,
and impacts

PATHWAYS

Introduction
pathways

IMPACTS

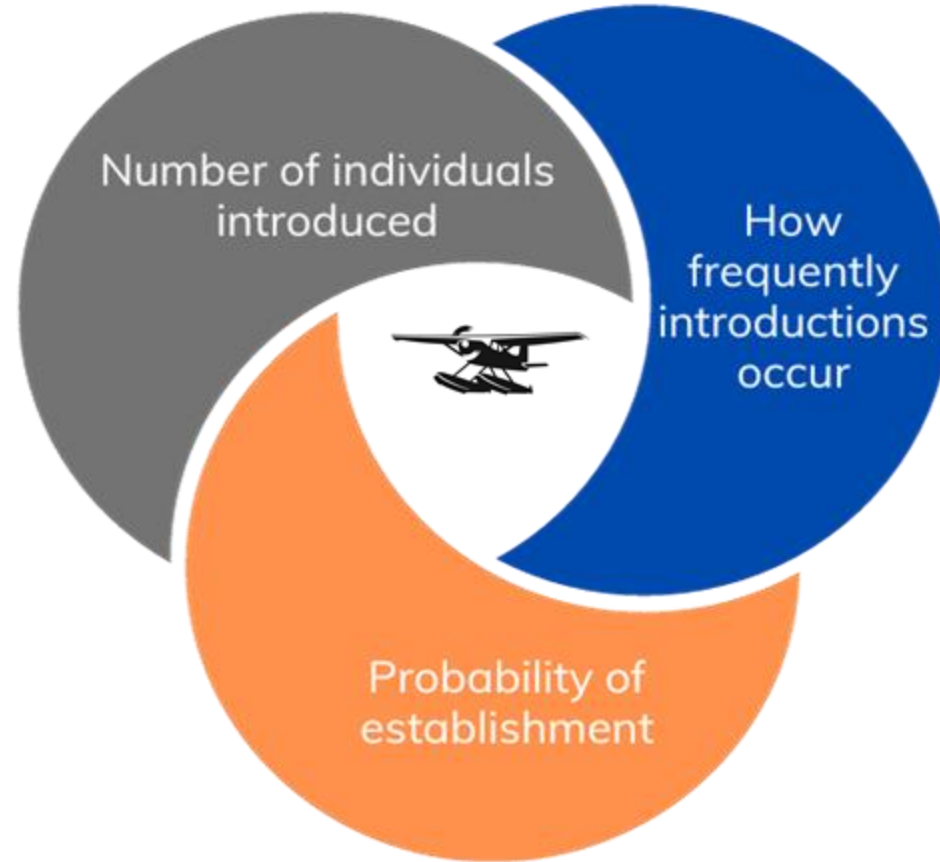
On biodiversity and
ecosystems
Ecosystem services
Socio-economic
impacts
T and E species
Climate change

STANDARDS

Ability to complete
assessment without
complete
information
Document
information sources
Summarize and
interpret
Incorporate
uncertainty
Include QA

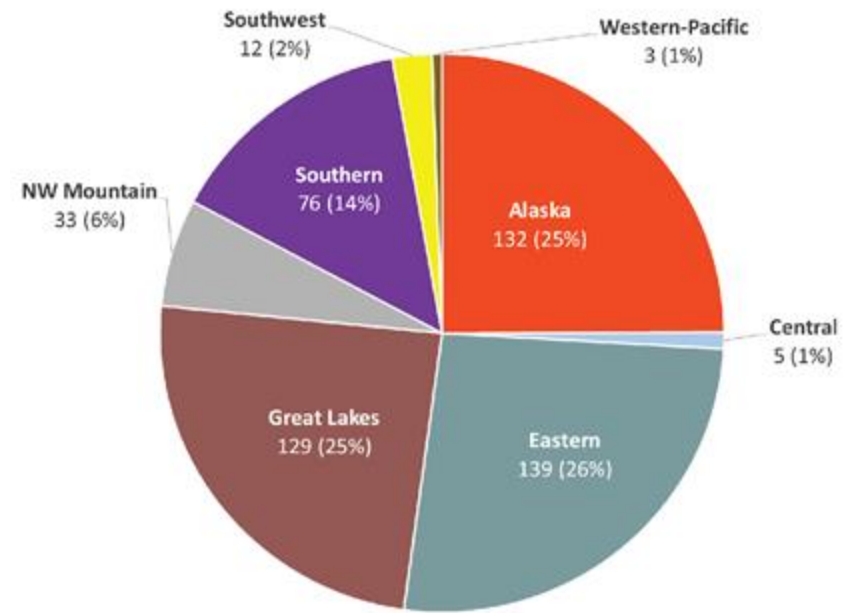
Risk assessment components described in Roy et al. (2018).

Estimating risk





Region	Total Pilots	Seaplane Bases
Alaska	9,847	132
Central	58,772	5
Eastern	131,469	139
Great Lakes	106,141	129
NW Mountain	91,347	33
Southern	132,110	76
Southwest	106,513	12
Western-Pacific	116,981	3
TOTAL	750,398	529



An estimated 35,000 pilots have seaplane ratings and current medical certificates – 3% of all pilots

U.S. PILOTS (OCT 2023) & SEAPLANE BASES

IMPACTS OF AIS ON ECOSYSTEM SERVICES



Changes to aquatic food chain



Impacts to equipment, infrastructure and activities



Potential restrictions to reduce spread



Increased cost and maintenance



Loss of revenue



Reduction in property values

CLIMATE CHANGE – AIS – SEAPLANE NEXUS



Changing climate conditions may enhance survival and facilitate expansion



Climate change will contribute to reduced water quality and quantity



Incorporation of climate considerations with invasion risk assessment

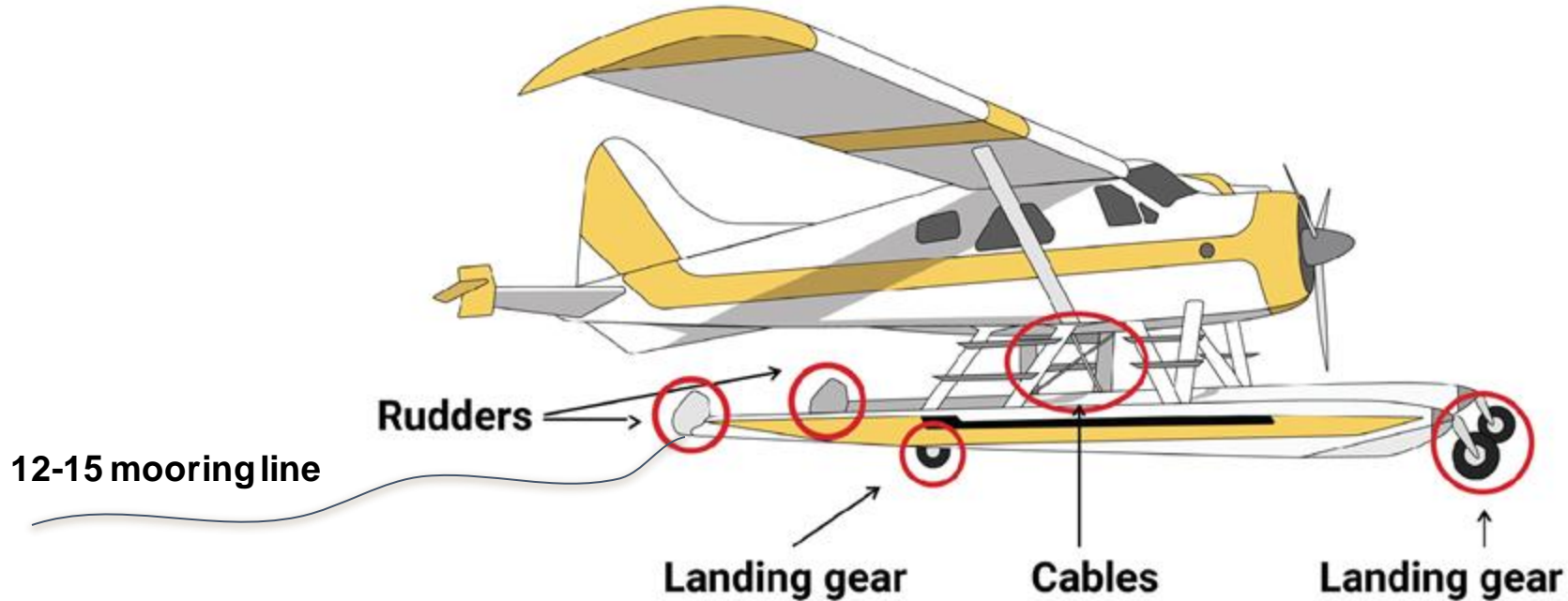


Incorporation of climate-smart actions to reduce invasion risk and impacts



Incorporation of stakeholder values to minimize impacts

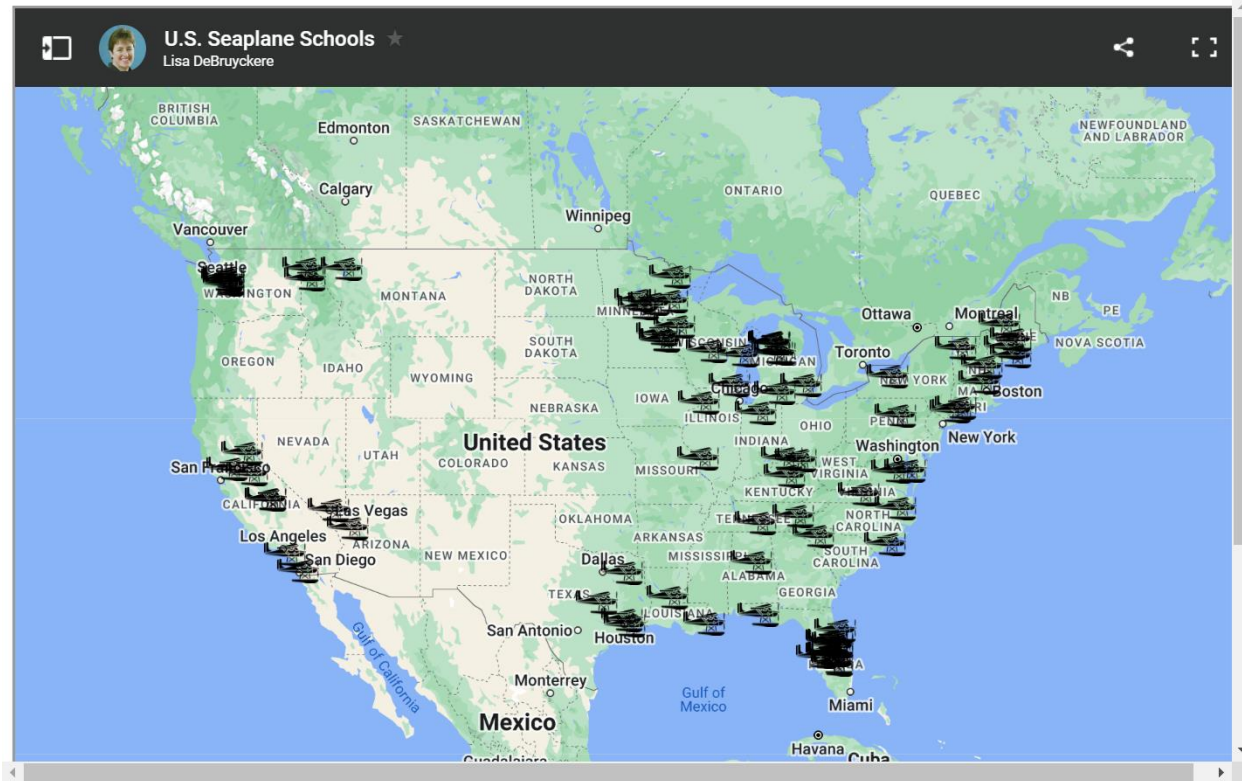
SEAPLANES AS A PATHWAY FOR AIS SPREAD



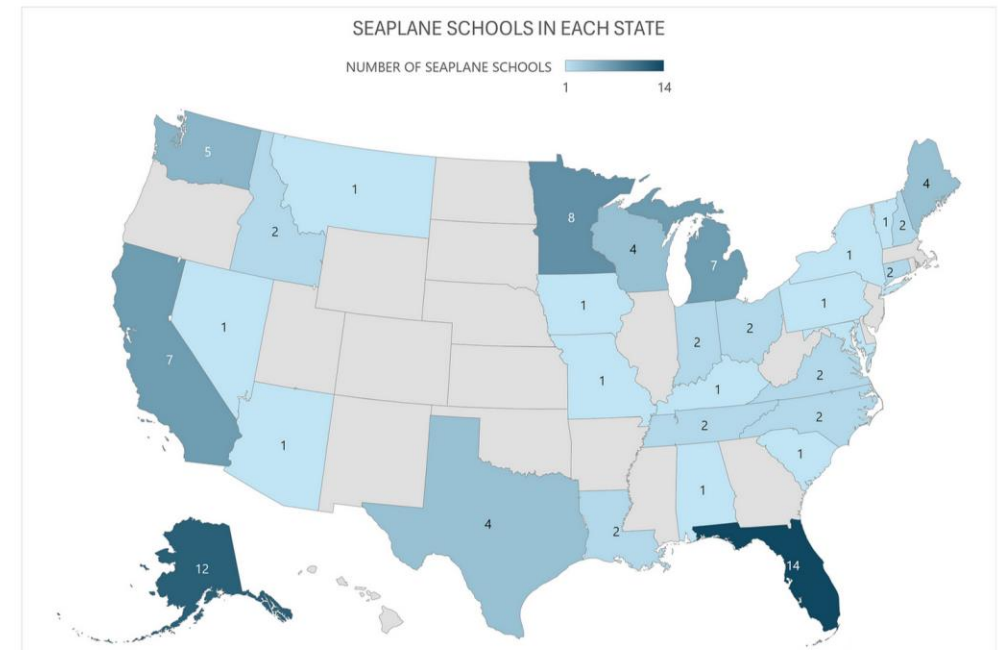
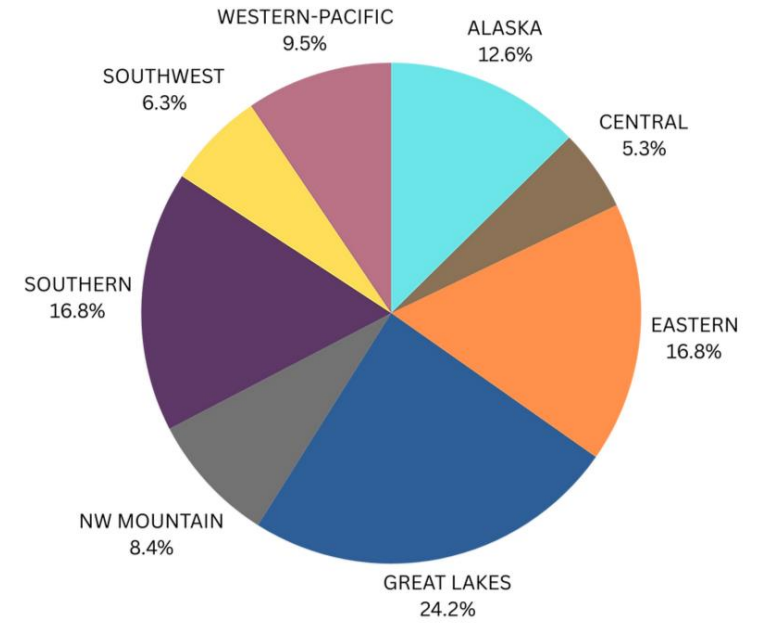
- Construction factors: floats
- Operation factors: taxi, moorage, landing, takeoff
- Survivability of AIS under various conditions

Seaplane Schools in the United States

As of May 1, 2024, there were a total of 95 seaplane schools in the United States ([Excel database file](#)).



SEAPLANE SCHOOLS BY FAA REGION



FEDERAL AND STATE LAWS – SEAPLANES

Seaplane use governed primarily at state and local level

- FAA oversees design, production, and airworthiness certification of seaplanes, as well as the training and licensing of pilots
- U.S. Corp of Engineers, Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Park Service have authority to regulate seaplane use at water bodies they manage
- 30 states have at least one statute or regulation referring to seaplanes. Most of these laws relate to base/pilot licensing, general safety requirements, or geographic restrictions.



Regulatory Crosswalk

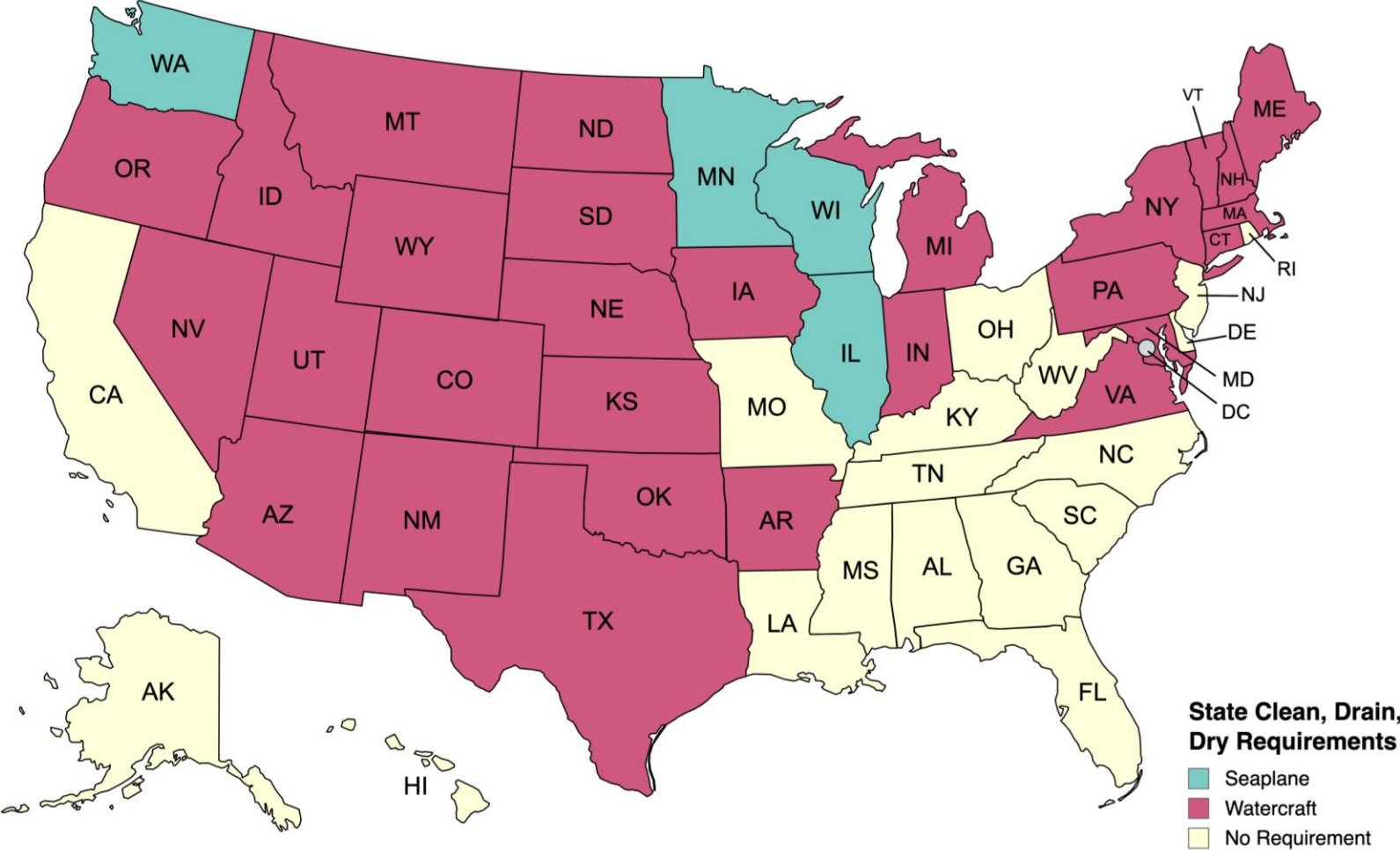
Five legal obligations equivalent to draft Best Practices:

- Duty to Inspect
- Duty to Clean or Remove Species
- Duty to Drain
- Duty to Report
- Duty to Train

One Optional, but Recommended:
Duty to Dry

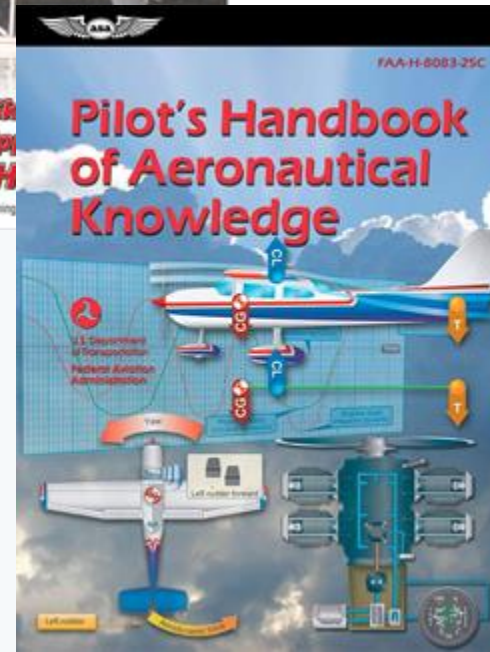
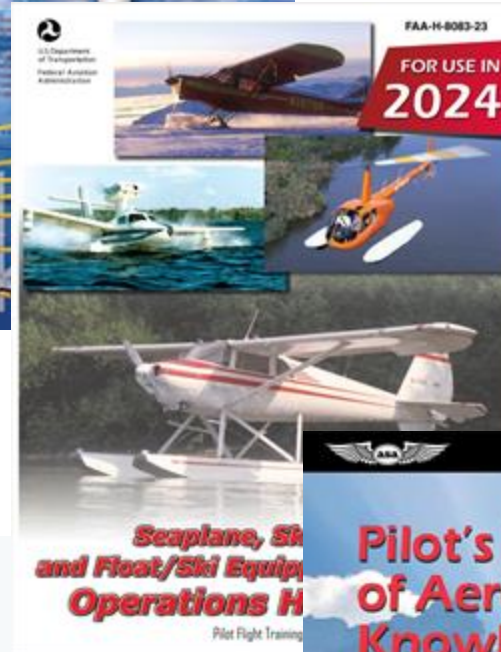
Crosswalk results – Other obligations

- Six states require individuals with knowledge of the presence of AIS to report.
- Three states mandate that boater education courses include modules on invasive species.



Test Standards for Aircraft Pilots

- Airmen Certification Standards – Guidance instructors follow to meet FAA expectations
- Advisory Circular AC 91-69A (Seaplane Safety for 14 CFR Part 91 Operators) to include hazards on floats and the environment from AIS



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Clean, Drain, Dry Seaplane Checklist

Before Planning a Flight

- Familiarize yourself with AIS you might encounter through your regional or state invasive species organization website.
- Determine if your itinerary includes waterbodies with confirmed high-risk AIS infestations, such as Elodea, hydrilla, or invasive mussels.
- If AIS have been confirmed in the waterbody you are departing from, and you are flying an amphibious aircraft, consider landing at an airport first to fully inspect and decontaminate your aircraft.
- Ensure you have acquired the necessary state or local permits to land on the water body.

Before Entering the Aircraft

- Inspect and remove any visible vegetation or other debris from the aircraft (floats, hulls, rudders, cables, lines, wheel wells, and crossmembers). Remove any weed growth on mooring lines, and dispose of any weeds or identified AIS in a landfill.
- Visually inspect submerged parts of the aircraft, and run your hands along surfaces that seem dirty.
- Using a brush, remove surface deposits from the aircraft that could be hiding attached aquatic invasive species, such as mussels.
- Do not move water between waterbodies - check and drain the aircraft's hull of any water, and pump water out of floats. Drain water into a bucket, or drain on gravel/cement away from surrounding waterbodies.

Before Takeoff

- Cycle landing gear and/or rudders in open water while taxiing to disentangle vegetation.
- Do not taxi through heavy aquatic plant growth.
- If taxiing through weed beds, stop once in open water, and manually clear vegetation from floats, hull, and rudders.

After Takeoff

- If circumstances allow, cycle landing gear and/or rudders again in flight over the waterbody you are leaving, to remove any remaining aquatic plant fragments.

Storage and Mooring

- Ensure you thoroughly *Clean, Drain, Dry* the aircraft prior to flying to another waterbody.
- If floats take on water, completely drain and, if possible, flush the floats with 60 degree C hot water. Allow to dry completely.

Report

- Report any invasive species you see to your state AIS reporting system.

THE PILOT TOOLKIT

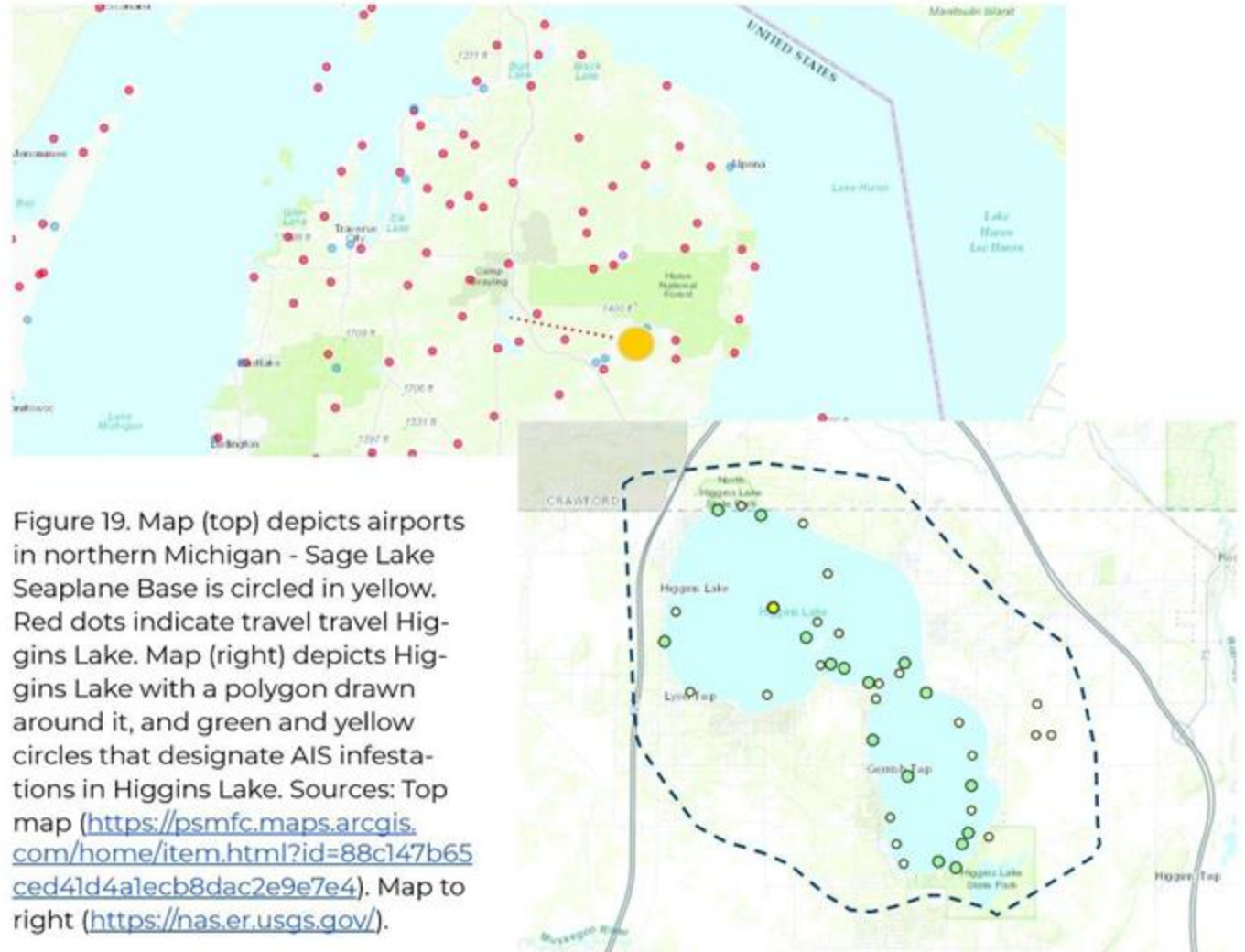


Figure 19. Map (top) depicts airports in northern Michigan - Sage Lake Seaplane Base is circled in yellow. Red dots indicate travel travel Higgins Lake. Map (right) depicts Higgins Lake with a polygon drawn around it, and green and yellow circles that designate AIS infestations in Higgins Lake. Sources: Top map (<https://psmfc.maps.arcgis.com/home/item.html?id=88c147b65ced41d4a1ecb8dac2e9e7e4>). Map to right (<https://nas.er.usgs.gov/>).

Putting information in the hands of pilots . . . USING TOOLS THEY ALREADY USE

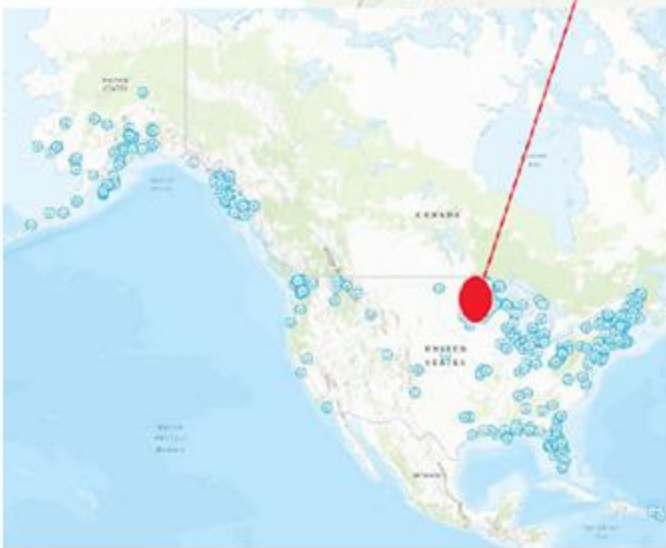
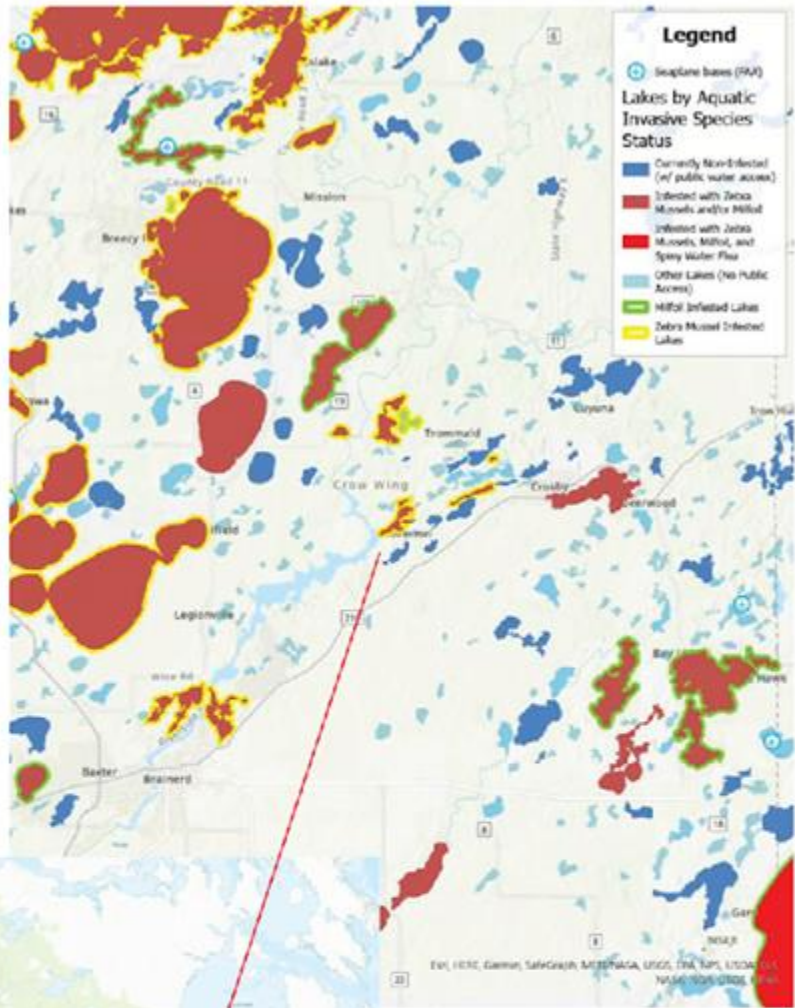
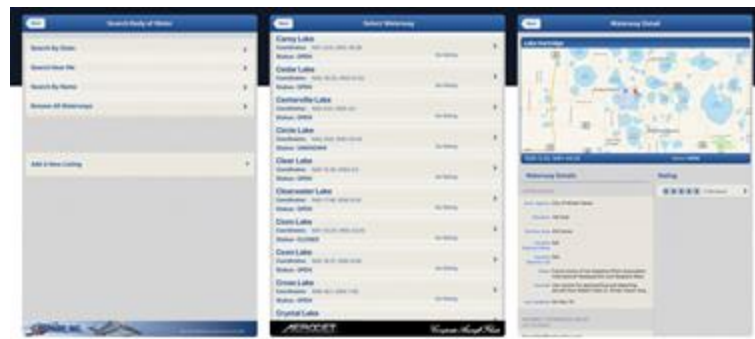
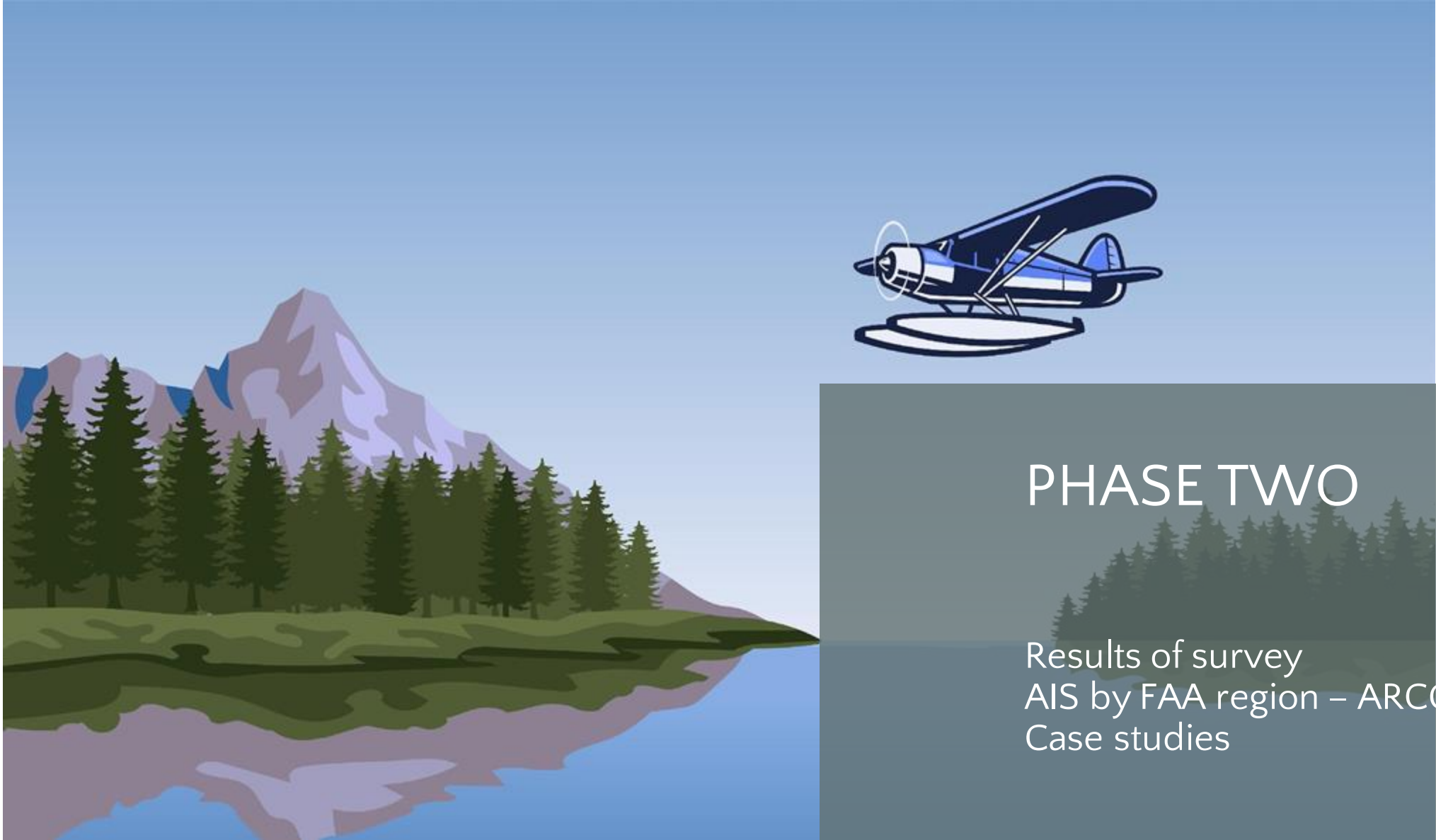


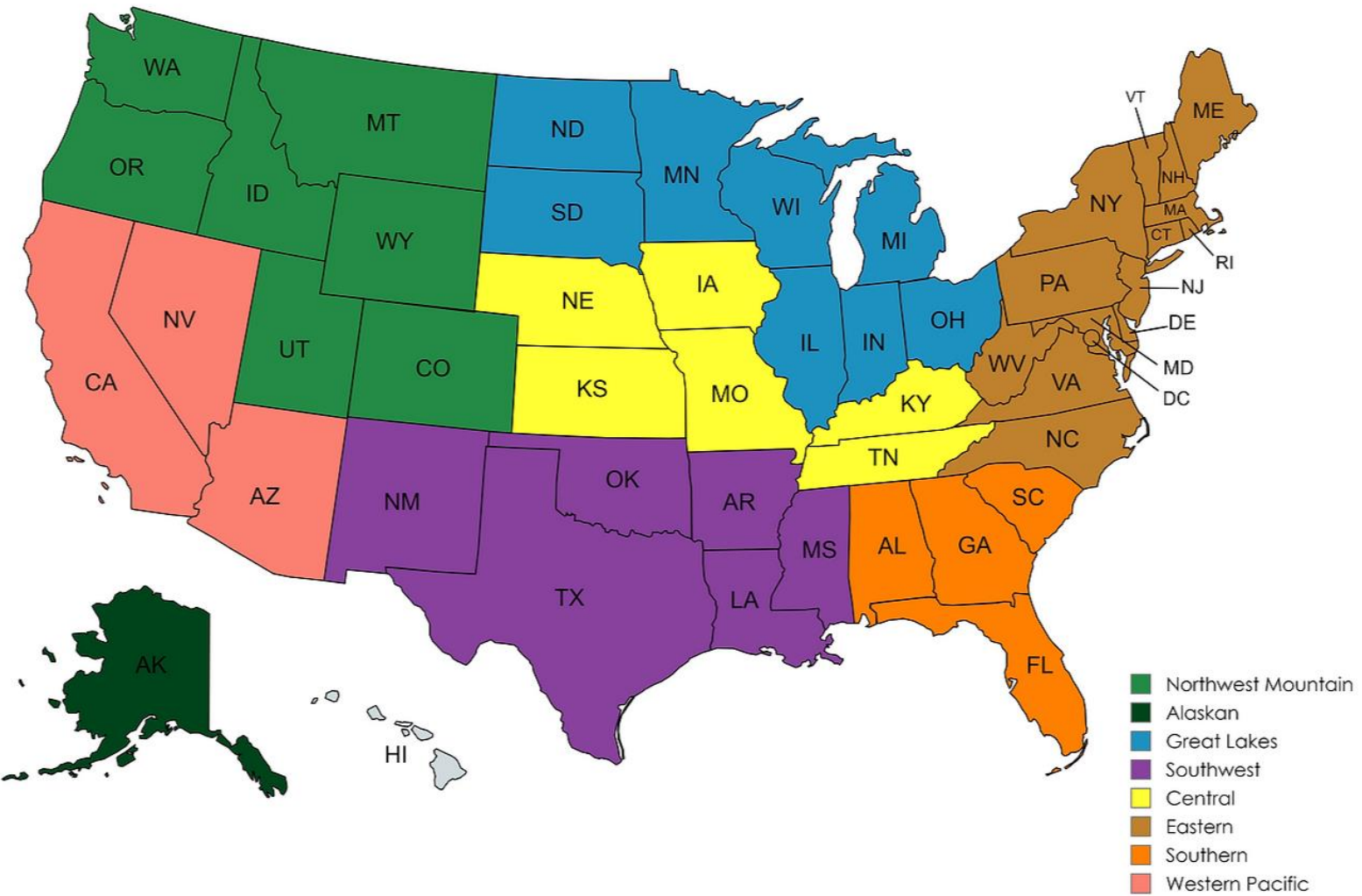
Figure 8. Seaplane bases in the lower 48 states and Alaska (left map), illustrating the majority of bases exist in Alaska and the eastern part of the lower 48 states. The map with the colored lakes indicates waterbodies with high-risk AIS in the area denoted with the red dot on the seaplane base map.





PHASE TWO

Results of survey
AIS by FAA region – ARCGIS – PSMFC
Case studies

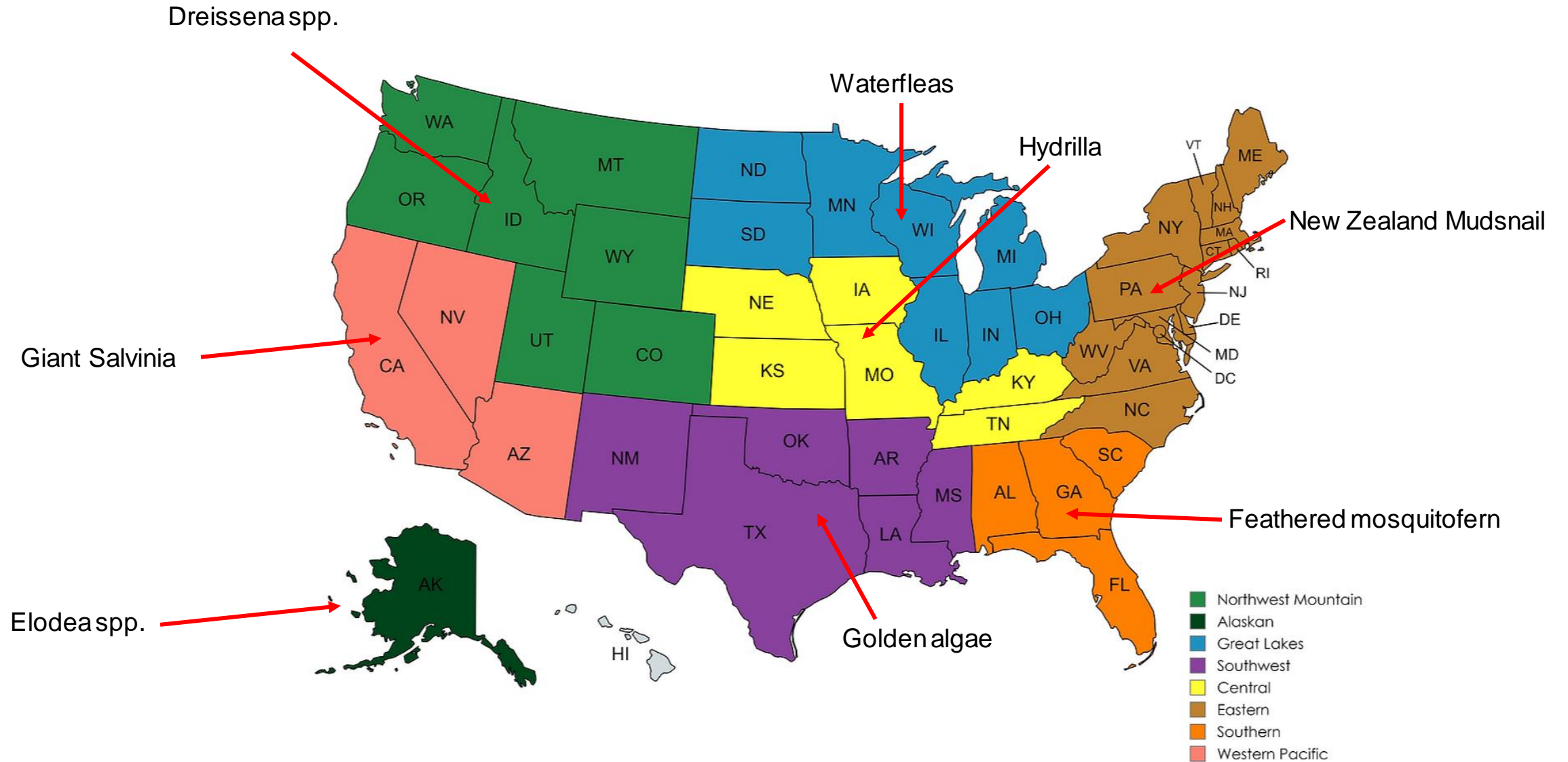


Prohibited Species (P), Species of Concern (SOC), and Existing (E) AIS by FAA Airmen Region

Alaskan Region

P, SOC	<i>Bythotrephes longimanus</i>	Spiny Waterflea
P, SOC	<i>Dreissena bugensis</i>	Quagga Mussel
P, SOC	<i>Dreissena polymorpha</i>	Zebra Mussel
P, SOC	<i>Egeria densa</i>	Brazilian Waterweed
P, SOC, E	<i>Elodea canadensis</i>	Elodea
P, SOC	<i>Hydrilla verticillata</i>	Hydrilla
P, SOC	<i>Landoltia punctata</i>	Dotted Duckweed
P, SOC, E	<i>Lythrum salicaria</i>	Purple Loosestrife
P, SOC	<i>Myriophyllum spicatum</i>	Eurasian Watermilfoil
P, SOC	<i>Myxobolus cerebralis</i>	Whirling Disease
P, SOC	<i>Potamopyrgus antipodarum</i>	New Zealand Mudsnaill
P, SOC	<i>Utricularia inflata</i>	Swollen Bladderwort
P, SOC, E	<i>Elodea nuttallii</i>	Nuttall Elodea
E	<i>Radix auricularia</i>	Big-Eared Radix
E	<i>Didymosphenia geminata</i>	Didymo

Case Studies by FAA Region





CASE STUDY: ELODEA SPP.—CANADIAN WATERWEED AND NUTTALL'S WATERWEED (*Elodea canadensis*, *E. nuttallii*)

The introduction and spread of aquatic invasive species (AIS) poses a threat to lakes, rivers, and other water bodies throughout North America. One pathway that has been shown to contribute to AIS spread is seaplanes. This case study illustrates the role seaplanes can play in the spread of AIS and the negative impacts AIS establishment can have on the environment as well as seaplane safety and operations. These case studies also illustrate the important role seaplane pilots can play to prevent the spread of AIS.

FAA Geographic Region: Alaska

Elodea spp. were the first freshwater AIS reported from the State of Alaska. First reported in 1982 from Eyak Lake, a large lake in Cordova, nearly half of the known infestations in Alaska have been in seaplane-accessible water bodies. In 2015, Lake Hood, home to the world's busiest seaplane base, was the site of a successful extensive and costly *Elodea* spp. eradication project by the State of Alaska.

What are *Elodea* spp.?

Canadian waterweed and Nuttall's waterweed, also known as *Elodea* spp., are closely related freshwater aquatic plants native to much of the contiguous United States and southern Canada. *Elodea* spp. are submerged aquatic plants that grow in lakes and streams and can form large, dense beds that grow from the bottom of a water body to the surface and then spread horizontally. Aggressive, weedy growth occurs in many types of water bodies, including nutrient-rich as well as clear, cold waters. This plant continues to grow under ice during the winter season when native plants cease to grow.

Why are *Elodea* spp. a problem?

Once established, *Elodea* spp. grow rapidly, compete with native plants for light and nutrients, and create a dense mat. These dense mats impair water bodies and reduce the quality of spawning and rearing habitat for salmon, whitefish, and grayling. The explosive growth and dense mats of *Elodea* spp. pose safety hazards for seaplanes, boats, and people. When *Elodea* spp. dieback, oxygen levels for fish and other organisms are reduced as the plants decompose. The relentless boom and bust of *Elodea* spp. may decrease property values while increasing management costs.

How can *Elodea* spp. be spread by seaplanes?

Known as oxygen weed in the aquarium trade, uninformed aquarium owners that dump their tank vegetation into water bodies contribute to the spread of *Elodea* spp. Once established, *Elodea* spp. spread easily. Fragments of *Elodea* spp. as small as two inches can root and establish a new population. These fragments, which can withstand both periods of freezing temperatures and drying, can easily be transported on seaplane floats, mooring lines, wires and cables, and rudders.

Seaplane pilots can help prevent the spread of aquatic invasive species.

Other aquatic invasive species you may encounter in your region:

- Didymo (*Didymosphenia geminata*)
- Purple Loosestrife (*Lythrum salicaria*)
- Big-Eared Radix (*Radix auricularia*)



SEAPLANE PILOT BEST MANAGEMENT PRACTICES

There are many ways aquatic invasive species (AIS) are spread. The steps you take as a seaplane pilot will help improve your flying safety while preventing the spread of AIS:

Planning a Flight

Familiarize yourself with AIS at destination water bodies, but recognize that not all water bodies are monitored for AIS— always assume a waterbody has AIS.

If you are departing from a waterbody that has confirmed high-risk AIS, consider landing at an airport first to fully inspect and clean your aircraft.

Before Entering the Aircraft

Inspect and remove any visible vegetation or other debris from the aircraft. Remove any plant growth on mooring lines and dispose of any plants or identified AIS in a container, which can then be disposed of properly upon returning to the base location. Inspect the following for AIS:

- Floats
- Hulls
- Rudders
- Wires and Cables
- Mooring lines
- Wheel Wells
- Crossmembers

Visually inspect submerged parts of the aircraft and run your hands along the surfaces to check for any AIS that may be attached.

If no cleaning equipment is available, hand-clean the submerged floats with a scrub brush, and physically remove any attached life. This is especially important if the aircraft has been moored on a lake for more than a few hours.

Pump any water out of bilge compartments. The removal of water from the float or bilge compartments prior to departure will limit the possibility of transporting microscopic AIS.

Before Takeoff

Just prior to takeoff, raise and lower your water rudders several times to remove aquatic hitchhikers, which can cause cable stretch and affect steering.

Avoid taxiing through aquatic plants. If you must taxi through aquatic plants, stop once in open water and manually clear vegetation from floats, hull, and rudders.

After Takeoff

After takeoff at a safe altitude, if conditions permit, raise and lower your water rudders numerous times while flying over the water body you are departing to clear aquatic plants from the water rudders and cables. If aquatic plants remain visible on the plane, return and remove them.



Storage and Mooring

Thoroughly Clean, Drain, Dry the aircraft prior to flying to another waterbody. If the aircraft floats take on water, completely drain and dry if possible, and flush the floats with hot water. Allow to dry completely.

Report

Report any invasive species you see to your state AIS reporting system.

Spread the Word about Clean, Drain, Dry

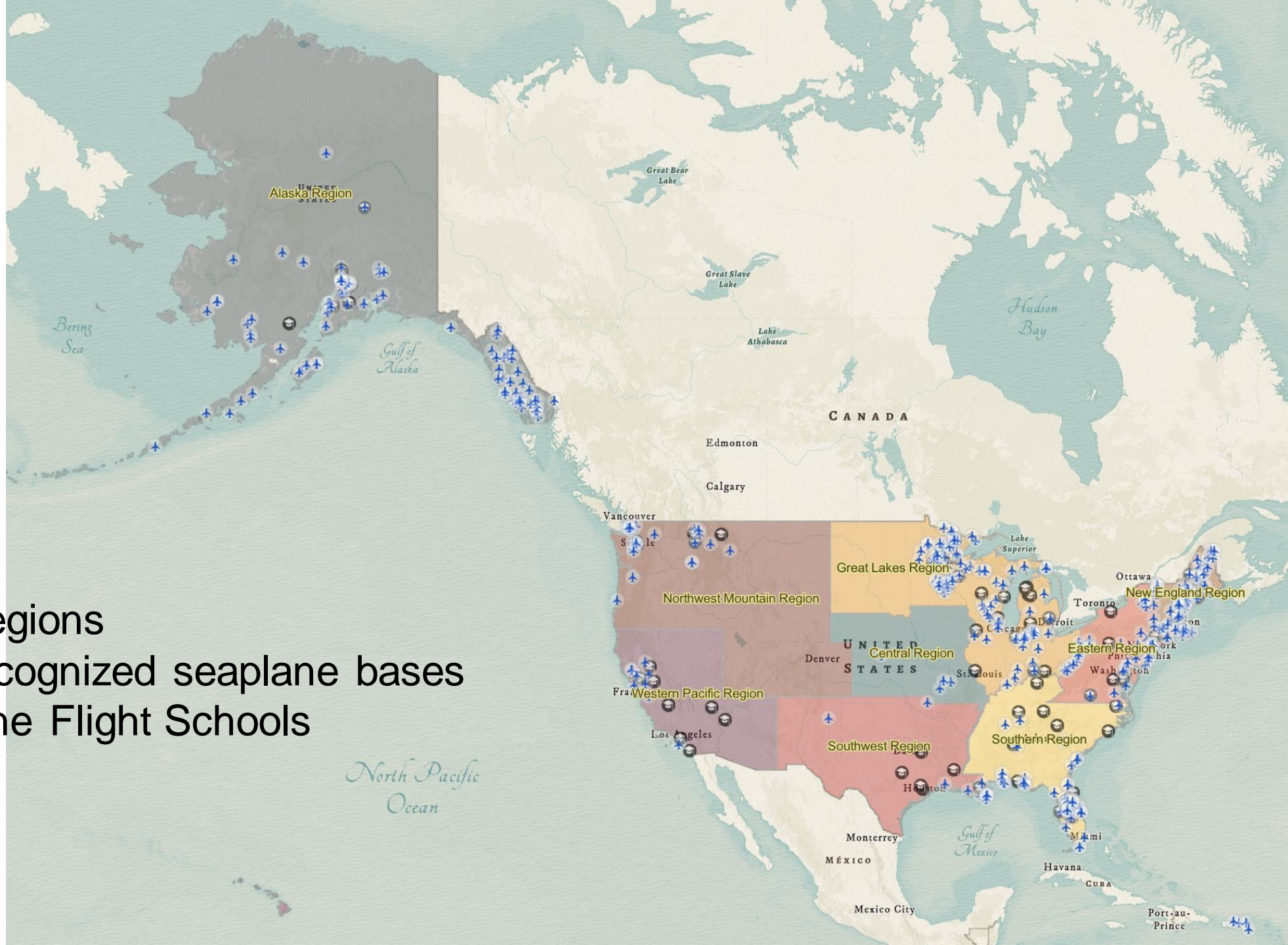
Informed seaplane pilots can make a difference in preventing the spread of AIS. Talk with your colleagues and spread the word about the importance of Clean, Drain, Dry and the steps pilots can take to minimize the spread of AIS.

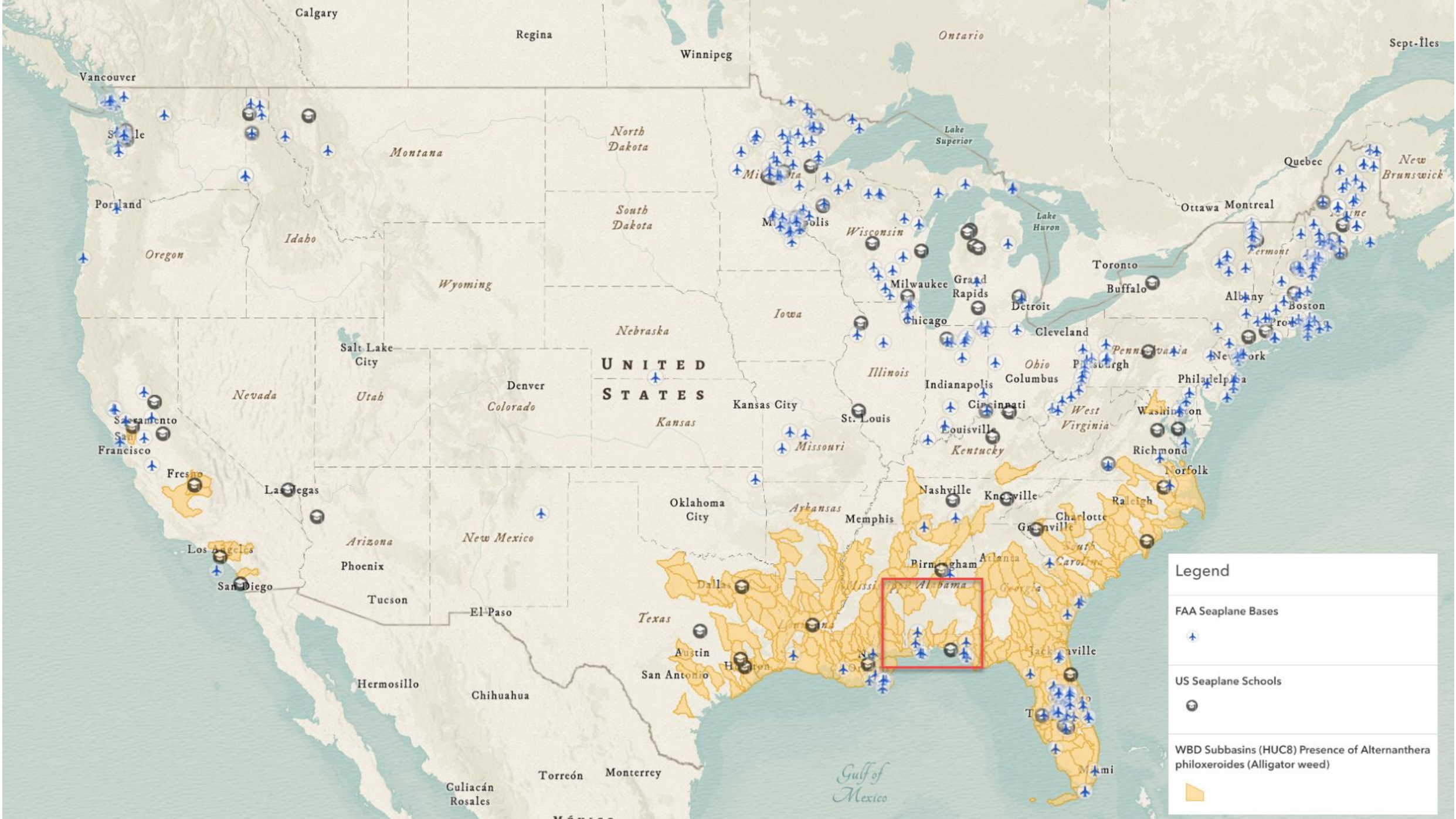
Expand your understanding of the types of AIS you might encounter in local and regional waterbodies.

Take the Seaplane Pilot Training for Aquatic Invasive Species challenge!

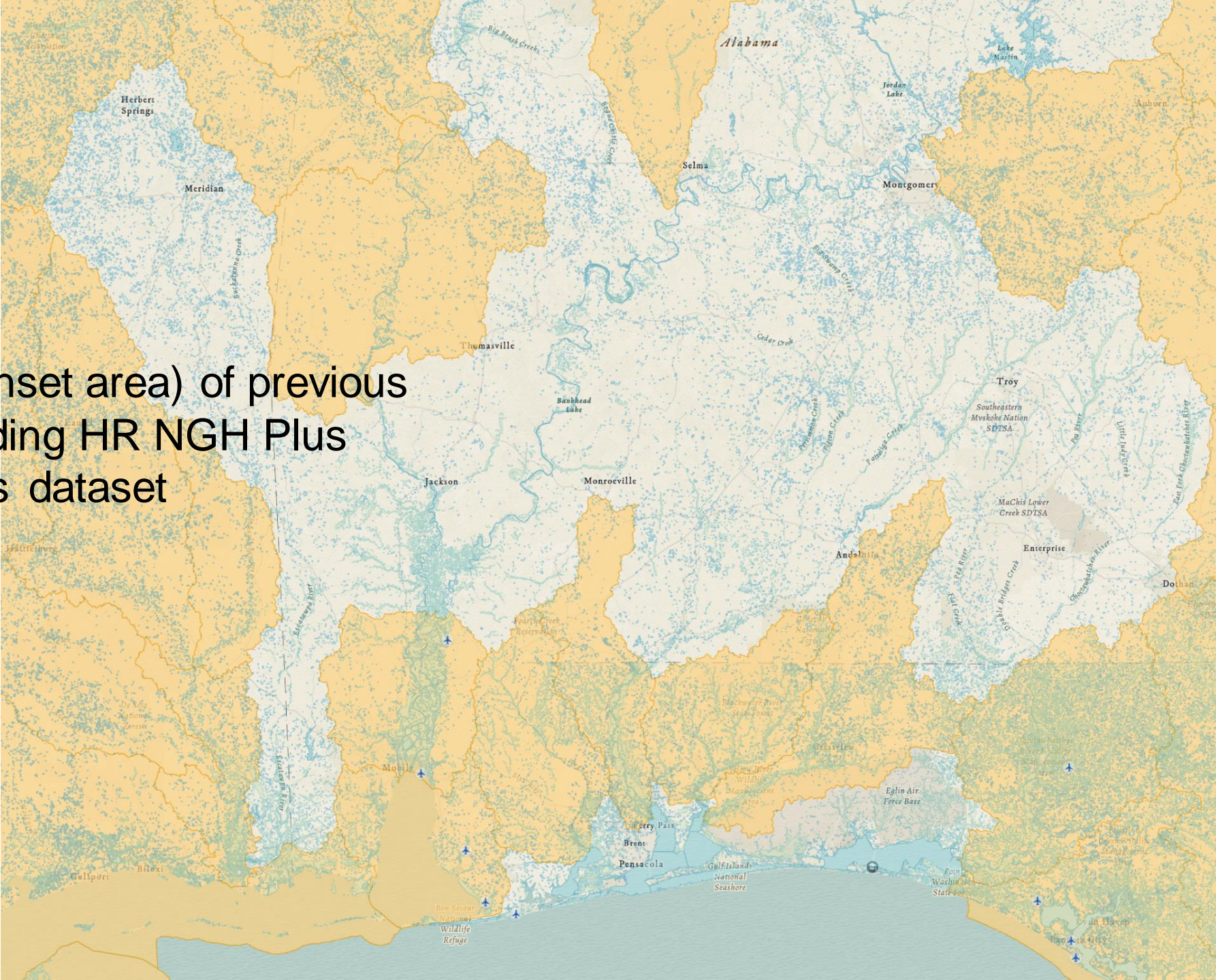
And remember, invasive species knowledge is important, but your actions to Clean, Drain, and Dry your aircraft and avoid visible vegetation during taxi, takeoff, and landing are critical.

FAA Regions
FAA-recognized seaplane bases
Seaplane Flight Schools





Close-up (inset area) of previous slide, including HR NGH Plus waterbodies dataset



NEXT STEPS

- Compile results of pilot and instructor survey - closed 31 May 2024.
- Discuss w/industry potential design modifications to lessen spread of AIS.
- Recommend AIS-specific language and inspection protocols into pilot instruction.
- Recommend model legislation.
- Finalize case studies.
- Complete risk assessment.



TIMELINE

OCT-DEC 2023

Literature review
Scoping of next steps



JULY-DEC 2024

BMPs
Think Tank Summit

JAN-JUN 2024

Seaplane pilot information
Case studies
AIS-Seaplane nexus



JAN-FEB 2025

Final report
Share recommendations





THANK YOU . . . And track project progress on seaplane website.

<https://www.seaplanesandais.com>