Suspicious Shrimp

The Health Risks of Industrialized Shrimp Production

food&waterwatch

About Food & Water Watch

Food & Water Watch is a nonprofit consumer organization that works to ensure clean water and safe food. We challenge the corporate control and abuse of our food and water resources by empowering people to take action and by transforming the public consciousness about what we eat and drink. Food & Water Watch works with grassroots organizations around the world to create an economically and environmentally viable future. Through research, public and policymaker education, media, and lobbying, we advocate policies that guarantee safe, wholesome food produced in a humane and sustainable manner, and public, rather than private, control of water resources including oceans, rivers, and groundwater.

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Executive Summary

Whether dipped in cocktail sauce at a party, sizzling in butter at a tapas bar, or topping a salad on a lunch break, shrimp has become the most popular seafood in the United States. The typical American eats three-and-a-half pounds of shrimp a year – surpassing even canned tuna, our long time former favorite.

However, even as they pop popcorn shrimp into their mouths, many consumers are not aware that a significant portion of shrimp consumed in the United States – even most of the shrimp labeled as "eco-friendly" – is not caught in U.S. waters. Instead, much of it is grown in man-made ponds containing a mix of ocean and fresh water along the coast of countries such as Thailand, Indonesia and Ecuador. These shrimp are often referred to as "farmed" and may be labeled "farm-raised," but in reality, they often are produced under unsafe and unhealthy conditions.

This report, *Suspicious Shrimp*, addresses the consumer health risks of eating shrimp that is farmed abroad – neurological damage, allergies, and other infections and illnesses. These can occur from ingesting shrimp contaminated with pesticide residues, antibiotics or pathogens resistant to antibiotics, such as *E. coli*.

In order to export large quantities of shrimp, shrimp farm operators densely stock their ponds to produce as much as 89,000 pounds of shrimp per acre. Although these facilities profit in the short-run, the water is quickly polluted with waste, which can infect the shrimp with disease and parasites. In response, many such operations in Asia and South or Central America use large quantities of antibiotics, disinfectants and pesticides that would be illegal for use in U.S. shrimp farms.

But exemptions to federal labeling laws mean that U.S. consumers often have no way of knowing the origin of the shrimp they buy and eat. Sadly, consumers also can't count on the government to stop contaminated shrimp at the border. The U.S. Food and Drug Administration inspects less than two percent of seafood that is imported into the United States, which means that large quantities of shrimp contaminated with antibiotic-resistant bacteria, antibiotics and pesticide residues are likely reaching consumers.

Suspicious Shrimp highlights the dangers of eating imported industrial shrimp and calls on consumers to ask questions about where their shrimp comes from.

Abandoned shrimp farm, Brazil.

Introduction

Whether dipped in cocktail sauce at a party, sizzling in butter at a tapas bar, or topping a salad on a lunch break, shrimp has become the most popular seafood in the United States. The typical American eats three-and-a-half pounds of shrimp a year – surpassing even canned tuna, our long time former favorite.

Driving this surge in the consumption of shrimp is a method of intensive production that began expanding in the 1970s. Rather than being caught at sea, large quantities of shrimp are grown in man-made ponds containing a mix of ocean and fresh water along the coasts of Southeast Asia and South or Central America. Unfortunately, this industrial-scale shrimp production, often with hefty doses of antibiotics and pesticides, creates a series of food safety concerns.

The negative effects of eating industrially produced shrimp may include neurological damage from ingesting chemicals such as endosulfans, an allergic response to penicillin residues or infection by an antibiotic-resistant pathogen such as *E. coli*.

What is Shrimp Farming?

Shrimp farming itself is not new – in Asia, it's been practiced since at least the 15th century. But those earlier traditional farms used low densities of shrimp that sometimes coexisted with other species, such as milkfish. By working in balance with the ecosystem, farmers sustained small crops of shrimp indefinitely. Only recently has shrimp production become a large-scale industrial operation.

In the 1970s and '80s, intensive shrimp production became big business. Shrimp farmers, with the backing of corporate investors and international development banks, began building new ponds and stocking them with more and more shrimp to produce bulk quantities for export. People with no experience in the field were lured by generous loans and the promise of a quick profit to start their own ponds. While traditional shrimp farms yield up to 445 pounds per acre, these concentrated shrimp operations may produce as much as 89,000 pounds per acre.[1] In 2007, Thailand alone exported about $1.24 billion worth of shrimp to the United States. In total, the United States imported a staggering $3.9 billion dollars worth of shrimp that year.[2]

Although it is possible to build sustainable shrimp farms in land-based facilities completely closed off from the environment and equipped to recycle their water, such operations are still an anomaly in the industry, in large part because they require more start-up capital and do not generate immediate profit. The ponds do, but not without a price: polluted water and, often, shrimp infected with disease and parasites. Indeed, many shrimp producers in Asia and South or Central America use hefty doses of antibiotics, disinfectants and pesticides, many of which are illegal for use in the United States.[3] Most consumers are not aware that there may be traces of this chemical cocktail in the shrimp they eat.

Who Grows It? Who Eats It?

The United States and Japan import more shrimp than any other country, and Europeans also consume a fair amount. In 2006, more than 90 percent, about 868,265 tons, of the U.S. shrimp supply was imported.[4] Thailand is the leading

exporter of shrimp to the United States, followed by Ecuador, Indonesia, China, Mexico and Vietnam. (See Appendix A)

Industrial shrimp production has harmed the environment of these countries. Coastal mangroves, which provide habitat for a variety of marine species, are frequently chopped down to make way for shrimp ponds. These shrimp facilities pollute the surrounding land and water and deplete the freshwater supply. Then, after an average of seven years, the ponds become so polluted with shrimp waste and chemicals that shrimp producers move on to build new ponds, leaving behind abandoned wastelands. (For more, see "Production Problems," p. 7)

U.S. consumers often have no way of knowing where the shrimp they purchase was produced. Under the federal Country of Origin Labeling Law, also known as COOL, labels on fresh seafood are required to tell consumers where the fish was farmed or wild-caught. Unfortunately, nearly 50 percent of the shrimp found in grocery stores have no label because they have been processed – boiled, breaded or added to a seafood medley – and thus are exempt from labeling requirements. Stores that carry only a small amount of seafood are also exempt from COOL, as are restaurants. Even if a label isn't apparent, consumers still can ask about the origin of their seafood.

Crowded Shrimp are Sick Shrimp

With millions of shrimp crammed together in ponds, diseases can run rampant, in some cases severely enough to kill off entire ponds and even a country's entire shrimp industry. On average, an intensive shrimp operation only lasts for seven years before the level of pollution and pathogens within the pond reaches a point where shrimp can no longer survive.[5]

In 1988, Taiwan, then the top producer of industrial shrimp, lost 75 percent of its harvest to a virus called *Monodon baculovirus*.[6] The industry has never recovered, and Taiwan is no longer considered a significant producer of shrimp. China then became the top producer, until it was hit with disease caused by hypodermal and hematopoietic virus.[7] In 1999, Ecuador lost half of its crop to Taura syndrome and white spot syndrome virus.[8] The shrimp industries of Indonesia, India, Honduras and Mexico also faced significant disease outbreaks in the 1990s.[9]

While traditional shrimp farms yield up to 445 pounds per acre, modern concentrated shrimp farms may produce as much as 89,000 pounds per acre.

Mangrove forest in Venezuela.

Even before a country's industry collapses, shrimp producers face constant battles with disease in their ponds. The World Bank estimates that about $3 billion worth of shrimp is lost each year to disease.[10] According to one survey, 96 percent of shrimp producers interviewed in Northwest Mexico combated disease in 2001.[11]

White spot syndrome virus is currently the leading disease that reduces shrimp yields. White spots appear on shrimp flesh and their bodies steadily decompose in as few as 10 days. White spot is usually accompanied by vibriosis, which is caused by *Vibrio* bacteria. These bacteria exist naturally in coastal waters and infect shrimp when they become stressed by problems like poor water quality, another disease or crowding. A devastating outbreak of the white spot syndrome virus struck the shrimp farms of southern Iran in 2005.[12] The previous year, Iran exported $2.2 million worth of shrimp to the United States. The year after the outbreak, it exported only $178,547, and by 2007 the country was not exporting any shrimp to the United States.[13] *Vibrio* bacteria are especially problematic: if humans eat the infected shrimp, they can become sick with gastroenteritis (caused by *Vibrio parahaemolyticus*), cholera (caused by *Vibrio cholerae*) or suffer from fatal septic shock (caused by *Vibrio vulnificus*).

Shrimp on Drugs

In an attempt to stave off disease, shrimp in many foreign farms are given daily doses of antibiotics, either mixed in with feed pellets, dumped directly into pond water or both.

Oxytetracycline and ciprofloxacin, both of which are used to treat human infections, are two of the most common drugs in shrimp farming. The use of chloramphenicol, penicillin and other antibiotics pose serious health risks – such as susceptibility to antibiotic-resistant bacteria – to consumers if residues of the drugs remain in the shrimp.
(For a complete list of most commonly used antibiotics, see Appendix B)

It is illegal to use antibiotics in U.S. shrimp farms, but because most of the shrimp eaten in the United States is produced elsewhere, this law does little to protect most consumers. In a 2003 survey of Thai shrimp producers, 74 percent reported using antibiotics on their shrimp.[14] To make matters worse, producers knew little about applying the drugs, leading to serious overuse. Many tried using antibiotics to treat viruses – without knowing that antibiotics don't kill viruses.

Bacteria Fight Back

A population of bacteria repeatedly exposed to an antibiotic can develop antibiotic resistance, the ability to survive even in the presence of the drug. This means that a person infected with bacteria resistant to penicillin, for example, could take the drug indefinitely without getting better.

According to the National Institutes of Health, tuberculosis, gonorrhea, malaria and childhood ear infections have all become more difficult to treat than they were a few decades ago because of antibiotic resistance.[15] Antibiotic-resistant *E. coli* infections, which cause diarrhea and urinary tract infections, have grown increasingly common around the world.

How does it happen? When first administered, an antibiotic drug kills a significant portion of the bacteria population. However, some of the individual microorganisms may survive. They rapidly reproduce, increasing the number of organisms that can resist the antibiotic. This process continues for as long as the bacteria are exposed to the drug. The weaker organisms get killed off, and only the strong survive. The more frequently a drug is administered, the greater the percentage of the bacteria in the shrimp facility that will be antibiotic-resistant.[16]

Additionally, bacteria have the habit of trading pieces of their genetic material, called plasmids, with each other. Thus, if a bacterium has the ability to resist a specific drug, it can pass that trait along to other microorganisms, increasing the speed and ease with which a population develops antibiotic resistance.

To make matters worse, a trait that helps bacteria resist one antibiotic may allow it to be resistant to other types, as well. One study found that bacteria exposed to oxolinic acid also became resistant to flumequine and oxytetracycline.[17]

On average, an intensive shrimp operation only lasts for seven years before the level of pollution and pathogens within the pond reaches a point where shrimp can no longer survive.

Resistance in the Pond...

The daily feeding of antibiotics to shrimp encourages antibiotic resistance in the ponds. On average, shrimp eat only 20 percent of their feed. That means the other 80 percent, including the antibiotics it contains, end up in the water and on the muddy pond bottom.[18] Many antibiotics are not biodegradable and persist in the surrounding environment, where they fight against bacteria that continue to develop resistance. Studies of shrimp ponds in Thailand, Vietnam, the Philippines and Mexico have found relatively high levels of bacteria that are resistant to antibiotics, especially *Vibrio* bacteria.[19]

...and at the Dinner Table: Bacteria Gourmet

Any time you handle or eat raw or undercooked shrimp, you run the risk of getting food poisoning. However, when the shrimp you eat were grown

A lagoon in Honduras in its natural state.

A lagoon in Honduras after conversion to industrial shrimp production.

with large quantities of antibiotics, you take on the additional risk of getting food poisoning from antibiotic-resistant bacteria, which by definition is much more difficult to treat.

The three major *Vibrio* bacteria that cause illness in humans are *V. parahaemolyticus*, *V. vulnificus* and *V. cholerae*. *V. parahaemolyticus* is the most common cause of food poisoning from seafood in the United States.[20] It causes typical gastroenteritis: diarrhea, cramps, nausea, vomiting, headache and fever that last an average of two and a half days. Most cases do not require hospitalization.

In healthy people, *V. vulnificus* has the same effect. However, for those with chronic illness (such as liver damage, diabetes, asthma or cancer), *V. vulnificus* can cause septic shock, resulting in death in about half of the cases. Disturbingly, in a 1996 study of frozen shrimp imported into Denmark from mostly tropical countries, 7 percent were contaminated with *V. vulnificus*.[21]

V. cholerae is the bacteria that causes cholera, an intestinal illness that can be mild or severe. The latter is characterized by watery diarrhea, vomiting and leg cramps, which can lead to dehydration and shock. Without treatment, death can occur within hours. (See "Cholera in Ecuador")

Cholera in Ecuador

Between 1991 and 1995, a cholera outbreak in Latin America killed more than 10,000 people. A 1994 study in Ecuador found that 36 percent of the samples of *Vibrio cholerae* collected from cholera patients had resistance to more than one antibiotic. In total, resistance was found to seven different antibiotics. The authors suggest that the use of antibiotics in Ecuadorian shrimp hatcheries could have contributed to the development of antibiotic resistance in the cholera bacteria.[26]

Salmonella bacteria are also found in shrimp. Even though shrimp accounted for only 22 to 24 percent of seafood imports between 2003 and 2006, it amounted to almost 40 percent of the imports refused because of *Salmonella* contamination.[22] One third of human cases of *Salmonella* infection worldwide are resistant to five or more antibiotics.[23]

S. enteriditis causes salmonella gastroenteritis. The initial symptoms include diarrhea, cramps, nausea, vomiting, headache and fever. After three to four weeks, the infection may cause chronic arthritis. Scientists have suggested that antibiotic-resistant *Salmonella* from fish or shrimp facilities in Asia likely caused several outbreaks of salmonella infections in Europe and the United States in 2000 and 2004.[24]

Another type of *Salmonella*, *S. typhi*, are the bacteria that cause typhoid fever, a potentially fatal illness involving high fever, abdominal pain, rash and an altered level of consciousness. Outbreaks of typhoid that are resistant to the antibiotics chloramphenicol, ampicillin and trimethoprim have occurred in South and Southeast Asia.[25] In fact, there is such a high level of resistance to chloramphenicol among *S. typhi* that the drug is no longer considered useful in treating the disease.

Illegal Residues

In addition to the dangers of antibiotic resistance, there is the risk of consuming shrimp that still have antibiotic residues in their flesh. The U.S. government is aware that shrimp facilities in other countries use antibiotics but still does little to prevent contaminated product from entering the U.S. marketplace. The U.S. Food and Drug Adminis

tration does test some imported shrimp for residues of chloramphenicol, nitrofurans, quinolones and oxytetracycline – but not enough of it.[27] In 2006, only 1.34 percent of seafood shipments were given a sensory examination and only .59 percent received a more thorough laboratory inspection. If any residue is detected during inspection, the importing company chooses whether to send the shipment back to the country of origin or destroy it. Between 2003 and 2006, the number of countries with refusals of entry for seafood with veterinary drug residues went from four to more than 10. Shrimp has accounted for anywhere between 15 (in 2006) to 84 percent (in 2003) of the seafood shipments refused because of veterinary drug residues. Because the percentage of seafood shipments collected for any type of inspection is so low, and the budget for inspecting foreign seafood processing facilities has been cut to zero, it is highly likely that contaminated shrimp are reaching U.S. consumers.[28]

The issue of antibiotics in imported shrimp made headlines in Europe and subsequently in Japan, Canada and the United States when, in late 2001 and into 2002, European Union food authorities detected unacceptable levels of chloramphenicol and nitrofuran antibiotics in imported shrimp from China, Vietnam, Indonesia, Thailand and India.[29] These antibiotics are banned for use in food animals in the United States and Europe because nitrofurans are potentially carcinogenic, and chloramphenicol can cause aplastic anemia.[30]

In 2007, increased monitoring of imported seafood from China led FDA to issue an import alert concerning farmed shrimp and several other types of seafood. Between October 2006 and May 2007, the agency tested 89 samples of seafood imported from China and found that 25 percent contained drug residues. These residues included nitrofurans in shrimp; malachite green (a pesticide) in dace, eel and catfish; gentian violet (an antifungal) in eel and catfish; and flouroquinolones (an antibiotic) in catfish. FDA stated that clear scientific evidence indicates that the use of these drugs and chemicals in aquaculture can lead to an increased antimicrobial resistance in human pathogens and that prolonged exposure to some of these chemicals has been shown to have carcinogenic effects.[31]

In just the 1.2 percent of seafood that the FDA inspected in 2005, 2817 seafood shipments were found to be in violation and sent back or destroyed.

Chloramphenicol

Chloramphenicol is a drug of last resort to treat typhoid fever and meningitis in humans. It is generally not used when less toxic drugs are available. Unfortunately, the drug also is used in industrial shrimp production. Although many countries restrict the direct application of chloramphenicol, it is still often applied illegally or indirectly by mixing it with the shrimp feed. According to analysis of FDA data Food & Water Watch obtained by submitting a Freedom of Information Act request, 39 shipments of shrimp failed import inspections due to the presence of chloramphenicol between 2003 and 2006.[32]

The drug is used sparingly in human medicine because it can cause aplastic anemia, a condition in which bone marrow stops producing red and white blood cells and platelets, which are essential for carrying oxygen and for a healthy immune system.[33] Aplastic anemia is often irreversible and fatal, and onset may occur three weeks to 12 months after exposure. Chloramphenicol is only partially deactivated by cooking. In one study, shrimp cooked for 30 minutes at 212° F still retained 71 percent of the antibiotic.[34] Even less chloramphenicol was destroyed when the shrimp was cooked for a shorter, more typical length of time.

Allergies: Not Just Sneezes

Even common drugs that are generally considered safe can be deadly for those with serious allergies. In fact, 2 to 5 percent of hospitalizations are caused by allergic reactions to antibiotics.[35] Most concerning is the use of penicillin-like drugs in aquaculture. Penicillins cause more fatal allergic reactions than any other group of antibiotics. The common allergic response to a penicillin-like drug is a skin rash and facial swelling. However, 2 to 4 percent of people with penicillin allergies will go into anaphylactic shock and can die without immediate medical treatment. When a person goes into anaphylactic shock, their air passage constricts and their blood pressure drops, causing them to pass out.

To prevent anaphylaxis, individuals with penicillin allergies will seek out alternative medications. However, there is no warning label to inform consumers that their shrimp could contain penicillin residues. It raises the question: could some patients hospitalized for what a doctor might assume to be a shellfish allergy actually be reacting to antibiotic residues? This is an area that merits further investigation.

Pesticides: Poisons on Your Plate

In addition to antibiotics, shrimp producers often use large quantities of chemicals to kill fish, mollusks, fungi, plants,

insects and parasites in their ponds. Some of these chemicals can remain in the shrimp, which is then served to consumers, potentially causing human health impacts. A sampling of the chemicals is described in the following pages.
(For an extended list, see Appendix C)

The cumulative effects of pesticide consumption, including cancer and neurological damage, develop slowly. Pesticides accumulate over a lifetime and may cause problems long after the first exposure. However, outside of a laboratory setting, it is often difficult to trace the origin of cancer to one specific carcinogen.

All but one of the pesticides used globally in shrimp production are banned for use in U.S. shrimp farms. Only a diluted form of formaldehyde, called formalin, is approved for U.S. shrimp farms.[36] Formalin is also a potential carcinogen.[37]

FDA is capable of testing imported shrimp for residues of 360 different pesticides and can refuse shipments of shrimp that are over the legal limit.[38] With such limited seafood inspections, it is likely that shrimp contaminated with the following illegal pesticides are entering the U.S. marketplace.

Organophosphates

Organophosphates are a group of pesticides widely used in shrimp farms. These chemicals can be toxic to the neurological system.

Exposure to an organophosphate, such as carbaryl, can cause a reaction called cholinesterase inhibition. Immediate symptoms include nausea, vomiting and blurred vision. The air passage can constrict and the victim can go into a coma. Exposure to small amounts of the chemical over a long period of time can cause headaches, memory loss, muscle weakness, cramps and loss of appetite.

Malachite Green

Malachite green is often used to kill fungus on shrimp eggs. This chemical is popular among shrimp producers because it is cheap, effective and widely available. However, it is also a potential carcinogen that has been found to cause tumors in laboratory mice and rats.[39] Once it has been used, malachite green will stay in the flesh of shrimp for a very long time – more than 200 days in water that is 50° F.[40]

Rotenone

Rotenone is used to kill off fish living in the pond before it is stocked with young shrimp. If inhaled, it can cause respiratory paralysis. It has also been found to cause characteristics of Parkinson's disease in laboratory rats.[41]

Organotin compounds

Prior to stocking a shrimp pond, organotin compounds are used to kill mollusks. These compounds are endocrine disruptors: they interfere with the activity of hormones, often by mimicking a hormone such as estrogen. Research suggests that these chemicals have caused decreased fertility in humans.[42] Another study suggests that organotin exposure could alter hormonal function to predispose people to chronic obesity.[43]

Uncharted Waters

Unfortunately, there is a lack of concrete data about the quantity and frequency of use for each chemical in shrimp facilities. In studies, producers have only characterized their use of different substances in vague terms no more informative than "a lot" or "not too much."[44] Another largely unanswered question is how these chemicals might interact with one another to create new compounds. Although scientists do not always fully understand the nuanced activity of each chemical, as many as 13 products are regularly dumped into a typical shrimp pond.[45] Appropriate testing has not been done to determine how much pesticide residue is left on shrimp that enter the marketplace. Scientific research has not caught up with the increase in production and consumption around the world.

Filthy Transport: Shrimp with a Side of Cockroach

Food safety is further compromised during transport to the United States if shrimp are not kept adequately cold or in sealed containers. Fresh and frozen shrimp have been

All but one of the pesticides used globally in shrimp production are banned for use in U.S. shrimp farms.

Mangrove seedlings in the Philippines.

turned back at the border by FDA inspectors for being decomposed, infected with *Salmonella* or "filthy."[46] A shipment of shrimp is classified as filthy once inspectors find a specific amount of filth- a classification that includes dirt, insect fragments, rodent hair and other foreign material- after inspecting six different 2- to 3-pound samples of shrimp.[47] (See Chart 1) Shrimp accounted for only 22 to 25 percent of seafood imports between 2003 and 2006, but 26 to 35 percent of refusals for filth were in shrimp shipments.[48]

Chart 1: FDA Definition of Filth

Filth	Qualified as Filth
Disease-carrying insects	2 or more in 1 sample
Other insects	3 or more of same species in 1 sample
Fragments of disease-carrying insects	5 or more in 2 samples
Large pieces of disease-carrying insects	1 or more in 2 samples
Rat or mouse hair	Average of 1 per sample
Other hair	Average of 4 per sample

SOURCE: Import Alert IA #16-21. Office of Regulatory Affairs, U.S. Food and Drug Administration.

Production Problems: Environmental And Social Consequences

In addition to endangering consumer health, industrial shrimp production is environmentally destructive and has caused dislocation of people from coastal areas, as well as job losses. Building a shrimp farm might bring in $8,000 a hectare (2.47 acres), but it will destroy natural resources that have been estimated by the World Resources Institute to be worth $35,000 a hectare.[49]

Mangrove Ecosystem Destruction

The construction of shrimp ponds is considered the world's largest cause of coastal mangrove destruction. Prized for their ability to absorb the force of storms, provide habitat for countless plant and animal species, prevent erosion and filter pollutants, mangrove forests are among the most important ecosystems on earth. By producing staggering amounts of food, fuel, medicines and building materials, mangroves provide sustenance for millions of people around the world.[50] Shrimp facilities are also built in ecologically important salt flats and marshes, but intensive production almost always requires large-scale removal of coastal mangrove forests. Over the last 50 years or more, anywhere from five to 80 percent of mangrove areas in various countries have been lost.[51] A report released by the United Nations Environment Program uses pictures of coastal areas taken from outer space to reveal the rapid increase of shrimp farms in Honduras, Ecuador, Thailand, and India/Bangladesh and the corresponding destruction of mangroves.[52] Many environmentalists say that it's a serious problem in Mexico, as well.[53]

Wild Fish Populations Decline

According to a 2006 study in Science, all commercial fish and seafood populations will be depleted by 2048.[55]

It may take 2.8 pounds of wild fish to produce one pound of industrial shrimp.

Unfortunately, industrial shrimp production only exacerbates the pressure on wild fish stocks. About 70 percent of commercially valuable fish and shellfish in Ecuador, Honduras and Mexico,[56] and 33 percent in Southeast Asia are dependent on mangrove ecosystems.[57] Studies conducted in Mexico have shown that for every acre of mangrove forest destroyed, approximately 675 pounds of commercial fish are lost.[58] Cutting down forests to create shrimp ponds trades the long-term availability of wild fish for short-lived industrial development.

Additionally, diseases in shrimp facilities can threaten wild shrimp and other sea life. Pond water is regularly discharged into the ocean, allowing diseases to spread to wild shrimp populations. In the Philippines, Thailand and Mexico, wild shrimp catches have declined while shrimp-facility output has increased.[59]

Feeding shrimp is also wasteful and inefficient. Shrimp feed is made of fishmeal produced from wild-caught fish. In some cases, producing just one pound of industrially farmed shrimp can require 2.8 pounds of wild fish in feed.[60]

Natural Disaster?

On December 26, 2004, a tsunami in the Indian Ocean shocked the world. Caused by an earthquake reaching 9.3 on the Richter scale, 20-foot-high waves slammed the coasts of 11 nations, killing more than 100,000 people. Coastal communities, beach resorts and shrimp facilities were devastated.

Even the United Nations acknowledged that clear-cutting coastal mangrove forests for shrimp production had compounded the devastating impact of the tsunami.[54] Mangroves serve as a buffer against storms and strong winds. When they are destroyed, communities along the coast are exposed to threats such as tornadoes, hurricanes and tsunamis.

Water Pollution

Industrial shrimp operations discharge polluted water and waste products directly onto surrounding lands and into nearby waterways without any treatment.[61] One study estimates that 155 square miles of shrimp ponds in Thailand produce more phosphorous waste than three million people.[62] A spokesman for the Committee for the Defense and Development of Gulf of Fonseca Flora and Fauna in Honduras says that the nutrients from shrimp feed and waste have led to a decline in local water quality.[63]

Sadly, shrimp operations not only pollute the water, they can destroy natural mechanisms for eliminating waste in the environment, as well. Mangrove forests serve as filters to clean the polluted waters from homes, factories and shrimp farms.[64]

For years, community leaders near shrimp facilities have been reporting that residents, especially children, complain about unexplained and unusual symptoms, including sore throats, burning eyes and skin rashes. Unfortunately, no long-term studies have been done to determine the precise causes of these symptoms and how they might be related to shrimp production.

Water Depletion

Up to 40 percent of pond water is exchanged with fresh water every day in some shrimp farms in order to remove pollution and to maintain the necessary levels of salinity.[65] Water that was once available to the local communities is pumped instead into shrimp operations.

Sometimes so much groundwater is extracted that not only is the water supply depleted directly, but as more and more water is pumped out of the ground, saltwater seeps in to replace it, causing salt contamination of the land and fresh water. Surrounding lands become salty, making the production of other agricultural crops virtually impossible.[66] In the worst cases, extreme depletion of aquifers has caused the land to sink, turning the ground level of buildings in Taiwan into the basement.[67]

Communities Torn Apart

Industrial shrimp production robs local communities of basic access to food, water and meaningful livelihoods. When mangroves are clear-cut, residents can no longer gather crabs, clams, oysters, fish and other seafood that once lived there. Access to traditional fishing areas in the sea is cut off by the physical placement of the shrimp facilities. Saúl Montufar, a spokesman for the Committee for the Defense and Development of Gulf of Fonseca Flora and Fauna says: "There has been marginalization and expulsion of fishing families in the shrimp farming areas, a loss of access to traditional fishing sites and a decline in the fish catch."[68] Fisherwomen around Guayaquil, Ecuador could once pull up several hundred shellfish in a morning, but now they're lucky if they find $3 worth of clams in a day. According to one of the women, "This isn't for profit. It's for survival. With this we can buy basic medicines for our children, but it's just the bare necessities."[69]

Many of the shrimp farms in Asia have been established in areas that did not previously have clear property distinctions. These coastal areas were legally claimed by the state but were inhabited by communities that, in some cases, had existed there for centuries. The prospect of building shrimp farms gave the land economic value that it had never been thought to possess, leading governments to sell it to investors. They then moved in to expropriate and enclose the

land and sometimes violently dispossess the communities.[70] This is not restricted to Asian shrimp farms. Leder Gungara, the director of an Ecuadorian environmental group says: "In the beginning the industry was very hostile… Everybody had a handgun. Because of that… we were very much afraid and the local people, as well, were very afraid of standing up to the shrimp farmers, because they did carry weapons and many of us have been beaten up, unjustly jailed, treated unfairly by the justice."[71]

Sadly, local areas rarely see any of the profits from shrimp farms. According to Leder, there are no schools, hospitals, or roads in the communities where shrimp farms are built. All of the profits leave Ecuador in the hands of foreign investors.[72]

Displaced Communities

In the Nellore district in the Andhra Pradesh state of India, more than 2,000 families in five coastal villages became "shrimp refugees" just a few years after investors moved into the area and started converting the landscape into shrimp operations. Construction of the 15,000-acre shrimp complex began in 1992. The facility was shut down in 1995 after a deadly viral disease killed off the shrimp crops.

After just three years of industrialized shrimp production, groundwater supplies used for drinking, household purposes and crop irrigation had become unusable due to saltwater and chemical contamination from the shrimp ponds.

The Andhra Pradesh state government evacuated more than 10,000 inhabitants of these fishing villages because the water was poisoned. Beginning in 1998, the removal of the five coastal villages forced the inhabitants to move many kilometers from the seashore. Village fishermen are now walking more than 10 miles daily to get to the coast to fish in the sea that once lay at their doorsteps. Families were separated because local land shortages made it impossible to relocate everyone together in one location.[73]

Shocking Labor Rights Violations

A report released in April 2008 by the Solidarity Center adds another reason to oppose imported industrially produced shrimp: labor abuses.[74] Based on interviews with workers in Bangladesh and Thailand, the report describes hideous conditions – a dangerous and unhealthy environment, abusive employers, long hours, low pay, informal work and the vulnerability of migrant workers. This occurs at the shrimp processing factories in response to pressure put on factories by both producers and importers and the demand for affordable shrimp products. In interviews conducted by partners of the Solidarity Center, Thai shrimp processing workers complained of forced overtime, hazardous working conditions, nonpayment of wages if production quotas were missed, regular exposure to harsh chemicals and lack of medical care. Interviewers heard shocking stories from workers at Ranya Paew, where Thai police and immigration authorities raided a shrimp processing factory in September 2006. They found squalid conditions and long hours, in addition to physical, emotional and sexual intimidation and abuse. Some workers said that if they attempted to escape the factory, take sick leave, or even if they made a mistake on the factory line, they might be beaten, sexually molested or publicly tortured. The Solidarity Center noted that small subcontractors operate many of the processing facilities in both Thailand and Bangladesh. The short term or "contract" employees working through subcontractors are not covered by labor laws or noted in official statistics. The Solidarity Center also reported unsafe conditions with long workdays, low pay and a lack of health care in Bangladesh. In addition, it calls attention to the industry's dependence on child labor and exploitation of women workers.

The report identified nine U.S. supermarkets that sell shrimp processed in Thai factories with substandard working conditions: Costco, Cub Foods, Giant, Giant Eagle, Harris Teeter, IGA, Tops Markets, Trader Joe's and Wal-Mart.

In addition to the ethical implications of substandard labor conditions, research has linked health and safety problems to food safety risks, as well. Reports have shown that many factory workers who might be infected with bacterial and fungal infections are not provided with gloves when they handle shrimp.

Responsible Purchasing: How to Decode Shrimp Labels

Increasingly conscious consumers are searching for shrimp with fewer negative impacts on their health, the environment and indigenous communities. In response to this demand, certification schemes have been developed to label farmed shrimp as "eco-friendly," and companies such as Wal-Mart and the parent company of Red Lobster have announced plans to partake in environmentally responsible sourcing of shrimp. The large number and variety of labels can be confusing for consumers, leaving them to wonder about each label's meaning and credibility. Unfortunately, most industrial shrimp production is really the antithesis of sustainable production, and many of these labeling schemes serve mainly as attempts to "greenwash" the industry.

The ideal accredited label would not be run by private industry and would have clear objectives, transparent standards and independent oversight. It is essential that the certifier be an independent body, separate from the standard-setting body, in order to avoid conflicts of interest. The United States Department of Agriculture, administrator of the National Organic Program, is set to develop standards for organic production of farm-raised seafood in the near future. Confusingly, some imported seafood products already are labeled as organic by certifiers who grant that label based on their own standards. Consumers should be wary of any "organic" seafood they find in the United States, because it is not yet USDA certified. California and Georgia laws prohibit organic labels on seafood until USDA sets a standard. In the meantime, use the following guide for information on existing labels:

Global Aquaculture Alliance's Best Aquaculture Practices (BAP) from the Aquaculture Certification Council

Global Aquaculture Alliance (GAA) is a powerful industry consortium that developed a set of standards known as Best Aquaculture Practices and uses the Missouri-based Aquaculture Certification Council as its exclusive certifying body.[75, 76] Their process combines annual site inspections and discharge sampling,[77] but allows for the use of antibiotics and chemicals.[78] Although GAA's standards are more measurable than others, they have received criticism from several organizations, including Mangrove Action Project and Environmental Justice Foundation, for purportedly using flawed standards that fail to adequately protect mangrove ecosystems.[79] In addition, the adaptation of ACC standards has forced many small family shrimp farmers, who lack the funds to pay for certification fees and upgrades, out of the market, leaving more space for the big players.[80] Most recently. the Solidarity Center has criticized the BAP program for alleged inadequacies in terms of labor standards and workers' rights: "Overly simplistic, with little grasp of the complexity of the industry, the standards treat labor issues almost as an afterthought."[81] Wal-Mart and Darden Restaurants (the parent company of Red Lobster) are set to use BAP-certification for all imported farm-raised shrimp.[82] GAA does not claim on its website that BAP-certified shrimp are organic.

Naturland

Naturland, based in Germany, began certifying shrimp as organic in 2001.[83] They too have received criticism for their certification process. The Swedish Society for Nature Conservation conducted field studies in Indonesia and reported that certified shrimp bearing Naturland labels was coming from farms that not only used chemicals and antibiotics, but also failed to live up to either environmental criteria or Indonesian law.[84] In 2007, the National Coordinating Association for the Defense of the Mangrove Ecosystem, an Ecuadorian environmental group, released a report on the destructive and illegal practices taking place on the six shrimp ponds certified by Naturland in Ecuador. According to the group, the ponds lack permits, agreements, management plans and environmental licenses. Moreover, their certification sets a precedent for the shrimp industry to continue to damage mangrove forests, contaminate water and land and displace ancestral communities. The group asks how Naturland can give a stamp of approval when the destruction and contamination that the ponds are responsible for is plainly visible.[85] Adding to Naturland's lack of credibility is the fact that it has its own certification body.[86]

In writing, but apparently not always in practice, the label does prohibit the use of all chemicals and genetically modified fish or feed, encourage the protection of adjacent ecosystems, and seek to avoid conflict with others who use aquatic resources.[87] Although Naturland-certified shrimp products are not found in many U.S. grocery stores, they are available at Wild Oats, which was recently purchased by Whole Foods. Blue Horizon Organic Seafood Co. is the prominent Naturland-certified brand in the United States.

Naturland claims that its certified shrimp are organic.[88]

GLOBALGAP Shrimp Standard

GLOBALGAP (formerly know as EUREPGAP), a private sector body that sets voluntary standards for the certification of agricultural products around the globe, has come under fire over its standards. Its goal is to establish one standard for Good Agricultural Practice with different product applications. Because GLOBALGAP is a business-to-business (producer-to-retailer) label, it is not directly visible to consumers.[89] Wal-Mart, McDonald's Corp. and Wegmans Food Market Inc. are members of GLOBALGAP. American farmers who are eager to sell to the European market are also getting involved.[90] In April 2008, GLOBALGAP launched a Shrimp Standard, which it announced as being based on demand for sustainable sources and focusing on food safety, animal welfare, environmental and social sustainability.[91] When the standards were proposed, World Wildlife Federation questioned their credibility, saying that they would not reduce or eliminate the key negative environmental and social impacts of shrimp farming. WWF's comments on the draft standards faulted them for not being measurable and for being managed by GLOBALGAP instead of an independent and credible third party. The comments also said that the standards would not be finalized based on consensus from multiple stakeholders.[92] These standards do not ban chemicals and drugs, but call for "Judicious use of antibiotics, which is defined as the use of an antibiotic to maximize its therapeutic effectiveness while at the same time minimizing the selection for antibiotic resistant bacteria."[93] The standards do not include a limitation on the amount of fishmeal or fish oil that can be used in feed. The checklist for compliance with GLOBALGAP standards allows checkpoints to be rated as minimum musts, maximum musts and recommendations. It is only a minor must that shrimp operations have action plans and precautions in place to prevent and monitor salt accumulation and minimize the direct impact on soil, ground water and natural water flows.[94] What's more, it is only recommended that farms take efforts to optimize energy use and minimize waste.[95] In addition, certain standards are based on national standards or requirements of the "competent authority." For instance, nitrate and phosphate levels in drain waters are based on national standards (of the country in which the operation is located); water abstraction and discharge must meet requirements set by the competent authority; and operations only have to have an environmental or biological parameter as a guideline for surrounding water if it is required by authorities.[96] In other words, operations are required only to meet national or international laws for these standards, but not to go beyond the status quo to achieve sustainability.

Quality Certification Services

Quality Certification Services is a private certification company that offers organic certification to farms, processors, handling operations and aquaculture facilities. Despite USDA's not yet ruling on organic aquaculture standards, QCS has pushed ahead with organic labeling for shrimp farms. Although the company avoids using USDA's seal for certified organic products, the fact that other products it certifies are USDA-accredited as organic can be very misleading for consumers. QCS bases aquaculture standards on applicable portions of USDA organic livestock standards with three additional rules: the origin of aquatic animals must be consistent with a recommendation of the National Organic Standards Board, fish meal standards must be consistent with NOSB task force recommendations, and phosphates must be prohibited.[97] The recommendations made by the NOSB have not been finalized or adopted at this point and are likely to be modified before USDA implements a program for certifying organic aquaculture. The fish feed standards that QCS follows could lead to a depletion of wild fish stocks by allowing farmed fish to be fed fishmeal with too high a percentage of wild-caught fish.

QCS has certified five shrimp companies and is working on several more certifications.[98] Three of the five companies operate shrimp farms outside the United States.[99]

Conclusions

The current model of foreign industrial shrimp production – often heavily reliant on antibiotics, pesticides, and crowded conditions – is unsustainable and unhealthy in most cases, even when private eco-labels might suggest otherwise. Policymakers must ensure that the U.S. shrimp supply is safe and that consumers have the necessary information to choose between domestic or imported and between wild-caught or industrially farmed seafood. Consumers should insist that policy makers provide them with information to make informed decisions and ask questions in grocery stores and restaurants about the origins of their shrimp.

Recommendations for Policymakers

- Congress must increase funding for inspections of imported shrimp and other seafood.
- The Food and Drug Administration must significantly increase physical inspections and testing of imported seafood and develop a similar process to the one USDA has for meat.
- The U.S. Department of Agriculture and Congress should close the loopholes in Country of Origin Labeling rules to include all seafood – whether processed or fresh, at every store and restaurant.

Recommendations for Consumers

- Consumers should contact their member of Congress and government agencies that regulate shrimp:
  - Tell USDA to tighten Country of Origin Labeling to include all seafood at every store and restaurant.
  - Tell Congress to increase funding for seafood inspections.
  - Take action at www.foodandwaterwatch.org/take-action
- Shrimp-lovers should avoid foreign industrially produced shrimp. Instead, they should:
  - Ask at grocery stores and restaurants where their seafood comes from and if it is wild-caught.
  - Choose wild-caught domestic shrimp.
  - Choose shrimp that have been farmed in the United States by a more environmentally responsible closed-system shrimp operation.

Appendix A: U.S. Shrimp Imports by Weight and Value in 2007

Country	Weight in Tons	Value in U.S. Dollars
Thailand	207,587	1.2 billion
Ecuador	65,178	308.9 million
Indonesia	65,112	447.2 million
China	53,373	235.5 million
Mexico	44,708	358.5 million
Vietnam	43,319	459.9 million
Malaysia	25,169	153 million
India	22,901	194.7 million
Bangladesh	16,442	154.4 million
Venezuela	11,899	47.9 million
Guyana	9,844	31.2 million
Honduras	8,066	41.4 million
Peru	7,889	40.1 million
Canada	6,612	44.2 million
Panama	4,909	36.64 million
Nicaragua	4,615	27 million
World Total	**613,917**	**3.9 billion**

SOURCE: Fisheries Statistics and Economics Division, National Marine Fisheries Service

Appendix B: Antibiotics in Shrimp Aquaculture

Group	Drugs	Human Use?	Health Hazards	Comments
Aminoglycoside[100]	Gentamycin Kanamycin Neomycin	Yes Yes Yes	Antibiotic resistance[101]	
Macrolides[102]	Erythromycin	Yes	Antibiotic resistance	
Monensin sodium[103]		Yes	Antibiotic resistance	
Nitrofurans[104]	Furazolidone Nirfurpirinol	Yes --	Potential carcinogen; Antibiotic resistance	Banned for use in food animals in U.S., EU; FDA tests for residues
Penicillin-like[105] (b-lactams)	Amoxycillin Ampicillin Penicillin	Yes Yes Yes	Serious allergy risk: anaphylactic shock; Antibiotic resistance	
"-phenicols"[106]	Chloramphenicol	Yes	Aplastic anemia; Potential carcinogen; Genetic damage; Antibiotic resistance	Banned for use in food animals in U.S., EU, Japan, India; FDA tests for residues
Quinolones[107]	Ciprofloxacin Enrofloxacin Flumequine Nalidixic acid Norfloxacin Ofloxacin Oxolinic acid Perfloxacin Sarafloxacin	Yes -- -- -- Yes Yes -- Yes --	Antibiotic resistance	Banned for use in food animals in U.S.; Use restricted in other industrialized countries; FDA tests for residues
Rifampicin[108]		Yes	Antibiotic resistance	
Sulfonamides[109]	Sulfadiazine Sulfamethazine Sulfachlorpyridazine Sulfamethoxazole	Yes -- -- Yes	Allergy concern; Antibiotic resistance	Used with Trimethoprim or Ormetoprim
Tetracycline-like[110]	Oxytetracycline Chlortetracycline Doxycycline Tetracycline	Yes -- Yes Yes	Antibiotic resistance	FDA tests for residues

Appendix C: Pesticides in Shrimp Farming

Chemical	Use in Shrimp Farms	Health Hazards	Legal Status
Carbaryl[111] (organophosphate)	Control burrowing shrimp	Cholinesterase inhibition	Not approved for use in U.S. shrimp farms
Chlorpyrifos[112] (organophosphate)	Used in hatcheries	Cholinesterase inhibition	Not approved for use in U.S. shrimp farms
Diazinon[113] (organophosphate)	Kill wild crustaceans	Cholinesterase inhibition	Not approved for use in U.S. shrimp farms
Dichlorvos[114] (organophosphate)	Kill insects	Cholinesterase inhibition	Not approved for use in U.S. shrimp farms
Endosulfan[115]	Kill mollusks	Toxic to neurological system, eyes, respiratory system. May disrupt endocrine system.	Banned in Philippines, Indonesia Use restricted in U.S., UK, Canada, France, Germany, Switzerland
Formalin[116]	Kill fungus, parasites	Potential carcinogen	Parasite-S®, Formalin-F® approved by FDA for use in U.S. shrimp culture
Glutaraldehyde[117]	Kill fungus, parasites	May cause DNA mutations, potential carcinogen	Not approved for use in U.S. shrimp farms
Malachite green[118]	Kill fungus	Respiratory enzyme poison, may cause DNA mutations, potential carcinogen	Banned for use in fish farming in U.S., Canada, EU, Thailand
Malathion[119] (organophosphate)	Used in hatcheries	Cholinesterase inhibition	Not approved for use in U.S. shrimp farms
Methylene blue[120]	Kill fungus, protozoa	Induces hemolytic anemia in some humans	Not approved for use in U.S. shrimp farms
Nicotine[121]	Kill snails before stocking	Symptoms similar to poisoning by organophosphates	Not approved for use in U.S. shrimp farms
Niclosamide[122]	Kill mollusks	Harmful if swallowed	Not approved for use in U.S. shrimp farms
Organotin compounds[123]	Kill mollusks before stocking	Endocrine disruptors, may cause chromosomes to mutate, may predispose humans to obesity	Not approved for use in U.S. shrimp farms
Pyrethroids[124]	Kill insects	Affects central nervous system, potential developmental neurotoxicity	Not approved for use in U.S. shrimp farms
Rotenone[125]	Kill fish before stocking	Respiratory paralysis, potential link to Parkinson's Disease	Use strictly controlled in EU; Not approved for use in U.S. shrimp farms

Chemical	Use in Shrimp Farms	Health Hazards	Legal Status
Trichlorfon[126] (organophosphate)	Kill wild crustaceans	Cholinesterase inhibition	Not approved for use in U.S. shrimp farms
Trifluralin[127]	Kill fungus, algae, plants	Potential carcinogen, endocrine disruptor	Not approved for use in U.S. shrimp farms

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