

Commercial Internet trade of endangered plants cultivates opportunity for citizen-initiated assisted colonization

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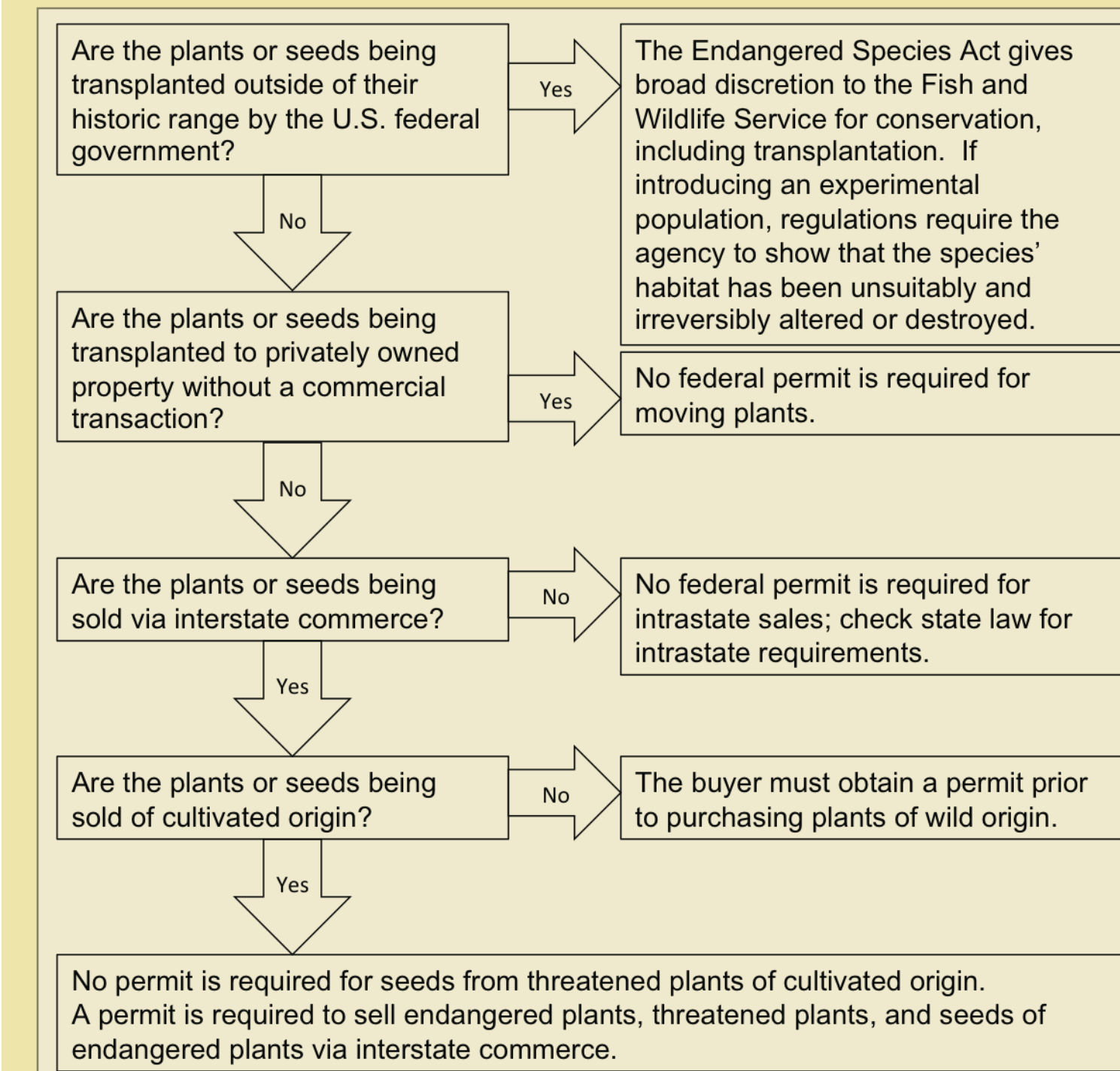
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ASSISTED COLONIZATION

Assisted colonization is a controversial conservation strategy that involves moving species to new environments to mitigate for habitat loss and climate change (Hunter 2007; McLachlan *et al.* 2007; Hoegh-Guldberg *et al.* 2008).

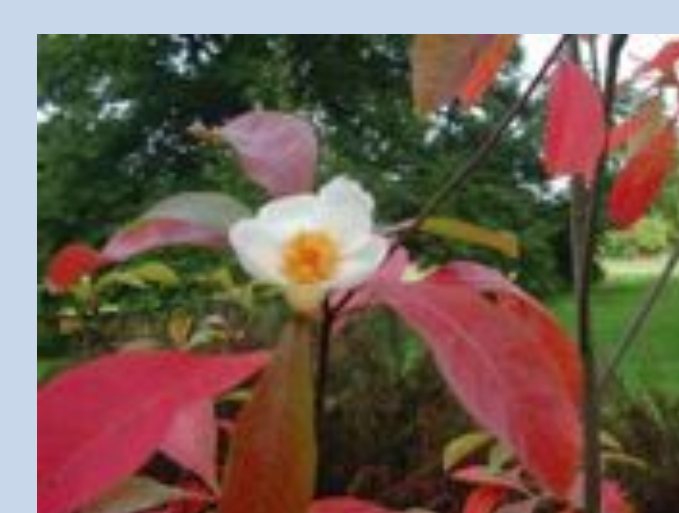
While scientists debate the merits of this strategy, human-mediated assisted colonization of plants listed under the Endangered Species Act continues legally. The only federal restriction on the movement of endangered plants is the regulation of interstate commercial trade, which requires a permit from the U.S. Fish and Wildlife Service (USFWS).



To aid conservation of the species, members of the Torreya Guardians legally plant a Florida Torreya seedling outside its historical range
Shirey and Lamberti 2011 Nature 469: 465-467

REASONS TO ALLOW COMMERCIAL TRADE

Conservation by propagation



Franklinia alatamaha
The Franklin tree is extinct in the wild, but exists in cultivation
Evans and Bohn 1986
Falk and McMahan 1988

Photo by Francine Riez

(For more information, see Winter and Botha 1994; Affolter 1997)

Promote backyard conservation & endangered species education

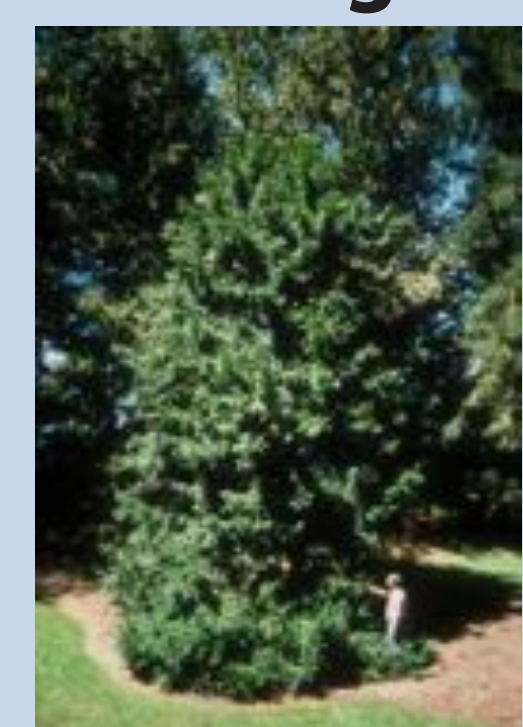


Photo by Tom Ward (Arnold Arboretum of Harvard)

Torreya taxifolia
For charismatic species like the Florida Torreya, backyard conservation efforts may help prevent extinction. Plans for establishing experimental populations of Florida torreya through assisted colonization to locations away from the disease and outside of its range were initially discussed over twenty years ago (Falk 1990), but never materialized. The population of Florida torreya declined 98% during the last century due to disease and lack of recruitment, making restoration in its historic range very difficult (Schwartz *et al.* 2000)

Provide novel funding source for conservation



Wollemia nobilis
Fewer than 100 mature Wollemi pine propagated and distributed worldwide. Royalties from sales support conservation of wild populations
www.wollemipine.com

Photo by John Dalton



Reduce wild plant collecting



Photo courtesy of USDA

Echinacea tenesseeensis
The Tennessee purple coneflower was recently delisted because 20 new colonies were established in the species' historic range; cultivation in botanical gardens and native plant nurseries provided a source of plants for reestablishing the colonies while also providing a commercial source of plants to reduce likelihood of collecting from the wild.
76 FR 46632

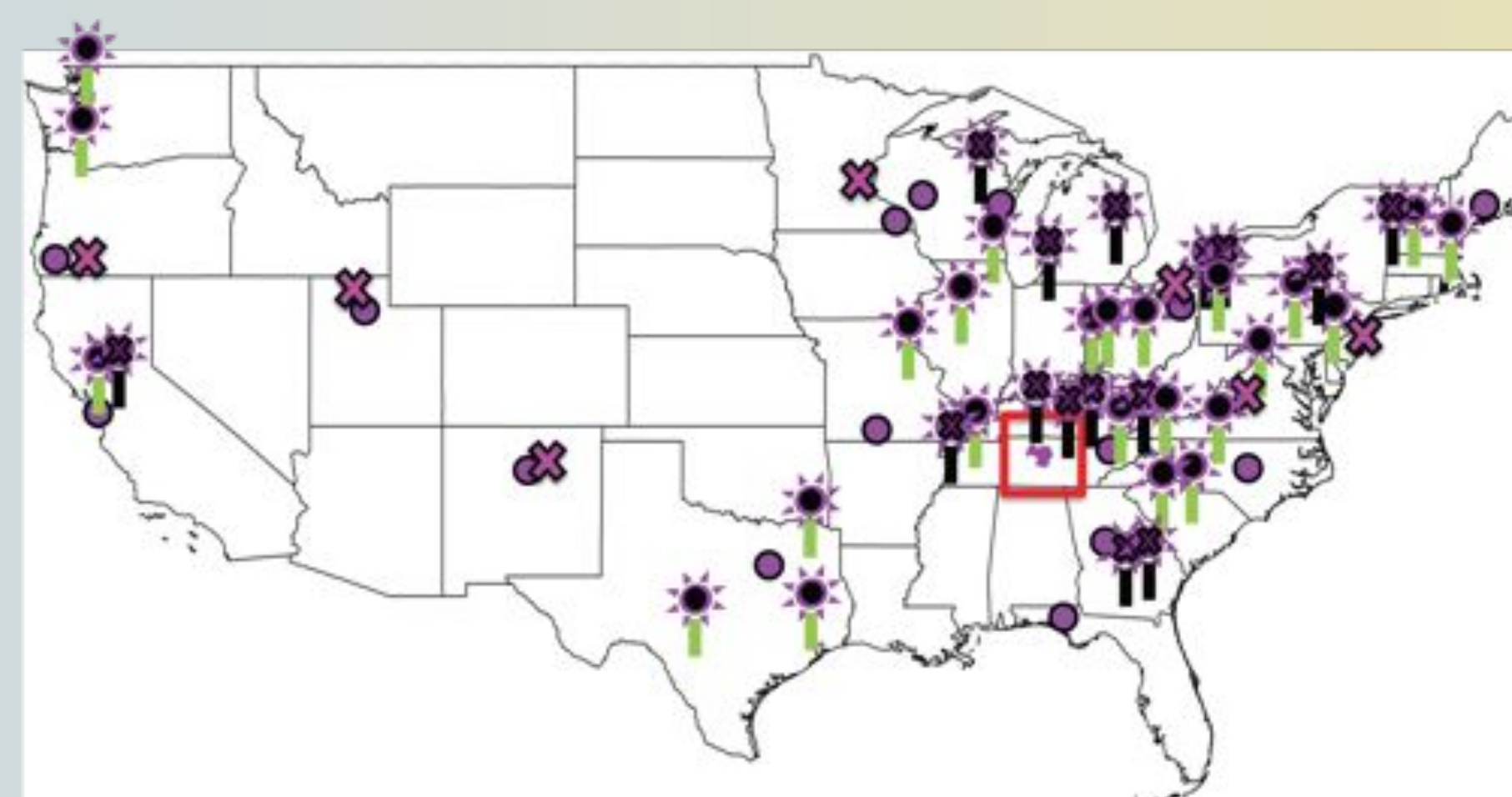
EXAMPLES OF ASSISTED COLONIZATION

Florida torreya: native range & introduced locations



Native range
Sellers / Distributors
Reported introduced locations

Tennessee purple coneflower: native range & introduced locations



Native range
Sellers / Distributors
Reported backyard locations
Sellers / Distributors of hybrids
Reported backyard locations of hybrids

REASONS TO REGULATE COMMERCIAL TRADE

Introduction of pathogens



Photo courtesy of Torreya Guardians

Pathogens could pose a threat to wild populations since the ecology of many plants and their pathogens is relatively unknown (Mauder 1992; Brasler 2008; Moralejo *et al.* 2009).

Torreya taxifolia

A canker disease caused by a fungus (*Fusarium*) has contributed to the decline of Florida Torreya in its native range. If diseased plants were moved to new locations, the fungus could be moved with them.

Trade can encourage exploitation



Photo courtesy of National Tropical Botanical Garden (Photo by S. Perlman)

Pritchardia viscosa
In Hawaii, the lack of enforcement of laws preventing illegal seed and tree collection contributed to the species' continued decline (4 trees in wild) Burney and Burney 2007 Chapin *et al.* 2004

(For more information, see McMahan 1980; Coggins and Harris 1987; Read 1989; Robbins 2003; Phelps *et al.* 2010)

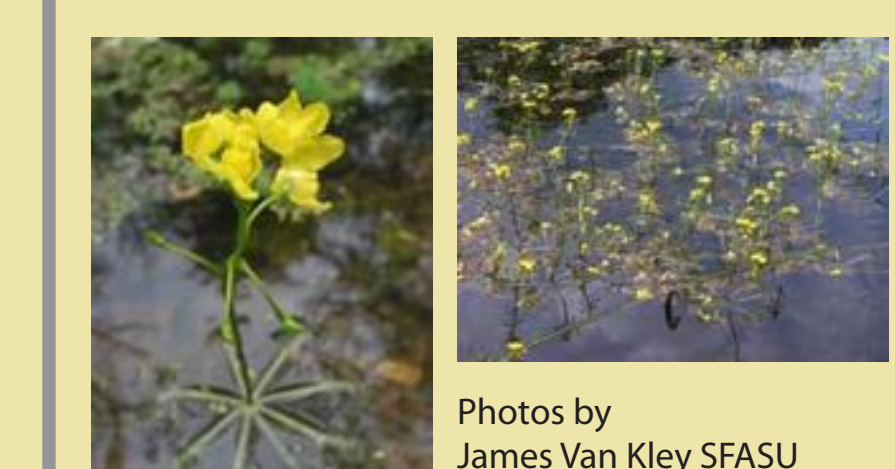
Hybridization & genetic pollution



'Rocky Top' Hybrid Tennessee Coneflower

Echinacea tenesseeensis X purpurea
A commercial seed company introduced a cultivated hybrid Tennessee coneflower, partially to circumvent the interstate commerce permit. Cultivated hybrids can cross-pollinate with wild populations if hybrid plants are grown within pollinating distance (Walck *et al.* 2002; Ault 2006).

Introduction of pests



Utricularia inflata

The swollen bladderwort is an aquatic, carnivorous plant attractive to aquatic gardeners and carnivorous plant enthusiasts because of its showy yellow flowers and bladders that trap invertebrates. The plant is rare and protected in portions of its native range (protected in Maryland and Tennessee), but is listed as a noxious weed in Washington state where it has been introduced (USDA database).

USFWS REGULATIONS OF COMMERCE

Endangered plants can be transplanted anywhere if privately owned, but interstate commercial trade of endangered plants is regulated

What is Legal?

Selling listed plants intrastate



Selling hybrids of listed plants

Selling plants interstate with a USFWS permit



Selling seeds of threatened plants of cultivated origin



What is Not Legal?

Selling listed plants interstate without a permit

Selling endangered seeds interstate without a permit

QUANTIFYING ENDANGERED PLANTS FOR SALE

In researching examples of assisted colonization of plants, we noticed that some endangered plants were being sold over the internet.

Question: *If someone wants to move an endangered plant species outside of its range, how easy is it to obtain individual plants online?*

Method: We used Google's search engine to quantify the number of threatened and endangered plant species being sold online. We searched for the 753 species listed in October 2009 using both common and scientific name with phrases 'plants for sale', 'seeds for sale', and 'add to cart', restricting searches to the top 50 page hits



Total US Endangered Plants: 753
Plants available for purchase: 99

Of those available for purchase,
Sold interstate: 47
Sales restricted to in-state: 52
Sellers with USFWS permits: < 10%

Interstate offers to sell

	Plants		Seeds		Most online interstate sales are unlawful
	Lawful	Unlawful	Lawful	Unlawful	
Endangered	4	31	8	10	
Threatened	1	9	3	No permit required	

- All legal offers to sell in interstate commerce were by 4 sellers
- Over 50 sellers are offering 44 plant species illegally
- Some plants are sold legally and illegally (e.g., cacti, pitcher plants, asters)

RECOMMENDATIONS FOR USFWS & SELLERS

The USFWS could reward compliant sellers by

- Offering a simple electronic permit application
- Assisting with the application process
- Purchasing propagated plants for restoration of wild populations from these compliant sellers
- Rigorously enforcing the permit requirements for non-compliant sellers



Coryphantha (Escobaria) minima
The nelly cory cactus is listed as endangered under the ESA

Compliant sellers can help the USFWS by

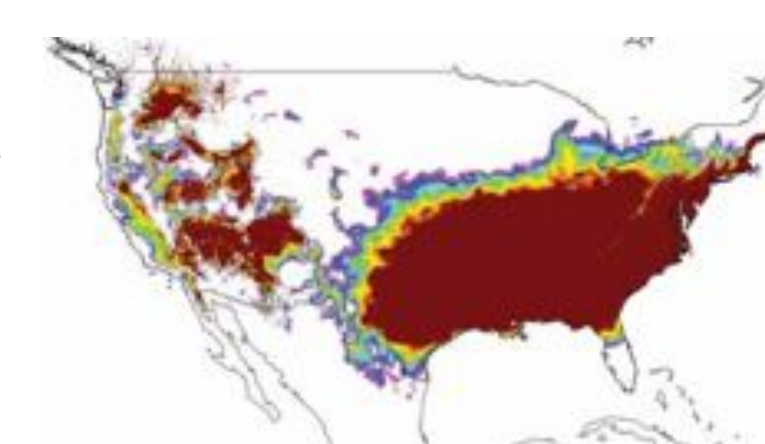
- Participating in a voluntary, cooperative propagation program
- Following propagation standards from the Center for Plant Conservation, botanical gardens, conservation biologists, and restoration nurseries
- Keeping detailed records of plant origin and avoiding hybridization from artificial sympatry
- Contributing a portion of sales profits to conservation of wild populations

INFORMING MANAGEMENT EFFORTS

- Create an online database of self-reported plant locations from botanic gardens, nurseries, and 'backyards' (Reinartz 1995)
- Use backyard locations of commercially traded plants to predict where a species could survive if assisted colonization is necessary



Example of Projected environmental niche for Tennessee coneflower using only native range (left), native range and introduced locations (right)*



*MaxEnt model input included information from native range and backyard locations, and data layers for 19 bioclimatic variables derived from temperature and precipitation. Model available by download at: <http://www.cs.princeton.edu/~schapire/maxent/>

MAXIMIZING BENEFITS -- MINIMIZING RISKS

Endangered species regulation and education should be evaluated in light of what constitutes a 'perfect storm' of

- the burgeoning legal and illegal Internet trade
- the potential creation of hybrids to skirt laws
- the growing interest in assisted colonization
- the flexible laws that allow citizen-initiated projects

Should endangered species need to be propagated and reintroduced to mitigate for climate change, we recommend collaborative, monitored studies that

- consider genetic diversity (Reinartz 1995; Weeks *et al.* 2011)
- take an experimental approach to address ecological questions (Falk *et al.* 1996; Gordon 1996; Guerrant and Kaye 2007; Wendelberger *et al.* 2008)
- minimize negative impacts (Weeks *et al.* 2011)

Conclusion: If society wishes to minimize risks associated with moving species while maximizing potential benefit to species recovery, then scientists, government agencies, organizations, and commercial entities should work collaboratively on planning, implementing, and monitoring assisted colonization projects

For additional information

Shirey, PD, and Lamberti GA. 2010. Assisted colonization under the U.S. Endangered Species Act. *Conservation Letters* 3: 45-52.

Shirey, PD, and Lamberti GA. 2011. Regulate trade in rare plants. *Nature* 469: 465-467.

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lab website: <http://www.nd.edu/~strmec>
personal website: <http://www.nd.edu/~pshirey>