



# The Great Mushroom Escape

Imported golden oyster mushrooms have spread from farms and home-grow kits into the wild, where they threaten native species.

By **Brian Banks**

GOLDEN OYSTER MUSHROOMS

Since his retirement, John Downey has focused on two activities: mushroom cultivation and foraging, and beekeeping. Every Saturday, from May through October, he and his wife, Tess, sell mushrooms and honey at the Port Hope Farmers' Market. "Once the morels and the pheasant backs are done [in early spring], I'm busy with my bees," says Downey. "When I get some free time, the chanterelles are going to be out. Chicken of the woods and a few others take me into July and August, and then we're into early puffballs."

Lately, he's heard a lot about a new species: golden oysters. These edible Asian mushrooms were first imported to North America in the early 2000s as a cash crop for commercial producers and home-grow kits for the public. Popular for their nutty flavour, golden oysters are now a hot topic among growers, foragers, botanists and forest ecologists for a different reason: about 15 years ago, this species found its way out into the wild and immediately took hold, spreading rapidly into at least 25 U.S. states and, more recently, Ontario and Quebec. The Downeys have yet to see the bright yellow mushrooms in a forest, but Tess sees plenty of photos and recipes on social media. "People are saying they're invasive," she says.

Experts agree. Earlier this year, the Invasive

Species Centre (ISC), a non-governmental organization based in Sault Ste. Marie, added the golden oyster mushroom to its list of species that are established in Ontario and threaten native animals and plants. According to Sophie Anderson, the centre's terres-

health and the big picture of climate change," she says.

Since golden oysters do not attack live, healthy trees as do some fungal pathogens, they aren't considered a threat to the forestry industry. However, the first study of golden oysters' impact on native fungi, which researchers at the University of Wisconsin–Madison published last year, has raised considerable concern. The study found that dead elms that golden oysters colonized had only half the fungal species diversity of other dead elms. "Since fungi provide ecosystem services ..., loss of native species could dramatically alter how an ecosystem functions," write the authors. Those services include breaking down dead matter, recycling nutrients, removing environmental contaminants and enabling interactions between different tree and plant species.

Golden oysters could also wipe out native species, including fungi known to have pharmaceutical benefits, such as the mossy maze polypore that contain compounds with antioxidant and antimicrobial properties, says Aishwarya Veerabahu, a PhD candidate who led the Wisconsin study. That loss could have a profound long-term impact, says Bob Bowles, an ecologist and seasoned mushroom forager who leads the Ontario Master Naturalist Certificate Program at Lakehead University. "We think of mushrooms as working in the ecosystem together," he says. "But now you get one that doesn't support native species and may even work towards their demise. That's a big concern."



**Cultivated spread:** *Once a prized edible crop, introduced golden oysters have a dark side.*

trial programs and outreach coordinator, the biggest concerns are the golden oyster's ability to outcompete native fungi and its capacity to accelerate the decomposition of the dead trees on which it grows. "Increased decay rates, increased CO<sub>2</sub> release—these things are important factors in ecosystem

**Fungal fallout:** *Golden oysters are reducing fungal diversity in forest ecosystems.*



BLACK MOREL MUSHROOM



GIANT PUFFBALL



CHANTERELLE MUSHROOM



GOLDEN OYSTER MUSHROOMS

**W**orldwide, there are numerous species of oyster mushrooms, many of which are cultivated or foraged for food. All are saprotrophic, which means they feed on dead organic matter by excreting chemicals via their mycelium (the root structure of fungi) that break it down so they can digest it. (Mycelium consists of many long strands of hyphae that grow in soil, wood or other substrate; what people typically call “mushrooms” are the fruiting body from which a fungus releases spores to reproduce.)

Oyster mushrooms have fan-shaped caps, either flat or slightly convex, that are typically under 10 centimetres in diameter. These mushrooms grow in clumps directly out of dead wood and have short or absent stems. Native oyster mushrooms in Ontario are easy to distinguish from golden oysters by their colour—white or grey rather than brilliant yellow. But that is not the only

difference. Golden oysters can grow very quickly, creating the fruiting body in three to five days versus five to seven for native varieties, and can produce billions of spores a day. While native oyster mushrooms fruit mainly in cool spring weather, golden oysters have multiple flushes of fruiting bodies per year, from May to October. In the wild, golden oysters are most commonly associated with elm trees but can grow on many different dead hardwoods (including maple, cherry, ash and beech) as well as in straw, sawdust, even coffee grounds.

All of these attributes give golden oysters “a competitive edge” over native fungi, says Monica Liedtke, the ISC’s terrestrial invasive plant coordinator. “Like all invasive species, they come in and outcompete very quickly, with few to no predators. And that’s exactly what’s happening with golden oyster mushrooms.”

Mushroom grower and forager groups

**Spreading spores:** *Climate change and improperly discarded grow kits spread this invasive species in Ontario.*

commonly post pictures of golden oysters on social media. The most comprehensive sources for sightings in the wild, however, are Mushroom Observer, a mycology community site, and the iNaturalist database, which the Wisconsin team used in its study. As of mid-July, just over 100 reports have been verified in Ontario, chiefly in the southwest and south of Georgian Bay. The total for the United States and Canada is about 14,300, mainly in the U.S. Midwest around the Great Lakes and along the eastern seaboard from Vermont to Virginia.

But the invasion is unlikely to stop there. Modelling by the Wisconsin researchers suggests that golden oysters’ range will continue to expand to other hardwood forests in the United States and Canada, aided by a

warming climate. Here, that could take the species east through southern Quebec and into Atlantic Canada, and potentially into coastal zones in the west. “How far north they push will unfortunately tie to climate change,” says Veerabahu.

Given that early golden oyster sightings were geographically disperse, scientists are certain that they were introduced into the wild at multiple locations. Commercial cultivators are one potential group of culprits, but some experts point the finger at improperly disposed home-grow kits, which are widely available online and in some retail stores. “If you throw [the kit] in your green bin or compost or in the woods, that’s a great way for [spores] to spread,” says Sara Scharf, vice-president of the Mycological Society of Toronto. “If someone has golden oysters in their home, they can put them in the garbage

for collection (they’ll be taken to a landfill), or burn them.”

Once the mushrooms are established in the wild, natural dispersal through spores



## We can wrap our heads around insects and plants that are invasive. But a mushroom? It’s like Pandora’s box.

takes over. “If the timing is right and the wind is in the mushroom’s favour, you can get spores spreading a really far distance,” says Liedtke. “And once it’s out there, it’s pretty much there to stay.”

While a handful of online retailers have voluntarily stopped selling golden oyster grow kits, the Ontario government has yet to add the mushroom to its prohibited or restricted invasive species list. That means golden oyster cultivation and sale of grow kits are likely to continue in the province, increasing the risk of further spread. Mike Fenn, a spokesperson for the

provincial Ministry of Natural Resources, says the Natural Heritage Information Centre, which focuses on tracking native species and species at risk, is not currently monitoring the species. For these reasons, Liedtke says, now is a critical time for more research, public education and reporting of golden oyster sightings. “That really helps to keep conversations going and get attention on the topic.”

Further study is also needed to determine how much golden oyster mushrooms accelerate decomposition. Currently most forest ecosystems are balanced between two classes of fungi: white-rot and brown-rot. White-rot fungi, which include golden oysters, break down wood faster than brown-rot fungi, and, according to Anderson, experts worry that if golden oysters push out native brown-rot fungi, the rate of decay will increase. This not only raises the spectre of faster CO<sub>2</sub> release into the atmosphere, she says, but also could diminish critical habitat and food sources for many species—from insects, salamanders and reptiles to birds and small mammals—that live in decaying logs, snags, stumps and other woody forest floor debris.

Ecologists studying threats to forest floor ecology have typically focused their concern on logging practices that remove too much of this debris. Now they face the potential of a new, stealthier threat about which there are still more questions than answers.

“We can wrap our heads around insects and plants that are invasive,” says Bowles. “But a mushroom? It’s like Pandora’s box.” 🦋

**Brian Banks**, a writer and editor, wrote about rollbacks to protections for species at risk in the previous issue.



MOREL MUSHROOM

## Rules of Responsible Foraging

Interest in foraged mushrooms as a renewable food source has increased in recent decades. But that renewability depends on pickers using care and common sense, which includes steering clear of areas where foraging is illegal, such as provincial parks.

Foragers need to bear in mind that fungi produce mushrooms (fruit) to release spores and reproduce. “If people take these mushrooms before they’ve had a chance to release their spores, they’re reducing the organisms’ ability to spread, to reproduce and to perpetuate themselves,” says Sara Scharf of the Mycological Society of Toronto (MST).

Responsible pickers always leave more behind than they take, but even that has its limits, says Scharf. “If you tell people, ‘Only take 10 percent,’ but everyone takes [that much], so few may be left that they may not be able to reproduce sustainably.” For this reason, the MST discourages mushroom foraging, especially for beginners—“both from an ecological perspective and because there is a risk involved, as many edible mushrooms resemble toxic ones, especially to beginners, and there are deadly species in Ontario.”

For knowledgeable foragers, Andrew Langevin, founder of Nature Lion, a mushroom-cultivation and product company in Brantford, offers these additional tips: to preserve the mycelium (or body) of the fungi: do not disturb the forest floor; vary picking locations; and to prevent damage to host fungi, always cut mushrooms rather than pulling them out.

—**Brian Banks**