H.R. 962

Preserve Fishing on Wild and Scenic Rivers Act

Analysis of the Environmental Problem and Legislative Solution

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Prepared by

Diana Lee (Manager), Daniel Wohl (Deputy Manager), Anne Canavati, Ethan Forauer,
Becky Hopkins, Phil Malley, Zac Meyer, Johan Møller Nielsen,
Amanda Rickert, Alex Rudnicki, and Ella Wynn.

Faculty advisor
Louise Rosen

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Disclaimer

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Mark Sussino

Executive summary

Wild fish populations are under pressure from human activities all over the world. In the United States and worldwide, the total amount of wild fish caught has not increased since the 1980's. To meet the demand for animal protein of a growing global population, the amount of farmed fish on the market has skyrocketed in the past decades and is expected to continue rising. Since 1980, the U.S. aquaculture industry has more than doubled in size to produce 426,000 tons of fish in 2015. Over the same period, the global production increased from 7.3 million tons to 106,000 million tons.[1]

The expansion of the aquaculture industry comes with an environmental and social cost. The intense nature of fish farming leads to effluents containing large concentrations of fish feed, excrement, and chemicals. These pollutants are discharged into natural aquatic environments, and present potentially harmful effects on natural habitats. Particularly, wild fish populations are vulnerable to depleted oxygen levels as a result of elevated nutrient contents.

One such environment is the wild and scenic rivers in the United States, which are federally designated for their unique natural and recreational significance. Stretching more than 12,000 miles over 40 states, these rivers have great value for fishermen and tourists who enjoy the pristine ecosystems and robust fish populations. Trout fishing in particular is popular on many wild and scenic rivers; however, the continuing expansion of aquaculture creates fears among river-goers of depleted trout stocks as a result of pollutant discharge.

In an attempt to address the environmental risks to wild and scenic rivers, Congressman Daniel Kildee (D-MI 5th District) introduced H.R. 962, the Preserve Fishing on Wild and Scenic Rivers Act, in February 2017. In the spirit of the precautionary principle, the bill proposes strict regulation standards for aquaculture operations by prohibiting any level of pollution on any portion of a wild and scenic river.

If passed, the bill will directly affect approximately 15 trout farms currently operating on wild and scenic rivers nationwide. For the purpose of illustrating both the need for and possible environmental consequences of that type of aquaculture, the primary focus of this report is on trout farming. Farm owners and the industry as a whole oppose the bill, arguing that its proposed measures of action are unnecessarily conservative and would hinder the sustainable production of animal protein demanded by a growing population. In addition, detractors claim that local employment and economic development are at stake.

This report explores the balance between securing sustainable food production and preserving the unique ecosystems of wild and scenic rivers for generations to come. It addresses the main environmental concerns associated with freshwater aquaculture and analyzes the political, economic, and technical feasibility of the solution proposed by H.R. 962.

Glossary

Antibiotic- A drug that kills and/or inhibits the growth of microorganisms, used in fish food to prevent bacterial infection.[2]

Aquaculture- The rearing and cultivation of aquatic animals and plants for the purpose of consumption or maintaining wild populations.[3]

Effluent- Wastewater discharge from a facility[4]

Eutrophication- An excess of nutrients in a body of water that causes a high density of plant growth and results in decreased dissolved oxygen levels in the water.[5]

Hypoxia- A deficiency of oxygen in an environment that oftentimes leads to organism death.

Nutrient- A substance essential for growth and maintenance of an organism.

Pathogen- A microorganism that can cause disease.[6]

Pesticide- A substance used to kill organisms harmful to the rearing of plants and animals.[7]

Pollution- Defined in the Clean Water Act as "man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water".

Precautionary Principle- An approach to risk management stating that if an action, substance, or event is suspected of causing harm, despite lack of scientific certainty, it is best to err on the side of caution in order to avoid detrimental consequences.[8]

Preservation- To keep an environment in its original state.[9]

Scenic Rivers- Defined by the Wild and Scenic River Act of 1968 as "those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads".

Sustainability- To refrain from the depletion of natural resources in order to maintain an ecological balance under which humans and nature coexist in harmony for current and future generations.[10]

Wild Rivers- Defined by the Wild and Scenic River Act of 1968 as "those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted".

1. Introduction

House Resolution (H.R.) bill 962, also known as the "Preserve Fishing on Wild and Scenic River Act", proposes to prohibit the operation of aquaculture facilities from discharging any pollutants into wild or scenic rivers.[11] There are 12,734 miles of 208 rivers in 40 states and Puerto Rico that are designated as wild or scenic, as determined by the Secretary of the Interior.[12] The bill would directly affect approximately 15 aquaculture facilities that currently operate on wild and scenic rivers, as well as others in close proximity to the protected areas. All facilities identified in Figure 1-1 exclusively raise trout, since these rivers are natural habitat for this fish species. Thus, this report will focus on the environmental consequences of rearing trout in particular.

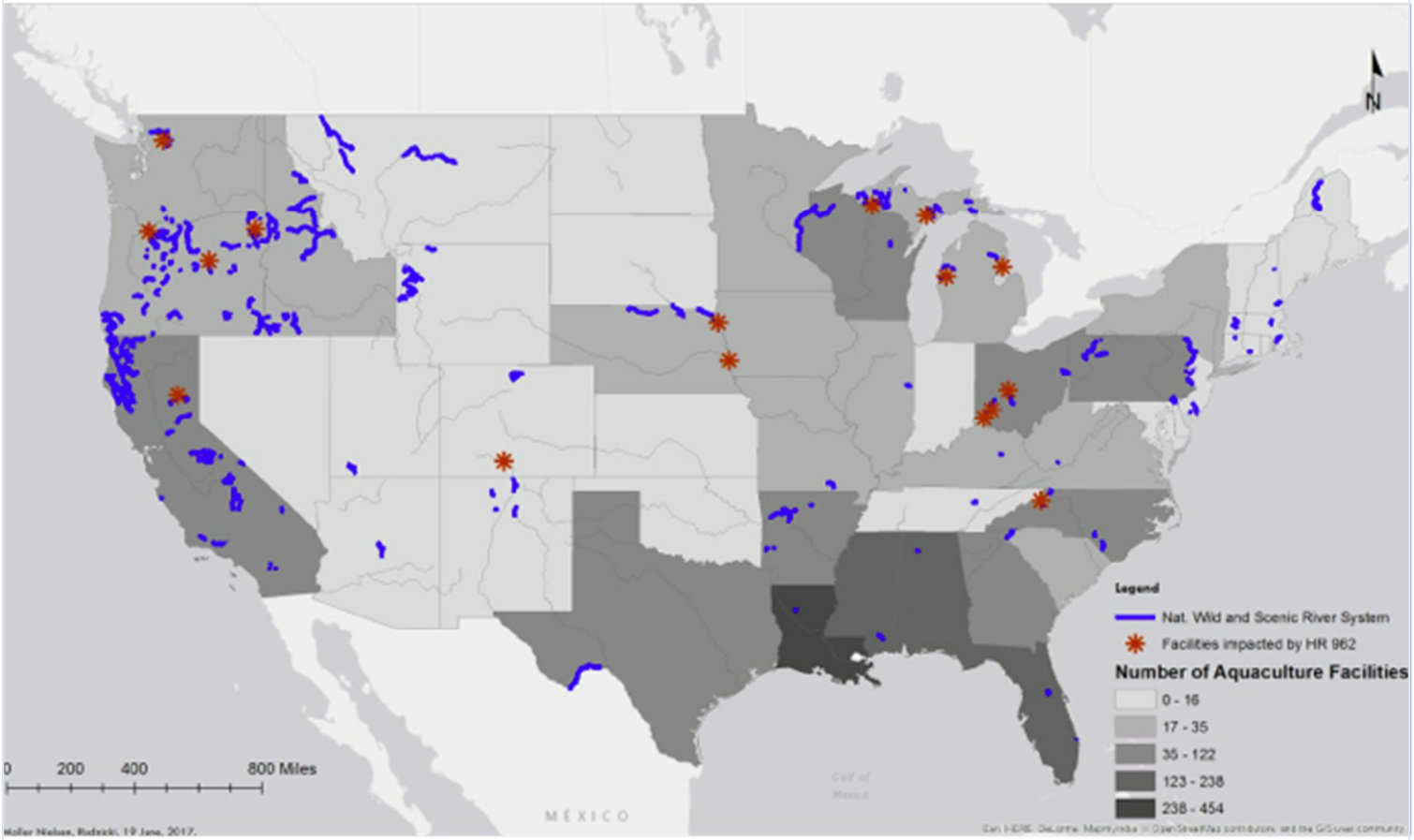

Figure 1-1. United States wild and scenic rivers and freshwater aquaculture farms by state. The shade of grey represents the number of aquaculture facilities in each state. The blue lines depict wild and scenic rivers. The red stars show the location of aquaculture facilities on wild and scenic rivers.

The Wild and Scenic River Act of 1968 created a new designation to preserve the river's "outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations."[13] Both wild and scenic rivers are defined as being free of impoundments, straightening, and any other man-made modifications. While scenic rivers are accessible via roads, wild rivers are accessible only by trails.

H.R. 962 proposes that any aquaculture facility currently discharging into federal wild and scenic rivers must apply for a special permit from the Department of the Interior, and the Secretary of the Interior will certify that the aquaculture facility does not discharge any pollutants into the river. An aquaculture facility near such rivers cannot operate without this permit. The bill states that this proposal will not be enforced until three years after it has been enacted. No appropriations have been proposed in H.R. 962.

To understand the implications of implementing H.R. 962 for wild and scenic rivers and bill stakeholders, this report will explore the environmental science underlying the issues addressed by the bill. In the following chapters, the report will describe the origins and context of the bill; the types of pollution caused by aquaculture facilities and the effect on water systems; the proposed solution to the problem; political and economic controversies associated with the solution; and how to monitor and evaluate the success of the bill.

2. Background

2.1 Origins of the Bill

Representative Daniel Kildee (D-MI 5th District) proposed H.R. 962 in response to a problem in his state revolving around the Au Sable River, the site of an ongoing battle between a local trout farm and the fly-fishing tourism industry. Known as the fly-fishing mecca of the Midwest, the Au Sable River is renowned for its cold clear waters and abundance of wild trout. The battle began when the Grayling Hatchery, a local trout facility, announced plans to expand its capacity of trout from tens of thousands to 300,000 pounds. Members of the community and conservation associations expressed concern that this expansion would pollute the Au Sable with excess nutrients, thus decimating the wild trout population. H.R. 962 aims to prevent this outcome by prohibiting any level of pollution on any segment of a wild and scenic river.

2.2 What is Aquaculture?

Aquaculture is the "breeding, rearing, and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes, and the ocean."[14] This includes the production of fish for consumption, ornamental fish, algae, and mollusks. Aquaculture and demand for fish protein is on the rise globally; as shown in Figure 2-1, the amount of fish raised through aquaculture production has surpassed the amount of wild caught fish since 2016.

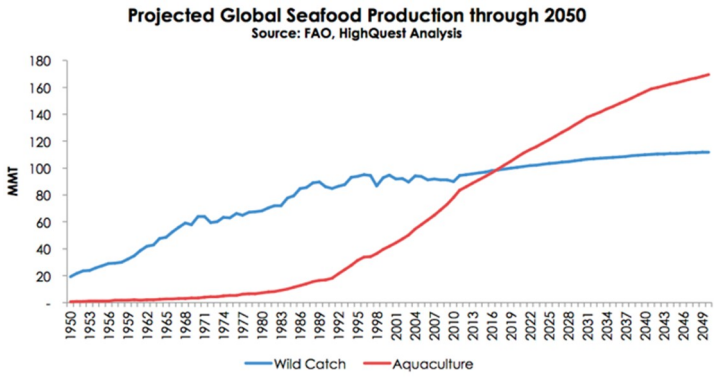

***Figure 2-1**. Projected global seafood production through 2050. The blue line represents output of wild caught seafood, while the red line represents aquaculture raised seafood. Both measures are in millions of metric tons of fish produced per year.[15]*

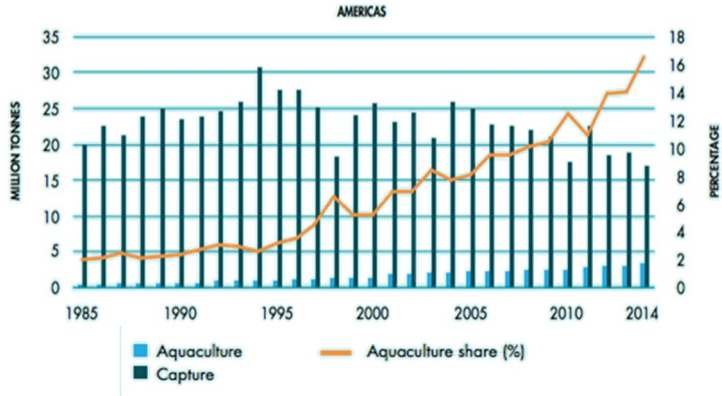

***Figure 2-2**. Share of aquaculture in total production of aquatic animals for the Americas. The light blue bars represent million tons of aquaculture production. The dark blue bars represent million tons of capture. The orange line shows the percentage of aquaculture production within the total production of aquatic animals.*

North America produces 1.1% of the world's aquaculture, despite being home to about 8% of the world's population. However, the aquaculture industry in North America is growing, and the United Nations predicts a 5% increase from the current amount of fish produced a year, 426,000 tons in 2015, for North America by 2030.[i] [16]

The United States is the top seafood importer in the world. In 2016, the United States had the highest demand for fresh and frozen salmon ($3.3 billion), fresh and frozen tilapia ($754 million), and fresh and frozen trout ($121 million).[17] Domestically, the most popular farm raised fish are catfish, trout, and salmon.

Different species require different types of aquaculture facilities, as shown in Figure 2-3. The most common type of facility used for commercially rearing trout is the raceway system.[18] These facilities are built next to and in rivers in order to divert river water into the raceways and maintain a higher velocity of water. Because H.R. 962 focuses on aquaculture facilities on wild and scenic rivers and these facilities rear trout, this report will focus on trout and raceway facilities.

Trout grow best in oxygen-rich water between 4 and 6 milligrams oxygen per liter.[vii] A cost-effective way to provide such high oxygen content is to constantly bypass river water into raceways where the trout are held and then release the water back out. This open system ensures that the trout are continually being supplied with fresh, oxygen-rich water. However, as the water returns to the river, it takes along with it all the pollutants created by the raising of trout, such as fish excrements, pesticides, and antibiotics.

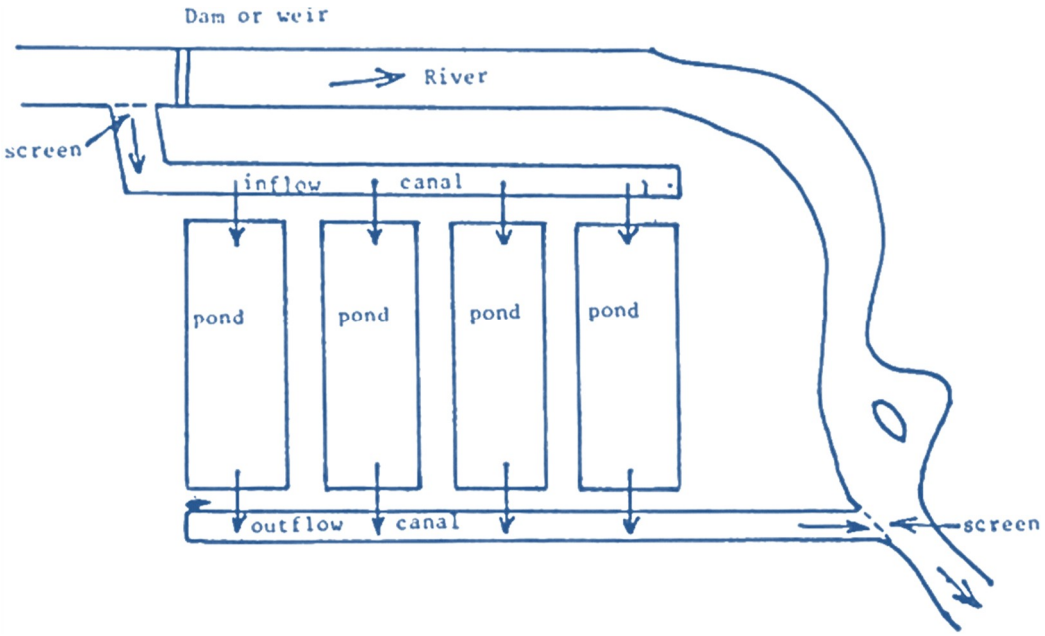

Figure 2-4 Diagram of a typical raceway aquaculture system. The annotated black arrows depict the flow of river water, nutrients and discharge in this system. River water is diverted into the system through the inflow canal. Antibiotics and other chemicals are introduced in the ponds in order to maintain the health of the fish. These fish then produce nitrogen and phosphorous as part of their excrement. The antibiotics, nitrogen, and phosphorous then move from the ponds into the outflow canal, and ultimately into the river.

Type of Facility		Description	Primary Type of Fish
Raceway		Built next to and on rivers. Maintains high water velocity. Main type of facility found on wild and scenic rivers.	Trout
Earthen Pond		Built next to rivers. Maintain low velocity water. Not found on wild and scenic rivers.	Catfish
Tank		Must be situated near a source of water. Suited for temperate regions since winter heating of these facilities is costly.	Tilapia
Recirculating System		Recirculates water within large tanks. Uses least amount of water compared to other facility types. Highest concentration of pollutants in effluent discharge.	Ornamental Fish

Figure 2-3. *Overview of key features of the four main types of freshwater aquaculture facilities.*

2.4 Sustainability versus Preservation

H.R. 962 can be thought of as an attempt to strike a balance between sustainability and preservation. On one hand, there is a clear trend of increasing demand for fish protein driven by a growing global population. How will the Earth be able to sustain the lives of 9.6 billion people by 2050, especially in light of the fact that global wild fish populations are declining?[vi,19] Aquaculture could be part of the answer to sustainable food production. On the other hand, how can communities also ensure that aquaculture will not pollute the rivers and therefore the wild fish populations upon which they rely?

According to Figure 2-5, the U.S. production of trout is on the decline. Yet the U.S. importation of trout is increasing at a faster rate, suggesting that the demand for trout is not declining despite the decreasing trout production. To meet this demand, the U.S. is replacing domestic production of trout with imports, instead of harvesting wild trout, because there has been a decline in native wild trout populations over the past decade.[20] Currently, 52% of native trout species occupy less than 25% of their historical habitat.[21] Wild trout populations are threatened by a loss of habitat, overfishing, and water pollution, to name a few of the challenges.[x] With decreasing wild populations, how will the U.S. meet the demand for trout? These questions are the backdrop to the proposal of H.R. 962 as well as the scientific and political discussions revolving around it.

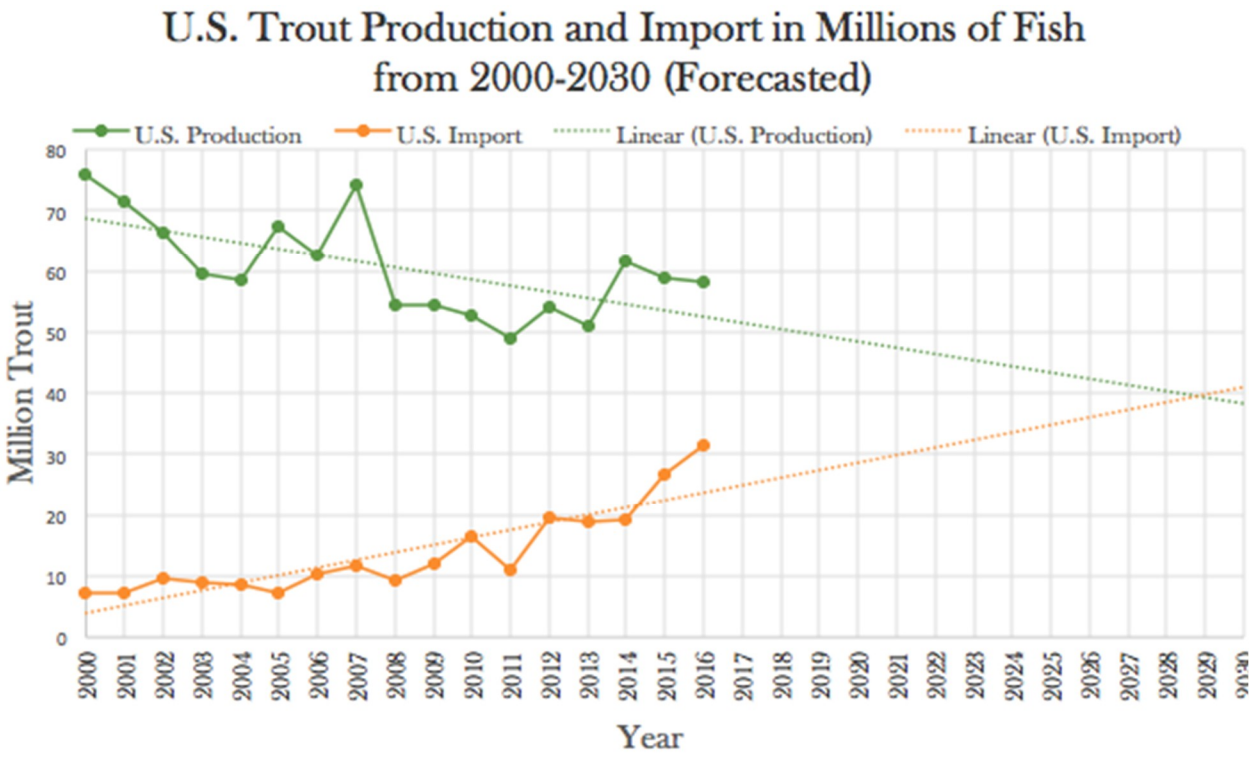

Figure 2-5. *Historical and forecasted U.S. Trout production and import in millions of fish from 2000-2030. The historical U.S. trout production is shown by the green line while the orange line represents U.S. import of trout. The dashed lines represent linear extrapolations of both of these trends.*

3. Environmental Problems

3.1 The Transportation of Contaminants

All of the roughly 15 aquaculture facilities currently operating on wild and scenic rivers are raceway systems used to breed trout (see chapter 2 on aquaculture systems). A typical raceway system uses and discharges around 30 liters of water each second, or roughly 2,600 m^3 every 24 hours.[22] The discharged water then mixes with the natural water of the river, thus introducing contaminants with potentially harmful effects to the river.

Rivers are not closed systems. In the natural environment, pollutants can travel in various ways not only within the river, but also outside of the system through the water cycle (see Figure 3-1). The tributaries and watersheds of wild and scenic rivers expand throughout the country, making it difficult or even impossible to definitively demarcate the area affected by the contaminants released by aquaculture. As a consequence, pollutants have the potential to degrade groundwater because surface water infiltrates through the soil to the water table. Likewise, polluted rivers may cause damage to the lakes or oceans to which they flow.

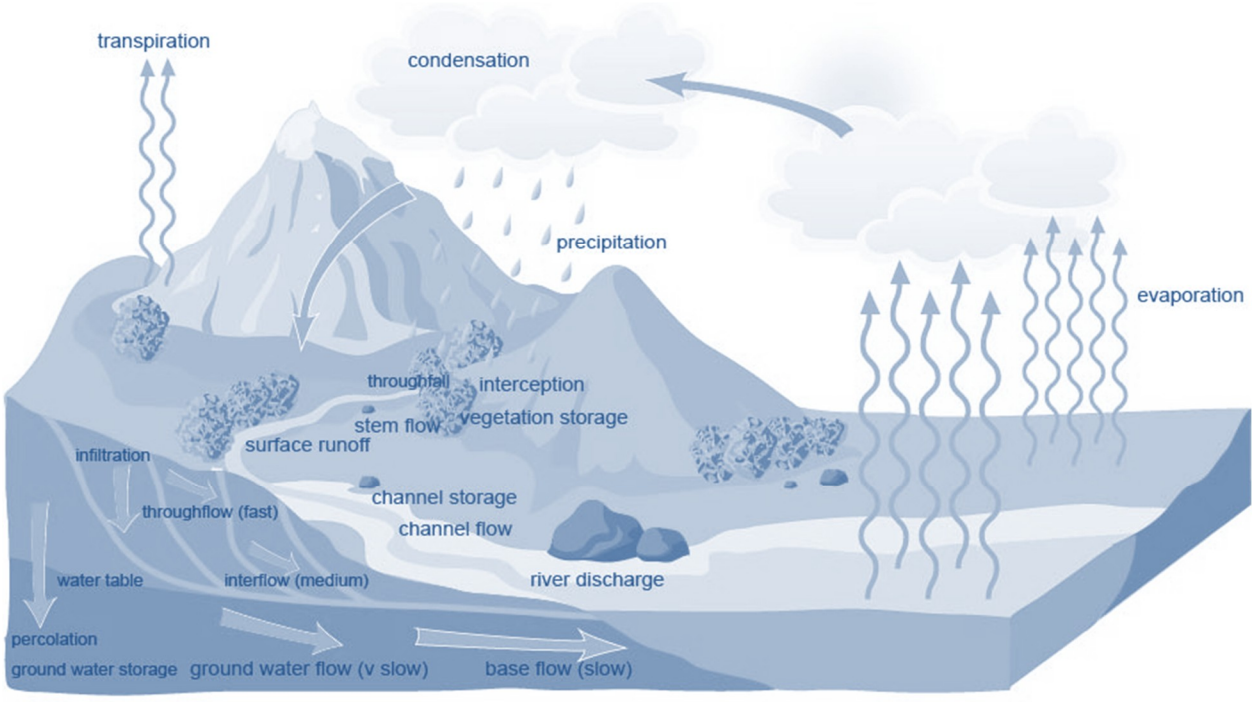

Figure 3-1. The water cycle. Contaminants such as chemicals can travel in various ways not only within the river, but also in and out of the system through the water cycle.[23] For example, chemicals released in a river can infiltrate groundwater, deposit in sediments, or flow to the oceans.

Chemical compounds released from aquaculture facilities exit the water cycle through deposition in sediments and soils or by entering the food chain after being consumed by plants and animals. That way, pollution in wild and scenic rivers not only poses a potential risk to animals and humans through dermal contact, but through ingestion as well. One immediate risk to recreational fishermen is the ingestion of wild fish caught in polluted environments. As predatory fish feed on smaller prey, the concentration of chemical contaminants accumulate in the animal tissues at higher trophic levels in a process known as bioaccumulation.[24] With recreational fishermen catching and eating the larger individuals of, for example, the trout populations of the river, bioaccumulation poses a potentially severe health risk to the fishermen and their families.

Because the quality of the discharged water from aquacultural operations has implications well beyond the physical boundaries of the facilities and the rivers they pollute, the rationale behind H.R. 962 is that government action and regulation is needed to protect the natural commons and human health.

3.2 Overview of Pollutants

In order to understand the nature and scope of the environmental problem addressed by H.R. 962, this section covers the pollutants most relevant to the effluent discharge from typical aquaculture facilities. In general terms, pollution can be understood as "the presence of a substance which has harmful effects."[25] By way of this definition, a substance introduced to a wild and scenic river is not considered a pollutant before it has been shown to be harmful to the ecosystem or humans. This inherent room for interpretation may give rise to political and administrative discussions (see chapter 5 on political controversies). For example, dissolved nutrients are naturally occurring in all aquatic environments, but have adverse effects on the ecosystem if concentrations are too high for the system to absorb. Mirroring the Federal Water Pollution Control Act, a pollutant is defined in H.R. 962 as:

> "...dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water…"[26]

As can be inferred from this extensive definition, many substances have the potential to be a pollutant. Yet not all are equally relevant in the context of this bill. The main pollutants from freshwater aquaculture to cause environmental problems are identified in the table below as being excess nutrients, antibiotics, pesticides, alteration of water properties, pathogens, and escaped fish.

Pollutant	Origin	Effect
Excess nutrients	*Uneaten food and discharge of metabolic wastes*	Elevated levels of nitrogen and phosphorus may cause an increase in phytoplankton growth, resulting in toxic algae blooms and oxygen depletion, causing fish kills.[27] [28] Water quality recommendations span from 47 µg/L to 76 µg/L for nitrogen and 0.3 mg/L to 2.2 mg/L for phosphorus.[29] [30]
Antibiotics	*Added to water to prevent bacterial infection*	Antibiotics are non-biodegradable and will therefore remain in the environment, resulting in antibiotic resistant bacteria and pathogens to fish, animals, and humans.[31] The concentration of antibiotics may bioaccumulate in humans.
Pesticides	*Used to kill weeds, bacteria, fungi, and to rid waters of competitive fish*	Pesticides are used to varying degrees and vary in their toxicity to fish and humans. Some bioaccumulate in the fat tissues of fish, and certain pesticides are suspected of being linked to the development of cancer in humans.[32] [33] Glyphosate, an active ingredient in RoundUp, is considered unsafe by the EPA at concentrations of 2 mg/L.[34]
Alteration of water properties	*Effluent can be warmer than its surroundings due to the high density of fish in the raceway system*	Increased temperature negatively affects the ability of the water to hold dissolved oxygen. Since oxygen is critical to aquatic animals, heated water has the potential to be an important pollutant if dissolved oxygen levels drop below around 5.5 mg/L.[35]
Pathogens	*Confining large numbers of fish to a small area creates a breeding ground for pathogens*	If transferred to wild individuals, pathogens may pose a danger to native fish populations.[36] The risk of disease spread increases with antibiotic resistance.
Escaped fish	*Fish rearing involves the risk that captive individuals escape into the wild river.*	Escaped farm fish increase competition with existing populations, resulting in displacement of native species and an ecosystem imbalance of native fish populations.[37]

Figure 3-2. Summary of the different types of pollutants that emanate from aquaculture facilities, their origins, and what effects they cause on the local ecosystem.

3.3 Nutrient Pollution

Of the many contaminants that may be sources of concern, the most important issue in terms of preserving fishing on wild and scenic rivers is nutrient pollution. Raceways with large fish populations discharge excess amounts of nutrients, specifically chemical compounds rich in nitrogen (N) and phosphorus (P). These nutrients are released as a result of uneaten food, feces, and metabolic wastes like urea and ammonia (NH_3), which is toxic to the native fish in the river. Other contaminants include nitrate (NO_3^-) and phosphate (PO_4^{3-}). Because phosphorus is often the limiting nutrient in aquatic systems, even small changes in its concentration lead to significant changes to aquatic ecosystems.[38]

Caused by critically high levels of excess nutrients, eutrophication and hypoxia are among the most devastating consequences to the ecological system associated with the pollution of rivers. The problems arise because only 20-50% of the supplementary nitrogen provided to farmed species is converted to biomass. Thus, for every ton of fish produced at a typical facility, 93-145 pounds of nitrogen waste and 16-45 pounds of phosphorus waste are discharged into the river.[39] On an annual basis, this means that an estimated total of 134,000 pounds of nitrogen and phosphorus waste enter wild and scenic rivers from the 15 trout farms that have been identified there.[40]

Eutrophication occurs when elevated levels of nitrogen and phosphorus cause a rapid increase in phytoplankton growth, resulting in toxic algae blooms such as cyanobacteria and brown tides. As the algae in the eutrophicated river die, large amounts of oxygen are needed for bacteria to decompose the dead organic matter, resulting in reduced levels of dissolved oxygen (DO) in the river. This problem may arise with nutrients concentrations of only 2-3 milligrams of nutrients per liter water in the river. As DO levels fall below certain thresholds, life cannot be sustained and fish kills may occur.[41] For trout, the critical threshold is around 5 milligrams of oxygen per liter water.[42] An ecological catastrophe in its own right, hypoxic dead zones as a result of aquacultural activity have the potential to severely damage recreational fishing, as was the case when entire brook trout populations were wiped out in Big Spring Creek, Pennsylvania in the 1950's and 1970's.

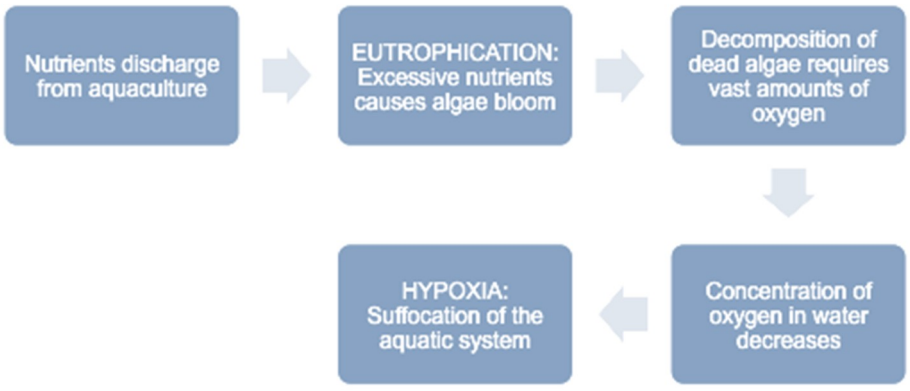

Figure 3-3. The figure above portrays how pollutants from aquaculture facilities may lead to devastating ecosystem collapse

Case Study: Big Spring Creek

Big Spring Creek in Pennsylvania was a famous brook trout fishing location in the 1920s-50s. It was one of the most productive wild brook trout rivers in the Eastern half of the U.S, due to its year-round warm waters. The location was so renowned that fly-fishing enthusiasts would come from all over the world to fish there.

In the mid-1950s, a commercial hatchery opened half a mile away from the source of the spring. Within a few years, the trout population downstream was decimated. This facility closed in 1968, but in 1973, the Pennsylvania Fish and Boat Commission built a fish hatchery at the source of Big Spring Creek.

As a result, the wild trout population collapsed. Although the effluent from this hatchery did meet the regulations of the time, the phosphate and nitrate pollution caused algal blooms and ultimately decreased the dissolved oxygen levels to a point that was incompatible with aquatic life. This destroyed the trout population and, along with it, the tourism in Big Spring Creek.

After years of debate, the Pennsylvania Fish and Boat Commission shut down the hatchery in 2001. Big Spring Creek is slowly regaining its trout population, but it is uncertain whether it will regain its former glory. Big Spring Creek is a classic case of aquaculture mismanagement. This is what the Preserve Fishing on Wild and Scenic Rivers Act aims to guard against: an unviable ecosystem.

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SUMMARY OF THE ENVIRONMENTAL PROBLEM

- The effect of pollutants released from aquaculture is not necessarily confined to river systems. Chemicals can contaminate groundwater or end up in lakes and oceans, and some compounds bioaccumulate in the tissues of animals and humans.
- Potential pollutants involve excess nutrients, antibiotics, pesticides, alteration of water properties, pathogens, and escaped fish.
- The main environmental concern associated with the rearing of fish on wild and scenic rivers is eutrophication. Caused by excess nutrients from fish feed and waste, eutrophication depletes the water of oxygen with potentially vast ecological consequences.

4. A Legislative Solution

The following chapter will analyze the solution proposed in H.R. 962, its key components, and the impact of certain terms within the bill. These items are needed to understand the main policy approach behind this bill, the precautionary principle.

4.1 Framing the Solution

Regulating the amount of pollution that is released into the environment has been attempted in the past. The Clean Air Act and the Clean Water Act are landmark pieces of federal legislation that govern the types and quantities of pollutants that enter our air and water systems.[43] Like other legislation, these bills were introduced in the wake of resounding public opinion. H.R. 962 is also responding to public concern that pollution from aquaculture facilities causes ecological damage to wild and scenic rivers.

Overall, the goal of H.R. 962 is to protect the conditions on wild and scenic rivers from the potentially harmful effects of aquaculture pollution. The language within the legislation reflects this intent; the bill's short title is the "Preserve Fishing on Wild and Scenic River Act." Additionally, the subheading reads, "To prohibit operation of aquaculture facilities that contribute to pollution of wild and scenic rivers."[xi] In order to fulfill its goal, the bill outlines three key components that together comprise the solution for reducing pollution:

- Defining and mitigating the pollutants from aquaculture facilities
- Determining an agency to oversee or enforce the law
- Establishing the jurisdiction of the agencies

There is one critical sentence within the bill's text that encapsulates all the parameters mentioned above:

> …[A] person shall not operate an aquaculture facility unless the Secretary of the Interior has certified that such operation will not discharge a pollutant into a river any segment of which is a wild and scenic river.

In other words, before an aquaculture facility can operate, the Secretary of the Interior must certify that it will not pollute into a wild and scenic river. Upon closer inspection there are key phrases within that very sentence that amplify the effects of the solution's key components:

"…will not discharge a pollutant…"

The purpose of this bill is to regulate the amount of pollution discharged from aquaculture facilities. As defined in chapter 3, the pollutants from aquaculture facilities fit into all of the categories mentioned. The remainder of the bill does not mention any acceptable levels,

tolerances, or existing regulations to utilize as guidelines, therefore the phrasing above is interpreted as *any level of pollutant* will be considered noncompliant with the regulation.

"...any segment of which..."

In chapter 2, it was shown that the wild and scenic river designation does not apply to the entirety of the river's course. However, the above phrase suggests that the jurisdiction of this bill extends beyond the protected areas. An aquaculture facility that is located on a river connected to a wild or scenic segment would be subject to the same definition of pollutants as a facility located directly within the protected areas.

4.2 Why Zero Pollution?

The Clean Water Act and the Clean Air Act typically have acceptable limits of certain pollutants once they enter the environment, and the proposed limits are based on scientific studies suggesting a "safe" level for human exposure. H.R. 962 takes a much stricter stance on the discharge of pollutants into wild and scenic rivers, proposing their level be reduced to zero. There is precedent for such a policy approach known as the *precautionary principle*.

The precautionary principle is a policy strategy that is employed when existing scientific uncertainty could prevent effective assessment or management of a risk.[44] Some precautionary principles follow the "first, do no harm" approach; the best way to mitigate the damages to an environmental system is to release no pollutants to begin with.

There are many uncertainties regarding the nature and quantity of pollutants that could be emitted from aquaculture facilities at any given time. Chapter 3 covered the main types of pollutants, the effects of which are numerous and vary greatly in time and space. Because the facilities are intricately linked with their local ecosystems, it is difficult to ascertain how much of a specific pollutant could begin to cause harm or irreversible damage once discharged into the waters.

From the case of Big Spring Creek (see chapter 3), there is evidence that an unregulated aquaculture industry can cause serious damage to a protected ecosystem. Therefore, it is the view of the bill drafters that the precautionary principle must be applied in this case in order to protect the wild and scenic river system, its ecological balance, and the people that either recreate or profit from its use. Although the number of farms currently operating on wild and scenic rivers is relatively modest (approximately 15), the growing demand for fish will potentially increase proliferation of these facilities in the years to come. Today, Big Spring Creek has regained its reputation as a fly-fishing destination, indicating that ecological restoration is possible.[45] However, the timeline to do appears to be on the scale of many years, possibly much to long for economic rebound.

4.3 Exclusions Within the Legislation

H.R. 962 does not provide additional specifics as to how the Department of the Interior will manage the certification of aquaculture facilities. It must establish a framework for regulation including qualified administrators, forms, and a database for record-keeping. It is assumed that the Department of the Interior must find room within its existing budget to accommodate the certifications, since the bill does not propose any appropriations for these purposes. Within H.R. 962, there are several exemptions that may ultimately alter the way the bill is administered, or generate conflict among other departments.

Firstly, within its definition of aquaculture facilities, the bill specifically excludes fish hatcheries operated by State or Federal agencies. Therefore, all hatcheries operated by the U.S. Fish and Wildlife Service are not subject to the regulations in this bill, regardless if they are on wild and scenic rivers or not. There are currently seven known government-operated hatcheries that are located on wild and scenic rivers. Among the private operations, the definition of aquaculture facility does not distinguish between different methods of fish raising as described in chapter 1; all these systems would be subject to H.R. 962 regardless of initial pollution level.

Secondly, aquaculture facilities have been subject to the Federal Pollution Control Act since 1977, which requires them to obtain a permit to discharge pollutants.[46] The issuing of these permits would fall under the jurisdiction of state agencies, unless they are federal facilities. H.R. 962 specifically states that this law "shall not be construed to affect" the previous law since it is under the direction of the Environmental Protection Agency.

Thirdly, a significant portion of the wild and scenic river system is administered outside of the Department of the Interior, namely the Department of Defense (through the Army Corps of Engineers) and the United States Department of Agriculture (through the Forest Service).[47] H.R. 962 does not specify whether the aquaculture facilities located on these other rivers need not comply with the proposed regulations.

SUMMARY OF THE LEGISLATIVE SOLUTION

- H.R. 962 is based on the precautionary principle; it protects wild and scenic rivers by preventing any pollution from aquaculture facilities to occur in the first place.
- The language of the bill impacts aquaculture facilities that are not directly on wild and scenic river segments because pollutants can travel downstream of the source.
- There are several exceptions and unclear provisions within the bill that have the potential to cause controversy.

5. Stakeholders, Controversies, and Consequences

This chapter introduces the stakeholders that will be affected by H.R. 962, including government and private entities. Furthermore, the potential conflicts, controversies, and uncertainties regarding the bill's current language is explored. The implications are analyzed for its impact on the aquaculture industry as a whole.

5.1 Stakeholders of H.R. 962

Once enacted, there will be a host of entities that must react to the strict regulations contained within this bill. The case of the Au Sable River mentioned in section 2 provides a relevant microcosm of the stakeholders that will be impacted. It shows passionate groups supporting and opposing this bill as well as a government agency that must first establish a regulatory framework before it can intervene.

Administrators

As mentioned in section 4, the Secretary of the Interior will issue certifications to the aquaculture facilities once they have proved they will not pollute into wild and scenic rivers. The intent of H.R. 962 is to define the Department of the Interior as the agency of enforcement. Furthermore, the Department of the Interior has several operating units that administer to both aquaculture facilities and the wild and scenic river system.

Over half of wild and scenic rivers are protected by the Bureau of Land Management, the National Park Service, and the Fish and Wildlife Service – all agencies contained within the Department of the Interior.[48] Additionally, the Department of the Interior is a leader of the National Aquatic Animal Health Plan, an interdepartmental task force tasked with establishing guidelines for aquaculture operations.[49] The Fish and Wildlife Service manages all federal fish hatcheries, which are typically used for ecological and recreational purposes.

Supporters

The entities that will benefit from the passage of H.R. 962 are the established community organizations and small businesses that utilize the wild and scenic designated areas. The example of the Au Sable River features these two categories of stakeholders, which promote the passage of this bill to maintain the status quo on the river.

Currently, the river is a fly-fishing destination for both tourists and locals, which supports the local economy and provides a sense of identity to the region. The Anglers of the Au Sable Club, North Branch Outing Club, and Old Au Sable Fly Shop are all entities related to tourism, and they therefore rely on the natural resources of the river.[50] One entity, For the Love of Water (FLOW), is primarily concerned with the ecological impacts of aquaculture on existing river systems.[51] For

these supporting entities, employing the precautionary principle is the most effective method of preserving the Au Sable's designation as a wild and scenic river.

Opponents

Aquaculture businesses that are located on rivers with wild and scenic designations stand to lose the most from this bill. These facilities would have to alter their operations to comply with the precautionary approach utilized by H.R. 962 within three years of its enactment. As mentioned previously, there are currently around fifteen farms, in total producing between 30,000 to 200,000 pounds of trout annually, that are going to be impacted the moment the bill is enacted.

One such raceway facility that is impacted by H.R. 962 is the Grayling Fish Hatchery located on the Au Sable River in Grayling, Michigan. The business is seeking to expand from the current production of 68,000 pounds to 300,000 pounds of trout.[52] Both the expansion and its current operation will have to comply with the requirement for zero discharged pollution. Otherwise, they will be prevented from operating by the Department of the Interior.

If the provisions of H.R. 962 force a long-term cessation, this and the other aquaculture businesses on wild and scenic rivers could close down or relocate to a non-wild and scenic river. Both closure and relocation could mean lost jobs locally to these areas, which are typically small blue-collar towns. The Grayling Fish Hatchery and Harrietta Hills Trout Farm, for instance, employ 12 people combined.[53] If this bill were to impact all fifteen facilities equally, the result could be a loss of aquaculture practitioners for the growing industry since these facilities potentially employ a total of around 100 people. Furthermore, since H.R. 962 prohibits any pollution on any segment of any wild and scenic river, many more aquaculture facilities than the approximately 15 facilities identified in this report could be impacted by the bill. In that event, relevant associations such as the National Aquaculture Association or the American Farm Bureau Federation are expected to oppose the passage of this bill because it impacts the aquaculture industry as a whole.

Against H.R. 962	Support H.R. 962
Harrietta Hills Trout Farm and Grayling Fish Hatchery (12 staff)	Anglers of the Au Sable (800 members)
	For the Love of Water (FLOW) (9 staff)
	North Branch Outing Club (4 staff)
	Au Sable Fly Shop (9 staff)

Figure 5-1. Stakeholders on the Au Sable River and their support base. This table represents the organizations that support and oppose H.R. 962 and each organization's membership base.

5.2 Controversies and Uncertainties

The controversies surrounding H.R. 962 are focused on its impact on the aquaculture industry. The American Farm Bureau Federation, a national organization of local farm bureaus with nearly 6 million member families, opposes the bill. They oppose any legislation that would prevent the economic development of a stretch of river having potential resource value, which includes this bill.[54] H.R. 962 will likely close aquaculture facilities, and its impact will vary widely depending on how the Secretary of the Interior chooses to interpret and enforce two controversial aspects of the bill:

1. The pollution threshold of zero.
2. The vague geography of the bill's territory because of the connectivity of water systems.

The pollution threshold of zero and the vague geography of the bill carry implications regarding H.R. 962's impact on the aquaculture industry, and they are worth exploring in detail.

Difficulties with a Pollution Threshold of Zero

As mentioned previously, the phrase "...will not discharge a pollutant..." implies that the threshold of allowed pollutants from aquaculture facilities is zero and defers to the broad definition of "pollutant" in the Clean Water Act. The main pollutants from aquaculture – nitrogen and phosphorus in fish waste as well as antibiotics and chemical pesticides – are all included in this definition as "solid waste," "biological materials," "chemical wastes," and "agricultural waste." Thus, in order to obtain a permit for continued operations under H.R. 962, aquaculture facilities on wild and scenic rivers must demonstrate within three years that the facility emits none of the pollutants outlined above. There is no existing peer-reviewed literature demonstrating that treatment of discharge from an aquaculture facility can eliminate all pollutants. There are, however, biological and mechanical treatments that aquaculture facilities can install to purify their effluent and attempt to reach the pollution threshold of zero.[55]

Biological methods rely on the usage of aquatic plant life, which can physically filter and chemically transform pollutants. For example, water hyacinth and water lettuce are highly effective at removing nitrogen and phosphorus while creating aerobic conditions.[56] Non-biological methods currently include gravitational sedimentation and mechanical filtration, and could be expanded to utilize wastewater management techniques such as phosphorus reclamation, denitrification, and antibiotic reclamation.[57] Best management practices include limiting the amount of feed given to fish and removing dead fish to prevent the spread of disease, which can reduce reliance upon antibiotics.[58]

Issues with these pollution treatment methods include:

- Cost: Substantial initial investment and annual operating costs, especially for mechanical filtration systems. For example, President of Michigan Aquaculture Association and Owner of Harrietta Hills Trout Farm Dan Vogler estimates that the mechanical effluent treatment facility at Platte River State Fish Hatchery – a government facility – costs $9 million initially with an additional expense of $200,000 a year to maintain operations. This may be cost-prohibitive for small scale aquaculture businesses.
- Spatial Considerations: The size of constructed wetlands for biological treatment vary from 0.7 - 2.7 times the size of the operating facility required for effective treatment,[59] either requiring facilities to acquire new space to accommodate the constructed wetland or to convert existing aquaculture operations to treatment resulting in a loss of productivity, depending on how much of the existing aquaculture facility is converted to treatment facilities.
- Feasibility: There is lack of convincing evidence that any treatment of aquaculture discharge will be sufficient to reach the zero level of pollution necessary to meet the requirements of H.R. 962.

If the threshold of zero pollutants is strictly enforced, it is likely that most or all aquaculture facilities on the stretches of river where this bill is enforced will have to close because they do not have the capital or space for treatment facilities. Even if businesses do build them, they still may not be able to prove a pollution level of zero at point source if and when they are tested. For these reasons, the Michigan Farm Bureau and local media in Michigan have referred to H.R. 962 as a ban on aquaculture on wild and scenic rivers.[60] [61]

The Vague Geography of the Bill's Jurisdiction

The second factor that is subject to the interpretation of the Secretary of the Interior has to do with the unconfined space in which pollutants travel. H.R. 962 defines its territory as "a river any segment of which is a wild and scenic river," but because of the connectivity of rivers and watersheds in the USA, the Secretary of the Interior could theoretically interpret the territory to be the entire country's river system. Figure 5-2 shows a map of the watersheds of the USA and the connectivity of these waterways.

For example, a segment of the Missouri River, the longest river in the country, is designated as a wild and scenic river; therefore, according to the bill's language, the entire Missouri River is impacted. The Missouri River is connected to the Mississippi River, so it is conceivable that the Mississippi River would fall under H.R. 962's jurisdiction as well. Therefore, the inclusivity of the bill and number of businesses impacted will depend upon the final determination by the Secretary of the Interior.

Figure 5-2: The watersheds of the USA. Because of the connected nature of river systems, the language in H.R. 962 gives wide discretion to the Secretary of the Interior in determining the territory impacted.

5.3 The Economic Impacts of H.R. 962

American aquaculture is a growing industry, with revenue of $1.372 billion in 2013, projected to grow to about $1.442 billion by 2030.[62] [63] Research suggests that the aquaculture facilities on wild and scenic rivers are almost entirely trout rearing facilities, and that they represent approximately 4.8% of the trout farms in the USA.[64] [65] If the trout farms on wild and scenic rivers are on par with national average revenue per trout farm, then annual revenue from the approximately 15 aquaculture facilities on wild and scenic rivers is currently about $5.3 million.[66] [67] Using this data and North American aquaculture growth projections from the Food and Agriculture Organization of the United Nations, we can project estimates of this bill's impact on the American aquaculture industry, as seen in Figures 4-2 and 4-3, which increase with broader interpretation of the territory and subsequent inclusion of different kinds of aquaculture facilities.

While the approximately 15 aquaculture facilities identified – and possibly larger parts of the entire aquaculture industry - are likely to be negatively impacted by H.R. 962, the river tourism and recreation industries will benefit from it. A University of Montana study reports that the average annual recreation revenue from several wild and scenic rivers in Connecticut, North Carolina, and Tennessee is $4.5 million combined.[68] Assuming this is the average across the wild and scenic river system, then an estimated $936 million in annual revenue could be lost if all wild and scenic

rivers are polluted from aquaculture to the point where they no longer attract hobby fishing, recreation, and tourism. As discussed in the case study of Big Spring Creek in chapter 3, the potential of eutrophication to these rivers has real precedent. Eutrophication would have real consequences not only for the wildlife and ecosystems, but to the recreation and tourism industry that depend on them. Although eutrophication is a real potential consequence, it is not a certainty should H.R. 962 not be enforced. For all of the estimates discussed in this section, it is important to appreciate that they are dependent on whether the enforcement of the bill extends geographically to include locales popular for river or lake tourism and recreation.

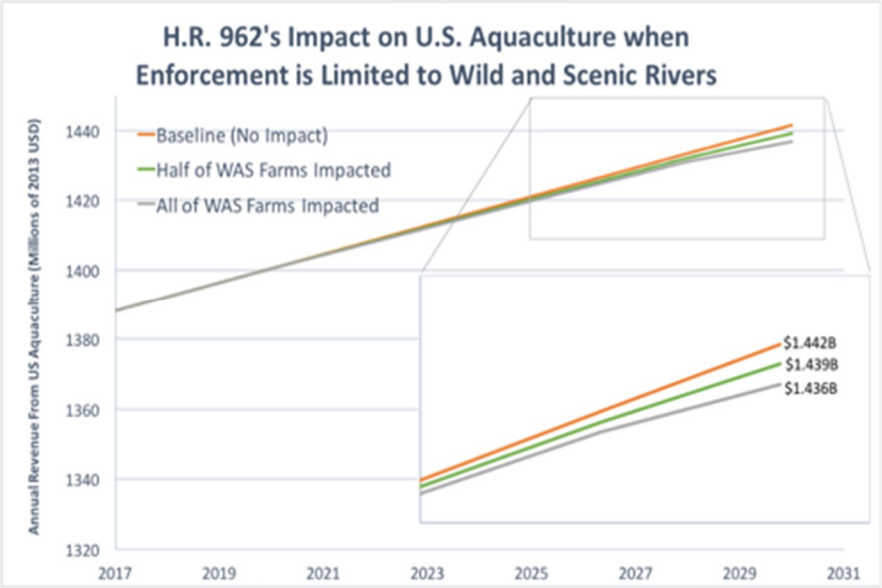

Figure 5-3:
Scenario projections of H.R. 962's economic impact with enforcement on Wild and Scenic Rivers only.[69]

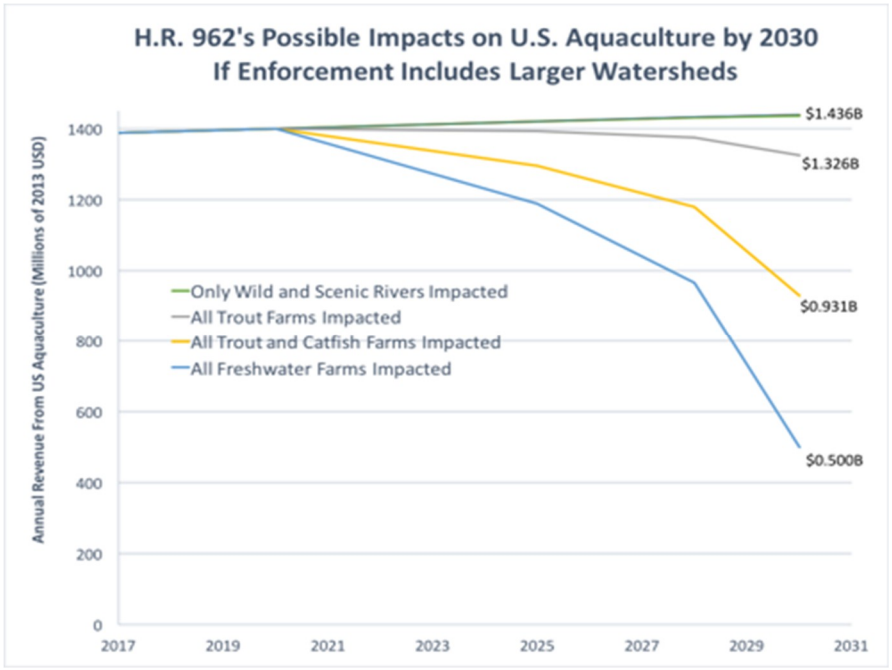

Figure 5-4:
Scenario projections of H.R. 962's economic impact with enforcement on watersheds of various size.[lxviii]

Considering Externalities

In attempting an economic analysis of the impact of H.R. 962, some externalities are difficult to quantify, including:

- The contribution of aquaculture to food supply as nutritious food, meaning a reduction of local aquaculture has a potential cost to public health and welfare.
- The recreational benefits of preserved nature (e.g. hiking, swimming and fishing).
- Ecosystem services such as the ability of the natural system to metabolize chemicals.

A simple cost benefit analysis comparing the cost to the aquaculture industry and the benefits to recreation and tourism leaves these important factors out. Even though these externalities are very difficult to quantify, they should be considered for a comprehensive understanding of this bill and its potential impacts.

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SUMMARY OF STAKEHOLDERS AND CONTROVERSIES

- The parties that support H.R. 962 include river recreation and tourism businesses, hobby anglers, and conservationist groups.
- The parties that oppose H.R. 962 are primarily aquaculture businesses.
- The threshold of zero pollutants will likely close aquaculture facilities directly located on wild and scenic rivers.
- The connected nature of river systems lead to vague geographical limits of enforcement.
- The combination of the zero pollutant threshold and vague geographical limits gives wide discretion to the Secretary of the Interior about the bill's impact on industry.

6. Measuring the Progress

A quantitative approach to measuring success requires the distinction between outputs and outcomes. Conceptually, the output is what the bill aims to regulate in order to obtain a certain outcome. In the context of H.R. 962, the output is the levels of pollutants discharged from aquaculture facilities, while the outcome is the quality of ecosystem health supporting healthy native aquatic populations, allowing for continued recreational activities on Wild and Scenic Rivers. Measuring the latter presents many challenges because each wild and scenic river and connected river system is different, with different plants and animals to monitor as indicators of ecological health. For example, the baseline number of naturally occurring trout in rivers fluctuates from year to year and varies greatly from river to river; while the Clarks Fork Yellowstone River contains up to 6,000 trout per mile, others contain no trout at all.[70] Because of the immense difficulty and potential infeasibility of measuring success of the broad outcome of preserving healthy ecosystems on wild and scenic rivers, this chapter will focus on measuring the progress of H.R. 962's desired output, which is to eliminate aquaculture pollutants relative to ambient levels.

6.1 Comparing Effluent to Upstream Levels

For both enforcement and measuring the success of this bill, the Department of the Interior must evaluate the effluent discharge from aquaculture facilities. The bill gives the Secretary of the Interior discretion on how to do this; the U.S. Fish and Wildlife Service, an agency within the Department of the Interior, is a likely candidate because this agency already monitors pollution on wild and scenic rivers.[71] For an aquaculture facility to comply with H.R. 962, the operators would need to prove that the quality of the effluent discharge does not differ from the water upstream of the facility. The primary aquaculture pollutants of nitrogen and phosphorus in fish waste occur naturally, so they are not pollutants in effluent at any nonzero level, but rather at any level higher than levels measured upstream. As a reference point, the EPA's recommendations for ambient water quality (water in lakes, rivers, non-drinking water) vary from 47.0 - 76.3 micrograms per liter for nitrogen and 0.31 - 2.2 milligrams per liter for phosphorus, but the language of the bill is such that any level higher than what occurs without aquaculture in any given river is prohibited, whether or not it is above those EPA recommendations.[72] [73] [74] [75] The enforcing or evaluating agency can test for pollution by comparing water samples from two locations:

1. Upstream, far enough away from the aquaculture facility to ensure that there is no effluent from the facility moving upstream to the sample site
2. Point source, where the effluent from the aquaculture facility re-enters the river

If the levels of nitrogen, phosphorus, antibiotics, pesticides, or any other pollutant from a point source are higher than they are in the upstream sample, then the aquaculture facility is not compliant with H.R. 962 and its operation is prohibited until its manager can prove it has lowered

the pollution level of the effluent to zero. As discussed in section 5.2, this is a very difficult threshold for the aquaculture facilities to reach, and it will likely lead to aquaculture facility closings; this is a primary way that this bill will effectively succeed in eliminating pollution from wild and scenic rivers. In enforcing the bill, the Secretary of the Interior can determine whether there will be additional chances for the non-compliant facilities to prove that they have reached a pollution threshold of zero. The bill itself provides a three-year period before the prohibition is in effect, and the Secretary of the Interior may choose to begin testing sooner than that in order to determine which facilities are non-compliant and give them time to prepare for the prohibition to take place.

6.2 Comparing Samples to Historical Data

Because of the natural variability of rivers from mile to mile, historical data on the nitrogen and phosphorus levels from a given sample site should be consulted when they are available. It is possible that the area of a river where an aquaculture facility is located has naturally higher levels of nitrogen and phosphorus than the upstream sample site. Historical data would be helpful in accounting for this possible discrepancy. When historical data is unavailable, comparing point source effluent to an average of multiple upstream sample sites may be another way to account for the natural variability of river systems.

6.3 Continued Testing for Thorough Evaluation

In order to thoroughly evaluate the success H.R. 962, the same locations should be tested at regular intervals even after aquaculture facilities have closed. This is necessary because it is possible that a facility could close and leave behind industrial, chemical, or biological waste or materials that continue to contribute pollution to the river. This continued testing is also necessary because it is possible that polluted soil sediment in the rivers will continue to contribute pollution into the river after the facility has closed. If the results of these tests show pollution after the aquaculture facility has been shut down, then the evaluating agency may want to report these findings to another agency such as the Environmental Protection Agency or a local municipal office to explore remediation.

SUMMARY OF THE PROCESS TO MEASURE PROGRESS OF THE BILL

- Compare point source water samples to upstream water samples.
- Use historical data or average of multiple upstream sites to account for natural variability of river water.
- Continue testing even after aquaculture facilities have closed to ensure that residual pollution does not occur.

7. Conclusions

H.R. 962, the Preserve Fishing on Wild and Scenic Rivers act, should be viewed as a regulatory measure for the protection of federally designated wild and scenic rivers from aquaculture pollutants. The most impactful of these pollutants are excess nutrients from fish waste, which, when released in high concentrations, can cause algal blooms leading to local ecological disruptions such as fish kills. Other pollutants include antibiotics and pesticides, some of which may bioaccumulate in animal and, eventually, human tissue. The bill aims to completely prevent such pollutants emanating from aquaculture facilities to enter a wild and scenic river, primarily with the purpose of protecting fishing and recreation on these unique natural sites. Such a policy measure is an application of the precautionary principle.

As this report shows, the bill in its current state is not without controversy. There is no evidence that a level of zero pollution is feasible with today's filtration technologies, and the definitions of certain key terms are open to wide legal interpretation. For example, how far does the enforcement of a river shed extend given inexact definitions? Such legal interpretations and the enforcement thereof will require the establishment of a program by the Department of the Interior, requiring additional oversight.

Controversies aside, H.R. 962 may only impact the approximately 15 facilities—all of which are trout farms identified in chapter 1. This makes any industry-wide impacts minimal as aquaculture continues its upward growth. Additionally, farms rearing the most popular species of raised fish in the United States, catfish, will not likely be affected by the bill’s zero-pollutant limits. One could conclude that the intent of the bill would be successful to the extent that it protects all 12,734 miles of the wild and scenic river system from the augmented risk of eutrophication and hypoxia due to aquaculture discharge, and does so with minimal disruption to the growth of the aquaculture industry as a whole.

However, the application of the precautionary principle in H.R. 962 sets a strong precedent on regulating aquaculture facilities above and beyond the standards of the Environmental Protection Agency. If this bill proves successful in preventing ecological disruption on federal wild and scenic rivers, it may be feasible for states to adopt the same precautionary measures for their own protected river systems. For example, the state of New York has eighty-six rivers in its own protected river system. If the zero-pollution standard is applied to a wider system it could impact the aquaculture industry significantly. If more facilities are required to change their wastewater management system, the number of facility shutdowns could drastically reduce overall industry production as shown in chapter 5.

A compromised aquaculture industry has undesired consequences for the U.S. economy. While more rivers would be further protected from aquaculture pollutants, the overall demand for fish protein will be even more difficult to meet with domestic produce. As a consequence, local jobs

and economic development might be at risk, and the fish market in the United States could further increase its reliance on fish imports, as discussed in chapter 2.

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