

A Consumer's Guide for Wisconsin Farm-Raised Fish



Developed and compiled by:

Wisconsin Aquaculture Association

**UW Stevens Point – Northern Aquaculture Demonstration
Facility**

UW-Extension Aquaculture Outreach

And the

**Wisconsin Department of Agriculture, Trade and
Consumer Protection**

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The Consumer's Guide for Wisconsin Farm-Raised Fish is an overview of Wisconsin's Aquaculture Industry providing the public with resources so they can make informed choices and answer questions on why they should buy healthy, locally grown fish. The guide references existing articles, websites or studies that provide detailed information on nutritional benefits and safety issues for consumers, along with how to purchase fish for food, fish for stocking into lakes and live bait for fishing.

The impetus of the consumer's guide stems from discussions held through the Wisconsin Aquaculture Association (WAA) and the Wisconsin Aquaculture Industry Advisory Council (WAIAC); the provision of best management practices for Wisconsin aquaculture; other similar consumer guides and a desire by the industry to be proactive, explaining to the public who they are and what the industry does. Wisconsin practices environmentally sustainable aquaculture.

Although the guide helps promote Wisconsin Aquaculture in a positive light, the real intention is to help consumer's and fish farmers form a dialogue and compile useful information that helps address consumer or media questions. Ultimately, it is our hope that the guide will help foster a greater consumer-farmer connection building trust and confidence.

If there are additional topics or resources you would like included in this guide, please forward those to a member of the Wisconsin Aquaculture Association Board; their information can be found at http://wisconsinaquaculture.com/Contact_Us.cfm.

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What is Wisconsin Aquaculture?

- A Picture of Wisconsin Aquaculture
- Types of Products and Aquaculture Activities
- Aquaculture Systems

Fish farms have been a part of Wisconsin agriculture since 1856.

What is Wisconsin Aquaculture?

Aquaculture is the controlled, agricultural cultivation of aquatic plants or animals. In Wisconsin, fish farmers raise fish for use as food, stocking, bait and recreation. Some common species include: trout, yellow perch, bluegill, walleye, northern pike, muskellunge, bass and minnows.

The Wisconsin aquaculture industry is composed primarily of recreational fish ponds, family farms, and state, tribal and federal hatcheries. Fish farms have been a part of Wisconsin agriculture since 1856.

A. Picture of Wisconsin Aquaculture

1. Registered Fish farms in Wisconsin (As of 6-1-09):

- 2314 of registered fish farms
- (1984) Type 1: Includes fish farms that have private fishing, public fee fishing and selling eggs/fish to a processing plant or restaurant.
- (330) Type 2 or 3: Includes fish farms which may conduct all Type I fish farm activities and in addition, may sell live fish or eggs to other entities.

2. Size and Scope of Industry ⁽¹⁾

- Wisconsin aquaculture sells over \$14 million annually in fish and baitfish.
- Wisconsin aquaculture contributes \$21 million in economic activity and provides 441 jobs to the State.
- Wisconsin has 125 farms with sales of \$1000 or more.
- The Wisconsin sport-fishing industry is valued at \$1.1 billion in direct expenditures and \$2.7 billion in economic activity.
- Wisconsin DNR has 14 state hatcheries and almost 100 cooperative rearing stations all registered with Wisconsin DATCP, with an annual budget of \$23 million (2001) and employment of 270 fisheries staff.
- Wisconsin has two federal hatcheries with a combined annual budget of \$1.6 million and a permanent staff of 14.
- There are 6 tribal hatcheries in Wisconsin rearing fish for restoration and sport fishing.
- There are three aquaculture programs in the UW System located at UW-Madison, UW-Milwaukee and UW-Stevens Point.

3. Compared to Aquaculture in the U.S. ⁽²⁾

- United States \$1.4 billion
- Wisconsin is 20th overall in aquaculture sales in the US at \$14,116,000 (1%)
- Wisconsin is #1 in total sales of aquaculture products for Midwestern states.
- Wisconsin is #9 in U.S. trout production.
- Wisconsin is #6 in U.S. game fish production.
- Wisconsin is #2 in U.S. Baitfish production.

4. Compared to Aquaculture in the World ⁽³⁾

- Worldwide aquaculture is about \$94 billion.
- The United States makes up approximately 1% of world aquaculture.
- China makes up about half of world aquaculture.
- The most eaten fish in the world is the Silver Carp.

What is Wisconsin Aquaculture?

B. Types of Products and Aquaculture Activities:

1. Food Fish

These fish are raised for human consumption. They may be sold live or processed as ready to cook fillets, smoked fish or other food products. Some farmers direct market their fish to consumers.

- Wisconsin value: \$5.53 million ⁽²⁾
- Top Wisconsin food fish species include trout and yellow perch.

2. Bait Fish

Most bait fish are hatched from eggs, raised in a pond and sold in bait shops to sport fishermen. The Wisconsin DNR and some private farmers raising game fish for stocking will also purchase bait fish as live feed.

- Wisconsin value: \$4.65 million ⁽²⁾
- Top Wisconsin bait fish species include shiners, fathead minnows and suckers.

3. Stocking (Game Fish)

Stockers are game fish raised for the DNR, Lake Associations, sport clubs and similar organizations for release into public waters to enhance fishing opportunities. These fish may also be sold to other registered fish farms for stocking into private fishing ponds. Stocking of any waters other than a registered fish farm require a stocking permit from DNR and a fish health certificate from DATCP.

- Wisconsin value: \$3.07 million ⁽²⁾
- Top Wisconsin game fish species include walleye, northern pike, muskie, bass and trout.

4. Fee Fishing

Fee fishing ponds offer the consumer the opportunity to catch and keep fish for a certain fee, which is generally based on the size or weight of the fish.

- Economic Value: 213 operations in Wisconsin.
- Top Wisconsin fee fishing species include trout, bass and panfish.

5. Non-fish animals & Plants

Other animals and plants can be raised in aquatic systems for food, research or ecological enhancement and water gardens. Some examples may include prawns, frogs, mollusks & clams, algae, and water plants.

6. Ornamentals or Demonstration

Fish and other aquatic life can also be raised for research/education purposes or as pets in aquariums or water gardens.

What is Wisconsin Aquaculture?

C. Aquaculture Systems

1. Pond systems:

A typical pond in Wisconsin is less than 1 acre (43,560 sq. ft.) in size and under 20 feet deep. The man-made fish-pond is designed to meet the natural environmental requirements of the fish being raised. When these environmental conditions are met, pond culture can be the most economical way to raise fish.

The natural growth of aquatic organisms provides a natural food for the fish and makes the pond an attractive habitat for other aquatic animals.

Wisconsin cool and warm-water species such as baitfish, yellow perch, walleye and bass are typically raised in ponds.

2. Flow-through systems:

Flow-through systems often use a pond or channels (called raceways) with a constant flow of water to create a favorable place to raise fish. The constant flow of water helps provide oxygen into the system while removing wastes from the system.

Often the water source for a raceway is a spring or artesian well. Because Wisconsin's ground water temperatures range from 45-52°, cold water species such as trout are normally raised.

A significant amount of aquaculture uses a hybrid pond/flow-through system to raise fish. In these systems, water flows from a pond through a pond-side tank or floating raceway. The farmer can then control temperature or other water parameters in the system and raise cool-water fish such as yellow perch.

3. Recirculation systems

A recirculation system cycles water through fish rearing units (tanks) and a series of filters to remove wastes and oxygenate the water. As a result, the system reuses up to 95% of the water. An aquarium is an example of a small recirculating system. Most commercial recirculating aquaculture systems are in buildings raising tropical species like tilapia or cool-water species like perch. An advantage of recirculating systems is the fish are grouped together, making it easier for the fish farmer to feed or care for the fish, make health assessments, or harvest the fish. Although the system has some advantages, recirculating systems often require a large amount of money to build and require tight management control over production parameters to be cost effective.

4. Aquaponic systems

In an aquaponic system, fish and plants are raised together in a special type of recirculating system similar to hydroponics. As the fish grow, they produce waste which plants use as fertilizer. The plants use the excess nitrogen from the fish waste and uneaten food particles to grow, and in turn filter the water for the fish. Although aquaponics has existed for many years, commercial systems in Wisconsin are relatively new and small. Typical crops include leafy vegetable, tomatoes and some fruit crops. Typical fish species in Wisconsin systems are Yellow Perch and Tilapia. Most aquaponic systems rely on the produce for profitability – the fish raised are a small added benefit.

What is Wisconsin Aquaculture?

Resources

Wisconsin Aquaculture Association (WAA):

<http://www.wisconsinaquaculture.com/>

University of Wisconsin- Stevens Point – Northern Aquaculture Demonstration Facility (NADF):

<http://aquaculture.uwsp.edu>

The National Aquaculture Association (NAA)

<http://www.thenaa.net/>

Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) – Aquaculture Information:

<http://www.datcp.state.wi.us/mktg/business/marketing/val-add/aqua/wynk/index.jsp>

Wisconsin Department of Natural resources (DNR) - Aquaculture Information:

<http://dnr.wi.gov/org/caer/cea/assistance/aquaculture/>

Superscript References

⁽¹⁾“Wisconsin Aquaculture Industry: Value and Economic Impact” (Brochure)[Online] Available http://www.wisconsinaquaculture.com/Forms/2009_WI_Aqua_Industry_brochure_2.pdf , 2009.

⁽²⁾USDA, National Agricultural Statistics Service. “Census of Agriculture (2007) – State Data.” Table 23 Aquaculture Sold: 2007 and 2002. [Online] Available http://www.agcensus.usda.gov/Publications/2007/Full_Report/index.asp http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_US_State_Level/st99_2_023_023.pdf , 2007.

⁽³⁾Food and Agriculture Organization of the United Nations. “State of the World Fisheries and Aquaculture (SOFIA - 2008).” [Online] Available <http://www.fao.org/fishery/sofia/en> , (2009)

Other References:

USDA, National Agricultural Statistics Service. “Census of Aquaculture (2005).” Table 1 Value of Aquaculture Products Sold by Type, by State and United States: 2005 and 1998. [Online] Available <http://www.agcensus.usda.gov/Publications/2002/Aquaculture/index.asp>, 2005.

“Wisconsin Aquaculture: Value and Economic Value” (Report), 2009:

“WAA Food fish Brochure” [Online] Available

http://www.wisconsinaquaculture.com/Forms/Food_fish_brochure_2009.pdf , 2009.

“WAA Gamefish Brochure” [Online] Available

http://www.wisconsinaquaculture.com/Forms/Bait_and_Gamefish_brochure_2009.pdf , 2009.

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How Are Fish Raised in Wisconsin?

- Water for Aquaculture
- Management and Reuse of Aquaculture Waste and Effluents
- Aquaculture Fish Health
- Fish Nutrition and Feeds
- Aquaculture and the Environment

The balance between appropriate regulatory requirements and aquaculture best management practices helps the industry provide the best and safest possible aquaculture products for consumers, while protecting the State's precious resources.

How Are Fish Raised in Wisconsin?

Aquaculture Best Management Practices⁽¹⁾ and Wisconsin Regulations

Wisconsin aquaculture is a diverse industry. Wisconsin farms raise over 25 different species of fish for food, stocking, bait and recreation; and in a variety of systems: ponds, flow through raceways, recirculating aquaculture systems, and aquaponics. Regardless of the system that is used, Wisconsin fish farmers use Best Management Practices (BMP's) to produce fish and must adhere to some of the most stringent fish health and environmental regulations in the country. The balance between appropriate regulatory requirements and aquaculture best management practices helps the industry provide the best and safest possible aquaculture products for consumers, while protecting the State's precious resources.

In 2005, University of Wisconsin – Sea Grant Institute published “The Best Management Practices for Aquaculture” to provide guidance to fish farmers for appropriate fish production techniques. The management guidelines in the manual help fish farmers minimize or prevent any adverse environmental impacts, maximize the health and well-being of the fish being raised and produce fish efficiently and economically.

Below is an overview of some of the key aspects of the aquaculture best management practices and a summary of selected aquaculture permits and regulations.

A. Water for Aquaculture

Aquaculture is a water dependent industry. Obviously, fish need water to survive. Poor water quality will ultimately result in poor fish production. To maintain the health of the fish produced, the fish farmer needs to keep a number of water-related factors in balance within the aquaculture system. These include water temperature, dissolved oxygen, pH, nitrogen (ammonia, nitrite, and nitrate), solids and carbon dioxide.

Sources of Water for use in Aquaculture facilities:

1. Ground or well water is generally free of impurities that can affect the aquaculture system.
2. Surface water consists of water taken from lakes, rivers, or ponds, or it can consist of rain and snow water collected for aquaculture use.
3. Municipal water can be used for a recirculation aquaculture system (RAS) that does not require a high volume of water. Municipal water generally contains residual chlorine or other additives that must be removed prior to use in an RAS system.

Water use is regulated by the Wisconsin DNR and conservation practices are encouraged to preserve this precious resource. In most aquaculture systems, water is not consumed. The water is used for the production of fish and may be reused or cleaned before returned to the environment.

Water use requirements/regulations: (See Appendix 1)⁽²⁾

B. Management and Beneficial Reuse of Aquaculture Waste and Effluents.

Discharges from aquaculture facilities must meet the standards of the Environmental Protection Agency as well as stringent state and local regulations.

The primary source of aquaculture wastes are uneaten fish food and wastes excreted by the fish. Fish farmers manage this waste by feeding only what the fish can eat and by removing solids and dissolved

How Are Fish Raised in Wisconsin?

Aquaculture Best Management Practices⁽¹⁾ and Wisconsin Regulations

wastes. There is an economic benefit for fish farmers to manage their wastes. Uneaten fish food costs money and the aquaculture wastes will often have value as fertilizer for plant growth.

Water released from the aquaculture system can be re-used for irrigation or treated and recycled for fish culture and other purposes. For an aquatic farm to be profitable, it is essential that excellent water quality be maintained in the system. The waters leaving fish farms are often of the same or higher quality than the waters receiving them.

Water discharge requirements/regulations: (See Appendix 1)⁽²⁾

C. Aquaculture Fish Health

In developing the Wisconsin Fish Health Program, the State has taken a progressive, veterinary approach toward maintaining fish health and improving fish production efficiency.

With an emphasis on disease prevention versus drug treatment, Wisconsin fish health experts combine the disciplines of aquatic best management practices, water quality, fish nutrition, biosecurity, disease diagnostics and appropriate treatment.

The program balances education with regulatory requirements to protect the quality of aquaculture products for consumers, protect the livelihood of fish farmers and protect the health of fish and aquatic environments.

Routine testing is an important sentinel, alerting fish farmers, fish health experts and wildlife managers to potential fish health problems. Fish farmers also use fish health assessments and their animal observation skills as tools to monitor the health and well-being of their livestock. By monitoring health of their fish, the farmer can avert issues before they require drastic interventions and can provide a level of market assurance for the health of the fish.

Aquaculture Fish Health Regulatory Requirements: (See Appendix 1)⁽²⁾

In some cases, drug treatment is needed to protect the health of the fish, the farm or the environment. The approval and use of any drug or medication is regulated by the Food and Drug Administration (FDA). The FDA conducts inspections, and collects and analyzes samples of feeds and fish to help ensure that unsafe levels of any compounds used in animal production do not appear in the marketplace (NAA 2010).

D. Fish Nutrition and Feeds

Depending on their life stage, fish farmed in Wisconsin are either fed a natural or prepared diet. Young fish, especially yellow perch that are raised in outdoor ponds for the first few weeks of their lives, rely on the natural populations of zooplankton. Some game fish, such as walleye, northern pike and musky are fed live minnows. However, the majority of farmed fish are fed prepared diets. Providing the proper nutrition to fish is essential for their growth and development. The optimum diet provides the essential protein (amino acids), carbohydrates, lipids (fatty acids) and vitamins in the proper amounts and helps the fish grow, reproduce, fight infection and maintain health.

How Are Fish Raised in Wisconsin?

Aquaculture Best Management Practices⁽¹⁾ and Wisconsin Regulations

USDA Agricultural Research Service (ARS) aquaculture scientists are working to develop alternative fish feed ingredients to improve the nutritional characteristics, palatability and sustainability of aquaculture feeds.⁽³⁾

Fish are very efficient at converting feed into muscle (meat). A Feed Conversion Ratio (FCR) is defined as the amount of food per unit gain, or the number of pounds of feed it takes to get a pound of meat. Fish are much more efficient at converting feed into muscle than other livestock (Table 1). There are a couple reasons for this efficiency including the fact that fish are cold blooded, meaning they do not need to expend energy to maintain their body temperature like warm blooded livestock. Fish do not expend energy to fight gravity, since they live in an aquatic environment. The energy that is not being used to heat themselves or keep them upright can be used instead to produce muscle.

Table 1. Common Feed Conversion Ratios (FCR) for livestock; number of pounds of feed to produce one pound of meat

Species	FCR
Cattle	6-8:1
Hogs	3:1
Chickens	2-3:1
Fish	1-2:1

Frequently Asked Questions:

Question: Is fish meal used to feed fish? How is that sustainable?

Answer: Yes, fish meal makes up a portion of the prepared diets that Wisconsin’s fish farmers feed their fish. Fishmeal is used in a variety of animal feeds including those for poultry, swine, cattle, and fish. The fish meal that is used comes from fish that are harvested from the oceans. These fish are not normally used for human consumption. The amount of fish harvested domestically is regulated by the National Oceanic and Atmospheric Administration (NOAA) and quotas are set as to how much fish can be harvested. It is important to understand that farmed fish consume far less fish than the same species of fish captured from the wild.

When looking at fish diets we need to understand the comparison of FCR and the “fish-in fish-out” ratio (FIFO) between wild and farm raised fish. In the wild, fish eating other fish rely 100% on aquatic nutrients and it is estimated that between tropic levels the FIFO ratio is 10 to 1 wet weight or 2.86 to 1 dry weight. However, fish meal/oil in farm raised fish is only about 30 % of the diet; the rest of the diet is from terrestrial source nutrients. The yield of fish meal/fish oil from wild capture fish is approximately 35% or a ratio of 2.86 to 1. The FIFO ratio for wild fish (dry weight) would be 2.86 to 1, whereas in farm raise fish we calculate percent fish meal times FIFO ration times FCR (.30 X 2.86 X 1.2) = 1.03 or rounded 1 to 1. Said another way, farm raised fish are 2.86 times more ecologically efficient than wild fish because they utilize other non aquatic nutrients in their diet.⁽⁴⁾

Understanding that aquaculture cannot continue to grow if a high reliance on ocean harvest for fish meal continues, the aquaculture industry is actively looking at ways to substitute other proteins for fishmeal. “Scientists are investigating new feed formulations and other strategies to improve feed conversion rates and reduce the amount of wastes generated. Scientists and industry across the country are actively

How Are Fish Raised in Wisconsin?

Aquaculture Best Management Practices⁽¹⁾ and Wisconsin Regulations

working to develop a variety of sustainable feeds to ensure that the fish consume a nutritionally balanced diet to promote optimum health and growth, maintain great flavor and texture, and contain all of the important nutrients that consumers demand” (NAA 2010).

Question: Are salmon and trout fed chemicals to turn their flesh pink?

Answer: Salmon and trout species, both farmed and wild, get their pink color from carotenoids, organic pigments found in plants and animals. They are important nutrients for animal diets, including human diets, as many carotenoids are precursors to vitamin A and function as antioxidants.

There are over 600 known carotenoids, but the two that fish get their pigmentation from are astaxanthin and canthaxanthin. These nutrients are essential to the diet of salmon and trout and are needed for growth and reproduction. Salmon and trout can not produce these nutrients themselves so they get them by eating crustaceans (shrimp) that have eaten carotenoid-rich algae (Hertrampf and Piedad-Pascual 2000). We can get these same carotenoids by visiting a health food store; they are sold as dietary supplements.

These organic carotinoid pigments from algae or animals (crustaceans) are added from natural materials to the prepared diets to ensure optimum fish health and development (De Silva and Anderson 1995). Sometimes manufactured carotinoids that are chemically identical to the naturally occurring nutrients are added (Hertrampf and Piedad-Pascual 2000, Hardy and Burrows 2002).

Question: How are prepared feeds regulated?

Answer: “Aquaculture feeds are regulated under the FDA as well as respective State Departments of Agriculture and the American Association of Feed Control Officials (AAFCO). The FDA conducts inspections, and collects and analyzes samples of feeds and fish to help ensure that unsafe levels of any compounds used in animal production do not appear in the marketplace” (NAA 2010).

Aquaculture Feed Regulations: (See Appendix 1)⁽²⁾

E. Aquaculture and the Environment

Similar to other human activities, aquaculture operations can have positive, negative or no impact on wildlife. A primary goal of Aquaculture Best Management Practices is to provide guidance for fish producers to impact the environment in neutral or beneficial way.

The extent of environmental impact is dependent upon the thoughtful approach to development of new aquatic environments and the management of existing aquaculture facilities. How the aquaculture system and the addition of fish can impact wildlife needs to be considered. Food resources, nesting habitat, predation and competition can play an important role in whether an aquaculture facility may be a benefit or detriment to the environment.

For example, in Wisconsin, public water bodies are not used for new aquaculture facilities because of potential impacts on the existing wetland. However, construction of new ponds and other aquatic habitats in previously tilled upland areas can expand the areas available for organisms highly dependent on water or aquatic environments.

How Are Fish Raised in Wisconsin?

Aquaculture Best Management Practices⁽¹⁾ and Wisconsin Regulations

Resources

Wisconsin Aquaculture Association (WAA):

<http://www.wisconsinaquaculture.com/>

University of Wisconsin- Stevens Point – Northern Aquaculture Demonstration Facility (NADF):

<http://aquaculture.uwsp.edu>

National Aquaculture Association (NAA)

<http://www.thenaa.net/>

Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) – Aquaculture Information:

<http://www.datcp.state.wi.us/mktg/business/marketing/val-add/aqua/wynk/index.jsp>

Wisconsin Department of Natural Resources (DNR) - Aquaculture Information:

<http://dnr.wi.gov/org/caer/cea/assistance/aquaculture/>

Superscript References

⁽¹⁾UW Sea Grant Institute, Malison, Jeffrey A. and Hartleb, Christopher F. ed.: “Best Management Practices for Aquaculture in Wisconsin and the Great Lakes Region.” 2005. [Online] Available

<http://aqua.wisc.edu/publications/PDFs/AquacultureBMP.pdf>

⁽²⁾ UW Sea Grant Institute, Malison, Jeffrey A. and Hartleb, Christopher F. ed.: “Best Management Practices for Aquaculture in Wisconsin and the Great Lakes Region. Appendix II. Wisconsin’s Guidelines and Rules” 2005. [Online] Available

<http://aqua.wisc.edu/publications/PDFs/AquacultureBMP.pdf>

⁽³⁾Agricultural Research Magazine. Sharon Durham. “Finding Alternative Fish Feeds for Aquaculture.” October, 2010 Vol. 58, No.9. [Online] Available. (2010). <http://www.ars.usda.gov/is/AR/archive/oct10/>

⁽⁴⁾ Aquaculture North America, Volume 2 Issue 1 Jan/Feb 2011, Hicks, Brad, What is FIFO? Page 5.

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Hertrampf, J.W. and F. Piedad-Pascual. 2000. Handbook on ingredients for aquaculture feeds. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Wisconsin DATCP Fish Health Program:

<http://www.datcp.state.wi.us/ah/agriculture/animals/aqua/health/index.jsp>

<http://vetmedce.vetmed.wisc.edu/fhm/>

How Are Fish Raised in Wisconsin?

Aquaculture Best Management Practices⁽¹⁾ and Wisconsin Regulations

Appendix 1: Selected Aquaculture Permits and Regulations

Water use requirements/regulations:

- Permits regarding wells (NR 812)
- Permits regarding surface water withdrawal and use (NR 850, NR 852, NR 856)
- Dam Construction (Wis Stats. Ch. 31) (DNR permit)
- Pond construction (Wis Stats. Ch. 30) (DNR permit)
- Natural Water Body Permit (NR 19) (DNR permit)
- Army Corps of Engineers Permit # 404
- Water Quality Wetland Permit (NR 103) (DNR permit)

Water discharge requirements/regulations:

- Land application of aquaculture waste
- (Wisconsin Pollution Discharge Elimination System (WPDES) permit)
 - Production over 100,000 lbs Coolwater fish & 20,000 lbs cold water fish (Prior to 2004 EPA Best Management Guidelines)
- EPA Effluent Standards
 - Concentrated Aquatic Animal Production (CAAP) Guidelines:
<http://www.epa.gov/waterscience/guide/aquaculture/guidance/full-final.pdf>

Aquaculture Fish Health Regulatory Requirements:

- Fish Farm Registration (ATCP 10 Subchapter VIII) (ATCP 10.61)
- Animal Premise ID
- Wisconsin Livestock Identification Consortium:
<http://www.wiid.org/wisconsin-livestock-identification-consortium-home>
- Record Keeping (ATCP 10.61 (10))
- Health certificates (ATCP 10.65)
- Import Permits (ATCP 10.62)
- Reportable Disease (ATCP 10.66)

Aquaculture Feed Regulations:

- Feed Regulations FDA and State Agriculture Departments

Other Regulations concerning fish farming

- DNR Stocking Permits
- DNR Wild Bait Harvest Permit
- Aquatic Plant and Algae control on Fish Farms
- Aquaculture Pesticide Use

Lacey Act

- Federal Law – Lacey Act, 18 U. S. C. §§ 41-48 passed in 1900 to protect wildlife
- Applies to all “wild animals” even those bred, hatched or born in captivity
- Can be triggered by a violation of a federal law such as Endangered Species Act or species listed as Injurious Species
- Can be triggered by violation of state, federal, or foreign wildlife laws
- Penalties can be felony, 5 years in prison with fines up to \$500,000

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What are the Nutritional/Health Benefits of Eating Wisconsin Farm-Raised Fish?

- American Heart Association Recommendations
- 2004 FDA/EPA Consumer Advisory
- Nutritional Benefits
- Nutritional Data

Fish can be an important part of a balanced diet. Eating Wisconsin farm-raised fish provides high quality protein, omega-3 fatty acids and many of the minerals and vitamins beneficial to fueling a healthy body.

Nutritional/Health Benefits of Eating Wisconsin Farm-raised fish

Fish can be an important part of a balanced diet. Eating Wisconsin farm-raised fish provides high quality protein, omega-3 fatty acids and many of the minerals and vitamins beneficial to fueling a healthy body. Below, we summarize several dietary recommendations and highlight some of the benefits of including fish in a person's diet.

A. American Heart Association Recommendation ⁽¹⁾

The American Heart Association recommends eating fish (particularly fatty fish) at least two times (two servings) a week. Each serving is 3.5 ounce cooked, or about $\frac{3}{4}$ cup of flaked fish. Enjoy fish baked or grilled, not fried. Choose low-sodium, low-fat seasonings such as spices, herbs, lemon juice and other flavorings in cooking and at the table.

Fatty fish like salmon, mackerel, herring, lake trout, sardines and albacore tuna are high in two-kinds of omega-3 fatty acids: eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which have demonstrated benefits at reducing heart disease.

B. 2004 FDA/EPA Consumer Advisory ⁽²⁾

1. Key Parts of the Advisory:

Fish and shellfish are an important part of a healthy diet. Fish and shellfish contain high quality protein and other essential nutrients, are low in saturated fat and contain omega-3 fatty acids. A well balanced diet that includes a variety of fish and shellfish can contribute to heart health and children's proper growth and development. Thus, women and young children in particular should include fish or shellfish in their diets due to the many nutritional benefits.

2. General Dietary Advice:

FDA recommends that consumers eat a balanced diet, choosing a variety of foods including fruits and vegetables, foods that are low in trans fat and saturated fat, as well as foods rich in high fiber grains and nutrients. Fish and shellfish can be an important part of this diet.

Nutritional/Health Benefits of Eating Wisconsin Farm-raised fish

C. Nutritional Benefits:

1. Seafood is a good source of high-quality protein, is low in saturated fat, and is rich in many vitamins and minerals. ⁽³⁾
2. Besides containing protein and other nutrients such as vitamin D and selenium, fish (either finfish or shellfish) contain a specific type of fat, omega-3 fatty acids, that may reduce the risk of developing heart disease and other medical problems. ⁽⁴⁾
3. Omega-3 fatty acids are found in fish – especially oily fish such as salmon, sardines, and herring. These omega-3 fatty acids can help lower your blood pressure, lower your heart rate, and improve other cardiovascular risk factors. ⁽⁴⁾
4. Research has shown that omega-3 fatty acids decrease risk of arrhythmias (abnormal heartbeats), which can lead to sudden cardiac death. Omega-3 fatty acids also decrease triglyceride levels, slow the growth rate of atherosclerotic plaque and lower blood pressure (slightly). ⁽¹⁾
5. Eating fish reduces the risk of death from heart disease, the leading cause of death in both men and women. Fish intake has also been linked to a lower risk of stroke, depression, and mental decline with age. ⁽⁴⁾
6. For pregnant women, mothers who are breastfeeding, and women of childbearing age, fish intake is important because it supplies DHA, a specific omega-3 fatty acid that is beneficial for the brain development of infants. ⁽⁴⁾
7. Infants whose mother consumed EPA and DHA during pregnancy may gain benefits such as longer gestation and better vision and brain development. ⁽³⁾
8. Other benefits of seafood may include:
 - (a) relief of inflammation and symptoms caused by rheumatoid arthritis, ⁽⁵⁾
 - (b) relief of psoriasis and eczema symptoms, and ⁽⁵⁾
 - (c) reduction of symptoms from dry eye syndrome. ⁽⁵⁾

Nutritional/Health Benefits of Eating Wisconsin Farm-raised fish

Nutritional Data for Fish Commonly Eaten in Wisconsin

Serving size and nutritional information adjusted to 100g															
Species (cooked, dry heat)	Serving Size (g)	Calories		Total Fat		Saturated Fat		Mono-unsaturated fat	Poly-unsaturated Fat	Omega-3	Omega-6	Protein		Cholesterol	
		(g)	%DV	(g)	%DV	(g)	%DV	(g)	(g)	(mg)	(mg)	(g)	%DV	(mg)	%DV
Bass (Mixed species, freshwater)	100	146	8%	4.7	8%	1.0	5%	1.8	0.1	1013	112	24.2	48%	86.9	29%
Perch (Mixed Species)	100	117	7%	0.1	2%	0.2	2%	0.2	0.4	374	14	24.8	50%	115.0	39%
Pike (Northern)	100	113	6%	0.9	1%	0.1	1%	0.2	0.3	182	41	24.7	50%	50.0	17%
Salmon (Atlantic, farm-raised)	100	206	10%	12.4	19%	2.5	12%	4.4	4.4	2260	666	22.1	44%	62.9	21%
Sunfish (Pumpkinseed)	100	114	5%	0.8	3%	0.3	0%	0.3	0.3	194	19	24.9	49%	85.9	30%
Tilapia	100	128	7%	2.5	4%	1.1	4%	1.1	0.7	240	300	26.1	54%	57.1	18%
Trout (Mixed Species)	100	190	10%	8.5	13%	0.1	8%	4.2	1.9	1369	224	26.6	53%	74.0	24%
Trout (Rainbow, farm-raised)	100	169	8%	7.2	11%	2.1	10%	2.1	2.4	1235	949	24.2	48%	68.0	23%
Walleye Pike	100	119	6%	1.5	2%	0.3	2%	0.4	0.6	465	33	24.5	49%	109.7	36%

Source:

<http://nutritiondata.self.com> ⁽⁵⁾

Nutritional/Health Benefits of Eating Wisconsin Farm-raised fish

Resources

Wisconsin Aquaculture Association (WAA):
<http://www.wisconsinaquaculture.com/>

University of Wisconsin- Stevens Point – Northern Aquaculture Demonstration Facility (NADF):
<http://aquaculture.uwsp.edu>

The National Aquaculture Association (NAA)
<http://www.thenaa.net/>

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Nutritional/Health Benefits of Eating Wisconsin Farm-raised fish

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A Consumer's Guide for Wisconsin Farm-Raised Fish



Developed and compiled by:

Wisconsin Aquaculture Association

**UW Stevens Point – Northern Aquaculture Demonstration
Facility**

UW-Extension Aquaculture Outreach

And the

**Wisconsin Department of Agriculture, Trade and
Consumer Protection**

**Something Special
from
Wisconsin**

The Safety of Wisconsin, Farm-Raised Fish.

- Mercury
- PCBs
- Consumer Consumption Advisories for Fish
- How can Wisconsin farm-raised fish help reduce your risk of exposure to contaminants?
- Food Safety and Food Fish Processing

Like any food product, food concerns can arise through potential contaminants or improper food processing and handling. Good aquaculture and fish processing practices can reduce these risks.

The Safety of Wisconsin, Farm-Raised Fish

Many organizations have identified fish as an important part of a balanced diet. However, there have also been concerns raised about the safety of eating some types of fish. This can sometimes create confusion for consumers. Like any food product, food concerns can arise through potential contaminants or improper food processing and handling. Good aquaculture and fish processing practices can reduce these risks. Fish is a good, healthy food and you should be able to eat fish without concern and without hesitation.

To eat fish or not is an individual choice, and only you can make that decision for yourself. The goal of this document is to provide resources to you, so you can make the informed decision that is best for you and your family.

A. Contaminants of Concern

Mercury and PCBs are the contaminants of greatest concern in fish prompting recommendations that people limit or avoid eating certain species of fish from many waters throughout the nation. To reduce your exposure to these contaminants, Wisconsin DNR provides advice about wild caught fish to help you choose what fish and how much fish to eat. This information is not intended to discourage you from eating fish, but should be used as a guide to eating fish low in contaminants.⁽¹⁾

(Please note: These two contaminants are typically related to the consumption of wild caught fish. Based on testing conducted, there are no suggested restrictions of Wisconsin, farm-raised fish for men, women or children.)

1. Mercury ⁽²⁾

Mercury is a naturally-occurring heavy, silvery-white metal often used in thermometers, barometers, electrical switches, thermostats, energy saving light bulbs, and in dental fillings. Mercury is released into the environment when power plants burn coal, from some chemical manufacturing plants and incinerators, and when mercury containing products are not disposed of properly. When mercury is released into the air, it can travel long distances and be deposited on land and directly into water. Mercury is changed to a form of organic mercury (methylmercury), which can build up in fish. Mercury can reach higher concentrations in older, larger and predatory (fish that eat other fish) fish.

2. Polychlorinated biphenyls (PCBs) ⁽³⁾

PCBs are a group of man-made chemicals used in a variety of industries. From 1929 to 1977 PCBs were manufactured in the United States and widely used in electrical equipment and other industrial uses. Manufacture of PCBs was banned in the US in 1977. Because they take a long time to breakdown in the environment, PCBs cling to lake and river bottom sediments and can build up in the fatty tissues of fish and animals. PCBs can reach higher concentrations in older, larger, fatter species of fish, like carp and great lakes trout and salmon.

The Safety of Wisconsin, Farm-Raised Fish

B. Consumer Consumption Advisories for Fish

The Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), the Wisconsin Department of Natural Resources (DNR) and Wisconsin Department of Health Services (DHS) have developed consumption advisories for fish. It is important to remember that these advisories are primarily directed toward the consumption of wild caught fish.

Based on testing conducted, there are no suggested restrictions on the consumption of Wisconsin, farm-raised fish for men, women or children.

The fundamental goal of the fish consumption advisory is to keep dietary mercury ingestion on average below 0.1 µg mercury per kg body weight per day. ⁽⁴⁾

Fish consumption advisories are based on several primary components:

- 1) The US EPA reference dose (RfD) – This is an estimate, based on human studies, of a daily methylmercury exposure to people that is likely to be without an appreciable risk of detrimental health effects during a lifetime. The current RfD for methylmercury is 0.1 µg/kg/day.
- 2) Meal frequencies.
- 3) Testing protocols for fish sampled from wild fish populations. Since the 1970s, the State of Wisconsin has conducted fish sampling from waters suspected of or susceptible to contamination, popular angling waters or other lakes or streams that are being monitored for changes over time.

For details about the consumption advisories, please see:

- FDA/EPA Consumer Advisory on Methylmercury in Fish ⁽⁵⁾, or
- Wisconsin DNR “Fish Consumption Advisories.” ⁽¹⁾

The DNR's current fish consumption advisories are also available in [Choose Wisely: A Health Guide for Eating Fish in Wisconsin \[PUB-FH-824, PDF 1.25MB\]](#). ⁽⁶⁾

C. How can you reduce your risk of exposure to contaminants? (And how can Wisconsin farm-raised fish help?)

1. Educate yourself about the fish consumption advisories. Know what they mean and follow them for wild caught fish or when you are in doubt.
2. Know where your fish comes from.
 - (a) Avoid or limit eating fish from waters with elevated levels of contaminants.
 - Many farms use wells or springs to provide water for their aquaculture systems. These sources are typically low in contaminants and monitored similar to the wells that provide your drinking water.
 - Fish farms regularly remove wastes from the aquaculture systems so external contaminants cannot accumulate as rapidly.
 - (b) Buy Local, Buy Wisconsin

The Safety of Wisconsin, Farm-Raised Fish

- Wisconsin aquaculture operates under some of the most stringent standards and regulations in the world.
3. Avoid eating fish that are more likely to have higher levels of contaminants:
 - (a) Avoid or limit Shark, swordfish, king mackerel, tilefish
 - Note: NONE of these are Wisconsin aquaculture species.
 - (b) Avoid or limit larger, older, or predatory fish
 - Farm-raised food fish are processed at a preferred uniform size.
 - Overly large, trophy fish are not necessarily desired in an aquaculture facility.
 - Food fish are processed at a younger age – just as they reach adulthood.
 - Most farm-raised food fish are fed pelleted feed which is regulated and low in contaminants.
 - (c) Eat farm-raised fish that are more likely to have lower levels of contaminants:
 4. Know how best to select, handle and prepare the fish.(5)

A. Food Safety and Food Fish Processing

Fish processing must comply with Wisconsin Administrative Code ATCP 70 which includes a Hazard Analysis Critical Control Point (HACCP) Plan. These regulations are administered by the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) – Division of Food Safety.

The Safety of Wisconsin, Farm-Raised Fish

Resources

Wisconsin Aquaculture Association (WAA):

<http://www.wisconsinaquaculture.com/>

University of Wisconsin- Stevens Point – Northern Aquaculture Demonstration Facility (NADF):

<http://aquaculture.uwsp.edu>

National Aquaculture Association (NAA)

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And the

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**Something Special
from
Wisconsin**

Why Wisconsin Fish?

- “Fish Miles”
- Economic Benefits
- Environmental Sustainability
- Social Benefits
- Regulatory Standards
- Where can I find Wisconsin-raised fish?

“Aquaculture provides half of the world’s seafood, with about 50 million tons grown worldwide in 2006. Further half the seafood consumed in the United States comes from aquaculture, and yet about 85 percent of that amount is imported.”⁽¹⁾

Benefits of Local Fish - Why Wisconsin Fish?

What is local? This question does not often have a specific answer; however consumers often use the product's locality relative to other similar products as part of the buying decision. Often "local" is an idea rather than a location. Local may mean different things to different people. As we discuss the benefits of purchasing local fish, think about dropping a pebble into your favorite, local fish pond. The biggest splash is often at the center; followed by ripples that grow weaker the further they move out from the center. In the same way, your purchases may have the greatest impact in your immediate community, followed by impacts in your county, state, region and country.

Why buy local? There are probably as many reasons to buy locally as there are definitions of local. Below, we have listed a number of things to consider about buying local fish. Perhaps the greatest benefit of buying local is that you may have the opportunity to speak with the farmer and gain an understanding of how the fish are raised.

A. "Fish miles"

Local food advocates use the term "food miles" to describe the distance a food item travels from the farm to your home. Fish miles may then refer to the miles the fish need to travel whether they are used for food, stocking or bait. Buying local reduces the number of miles your fish have to travel and may help:

- Reduce the transportation stress on live fish.
- Reduce the time the fish are being transported.
- Reduce the amount of energy (fossil fuels) being used to transport the fish.
- Reduce the potential length of time to get the fish from the farm to market – increasing the potential quality and "freshness."

B. Economic Benefits

If you look at the global picture,

"Aquaculture provides half of the world's seafood, with about 50 million tons grown worldwide in 2006. Further half the seafood consumed in the United States comes from aquaculture, and yet about 85 percent of that amount is imported."⁽¹⁾

"In 2009, Americans consumed an average of about 16 pounds of seafood per person, but less than 1.5 pounds of that was from domestic aquaculture."⁽¹⁾

This suggests that 80 to 90 cents of every dollar of fish purchased currently leaves the U.S. So what's the economic benefit to buying local fish?

- Buying local keeps your dollars circulating in your community.
- Buying locally-grown fish decreases our dependence on seafood coming in from overseas.
- Supporting local farm businesses helps improve farm incomes and creates jobs in the U.S.

Benefits of Local Fish - Why Wisconsin Fish?

C. Environmental sustainability

Aquaculture is a water dependent industry and fish farmers know that without good water quality they are unable to raise any fish. Water and land are precious resources and fish farms are part of the larger mosaic of farmland and wild lands found in the State. A thoughtful approach to aquaculture and well-managed farms can aid the environment through:

- Providing wetland environments in the midst of dry land. Creating a mosaic of ecosystems.
- Production of farm-raised minnows can reduce our dependency on natural minnow populations.
- Production of farm-raised minnows and game fish can supply game fish or forage fish to supplement wild fish populations.
- Production of the mostly native or naturalized species available in Wisconsin reduces the risk of introducing or spreading invasive species into waters of Wisconsin.

D. Social Benefits

Does your support of local fish-farms matter? Wisconsin fish farmers are a part of the larger fabric of Wisconsin agriculture and they are your neighbors. When you buy Wisconsin farm-raised fish you help build the connections between fish farmers and you, their local customers. Buying local fish can help:

- Support local families, family farms, bait shops and other local businesses that depend on Wisconsin aquaculture.
- Make an investment in continuation of farms and the preservation of open spaces – marketing locally can sometimes provide the fish farm a better return, allowing the farmer to resist development pressures.
- Support local communities. Farms contribute more in taxes than in services required.
- Support the provision of live bait for recreational fishing and tourism.
- Support our local food security.

E. Regulatory Standards

Buying locally may remove the anonymity of a farmer and farmers take their responsibility to consumers seriously. And in addition to that there are considerable regulatory standards in the United States.

The U.S. has some of the strictest environmental and product safety rules and regulations found anywhere, but more than 88% of all the seafood consumed in the U.S. is imported. Almost half of that total is farm-raised, often in countries that do not have stringent environmental and food safety regulations. (NAA)

- Regulations in the state require that fish are certified free of disease before they are stocked or used for bait.

Benefits of Local Fish - Why Wisconsin Fish?

F. Where can I find Wisconsin-raised Fish?

1. Sources for Food Fish

NADF/WAA Local Food Resources List:

https://campus.uwsp.edu/sites/cols-ap/nadf/Extension_Results/Local%20Food%20Resources.pdf

WAA:

<http://www.wisconsinaquaculture.com/>

Something Special from Wisconsin program:

<http://www.somethingspecialwi.com/>

Savor Wisconsin Website

<http://www.savorwisconsin.com>

2. Sources for Wisconsin farm-raised Bait Fish

WAA:

<http://www.wisconsinaquaculture.com/>

3. Sources for Wisconsin farm-raised stockers

WAA:

<http://www.wisconsinaquaculture.com/>

Resources

Wisconsin Aquaculture Association (WAA):

<http://www.wisconsinaquaculture.com/>

University of Wisconsin- Stevens Point – Northern Aquaculture Demonstration Facility (NADF):

<http://aquaculture.uwsp.edu>

National Aquaculture Association (NAA)

<http://www.thenaa.net/>

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**Something Special
from
Wisconsin**

How to Purchase [Farm-Raised] Fish for Food?

- Finding Wisconsin Farm-raised fish.
- Purchasing and Handling Wisconsin Farm-raised fish.
- Aquaculture Systems

Probably the best way to find locally grown fish and fish products is to identify local growers. If you find the source, you can find the fish.

How to Purchase [Farm-raised] Fish for Food

“Aquaculture provides half of the world’s seafood, with about 50 million tons grown worldwide in 2006. Further half the seafood consumed in the United States comes from aquaculture, and yet about 85 percent of that amount is imported.”⁽¹⁾

How do you know if the fish you are about to enjoy is from Wisconsin? Unless a fish product specifically indicates that it is farm-raised, it can also be assumed it is wild harvested. How do you know if it farm-raised? Below we offer several tips of what to look for and how to tell where your fish is from.

A. How to find (identify) Wisconsin Farm-raised Food Fish:

In Wisconsin, most of the farm-raised food fish grown will be commonly known native or naturalized species, or in other words, fish that are commonly found in Wisconsin lakes, rivers or streams either because of natural wild populations or having been introduced under Wisconsin DNR programs to enhance fishing opportunities. Some popular food-fish species raised in Wisconsin include rainbow trout, salmon, perch, bluegill, bullhead, catfish, and walleye. With the increase of recirculation and aquaponics systems, you may also find Wisconsin farm-raised tilapia.

Many of these fish are not grown in great quantities, so their availability for purchase is never guaranteed.

1. Direct from the farm

Probably the best way to find locally grown fish and fish products is to identify local growers. If you find the source, you can find the fish. Some Wisconsin fish farmers sell fish directly from the farm, at farmer’s markets or through Community Supported Agriculture (CSA) groups. Some resources to find Wisconsin Farm-raised Food Fish include:

WAA:

<http://www.wisconsinaquaculture.com/>

NADF/WAA Local Food Resources List:

https://campus.uwsp.edu/sites/cols-ap/nadf/Extension_Results/Local%20Food%20Resources.pdf

Savor Wisconsin Website

<http://www.savorwisconsin.com>

Something Special from Wisconsin program:

<http://www.somethingspecialwi.com/>

How to Purchase [Farm-raised] Fish for Food

2. Supermarkets

In supermarkets, fish must be labeled as to the country of origin, and state of origin is also usually labeled. Ask the butcher if you are not sure. Look for the Something Special from Wisconsin label.

3. Restaurants

In restaurants, ask the server for the country/state of origin.

4. Questions to ask the producer or retailer

If you are purchasing fish from the farm, you may have an opportunity to gain information directly from the producer. If tours are provided, you may be able to observe how the farm operates while asking questions of the producer. Some questions you might ask include:

- How are the fish raised?
- How is water used on the farm?
- Are any chemical treatments used on the farm?
- What are the fish fed?
- How are the fish harvested?
- How (or where) are the fish processed?
- When were the fish processed?
- Do you have any recommendations on how to prepare the fish? Recipes?

If you are purchasing a fish or fish product from a retailer, the retailer may not know all the details relating to the products. However, if the retailer is selling local products, you should be able to obtain information regarding who the local farmer is and be able to backtrack to the farm of origin. Fish farmers are proud of their product and want their products labeled.

B. How to purchase and handle Wisconsin Farm-raised Food Fish:

Wisconsin fish farmers are proud of their products. As with any farmed product, the whole purpose of raising fish is to provide a product of good quality. To help ensure the enjoyment of the fish product, it is important that the consumer selects and handles the fish appropriately. Below are some tips summarized from the FDA Fresh and Frozen Seafood guide.⁽²⁾

Ask yourself: What is my general impression of this facility? Does it look and smell clean? Do I think the seller is practicing proper food handling techniques?

How to Purchase [Farm-raised] Fish for Food

1. Choosing Fresh Fish

Fresh fish is often purchased whole (“in the round”) or filleted with or without head, fins or skin. Only buy fish that is refrigerated or properly iced. If you are going to see fish or go to the farm market and intend to purchase fresh fish, it is best to carry along a small cooler with ice so that anything you purchase for home use does not lose quality prior to you preparing the product at home.

Some fresh products can be purchased as fresh at the farm market will likely have no labeling; however the vendor should be able to tell you exactly where the product was grown.

1. The fish should smell fresh and mild, not fishy or foul.
2. The eyes of the fish should be clear.
3. The flesh of the fish should be firm and shiny. (Note: dull flesh could mean the fish is old or that the fillet had been previously frozen.)
4. If the gills are still attached they should be bright red and free of slime.
5. Fish fillets should not have any darkening, discoloration or drying around the edges.

2. Choosing Frozen Fish:

Frozen fish is often packaged. Seafood can spoil if the fish thaws during transport or if it is left at warm temperatures for too long.

1. Make sure the package has not been opened or damaged.
2. Look for signs of frost or ice crystals. This could mean the fish has been stored a long time or has been thawed and refrozen.

3. Choosing Cured (Smoked, Salted, or Dried) Fish:

Prior to refrigeration, many people used traditional fish preservation techniques including salting, smoking or drying fish. Consumers often seek these products out for the flavor and use in selected recipes. Depending on the method of curing, the fish product can have a varying shelf-life. Check with the vendor to determine the appropriate length of storage. Also check the packaging for damage or if it has been opened.

Smoked fish is often eaten fresh. Fresh, smoked fish can be stored in a refrigerator for several days but will dry out in self defrosting refrigerators. Smoked fish can be frozen but lose their delicate fresh flavor rapidly when frozen.

4. Choosing Canned or Pickled Fish:

Canned or Pickled fish are often very shelf-stable if processed correctly. Check the can or jar for any damage or degradation.

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5. Storing Fish/Preservation:

In general, refrigerated fish and fish products should be kept below 38 degrees F (this includes fish products such as spreads and smoked fish). Keep the fish on ice or in the refrigerator if it will be eaten within two days. If it won't be used within two days, wrap it tightly in moisture-proof freezer paper or foil and store it in the freezer.

Frozen fish need to be stored below 32 degrees F. Some fish may be purchased as frozen fillets in water, packaged frozen without water, or individually quick frozen (IQF). IQF fish are packaged in bags and have an individual water seal on each fillet. These fillets have a very good shelf life however, in self defrosting refrigerators and freezers, the water seal may evaporate over time which would reduce their shelf life.

6. Preparation:

- (a) Thaw it safely: For frozen fish thaw it gradually, overnight in the refrigerator or immersed in a plastic bag in cold water.
- (b) Prevent cross-contamination while preparing the fish:
 - Wash your hands thoroughly before and after handling the fish.
 - Wash the cutting board with soap and hot water and sanitize.
- (c) Cook it properly.
 - Most fish should be cooked to internal temperature of 145°F.
 - Check the fish flesh. The internal flesh should be opaque and separate easily.

C. Recipes:

Ask your local fish farmer or fisherman for recipe recommendations. Or you can check the “cook's corner” on the Wisconsin Aquaculture Association webpage.

<http://www.wisconsinaquaculture.com/Recipes.cfm>

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Resources

Wisconsin Aquaculture Association (WAA):
<http://www.wisconsinaquaculture.com/>

University of Wisconsin- Stevens Point – Northern Aquaculture Demonstration Facility (NADF):
<http://aquaculture.uwsp.edu>

National Aquaculture Association (NAA)
<http://www.thenaa.net/>

Superscript References

⁽¹⁾ Agricultural Research Magazine. Jeff Silverstein. “Forum: Supporting U.S. Aquaculture.” October, 2010 Vol. 58, No.9. [Online] Available. (2010).
<http://www.ars.usda.gov/is/AR/archive/oct10/>

⁽²⁾ U.S. Food and Drug Administration. “Fresh and Frozen Seafood – Selecting and Serving it Safely.” [Online] Available. (2011).
<http://www.fda.gov/downloads/Food/ResourcesForYou/Consumers/UCM239497.pdf>