

COMMENT

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To aid conservation of the species, volunteers legally plant a Florida *torreya* outside its historical range.

Regulate trade in rare plants

Patrick D. Shirey and Gary A. Lamberti call for action to stem the rising tide of species redistribution caused by Internet sales.

Fewer than ten cabbage-on-a-stick plants (*Brighamia insignis*) are all that remain of the wild population in Hawaii. Yet for US\$29.99, anyone could buy the succulent at online auction. Thanks to loosely regulated Internet commerce and efficient shipping, people are increasingly obtaining endangered or threatened plants, legally and illegally, and moving them outside their native ranges.

The introduction of non-native plant species causes ecological and economic harm — at an estimated cost of more than \$30 billion a year in the United States alone¹ — by damaging crops, pastures and ecosystems. For example, the Australian paperbark tree (*Melaleuca* spp.) is a noxious weed in the United States, causing millions of dol-

“People are increasingly obtaining endangered or threatened plants, legally and illegally, and moving them outside their native range.”

lars of damage, even though its habitats are considered threatened in Australia owing to coastal development². Moreover, the trade in endangered plants can severely affect wild populations by introducing plant pathogens or increasing wild-plant harvesting. In the 1980s, for example, the export of more than 60 million wild bulbs a year from Turkey to the Netherlands significantly depleted wild populations of several rare Turkish species, including snowdrops (*Galanthus* spp.) and cyclamen (*Cyclamen* spp.)³.

Environmental agencies and governing bodies must better enforce existing species-protection laws, and establish legal frameworks to monitor and manage this rising tide of species redistribution.

SELLING OUT

Last year, we searched through thousands of websites containing the phrases ‘seeds for sale’ or ‘plants for sale’ to determine how many of the 753 plants listed as threatened and endangered under the US Endangered Species Act can be purchased online. We found that nearly 10% are being sold or at least advertised online and are available for in-state purchase. Most of these sales are illegal: of the more than 50 sellers we ▶



► found offering to ship plants between states, just four had the appropriate interstate commerce permit issued by the US Fish and Wildlife Service (FWS), which costs \$100, involves minimal paperwork and can be obtained in three months.

About half the endangered plants available to buyers in the United States are sold in states outside their native range. Some are even sold overseas. For example, the star cactus (*Astrophytum asterias*) is found in only a few locations in Texas and Mexico, but cultivars can be bought online from at least six states and several countries, including China, Japan, Australia, the United Kingdom and Canada.

“The purchasers of rare and endangered plants include those trying to protect them.”

Part of the problem is the failure to enforce existing laws. It is also relatively easy for sellers to exploit weak links in the current legislation.

Under federal law, the FWS can regulate sales between states but not within them. For example, it is legal to sell the endangered Florida torreya (*Torreya taxifolia*) within South Carolina even though the native range of the plant is in Florida and Georgia. If a plant's distribution expands through illegal sales, however, more sellers are likely to start offering it. Because it is legal to transplant plants anywhere in the United States if they are privately owned⁴, subsequent transfers

between states (as well as sales within them) become increasingly difficult to control. Ultimately, state laws may have a bigger effect on trade than federal law, but these vary widely, with most being more lenient towards commerce than the federal law⁵. Although some states such as Connecticut strictly regulate commerce, 25 states, including Alabama, Arkansas, West Virginia and Wyoming, lack laws protecting endangered species or allow trade without restriction, meaning that collection, trade and redistribution can go unchecked.

A HELPING HAND

Most online shoppers seem to be amateur horticulturalists seeking flowers for their gardens. But anecdotal evidence from online forums suggests that the purchasers of rare and endangered plants increasingly include those trying to protect them.

Assisted colonization — the movement of species or genetic subtypes to non-native environments where they are expected to thrive — has been proposed by conservationists as a way to preserve species at risk of extinction. This idea has grown in popularity worldwide as the effects of climate change have become more apparent, and scientists have begun to investigate where and when assisted colonization might work⁶. For instance, for the past two years, foresters in British Columbia, Canada, have been moving seedlings of commercially harvested pine and hardwood species to nearly 50 experimental reforestation sites. Historically, the

strains being transferred haven't grown in these sites, but they are expected to flourish under climate change⁷.

In the United States, the FWS allows biologists to conduct assisted colonization of animals only if they can demonstrate that a species' original habitat has been altered irreversibly. Such restrictions don't apply to plants⁴.

Several individuals and citizen groups have already begun to apply the approach to rare plant species. The Torreya Guardians, for example, a group of volunteers including botanists and professional conservationists largely based in Florida, Georgia, North Carolina and South Carolina, have been cultivating seedlings of the Florida torreya since 2005, and planting them outside the plant's formally described historical range (although the Torreya Guardians argue that the species may have thrived there during the last peak interglacial warm period⁸).

It is highly unlikely that the US Congress will change the law on the transport of listed species between states, in part because altering environmental legislation takes such an enormous bipartisan effort. (Also, people have been free to move privately owned plants around for thousands of years.) However, the FWS can tighten trade restrictions without waiting for the government to change the Endangered Species Act.

The agency should work with legitimate sellers to monitor the movement of plants and enforce existing legislation. As a first step, it should establish dedicated surveillance teams



For sale online: the American lotus (far left) is listed as threatened or endangered in three states (Michigan, New Jersey and Pennsylvania) but banned in Connecticut as potentially invasive. The Tennessee coneflower, the Florida *torreyia*, the star cactus, and the cabbagewort plant (pictured from left to right) are all listed under the US Endangered Species Act.

to monitor online transactions; for instance, low-cost automated search engines could trawl for species names along with phrases such as 'plants for sale' or 'add to cart'.

The agency could also restrict the ability of consumers to buy hybrids bred from endangered species. Currently, these are not formally regulated⁹ — allowing breeders to cultivate the unique characteristics of rare plants while evading endangered-species laws. Yet hybrids can have serious implications — good and bad — for the management of wild populations. Take the Tennessee coneflower (*Echinacea tennesseensis*). The FWS proposed delisting this endangered species in August 2010 in part because nursery-propagated plants have helped to re-establish 20 colonies in the species' historical range. The agency also suspects that the commercial availability of plants reduces the poaching threat to wild populations. Yet, in 2003, a commercial grower created a morphologically similar hybrid (*E. tennesseensis* × *Echinacea purpurea*) — a cross between the Tennessee coneflower and the purple coneflower.

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This could further improve the survival of the wild plants by reducing poaching, or it could pose a significant risk if it infiltrates the historical range of the Tennessee coneflower.

A thornier issue is how to regulate the trade and movement of plants in assisted-colonization efforts. The FWS and other government agencies face an enormous challenge in trying to manage biodiversity loss in the face of climate change with inadequate resources.

Individuals and citizen groups should not take the lead on this because of the risks associated with introducing any species. Instead, the FWS should carry out controlled pilot studies first, possibly using the grass-roots resources of volunteers. The agency has begun to make moves in this direction. A five-year review of its Florida *torreyia* recovery plan includes a proposal to work with the *Torreyia* Guardians on an assisted-colonization project if other approaches fail.

COORDINATE AND CONTROL

The management of natural resources under climate change is at once a local problem, and a national and international one. Ideally, the diverse range of state laws governing the protection for endangered species in the 50 US states, or lack thereof, should be replaced with a uniform and rigorous policy — admittedly a lofty goal for lawmakers. Similarly, worldwide, all exporting and importing countries should coordinate to ensure that domestic laws are enforced and treaties, such as

the Convention on International Trade in Endangered Species of Wild Fauna and Flora, are abided by¹⁰.

Although the redistribution of plant species around the world is nothing new, the ease with which people can now obtain and transfer specimens is unprecedented. This, combined with a growing interest in assisted colonization, makes it more important than ever for federal and local governments to wrest control of illegal Internet trade, develop a policy for hybrids and ensure that genetic diversity is considered when propagating plants. ■

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1. Pimentel, D., Zuniga, R. & Morrison, D. *Ecol. Econ.* **52**, 273–288 (2005).
2. Ricciardi, A. & Simberloff, D. *Trends Ecol. Evol.* **24**, 248–253 (2009).
3. Read, M. *Onyx* **23**, 127–134 (1989).
4. Shirey, P. D. & Lamberti, G. A. *Conserv. Lett.* **3**, 45–52 (2010).
5. Goble, D. D., George, S. M., Mazaika, K., Scott, J. M. & Karl, J. *Environ. Sci. Policy* **2**, 43–59 (1999).
6. Richardson, D. M. et al. *Proc. Natl Acad. Sci. USA* **106**, 9721–9724 (2009).
7. Marris, E. *Nature* **459**, 906–908 (2009).
8. Barlow, C. in *Gaia in Turmoil: Climate Change, Biodepletion, and Earth Ethics in an Age of Crisis* (eds Crist, E. & Rinker, H. B.) Ch. 10 (MIT Press, 2009).
9. Ellstrand, N. C. et al. *Bioscience* **60**, 384–388 (2010).
10. Phelps, J., Webb, E. L., Bickford, D., Nijman, V. & Sodhi, N. S. *Science* **330**, 1752–1753 (2010).