



From Pest to Profit:

Exploring Market Forces as a Tool
for Managing Invasive Species



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Invasive silver carp in the tailwaters of Bagnell Dam on the Osage River in Lake Ozark, Missouri. © ginospotos / iStock

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Important Information

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Executive Summary

Invasive species are a major environmental, economic, and social threat. They have contributed to 60% of global extinctions¹, are estimated to cost \$423 billion annually (with costs increasing fourfold each decade)², and can spread disease, degrade recreational areas, and damage local infrastructure and businesses. The end goal for invasive species management has traditionally been eradication, but many are now endemic and, for all intents and purposes, are un-eradicable.

In 2024, WWF released a [report](#) examining the potential to use market forces as a tool to hold in check and then reduce invasive species when eradication is not possible. WWF began by examining invasive carp species and the potential to build robust pet food demand for the fish. While carp is nutritious, there hasn't historically been a large market for human consumption of carp in the United States. It is a very bony fish, limiting uptake since it cannot be easily fileted, though technology continues to advance.

While human consumption may become a significant market for carp, it has several near-term hurdles. However, bones don't pose the same threat in pet food. Through WWF's work in Phase I, we found that a lack of large-scale processing of the fish has

been an obstacle to realizing the full potential of the pet food market. To put it succinctly, while there is an overabundance of carp in many rivers and streams, there is no way currently to tap into the large seafood demand in the pet food industry.

Looking at invasive species more generally, while markets can be a useful tool in addressing certain invasive species, considerable gaps exist that hinder moving most invasive species forward – if it were easy someone would probably have already done it. Throughout 2025, WWF focused its Phase II efforts on better understanding the market hurdles by developing the “Markets Use for Invasives” framework as well as supporting first-hand what it takes to get carp capture and processing efforts to scale.

[Chippin](#), an environmentally conscious pet food company, has launched a new business venture – IGNIZA – to scale the use of invasive species in the pet food industry. The company's processing ‘Fishility’ is located inside a former limestone mine in the greater St. Louis region. The site offers cold/frozen processing and storage, docks, and office space. By situating in a former limestone mine with a steady year-round temperature of 58° F, IGNIZA enjoys significant energy savings, an environmental and financial win that demonstrates a clear opportunity to repurpose an abandoned asset. The company



has also onboarded fishers; completed multiple successful trial runs; and secured a number of key contracts with major pet food companies.

This processing serves as an important proof of concept of what is possible. It will demonstrate how market uses can hold an invasive species in check and then draw down the population to a more acceptable level in the environment that also makes sense economically. Learnings from this effort will be applicable to a wide variety of species and products, bringing environmental, economic, and social benefits to other regions.

As WWF has worked with carp, however, we have found that while markets can be a useful tool in addressing certain invasive species and unlocking the benefits markets can bring to a region, there are also considerable hurdles in moving these efforts forward: namely, there must be ecological research documenting that market demand is a tool that can result in environmental benefits (not further harm). In addition, there must be a use for the product in markets.

This is a new approach to addressing invasive species. Many of these questions haven't been asked, much less fully probed, before.

To address this challenge and support this novel approach to fighting invasive species, WWF has created a 'Market Uses for Invasive Species' framework, presented below. It includes an explanation of why invasives matter, ecological and business checklists, examples of how the checklist would be applied to carp and black locust trees, and additional analysis and considerations that have been identified by our research thus far. This is meant to be a living document that serves as a jumping off point for further research and dialogue.

WWF is eager to catalyze further efforts. This may include continuing to revise, refine, and share the framework, spurring efforts through incubation and business support, developing case studies and categorizing lessons learned, and ensuring that all collected information and analysis has an easily accessed home for the long-term. Ultimately, our goal is to support a 'markets for invasives' ecosystem that lives beyond WWF's involvement. Invasive species are one of the largest threats to biodiversity and we are eager to harness market forces, where applicable, to help address this scourge in an environmentally, economically, and socially beneficial way, in line with WWF's key goals of endangered species conservation and invasive species management, in support of our broader mission of protecting the natural world and its resources.





Invasive silver carp (*Hypophthalmichthys molitrix*) caught by the Illinois DNR. © Keith Arnold/WWF-US

Phase I Work

Invasive species are a major environmental, economic, and social threat worldwide. They are a significant threat to biodiversity and currently threaten about 230 terrestrial vertebrate species.³ Invasives are estimated to have cost the world \$1.3 trillion over the past 50 years, with costs increasing fourfold each decade.⁴ They can also spread disease, degrade recreational areas, and harm local infrastructure and businesses. In general, one of the reasons invasive species cause so much harm is that their high proliferation rates outcompete native species. In 2024, WWF released a Phase I report examining the potential to use market forces to fight invasive species. To date, most invasive species efforts focused on containment and removal, which is a costly and time-intensive strategy. While this effort can sometimes be effective and may be needed in certain areas and for certain species, other species that are endemic and not eradicable may be ripe for market forces, which could reduce invasive species' numbers and help restore native biodiversity and ecosystem function.

WWF began its work by examining invasive carp and the potential to build robust pet food demand for the fish. Four species of carp – silver, grass, black, and bighead – were intentionally introduced into the US in the 1970s as a way to clean aquaculture retention ponds. The wily fish quickly escaped into the Mississippi River and its tributaries where, with no natural predators, it proliferated. Today, some estimates suggest that carp can make up to 95% of biomass in parts of the Mississippi and Illinois Rivers. As prolific breeders with a fast growth rate and high adaptability to new and changing conditions, carp have spread quickly, causing environmental and economic harm.

Historically, there hasn't been a market for carp in the United States. Carp is a highly nutritious and mild-flavored fish, but it has limited uptake in US markets since it is also extremely bony, making it difficult to cleanly filet the fish for human

consumption, though technology is improving. Throughout Phase I, WWF examined the pet food market, where bones do not present the same hurdle, and the potential to introduce carp into the pet food supply chain. We found that this healthy product may fill a need, particularly as pet food demand outpaces the availability of animal byproducts from human consumption, potentially leading to animal proteins being sourced solely for pet food. WWF also completed work around potential ecological endpoints, finding that medium levels of harvest could limit the spread of carp, decrease density, and improve local biodiversity.

Through this work, it quickly became apparent that there was a processing gap. Pet food companies were hesitant to invest in new, significant supply chains without seeing consistent quality supply, but entrepreneurs struggled to launch large-scale processing without commitment and interest from pet food companies. Over the past year, WWF has worked to support commercial-level carp processing as a way to unlock this opportunity and serve as a test case for how market forces can help address invasive species.

Finally, as WWF engaged in the carp work throughout Phase I, it quickly became clear that while markets can be a useful tool in addressing certain invasive species, there are considerable gaps in moving these efforts forward. Namely, there must be ecological research to ensure that market forces make sense for a given species from an environmental lens and there must be a use for the product in markets. These research needs were not typically being met by studies focused on eradication or preventing spread. WWF identified a need to build out an overarching framework to categorize species based on their suitability for market use and highlight key market and ecological steps that must be taken – leading to the creation of a framework below.



IGNIZA's 'Fishility' processing center under development inside a former limestone mine. © Chippin, Inc.

Scaling Carp for Pet Food

Over the past year, WWF has continued to work to build market demand for carp as a way to use financial forces to address an invasive species and its environmental and economic harm. This has included continuing to work to build processing and secure robust supply, sharing our research to boost market demand, and exploring additional markets.

IGNIZA and Carp Processing

Large-scale, high-quality processing has been a bottleneck in the carp supply chain across all markets. Without significant demand, it has been difficult to bring processing online. However, without that consistent product, it has been difficult to solicit market interest and commitments. WWF has been working to de-risk this opportunity by bringing together partnerships, increasing awareness, and completing ecological and market research (see [Phase I report](#).) Over the past year, strong gains have been made in this area. In particular, after incorporating carp into its own pet food, Chippin launched a new business venture, IGNIZA, to increase access to raw ingredients. The company is building a large-scale processing facility so other pet food companies can incorporate invasive species into their own products.

IGNIZA is moving forward with its processing 'Fishility' inside a former limestone mine. By locating in such a place, IGNIZA is also taking advantage of significant energy savings, an environmental and financial win. The cave stays at 58°F year-round. This consistent, cool temperature means that far less energy is needed to reach cold storage and freezing capacity. While specific data on electricity use for cooling for typical whitefish processing and storage is not available, it is likely that reduced energy demand for cooling carp during processing could reduce total emissions from processing, transport, and storage up to 40 percent. The site is also strategically located at the epicenter of both pet food manufacturing and the carp population to reduce transportation emissions.

The company has successfully developed its supply chain, procurement, and sales to scale the use of invasive carp in pet food. IGNIZA is working directly with fishers to increase catch volumes and has secured key contracts with major pet food companies.

This processing serves as an important proof of concept. WWF's effort hasn't been focused on pet food specifically or even carp, but rather on supporting a demonstration of how market forces can be used to fight an invasive species. These learnings will be applicable to a wide variety of species and products – with benefits that go beyond the environment. By building a commercial carp industry, fishers will have an opportunity to earn higher prices for carp and also see an increase in the population of native fish that they formerly sourced. Processing in the region will also create jobs and business income. Growing markets around invasives has a chance, if constructed thoughtfully, to bring environmental, economic, and social benefits regionwide.

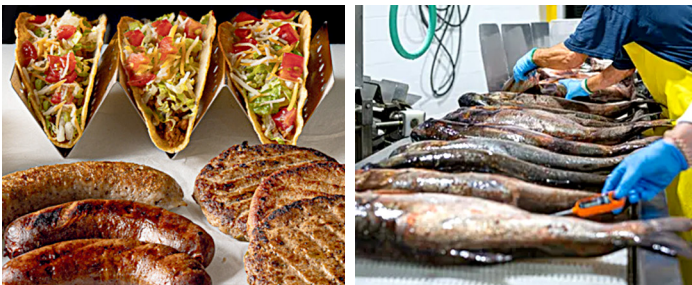
Outreach and Additional Market Demand

WWF has continued to work closely with partners to generate demand for carp. Many companies had questions around the potential environmental impact of using this fish, such as what types of biodiversity, water quality, or other benefits could their sourcing support? Based on work completed in Phase I, WWF has been able to share additional information around the potential to use market forces to limit spread of carp (especially into the Great Lakes), reduce carp density, and improve native biodiversity. Over the past year, WWF has worked to share this research through targeted outreach, and additional companies have explored adding carp to their supply chain. In April 2026, WWF will be on a panel with Mars and Inversa Leathers at the Seafood Expo Global, the largest seafood conference in the world, to discuss sourcing carp as well as other invasives more broadly.

We will continue to push outreach and communication efforts.

While pet food has provided one entry point, we have also continued to explore other markets. WWF is pursuing a partnership with the Madison Metropolitan School District in Wisconsin to test carp products in school. While bones make it difficult to produce filets, it is possible to produce a minced product that can be used in things like carp burgers, carp egg

rolls, and fish cakes. Two companies, Impact Fisheries and Two Rivers Fisheries, are now producing products like these that we hope to test in support of a river-to-school pathway. This will include the development of educational materials around invasive species and the impact of food on the environment to help turn school cafeterias into engines of innovation and learning.



By harvesting invasive fish species, Impact Fisheries, of Piedmont, Missouri, helps restore balance to U.S. rivers and lakes, ensuring the health of aquatic ecosystems while providing tasty, nutritious products. © Impact Fisheries, LLC

Two Rivers Fisheries, of Wickliffe, Kentucky, addresses the invasive carp problem by sourcing the fish from over 100 commercial fishermen, processing it into a variety of products, and exporting them to 11 countries. © Two Rivers Fisheries

Market Use for Invasives: A Framework Approach

As WWF has explored the potential to build robust pet-food demand for carp, we have found that while markets can be a useful tool in addressing certain invasive species, there can be considerable hurdles in moving these efforts forward. There must be ecological research to ensure that market forces are likely to provide environmental benefits, and there must be a use for the product in markets. Using market forces is a new approach to addressing invasive species, and many of these questions haven't been fully probed before. Tackling them will require collaboration between interested parties from both the conservation and business worlds.

To address this challenge, WWF has created a 'Market Uses for Invasives' framework to de-risk market-based solutions to address invasive species. It grounds the work in boosting and protecting biodiversity while highlighting some of the market and ecological steps that must be taken to explore suitability of this approach and bring new products to market. This framework is meant to be a living, guiding document that serves as a jumping-off point for further research and dialogue. As companies, ecologists, and others make use of the framework, it will continue to be refined, revised, and shared in the hope of spurring further innovations.

Framework (page 1)

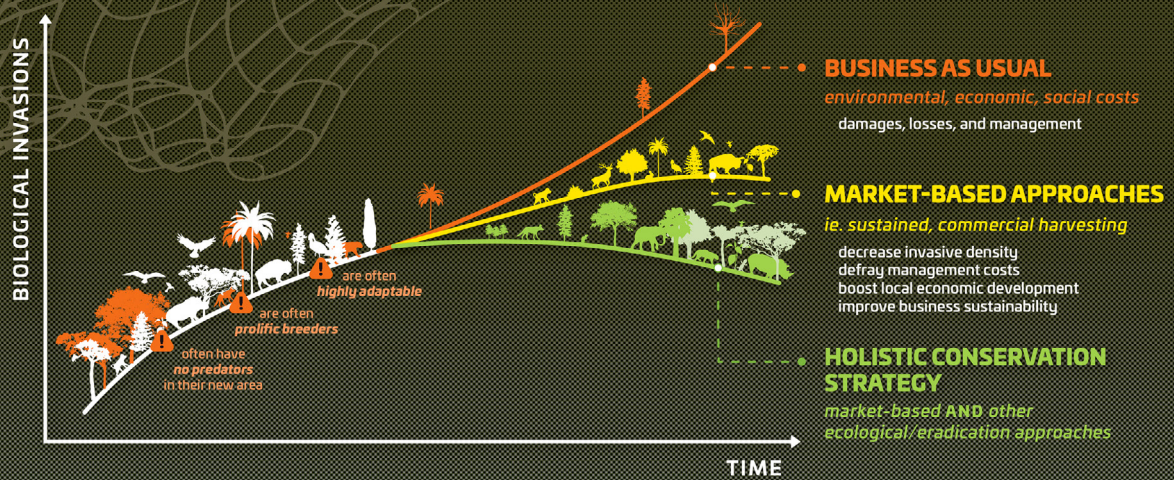
Market Uses for Invasive Species

Invasive species are animals, plants, or other organisms that are introduced by humans, either intentionally or accidentally, into places outside of their natural range, negatively impacting native biodiversity, ecosystem services, or human economy and well-being.

Invasives contributed to **60% of global extinctions**¹

Invasives cost **\$423 billion per year**, and costs increase **4x each decade**²

Invasive species cause **social harms**—
spreading disease, degrading recreational areas, damaging local infrastructure and businesses



We need new and creative approaches to add to our toolkit:

MARKET-BASED APPROACHES

If we can't eradicate a species, we may be able to find a **productive use** for it, leading to sustained harvest that not only brings **financial gains** through local product development but also drives down the invasive population, bringing **environmental wins** for native species and general ecological health.

However, due to invasive species' demonstrated ability to do ecological and economic damage, we need to assess the risks associated with harvest, in addition to ensuring the business plan is sound.

When are market-based approaches beneficial?



Species must have **value** and it must be **feasible** to source it



Risk assessment is completed




Sourcing or using this species will **make the world a better place**

¹ <https://zenodo.org/records/11254974> ² <https://www.weforum.org/stories/2023/09/invasive-species-cost-global-economy-billions/>

Framework (page 2)

Market Uses for Invasive Species Framework



STOP

Is the species **eradicable**?

Can the species be made into a **value-creating product**?

If the species **is eradicable** OR if the species **cannot** be made into a **value-creating product** THEN **DO NOT PROCEED**

STEPS

Ecological Steps

Can the species be eradicated?

Would harvesting worsen the invasion?

Are there ecologically relevant externalities to consider?

Would harvest harm native species?

Would harvest produce ecologically desirable outcomes?

Business Steps

Can the species be made into a value-creating product?

Is there a commercial opportunity?

Does market demand match environmental needs?

Is sourcing this product technically feasible?

Are there socio-cultural or reputational risks?



These are just the major questions.
Make sure you dig into the checklists below.



Ecological Checklist

1. Can the species be eradicated?

- Are there characteristics of the invasive species that make eradication unlikely (e.g. high reproductive rate, high likelihood of reintroduction, population rebounds, undetectability)?
- Is there a minimum population size to see negative environmental effects, making population control more cost-effective than eradication?
- Is the invaded range large?
- Has the invasive population been established for a long time (i.e. more than four years)?
- Would eradication harm non-target species?
- Do socio-cultural factors preclude eradication?

2. Would harvesting worsen invasion?

- Would harvest spread the invasive species further (e.g. by carrying stowaways or eggs)?
- Would harvest cause populations to increase beyond current levels?
- Should we be concerned about harvest-induced evolution for this species?
- Is there a risk of incentivized release or propagation?

3. Are there ecologically relevant market externalities to consider?

- Are there environmentally problematic complements needed for production?
- Would substitution of the invasive for current products be environmentally beneficial?
- Would market creation threaten the invasive species or its close relatives in their native ranges?

4. Would harvest harm native species?

- Is there a risk of bycatch or other direct harm?
- Have any native species become dependent on the invasive (e.g. for food)?

5. Would harvest produce ecologically desirable outcomes?

- Will harvest reduce the density of the invasive species?
- Will reduced invader density improve the ecosystem (e.g. by boosting biodiversity of native populations, preventing further spread of the invasive, improving general ecological health of an area)?
- Is the level of harvest needed to achieve ecological benefits compatible with the level of harvest needed to maintain a profitable business?



Business Checklist

1. Can the species be made into a value-creating product?

- Are there unique attributes to the species that would lead to product development? What are those attributes?
- Does the product meaningfully solve industry needs (e.g. protein shortage, sustainable materials, etc.)?
- Are there sensory or performance differences consumers must be educated about?

2. Is there a commercial opportunity?

- Is there a clear market demand for this invasive species product (food, pet food, materials, supplements, crafts, etc.)? Who would buy it?
- Is there a cost advantage?
- How does this invasive species compare to existing alternatives?
- What is the expected return on investment and timeline to profitability?

3. Does market demand match environmental needs?*

- Does harvesting truly support ecosystem restoration and not risk further spread?
- Is there enough consistent supply to support commercial scale?
- Are there ecological risks during transportation, storage, or processing?
- Is there a risk that commercialization could inadvertently increase demand beyond wild populations, incentivizing farming?

4. Is sourcing this product technically feasible?

- Can the product move through existing processing, logistics, and approval systems?
- What infrastructure is needed to scale (boats, processing plants, freezing capacity, quality control, trained harvesters or suppliers)?
- Are there safety concerns around sourcing?
- Are there traceability requirements?

5. Are there socio-cultural or reputational risks?

- What are the reputational risks?
- Will consumers understand why using invasive species is beneficial?
- How does harvesting affect local communities, fishers, farmers, etc.?
- Are there ethical concerns related to animal welfare or harvesting practices?

**Please see ecological checklist for additional information and guidance*

Examples

We applied the ecological and business checklist to two species, carp (encompassing silver, grass, bighead, and black carp) and black locust, a tree invasive to parts of the US, including the Midwest, New England, and the West, as well as to parts of Europe, Asia, South America, Australia, and New Zealand. The

analysis examines carp for pet food and black locust for lumber. This is meant to showcase, at a very high level, how to use the checklist; it is not a comprehensive analysis of all considerations around using these species.



Ecological Checklist



Carp

1. Can the species be eradicated?

- Are there characteristics of the invasive species that make eradication unlikely (e.g. high reproductive rate, high likelihood of reintroduction, population rebounds, undetectability)? **Yes – carp exhibit extremely high reproduction, population rebounds, and the ability to persist relatively undetected in small waterways.**
- Is there a minimum population size to see negative environmental effects, making population control more cost-effective than eradication? **Unknown – but catch per unit effort increases greatly as population decreases.**
- Is the invaded range large? **Yes (found in entire length of Mississippi rivers and some tributaries).**
- Has the invasive population been established for a long time (i.e. more than four years)? **Yes (first introduced in 1970s).**
- Would eradication harm non-target species? **Yes – eradication is likely only possible by such high levels of fish-killing chemicals or processes that the entire host ecosystem would be harmed.**
- Do socio-cultural factors preclude eradication? **No – carp are seen as a pest species in the invaded landscape.**

2. Would harvesting worsen invasion?

- Would harvest spread the invasive species further (e.g. by carrying stowaways or eggs)? **No.**
- Would harvest cause populations to increase beyond current levels? **Carp populations can exhibit rebound effects, but typically not enough to counteract the effect of harvest; many carp populations are overfished in their native ranges, suggesting that harvest-based suppression is possible.**
- Should we be concerned about harvest-induced evolution for this species? **Potential evidence of learned behavior for evading capture exists, but not considered a major issue.**
- Is there a risk of incentivized release or propagation? **Unlikely, as they are considered a nuisance species by most locals and are so abundant that, even with dedicated markets, there is unlikely to ever be a need to propagate.**

3. Are there ecologically relevant market externalities to consider?

- Are there environmentally problematic complements needed for production? **No – there are no specific other products needed to complement carp's inclusion in pet food.**
- Would substitution of the invasive for current products be environmentally beneficial? **Yes. Projected demand for pet food protein is likely to exceed the availability of animal byproducts from human consumption, so we expect carp will supplant livestock or fish reared specifically for pet food.**
- Would market creation threaten the invasive species or its close relatives in their native ranges? **No – though they are overfished in native range in Asia, invasive carp would be fished for US markets only.**

4. Would harvest harm native species?

- Is there a risk of bycatch or other direct harm? **Bycatch is low in carp fisheries since they occupy a different part of the water column than native species.**
- Have any native species become dependent on the invasive (e.g., for food)? **Some species eat juveniles (among other things) but there are basically no natural predators in U.S.**

5. Would harvest produce ecologically desirable outcomes?

- Will harvest reduce the density of the invasive species? **Yes.**
- Will reduced invader density improve the ecosystem (e.g. by boosting biodiversity of native populations, preventing further spread of the invasive, improving general ecological health of an area)? **Yes – models suggest harvesting source populations can prevent further spread and, at sufficiently high levels, boost biodiversity; water quality improvements are likely, too.**
- Is the level of harvest needed to achieve ecological benefits compatible with the level of harvest needed to maintain a profitable business? **Likely yes. While further analysis is needed, WWF found in its Phase I report that medium levels of harvest are likely to help prevent further spread into nearby ecosystems, to decrease carp population density, and to improve local biodiversity.**



Business Checklist



Carp

1. Can the species be made into a value-creating product?

- Are there unique attributes to the species that would lead to product development? What are those attributes? **Yes – highly nutritious fish with mild taste; abundant.**
- Does the product meaningfully solve industry needs (e.g. protein shortage, sustainable materials, etc.)? **Yes – increasing demand for sustainable products; imported fish rising in cost; pet food demand increasing faster than availability of animal protein byproducts from human consumption.**
- Are there sensory or performance differences consumers must be educated about? **No – but there may need to be education on carp generally.**

2. Is there a commercial opportunity?

- Is there a clear market demand for this invasive species product (food, pet food, materials, supplements, crafts, etc.)? Who would buy it? **Yes – interest from pet food companies though more awareness and knowledge is needed.**
- Is there a cost advantage? **Unclear – while carp are abundant and local there isn't largescale processing so costs not fully determined.**
- How does this invasive species compare to existing alternatives? **Local, abundant, sustainable – all benefits over imported fish.**
- What is the expected return on investment and timeline to profitability? **Still being determined but looks like a profitable business.**

3. Does market demand match environmental needs?*

- Does harvesting truly support ecosystem restoration and not risk further spread? **Yes – carp is already widespread across the US and the fish would be processed near harvest so there isn't a risk of live fish escaping into new areas.**
- Is there enough consistent supply to support commercial scale? **Yes – carp can be up to 95% of organic biomass in some US riverways.**
- Are there ecological risks during transportation, storage, or processing? **Unlikely to be the case – fish are not transported alive.**
- Is there a risk that commercialization could inadvertently increase demand beyond wild populations, incentivizing farming? **This is highly unlikely since carp are so endemic at this point.**

4. Is sourcing this product technically feasible?

- Can the product move through existing processing, logistics, and approval systems? **It can be processed and sold as whitefish; it is a bony fish so some extra processing capabilities may be needed.**
- What infrastructure is needed to scale (boats, processing plants, freezing capacity, quality control, trained harvesters or suppliers)? **Large-scale commercial processing; increased access to cold storage or cold freight to transport fish from river to processor.**
- Are there safety concerns around sourcing? **Standard food safety requirements but nothing unusual to carp.**
- Are there traceability requirements? **Not at this point.**

5. Are there socio-cultural or reputational risks?

- What are the reputational risks? **Carp are considered a 'trash fish' by many so there may be concerns from some pet owners that their pets are being asked to eat a new, less desirable product; but since the majority of pet food is made from byproducts from human consumption this risk is mitigated. Carp can also be sold as whitefish, which is a common label applied to a wide variety of fish.**
- Will consumers understand why using invasive species is beneficial? **At a high level, yes. Education on the specific benefits of sourcing carp may be needed.**
- How does harvesting affect local communities, fishers, farmers, etc? **Creating a market for carp could bring economic gains to commercial freshwater fishers in the US who are struggling to catch species that have been hurt by carp; it can also allow increased biodiversity of native fish which would help to protect the sportfishing industry.**
- Are there ethical concerns related to animal welfare or harvesting practices? **The same guidelines that apply to all fish should apply to carp.**

*Please see ecological checklist for additional information and guidance



Ecological Checklist



Black Locust

1. Can the species be eradicated?

- Are there characteristics of the invasive species that make eradication unlikely (e.g. high reproductive rate, high likelihood of reintroduction, population rebounds, undetectability)? **Yes – attempts at physical removal encourage suckering (growth of new shoots), making eradication difficult.**
- Is there a minimum population size to see negative environmental effects, making population control more cost-effective than eradication? **Unknown.**
- Is the invaded range large? **Yes – covers vast areas of Europe, Asia, and New Zealand as well as parts of the US where it isn't native.**
- Has the invasive population been established for a long time (i.e. more than four years)? **Yes - introduced in 17th century.**
- Would eradication harm non-target species? **Yes – large-scale eradication methods (bulldozing, aerial herbicides) would harm non-target species.**
- Do socio-cultural factors preclude eradication? **Maybe – different stakeholder groups have conflicting views on the species; for example, it may be locally prized for apiculture.**

2. Would harvesting worsen invasion?

- Would harvest spread the invasive species further (e.g. by carrying stowaways or eggs)? **Possibly (due to suckering or risk of dropping seeds during harvest/transport).**
- Would harvest cause populations to increase beyond current levels? **Possibly – certain methods of control (mowing, fire) can increase germination and sprouting.**
- Should we be concerned about harvest-induced evolution for this species? **Not particularly.**
- Is there a risk of incentivized release or propagation? **Possibly – black locust have been deliberately spread over the past 300 years; diverse management priorities already exist.**

3. Are there ecologically relevant market externalities to consider?

- Are there environmentally problematic complements needed for production? **Not for hardwood. Potentially for pharmaceutical applications that are in early stages of research.**
- Would substitution of the invasive for current products be environmentally beneficial? **Yes (if used in place of harvesting native trees).**
- Would market creation threaten the invasive species or its close relatives in their native ranges? **No (not threatened in native range).**

4. Would harvest harm native species?

- Is there a risk of bycatch or other direct harm? **No.**
- Have any native species become dependent on the invasive (e.g., for food)? **Some bird species use black locust for nesting but they don't prefer them.**

5. Would harvest produce ecologically desirable outcomes?

- Will harvest reduce the density of the invasive species? **Possibly – depends on harvest technique and efforts to mitigate vegetative spread.**
- Will reduced invader density improve the ecosystem (e.g. by boosting biodiversity of native populations, preventing further spread of the invasive, improving general ecological health of an area)? **Possibly (by reducing risk of spread).**
- Is the level of harvest needed to achieve ecological benefits compatible with the level of harvest needed to maintain a profitable business? **Unknown.**



Black Locust

1. Can the species be made into a value-creating product?

- Are there unique attributes to the species that would lead to product development? What are those attributes? **Yes – grows rapidly and is one of the most rot-resistant hardwoods; can be used for outdoor decking and flooring, specialty construction applications. It is also sought after by bees to pollinate the flowers for honey production.**
- Does the product meaningfully solve industry needs (e.g. protein shortage, sustainable materials, etc.)? **Yes – for industries requiring durable, outdoor, non-toxic materials, particularly where chemical treatment, short lifespans, or tropical hardwood sourcing are pain points. It lowers environmental and regulatory burden tied to treated wood.**
- Are there sensory or performance differences consumers must be educated about? **Moderate education is required, primarily around appearance, workability, and movement, rather than durability or safety.**

2. Is there a commercial opportunity?

- Is there a clear market demand for this invasive species product (food, pet food, materials, supplements, crafts, etc.)? Who would buy it? **Yes – particularly in outdoor construction and public infrastructure. It can be purchased by construction companies, municipalities and public works, specialty timber and furniture makers, among others.**
- Is there a cost advantage? **Black locust is often more expensive than pressure-treated softwood at purchase, but its exceptional durability and long service significantly reduce replacement, maintenance, and disposal costs. Over time, it is cost effective.**
- How does this invasive species compare to existing alternatives? **It outlasts pressure-treated softwood, matches or exceeds cedar and redwood in durability, while avoiding chemical treatments. Also, black locust can be used for honey production. When bees make honey from its flowers, it leads to abundant, high-quality nectar (sold for premium prices in European markets).**

- What is the expected return on investment and timeline to profitability? ***It depends on the product type and management systems.***

3. Does market demand match environmental needs?*

- Does harvesting truly support ecosystem restoration and not risk further spread? ***Yes – if done correctly, harvesting black locust for lumber can support ecosystem restoration and reduce spread.***
- Is there enough consistent supply to support commercial scale? ***Yes – for products like posts, poles, and decking, supply can be commercially viable at scale. Long-term timber supply will require forestry planning and sustainable management.***
- Are there ecological risks during transportation, storage, or processing? ***Without careful management, yes; pods and seeds can fall off during transport and germinate in new areas. They can also be toxic to many animals. However, dropping seeds and pods is unlikely if the proper precautions are taken.***
- Is there a risk that commercialization could inadvertently increase demand beyond wild populations, incentivizing farming? ***For use as lumber, commercialization could be ecologically beneficial, though without safeguards it could inadvertently incentivize expansion, so careful design and monitoring is essential. For honey, because the tree must be living rather than harvested, market creation is actually likely to incentivize protecting, maintaining, and even increasing tree populations, thereby increasing environmental harm.***

4. Is sourcing this product technically feasible?

- Can the product move through existing processing, logistics, and approval systems? ***Yes – black locust products can generally move through existing processing, logistics, and approval systems but there are some nuances depending on product type and region.***
- What infrastructure is needed to scale (boats, processing plants, freezing capacity, quality control, trained harvesters or suppliers)? ***Scaling black locust commercialization will require trained harvesters, standard timber processing facilities, controlled storage, transportation with seed containment quality-control systems, and monitoring to ensure sustainable, invasion-free supply.***
- Are there safety concerns around sourcing? ***Safety controls are essential around sourcing to prevent further spread and ensure ecological compliance including harvesting only from existing invasive stands, voiding seed dispersal during collection and transport, and treating or managing stumps to prevent regrowth.***
- Are there traceability requirements? ***Likely yes. As an invasive species, there are typically traceability requirements across state lines or country borders.***

5. Are there socio-cultural or reputational risks?

- What are the reputational risks? ***Stakeholders may perceive the use of black locust as an activity promoting the spread of an invasive plant, causing public backlash, buyer skepticism, or negative brand association.***
- Will consumers understand why using invasive species is beneficial? ***At a high level, yes. Education on the specific benefits of sourcing black locust may be needed.***
- How does harvesting affect local communities, fishers, farmers, etc? ***It can provide economic opportunities for harvesters, loggers, and suppliers and can create jobs in processing and transport.***
- Are there ethical concerns related to animal welfare or harvesting practices? ***There could be some ethical considerations related to harvesting practices, including concerns around sustainable removal to prevent uncontrolled spread or ecosystem damage and concerns around labor practices, such as ensuring fair wages, safe working conditions, and proper training for harvesters. It is also important to respect land rights and avoid conflicts over resource use.***

*Please see ecological checklist for additional information and guidance



Clockwise from top left: Other common invasive species include Japanese honeysuckle (*Lonicera japonica*), © Joseph Valencia/iStock; spotted lanternfly (*Lycorma delicatula*), © arlutz73/iStock; kudzu vine (genus *Pueraria*), © Martha Snider/iStock; fire ants (*Solenopsis invicta*), © Tom Stocker/iStock; nutria (*Myocastor coypus*), © Markus Semmler/iStock

Analysis, Considerations, and Questions

To assist in working through the checklists, there are some additional considerations, questions, and guidelines around some of the key questions. This guidance will continue to evolve as the framework is applied and lessons are shared.

Overall, the ecological analysis focuses on characterizing the risks of exacerbating harms from the invasive. Because the species has already proven to readily outcompete native species and cause harm to local ecosystems (that's why we're considering it in the first place!), we know that it is "risky." There have been many historical cases where invasion management has led to new or worse invasions, so these steps are to help ensure this is not the case.

Additional Ecological Analysis

Can the species be eradicated?

Invader characteristics

Characteristics of an invasive species, such as its reproductive rate, dispersal, population dynamics, detectability, and other life-history traits can greatly influence whether eradication is a

possibility. For example, some species can lie dormant for a long time, making eradication nearly impossible, while others may respond to decreases in population size by increasing fecundity. Meanwhile, other species may be likely to be continually re-introduced (e.g. those that are transported in ballast water) also likely preventing eradication.

Size of range

While not all-encompassing, studies have suggested that smaller infested areas, defined as 4,905 hectares or less, are likely to be more conducive to eradication campaigns.⁵ Invasions restricted to man-made habitats like green-houses are also more likely to lead to eradication. Therefore, market-based forces are likely most beneficial when there has been greater spread of a target invasive species.

Time since establishment

Eradication is more likely to be successful when attempted earlier in the invasion process, with one analysis suggesting four years to be a critical threshold.⁶ It is therefore likely that market-based forces would be most relevant for long-established populations.

Would harvesting worsen the invasion?

Spread

In some cases, harvesting (or subsequent transportation) could risk further spreading an invasive species. This is likely to depend on the species' mode of dispersal, the mode of harvest, where harvest and transportation are occurring, and any precautionary measures (or lack thereof) that are taken, such as cleaning harvesting equipment. For example, the invasive kelp *Undaria pinnatifida* is often spread by attaching to boat hulls or being transported (in its gametophyte stage) in ballast water, so harvesting it could risk spreading it further.⁷ For some species, this risk can be mitigated by precautionary measures. Proper analysis of risks and then a weighing against the potential benefits of reducing invasive density will be important.

Population rebound

Some species, such as the European green crab, are actually able to vastly increase their reproduction rate when their population decreases. While this makes them difficult to eradicate, which is a precondition for using market forces, it may paradoxically lead to an increase in abundance if harvest is attempted. For any species displaying this trait, there needs to be detailed research into the level at which this compensatory response is triggered, the strength of the response, and any other relevant factors such as size and stage specificity.

Harvest-induced evolution

In addition to the potential of some species to increase their reproduction rate, other species can quickly adapt in other ways that can lead to increased invasibility. While some up-front analysis should be completed to see if there has been any rapid evolution in a species since it arrived in an area, this analysis will likely need to continue through ongoing monitoring to ensure there are no unintended consequences.

Incentivized release

Creating a market inherently gives value to a species, which could then lead to further expansion if people are incentivized to farm, spread, or raise the invasive in a non-native range. This is why it is imperative that, to reduce this risk, any species selected for market use not only not be eradicable, but be widespread with significant population. This should be accompanied by ongoing education and regulations as necessary.

Are there ecologically relevant externalities to consider?

Supply chain complements

Even if harvesting an invasive brings benefits, it's possible that using that species in a market may require another complement or resource not previously used in the supply chain (e.g., an invasive species as a feed ingredient might require a supplement to balance the invasive's nutrient profile; if that supplement's sourcing creates a new problem, this should be characterized). The environmental impacts of sourcing any necessary complements should be investigated.

Substitution

One potential unintended consequence of creating a market for an invasive species would be if it is replacing a raw material that is also beneficial to use. For example, right now the pet food market uses a lot of byproducts from human consumption. If carp were to replace those byproducts, they may end up in landfills releasing significant quantities of methane. In this case, further research found that there is a growing gap in demand for pet food ingredients as it is outpacing the supply of byproducts. If livestock and plants are sourced solely for pet food, this risk is mitigated and using carp becomes beneficial. Alternatively, invasives may reduce pressures on currently exploited populations. This could occur if invasives are replacing an overexploited resource. This illustrates the importance, however, of weighing the benefits of utilizing an invasive species against any environmental impact of what it is replacing.

Native range

As an invasive species increases in value, it is imperative to consider whether that could affect the population of that species in its native range. We don't want market creation to lead to overexploitation of a species in its native range. Similarly, species that fulfill a similar functional role to invasive species in markets (such as close phylogenetic relatives) could be put at risk, particularly if market demand begins to outpace invader supply. It will be important to check the conservation status of invasive species in their native range up front, as well as of functionally similar species.



European green crabs (*Carcinus maenas*) are a widespread invasive species native to European and North African coasts. © MEDITERRANEAN/iStock

Would harvest harm native species?

Dependency within ecosystem

While invasive species are defined as causing harm, that harm may not be equally applied. It is possible that if an invasive species has been well-established, it may be causing harm to some populations but bringing benefits to others. This could include being used for food, habitat, or dispersal. One invasive species could also be controlling another problematic invasive. All of these should be explored to understand how an invasive species is currently affecting its environment.

Would harvest produce ecologically desirable outcomes?

Reduced density

If eradication is off the table, which is a precondition for using market forces, then reducing density (at least in some locations) is likely to be the goal. Analysis will be needed to understand the relationship between removal (including frequency and intensity of harvest) and population density. This will require upfront and ongoing collaboration between industry and ecology experts. The level of harvest may be more volatile with market-based approaches as compared to conventional management approaches, since the amount of biomass needed to sustain a profit may vary with market demand.

Ecosystem improvement

Likely ecosystem improvements include reduced risk of spread, improved native biodiversity, and ecosystem health. All of these will require collaboration between industry and ecology experts to understand market demand, supply chain logistics and feasibility, species characteristics, and habitat conditions.

There has been little ecological work to date on understanding how native species respond to reduced invader density, but abundance-impact curves could be useful in this context. These curves are similar to “stock-recruitment” curves for fisheries, except that instead of plotting how much new fish stock is possible at different harvest levels, these curves also show how much environmental impact is reduced by those harvest levels. These curves may help determine expected increase in native populations or richness given certain levels of harvest intensity, or even thresholds below which suppression density yields particularly significant effects.⁸ However, the creation and use of these curves is new, innovative work, so there are few species for which they exist, and continual sharing of information and lessons learned as market uses are used to address invasive species will be imperative.

This is also true of other ecosystem services. It is possible that reduced density of an invasive species could lead to better water quality, better soil health, or boosted local economies



Clockwise from top left: Numerous impactful invasive species include the northern snakehead fish (*Channa argus*), © FedBul/iStock; Burmese python (*Python bivittatus*), © jenjen42/iStock; Asian tiger mosquito (*Aedes albopictus*), © Pawich Sattalerd/iStock; Wakame seaweed (*Undaria pinnatifida*), © Makolovefish/iStock; and zebra mussels (*Dreissena polymorpha*), © sdphotographySemmler/iStock

through preservation or improvement of recreational areas. As efforts move forward, shared learnings will be key to further understanding potential cause and effect and avoiding unintended consequences.

Additional Business Analysis

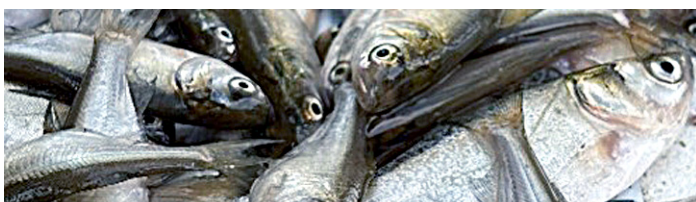
Can the species be made into a value-creating product?

Unique attributes

Invasive species may offer a variety of attributes that may make a product or material appealing. All of these should be explored since some species may offer multiple value-creating opportunities. There may be unique attributes best explored through nutritional or content make-up and verified with experts. This could also include things like innovative use cases, durability, and suitability. However, invasives may also offer an ability to showcase a product as sustainable, unique, and/or beneficial to a local environment or species that consumers may care about.⁹ These may also drive additional value.

Testing

While there may be existing data or information on some invasives, there may be limited information for many. It's important to consider what testing is needed (e.g. nutritional, chemical, safety, durability) that may lead to insights on attributes, but also to hurdles or important considerations. Speaking with a variety of experts outside of the business space may be useful to start.



Silver carp is a nutritional powerhouse for dogs – highly digestible, lean, low-fat, and a great source of omega-3 fatty acids. © nensuria/iStock, © Indiana DNR

Is there a commercial opportunity?

Cost advantages

When comparing the financials of invasives to existing materials/products/sources, there are multiple scenarios to consider. Like with any new material, companies will need to think through the full cost structure across the supply chain, including harvesting, processing, logistics, compliance, and marketing. While some invasives may fit into existing supply chains, others will require new ones or at least unique considerations. There may also be opportunities for cost efficiencies elsewhere, regardless of the traditional supply chain costs. Companies sourcing invasive species may be able to access grants, tax credits, or NGO partnerships. In other cases, local regulations may prohibit the marketing of invasives. It would also be worthwhile to consider byproduct revenues that may provide alternative revenue streams while also increasing the sustainability of the product.

Comparison to alternatives

In addition to cost, businesses should holistically examine how invasives may compare to existing alternatives across quality, durability, efficiency, and emotional connection. In addition to the more typical attributes, if a species is threatening beloved native species or a beloved local habitat, consumers may simply want to buy a product made with that material.

Does market demand match environmental needs?

See the ecological checkpoint for additional information and questions. These checklists are meant to be addressed in tandem. It is also important to consider how climate change may affect the target invasive population and how the balance of market demand to ecological need may shift as the climate continues to shift.

Is sourcing this product technically feasible?

While invasive species are generally abundant, which is why they are often harmful, populations may be varied, hard to reach, or come with additional sourcing or logistics complications. Thinking through the core conditions required for any sustainable supply chain, such as consistent biomass availability, accessible harvesting methods, workable processing pathways, supply chain logistics, and compliance with regulatory standards, is important up front.

Existing processes, logistics, approvals

Whenever a new ingredient is introduced, it may cause changes and ripple effects across a supply chain. There should be consideration up front as to what those changes will be and what parts of the supply chain (and who in the supply chain) may require the most effort to adopt this new ingredient or product. This way hurdles can be addressed proactively and fairly.

When companies use invasive species in products, it is critical that strong safeguards are in place to ensure the species

is never farmed, bred, or intentionally introduced into new environments. It is equally important for companies to identify and comply with all rules that govern how the invasive species can be captured, moved, processed or sold, and comply with required certifications and documentation – noting that sometimes these rules can be specific to a species.

These measures exist to prevent accidental spread, protect ecosystems, and ensure lawful trade. Additionally, businesses may need import or export licenses depending on how the species (or its processed products) move across state or national borders. Even though a species is invasive, it is still subject to trade, transport, and biosecurity controls.

Safety and Ethics

Sourcing invasive species requires careful attention to safety, ethics, and regulatory compliance. Some species may be hazardous or restricted, containing toxins, parasites, sharp bones, or chemicals that require special handling during harvest, processing, and transport. Ensuring suppliers follow standardized safety protocols helps guarantee that products meet food, feed, or general product safety standards, preventing contamination of the local environment during removal, transport, or processing.

Ethical considerations are also critical. Humane killing, bycatch prevention, and responsible handling needs to be observed, even for invasive species. Regulatory compliance ensures that the supply chain is legal and responsible.

Are there socio-cultural or reputational risks?

Reputational Risks

In addition to safety, ethics, and regulatory compliance, companies must consider the sociocultural and reputational implications of sourcing invasive species. Some species may be perceived negatively by the public, commonly referred to as “trash fish,” “weeds,” or otherwise undesirable materials. These perceptions can affect consumer acceptance, market demand, and overall brand image. It’s also possible that a species is viewed very differently in different locations. For example, carp are generally viewed in a negative light in the United States but are sought after in Asia.

Even if sourcing a product is environmentally beneficial, negative associations with the species can create barriers to adoption. Companies should proactively address these risks through transparent sourcing practices, clear communication about ecological benefits, and responsible marketing.

Alternatively, an invasive species may elicit positive emotions. For example, house cats are a highly invasive species. They are a leading threat to native birds. However, cats are obviously beloved pets. While cats may be an extreme example of a positive association, there are other invasive species that may not be as obvious but could still produce mixed reactions. This may also vary by location.

Considering these sociocultural factors is essential for long-term market success, ensuring that the product is not only safe, ethical, and legal, but also perceived positively by customers and stakeholders.



Though technically an invasive species, cats tend to elicit a more sympathetic emotional response than other invasive species such as the snakehead fish (top) and the cane toad (bottom). © Gregory DiSalvo, UrosPoteko, HuntedDuck / iStock



Illinois Department of Natural Resources staff use an electric current to catch carp as part of their research and mitigation efforts. © Keith Arnold/WWF-US

Next Steps

WWF will continue to work to support and explore the potential of using market forces to address invasive species. This will include continuing to revise, refine, and share the draft framework, spurring efforts through incubation and business support, developing case studies and categorizing lessons learned, and ensuring that all collected wisdom has a home for the long-term.

While WWF has shared a draft 'Market Use for Invasives' framework in this report, the approach will continue to evolve. We hope to promote use of the framework broadly at ecological and industry events and conferences, through research journals and streamlined communications efforts, and targeted outreach. As the framework is reviewed and (we hope) used, especially on different types of species and in different geographies, we will continue to incorporate learnings and update the tool. WWF also hopes to directly test the framework against other species and to develop industry-specific frameworks and approaches where relevant.

WWF's Markets Institute is also exploring the possibility of partnering with WWF Impact, WWF's impact investing arm, to offer a 'bootcamp' or similar effort to support innovative entrepreneurial endeavors tackling invasive species with products and markets. Our focus would be on providing ecological analysis, market support, and key connections to catalyze efforts. By working with young companies, or established companies exploring new supply chains, to apply this framework, we will be able to create a case-study compendium of efforts to use market forces to address invasive species, utilizing the framework to analyze successes and lessons learned. This case study effort can also encompass

other efforts outside of the bootcamp. By sharing lessons learned broadly, other companies will be able to learn the opportunities and pitfalls of utilizing this approach.

Ultimately, our goal is to support a "markets for invasives" ecosystem that lives beyond WWF's involvement. As additional efforts focus on this space, more examples come to life, and there are more successes and setbacks, the information and momentum will become self-sustaining. Throughout its continued work, WWF will explore opportunities for creating a living framework long-term, so that others can continue to edit, iterate, and expand upon it in years to come. Invasive species are one of the largest threats to biodiversity and we are eager to harness market forces, where applicable, to help address this scourge in an economically, environmentally, and socially beneficial way.

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Footnotes / Citations

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