23

HAVE YOU SEEN THIS FISH?

It looks and reads just like an FBI "Most Wanted" poster.[1] Neatly centered around a color photograph of a large, snakelike fish, the text reads:

Northern Snakehead
Distinguishing Features
Long Dorsal fin * small head * large mouth * big teeth
length up to 40 inches * weight up to 15 pounds
HAVE YOU SEEN THIS FISH?
The northern snakehead from China is not native to
Maryland waters and could cause serious problems if
introduced into our ecosystem.
If you come across this fish,
PLEASE DO NOT RELEASE.
Please **KILL** this fish by cutting/bleeding
as it can survive out
of water for several days and **REPORT** all catches to
Maryland Department of Natural Resources
Fisheries Service. Thank You.
Phone: 410 260 8320
TTY: 410 260 8835
Toll Free: 1 877 620 8DNR (8367) Ext 8320
E-mail: customerservice@dnr.state.md.us

The northern snakehead has certainly impressed the media. *National Geographic* describes it as "an air-breathing, land-crawling, voracious predator."[2] A CNN feature began by asking, "What has a head like a snake, a mouth full of teeth, a long dorsal fin, and the ability to live out of water and waddle around for days at a time?"[3] *CBS Evening News* was even more dramatic, leading its July 2, 2002, story with, "No one is sure how many of them are out there, but every one of them is wanted, not dead or alive—just dead."[4] Other stories promptly dubbed the creature "FrankenFish."

Channa argus is indeed an impressive predator. It has a primitive but effective lung and can live on land for up to four days (longer in wet, muddy conditions). It can also walk ("wiggle" would be more accurate) and travel as far as 100 yards across land in the right conditions. It reaches three feet in length and fifteen pounds in weight and grows rapidly. A voracious top-level predator, it has no natural enemies and can consume fish up to one-third as long as its own body. According to experts at the U.S. Geological Survey (USGS), it might be able to destroy or displace the native top predators in many North American waterways. "You're talking about a total rearrangement of the food chain when you introduce a top predator like this," said an ichthyologist with the USGS in Florida.[5] *Channa argus* is also a prodigious breeder. Mature females lay as many as 15,000 eggs and breed as many as five times per year. Both parents guard the newly hatched larvae in a protected nest. But the snakehead, a native of China, where it is considered a delicacy, is not an alien from outer space. It cannot tolerate salinity and thus will not threaten species or ecosystems in the Chesapeake Bay region.

On May 18, 2002, an angler caught an eighteen-inch northern snakehead in a small pond in Crofton, Maryland, about twenty miles northeast of Washington, D.C. Not knowing what the fish was, he photographed it and released it. By early June, the Maryland Department of Natural Resources (DNR) had identified the fish from the photographs: *Channa argus*. It was not the first live snakehead taken in U.S. waters: Single specimens have been caught in half a dozen other states, including Virginia, Massachusetts, and Washington. But when another angler caught a twenty-six-inch snakehead in the same pond on June 30, alarms went off: The second fish was six inches longer than the specimen photographed in May. As a biologist with the Maryland DNR noted rhetorically, "Either the fish grew eight inches in a few weeks or we have more than one in the pond. Our biggest fear is that they'll reproduce."[6]

Aggressive investigation by the Maryland DNR quickly determined that there were exactly two fish in the pond in the summer of 2000. That was

when the two snakeheads were dumped into the pond by a Maryland resident who had purchased the live fish at a market in New York. (He told authorities that he had intended to make a soup but changed his mind and released the fish.) After the second fish was caught in 2002, Maryland authorities immediately sandbagged the 100-yard channel leading from the pond to the Little Patuxent River and launched a publicity campaign to enlist local anglers in their attempt to catch and kill any more fish that might be in the pond. The critical question was whether the original two were male and female and, if so, whether they had bred. DNR officials got that answer in mid-July, when they netted more than 100 young snakeheads (apparently hatched in spring 2002 and measuring up to four-and-a-half inches long) in the pond.[7]

The DNR's immediate goal was simple: "eradication as expediently as possible."[8] But eradication would not be easy: The pond is too clogged with weeds to use either netting or electroshock. On July 19, a twelve-member panel of scientists advised Maryland to poison the pond with rotonene. Rotonene, which is absorbed through the gills and disrupts oxygen flow, is extracted from the roots of tropical plants and eventually degrades, leaving no long-term toxins. In tests conducted on July 23 at the University of Maryland, the rotonene was "highly effective" on three- to four-inch juvenile snakeheads captured from the pond. Experts hoped it would kill the adults as well but were prepared to drain and filter the entire four-acre pond if necessary.

On September 4, 2002, DNR employees poisoned the pond with rotonene. Over the next few days, more than 1,000 juvenile and six adult snakeheads were recovered. All were dead, as were sentinel fish released at multiple locations in the pond to monitor the rotonene's toxicity. In a press release on September 17, officials declared, "The application of rotonene was successful and has killed all the fish in the pond." The next day, the DNR treated the pond with potassium permanganate to neutralize any poison remaining in the pond.

For DNR Director Schwaab, the lesson is clear: "Perhaps most importantly, this situation again points out the responsibility we all share to refrain from purposeful release of fish to our waterways and to take great care to prevent even accidental introductions of non-native bait, plants or other species."[9] Federal officials have responded as well. On September 21, 2002, the secretary of the interior added all twenty-eight known snakehead species to the list of injurious species. The listing makes it illegal to import the fish into the United States and to transport the fish across state lines.

DISCUSSION

Invasive marine species can disrupt native ecosystems in many ways. They can decrease the biodiversity of a system by driving native plant or animal species to extinction. They can degrade water quality, contribute to soil erosion, or even clog waterways. Other invasive species that are of particular concern in North America include the zebra mussel (a small mussel native to the Caspian and Black Seas) and the nutria (a beaverlike rodent native to Argentina and Chile). The nutria has destroyed millions of acres of wetlands along the Atlantic and Gulf coasts, the Great Lakes, and the Pacific Northwest by destroying the roots of marine plants that hold the wetlands substrata together.

Nevertheless, exotic marine species are a very old problem. Several studies of major U.S. waterways have reached the same conclusion: at least 139 nonindigenous algae, plants, invertebrates, fishes, and fish pathogens (including the zebra and quagga mussels, sea lamprey, Eurasian water milfoil, purple loosestrife, and common carp) have been introduced into the Great Lakes alone since the 1830s;[10] about one new species a year has been introduced to the Chesapeake Bay system since the mid-nineteenth century;[11] and about one new species per year has been introduced to the Hudson River system since 1840.[12]

So-called exotic, feral, newcomer, or interloper species are at the center of many environmental controversies. In this volume, they appear in Case 22: Saving Mink, Killing Voles, Case 24: Australian Cats, and Case 25: Hawaiian Feral Pigs. But as either a conceptual or an empirical matter, it is not easy to say exactly which species deserve such a designation. Clearly, our first, intuitive understanding of the concept makes some appeal to the notion of human involvement: A species that reaches a new biosystem under its own power or by the action of "natural" systems is not an interloper; a species imported by human settlers is. But this distinction is fraught with difficulties, not the least of which is its implicit assumption that whatever humans do is, ipso facto, not natural.

The intuitive assumption is rather more complex: To most people, efforts to reintroduce species to habitats in which they once thrived (see Case 5: Yellowstone Wolves and Case 26: Tasmanian Tigers) seem very different than efforts to introduce new species to habitats in which they have never thrived—yet both involve human agency. In most cases, this may be because humans were involved in the past disappearance of the species to be reintroduced. But this need not be the case. Suppose that the last regional colony of a particular variety of marmot had been obliterated by the explosion of

Mount Saint Helens on May 18, 1980. And suppose that now, the mountain's alpine ecosystem having restored itself, the U.S. Forest Service were to reintroduce marmots to Mount Saint Helens using animals captured on Mount Rainier. It would seem absurd to regard these reintroduced marmots as interlopers simply because their 1980 disappearance had been caused by natural rather than human action.

QUESTIONS

1. What does this case have in common with the other exotic species cases (Case 5: Yellowstone Wolves and Case 26: Tasmanian Tigers) in this volume? How is it different?
2. When comparing the ethical and public policy questions raised by the cases of different exotic species in this volume, which factors seem most or least important to you? The kind and degree of human agency involved, for example, whether the release was accidental or deliberate? Well- or malevolently intentioned? The impacts of the introduced species on native species, on the ecosystem, or on human social and economic systems? How long the introduced species has been in the ecosystem? The extent to which the ecosystem had already been altered by human activity? The relative rarity or uniqueness of the ecosystem? Why are the factors you select important? Is there a moral or policy theory that explains your selections?
3. Exactly what are the criteria for regarding a particular species as an interloper in a particular biosystem? Are *exotic*, *feral*, *newcomer*, and *interloper* simply empirical terms, or does each involve a set (perhaps even a different set) of value judgments?
4. Assuming that the concept of being an exotic species can be made clear, is it also useful? That is, does knowing that a particular species is exotic in a particular ecosystem help us make better moral or public policy decisions regarding either the species or the ecosystem?
5. The person who released the original pair of northern snakeheads into the Crofton pond has been identified and has admitted releasing the fish. But because the Maryland statute banning the release of exotic species has a two-year statute of limitations, he cannot be criminally charged. Should the statute of limitations for such actions be longer than two years? How long?

6. Reread the comments of Director Schwaab. Is the responsibility he articulates ethically serious? Should it be legally serious as well? Should individuals who deliberately or accidentally release an alien species into a new ecosystem be statutorily responsible for the costs associated with control and eradication efforts? If control and eradication efforts fail, how can one be held accountable for long-term damages that may be beyond estimation?
7. The northern snakehead is considered a delicacy in China. Some might say that if it manages to spread and drive out the native top predator species in some North American lakes and rivers, it has only proven itself to be "more fit" under "nature's laws." What moral or ecological considerations justify the Maryland DNR's immediate decision to eradicate the fish as expeditiously as possible? Does it have as much "right" to a niche in the Crofton pond or the Little Patuxent River as any other species?
8. Poisoning the pond with rotonene has apparently eliminated the snakehead. It also killed every other fish in the pond. Is so much destruction justified to eliminate a single species?

NOTES

1. The poster is available at www.dnr.state.md.us/fisheries/fishingreport.

2. Hillary Mayell, "Maryland Wages War on Invasive Walking Fish," *National Geographic News* (online ed.), July 2, 2002, available at http://news.nationalgeographic.com/news/2002/07/0702_020702_snakehead.html.

3. "Wanted: Snakehead," *CNN News Online*, July 12, 2002, available at http://fyi.cnn.com/2002/fyi/news/07/12/news.for.you.

4. "Wanted Dead: Voracious Walking Fish," *CBS Evening News*, July 3, 2002, available at www.cbsnews.com/stories/2002/07/03/eveningnews/main514182.shtml.

5. Walter Courtenay, quoted in "Scientists Suggest Poisoning Alien Fish," *CNN News Online*, July 20, 2002, available at www.cnn.com/2002/US/07/20/alien.fish.ap.

6. Mayell, "Maryland Wages War on Invasive Walking Fish."

7. "Scientists Suggest Poisoning Alien Fish."

8. Eric Schwaab, "Director's Corner," July 2002, available at www.dnr.state.md.us/fisheries.

9. Schwaab, "Director's Corner."

10. E. L. Mills, J. H. Leach, J. T. Carlton, and C. L. Secor, "Exotic Species and the Integrity of the Great Lakes: Lessons from the Past," *Bioscience* 44, no. 10 (1994): 666–76. See also the same authors' "Exotic Species in the Great Lakes: A

History of Biotic Crises and Anthropogenic Introductions," Great Lakes Fishery Commission: Research Completion Report 117 (Brockport, N.Y.: National Aquatic Nuisance Species Clearinghouse, 1991).

11. Mills et al., "Exotic Species and the Integrity of the Great Lakes."

12. E. L. Mills, M. D. Scheuerell, D. L. Strayer, and J. T. Carlton, "Exotic Species in the Hudson River Basin: A History of Invasions and Introductions," *Estuaries* 19, no. 4 (1996): 814–23.

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"Wanted Dead: Voracious Walking Fish." *CBS Evening News*, July 3, 2002. Available at www.cbsnews.com/stories/2002/07/03/eveningnews/main514182.shtml.

"Wanted: Snakehead." *CNN News Online*, July 12, 2002. Available at http://fyi.cnn.com/2002/fyi/news/07/12/news.for.you.