

History of Aquaculture

Aquaculture is the process of growing/raising fish, shellfish, or other aquatic animals or plants in a controlled environment.

It is an important part of the global food and seafood supplies. The Food and Agriculture Organization of the United Nations (FAO) recognizes farm-raised seafood as a key source to grow the global food supply to feed the increasing world population.

However, aquaculture is not new. While large-scale, commercial aquaculture started in the mid-20th century, aquaculture itself goes back thousands of years. Evidence for aquaculture has been found around the world. While many cite China as the home of aquaculture, evidence indicates aquaculture started in many areas at various times that makes deciding on one specific time and place for the birth of aquaculture futile at best. For example, archaeological evidence points to the some level of aquaculture being practiced by the Maya and some North American native communities.

c.6000 BC

Australia

Gunditjmara people farmed eels in artificial ponds connected by canals near Lake Condah, possibly since as early as 6000 BCE

c.4000 BC

Europe Neolithic Age

Evidence of trapping wild aquatic animals in lagoons, ponds or small shallow lakes

c.3500 BC

China

Evidence of aquaculture practices such as using silkworm feces and nymphs to feed carp raised in ponds on silkworm farms and the integration of raising carp in ponds and rice culture. Some date the fish and rice culture integration back even further, up to 6000 BC.

c.2000 BC

Japan

Oyster farming

c.1400 BC

China

Records of criminal prosecutions of fish thieves

475 BC

China

Earliest known monograph, Fan Li's "Yang Yu Ching", on fish culture published.

c.300 BC

India

First description of fish held in reservoirs in that area

c.200 BC

Etruscans

Early coastal aquaculture, a system called “vallicoltura” involving the creation of permanent or semi-permanent embankments to enclose lagoons and trap fish, on the Adriatic and Tyrrhenian coasts. Shellfish farming established in the Adriatic (likely started hundreds of years earlier).

c.100 BC

Romans

Built coastal aquaculture ponds and raise carp in fish ponds. Aristotle recommended the culture of carp. Romans also cultivated oysters. Elite Romans living outside of Rome added fish ponds, called “stews,” to their plantations and are credited with the first fish ponds in England.

c.1 AD

Bolivia

Evidence of raised agricultural fields being integrated with irrigation canals serving dual purpose of holding fish in the region of Beni.

c.300 or 800

Hawaii

Marine aquaculture starts and continued up to the European colonization of the islands. Early Hawaiians farmed multiple species (milkfish, mullet, prawns, crabs...) with a variety of farming techniques including freshwater ponds (either in conjunction with taro or separate from taro), brackish water ponds, seawater ponds and shoreline fish traps.

c.400-1400

Europe Middle Ages

Stew ponds of Romans adapted by early Christian monasteries, wealthy landowners, and royalty. Castle moats also used to hold fish. Evidence of fishponds found throughout Europe during this time, including in Hungary, Czech Republic, Switzerland, France and Italy.

Southern Europe

Fish farming occurs in brackish water in structures built in lagoons and ponds to retain fish (seabass, seabream, mullet, etc) brought in by the tide.

618-906

China Tang Dynasty

Multispecies carp polyculture developed as a result of unfortunate wording. The Tang emperor family name, Li, was the same as or sounded similar to the name for common carp (the fish most predominantly grown at the time). An imperial decree was issued that prohibited farming and other activities involving the common carp. This forced the focus to turn to other fish species, specifically using 4 other species of carp that have complimentary life histories and needs.

746

China

First known reference to clam culture in Chinese literature

768-814

Europe Reign of Charlemagne

Charlemagne issued edicts to tenant farmers about maintaining and managing ponds along with protection against poaching among other important issues.

c.1000

Mexico

Chinampas (built floating garden islands in lakes) were separated by channels which may have also been used to grow fish. This technique may date back as far as 4000 BCE.

c.1200

Cambodia

Use of integrated agriculture/aquaculture systems

France

Intertidal pole culture of mussels and oysters

1216-1272

England

Henry III gave well-documented gifts of live fish to the nobles, encouraging development of fish raising ponds on the estates of the nobles.

c.1200-1400

Java

Marine aquaculture is practiced starting with trapping milkfish in coastal ponds during the high tide. The law code, Kutara Menawa, included punishments for those who stole fish from ponds.

1400s-1800s

1639

China

Complete Book of Agriculture, which included discussions on pond fish culture, released.

c.1670

Japan

Fishermen cultivate seaweed

1733

Germany

Farmer is first known to successfully gather trout eggs, fertilize them and rear the hatched fish to maturity

1741

Germany – Westphalia

1st known trout hatchery built by Stephan Ludwig Jacobi, a German scientist

1800s

France

Oyster larvae collected on strings on tiles placed into the water and then larvae transplanted to protected beds to grow out.

US

Oyster farming on the Atlantic coast

1812

US

Curriculum in aquaculture established for undergrads at Cornell

1853

US – Ohio

Trout farm run by Theodatus Garlic and H.A. Ackley is the first in the US to artificially fertilize its fish eggs

1870

US

The American Fish Culturists' Association formed in New York (name changed in 1878 to the American Fish Culture Association and again in 1884 to the American Fisheries Society)

1872

US – California

Salmon culture starts as hatcheries to supplement wild fish stocks

1897

US

A Manual of Fish Culture published by the US Commission of Fish and Fisheries.

Manual deals mainly with hatcheries for the production of fish to stock game waters but includes a little on food species of fish, oysters and clams.

1900s

1909

US – Idaho

1st commercial trout farm in US established

1910

US

Channel catfish farming techniques developed

1919

US – Washington

Pacific oysters from Japan placed in coastal waters starting the oyster farming industry in Washington.

1930s

Asia

Tilapia introduced to Asia

US

Federal subsidies for building and stocking fish ponds on farms provided by FDR's Farm Pond Program

1940s

Tilapia introduced to Caribbean, Latin America and US

1950s

Following the end of WWII, demand for fish in developed nations increases, making the idea of largescale aquaculture possible

US

Catfish culture developed as an industry

Japan

Start of netpen aquaculture for yellowtail

1960s

Asia

Aquaculture begins to develop on a commercial scale

Denmark

Intensive commercial rainbow trout farming developed and starts to spread throughout

Europe

Japan

Floating cages developed

Europe

1st commercial salmon farms in Norway and Scotland

1970s

North America

Commercial salmon farming expands to US and Canada

1976

New Zealand

1st commercial salmon farm in New Zealand

1980

US

National Aquaculture Act of 1980 passed to provide for development of aquaculture industry

1980s

US

Sturgeon farming begins in California. Commercial hard clam (quahog) farming begins in New England. Manila Clam farming begins in Washington and California.

1999

Production of farmed salmon exceeds amount of salmon caught in the wild for first time

1990s-2000s

Early development of land-based tank and recirculating aquaculture

2011

Production of farmed fish surpasses that of beef for the first time in the modern era (60 million tons of farmed food fish versus 57 million tons of beef according to the UN Food and Agriculture Organization (FAO))

2012

About 600 species are used in aquaculture in about 190 countries according to the FAO

2013

Consumption of farm-raised fish surpasses that of wild fish (including shellfish) for the first time

<http://seattlefishnm.com/about/blog-detail/aquacultures-long-history>

The cultivation of marine species is an ancient practice. Ancient Chinese manuscripts from the 5th century B.C. indicate the Chinese practiced fish culture. Although not as implicit, Egyptian hieroglyphics indicate the Egyptians of the Middle Kingdom (2052-1786 B.C.) attempted intensive fish culturing. Following in the footsteps of the Egyptians, the Romans also developed aquaculture practices as they are known to have cultivated oysters. The culture of oysters established by the Romans is the first known form of aquaculture that has continued in some form or another to the modern day.

All of the early forms of aquaculture differed greatly from much of the aquaculture practiced today. The major difference is that aquaculture in ancient times involved harvesting immature fish or shellfish and transferring them to an artificially created environment that is favorable to their growth. Carp, in China, thousands of years ago were collected as youngsters and transferred to special ponds where they were grown. As the Egyptians and Romans proved this practice was not limited to carp but was used with many other species such as oysters and other hardy creatures capable of surviving the transfer to the culture ponds.

Fish farming in its modern form was first introduced in 1733 when a German farmer successfully gathered fish eggs, fertilized them, and then grew and raised the fish that hatched. To do this, male and female trout were collected when they were ready for

spawning. The eggs and sperm were pressed from their bodies and mixed under favorable conditions. After hatching, the fishlings were taken to tanks or ponds in which they were cultivated. Initially this "fish farming" was limited to freshwater fish. In the 20th century new techniques were developed to successfully breed saltwater species.

As scientists have learned more about the life cycles of the harvested fish and the stimuli that encourage development, fish farmers are adapting their techniques to gain more control over the fish's development. Such factors that are important to commercial fish farmers are the stimuli that encourage growth, sexual maturation, and reproduction. Other recent advances include disease control and immunology.

For most of the history of modern aquaculture, only luxury items such as salmon and shrimp were harvested. That trend is changing, as new technologies allow for efficient and cost effective cultivation of non-luxury cheap foodfish.

<http://www7.taosnet.com/platinum/data/light/whatis/history.html>

- Gunditimara people - Australia 8,000 BC developed 100 km² (39 mi²) of volcanic floodplain near Lake Condah into channels and dams - used these to culture eels year round.
- Chinese Aquaculture ~ River Flooding 3,500 BC waters subsiding after annual river floods carp left behind. Farmers fed them nymphs and silkworm feces (stimulate plant biomass?)
- 475 BC Treatise on Fish Culture by Fan Lei.
- Japanese Farming Intertidal Oysters 3,000 BC
- Unlikely to Recover Real Origins of Aquaculture
 - 14,000 - 8,000 YBP – Oceans Rose 100 meters.
 - Original Marine Sites Now under Water
 - FW Sites: Decay of Organic Materials
- Aristotle Recommends Europeans Culture Carp
- Roman Lucius Murena Digs Fish Ponds at Grotta Ferraia, 1st century BC
- Romans Grow Carp 30 BC - 400 AD
- Tang Dynasty (618 - 907) Polyculture Developed with Co-Culture of 4 Species of Carp
- Middle Ages - Growth of Local Carp Aquaculture in Europe – Heavy Penalties for Fish Theft.
- Native Hawaiian marine fish ponds, dates uncertain perhaps 800 YBP

<https://www.sfos.uaf.edu/fitc/teaching/courses/fish336/materials/FISH%20336%20Lect%202%20History%20&%20Future%20Aquaculture%20.pdf>



The Gunditjmara people engineered channels to bring water and young eels from Darlots Creek to low lying areas. They created ponds and wetlands linked by channels containing weirs. Woven baskets were placed in the weir to harvest mature eels.
[<http://www.gunditjmirring.com/nationalheritagelistin g>]



A tilapia shown in an Egyptian frieze, circa 2000 B.C.
(Nikola Fijan, courtesy of Mirjana Fijan).

Ancient Egyptians devised a land-reclamation method around 2000 BCE which is still highly productive, reclaiming over 50,000ha of saline soils and supporting over 10,000 families. During the spring, large ponds are constructed in saline soils and flooded with fresh water for two weeks. The water is then drained and flooding is repeated. After the second flooding is discarded, the ponds are filled with 30cm of water and stocked with mullet

fingerlings caught in the sea. Fish farmers regulate the salinity by adding water throughout the season and there is no need for fertilizer. About 300-500kg/ha/year of fish are harvested from December through April. Diffusion takes place where the low salinity standing water forces the higher salinity groundwater downward. Each year after the spring harvest the soil is checked by inserting a eucalyptus twig into the pond's soil. If the twig dies the land is used again for aquaculture for another season; if the twig survives farmers know the soil has been reclaimed and is ready to support crops. This aquaculture method reclaims soil in a three to four year period, compared to 10-year periods required by other practices used in the region.
[<http://voices.nationalgeographic.com/2013/07/11/sustainable-ancient-aquaculture/>]

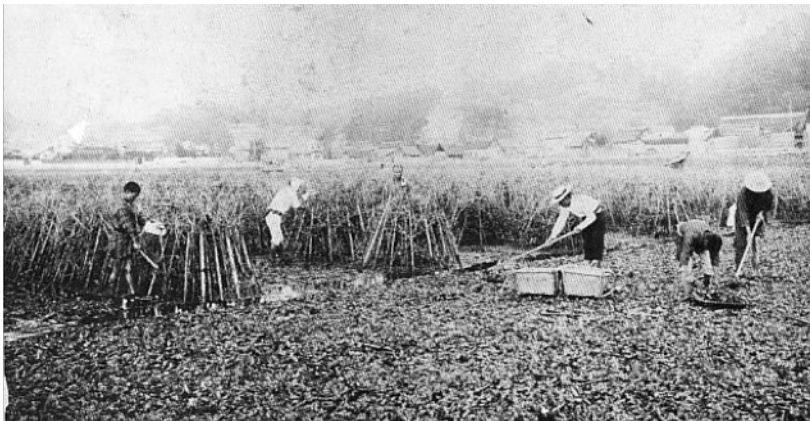


c.100 BCE, Romans built coastal aquaculture ponds and raise carp in fishponds. Aristotle recommended the culture of carp. Romans also cultivated oysters. Elite Romans living outside of Rome added fishponds, called “stews,” to their plantations and are credited with the first fishponds in England.

[<http://seattlefishnm.com/about/blog-detail/aquacultures-long-history>]

During the golden age of Greek culture, Aristotle reported “oysters from banks near the island of Lesbos were transplanted to similar hitherto unpopulated ground of Chios.” Rowan Jacobsen describes one entrepreneurial Roman, Sergius Orata, who set nets of twigs around adult oysters to catch the larvae when the oysters spawned. He would then move the twigs to other locations for growth, serving the oysters to rich Romans in spa locations throughout the empire.

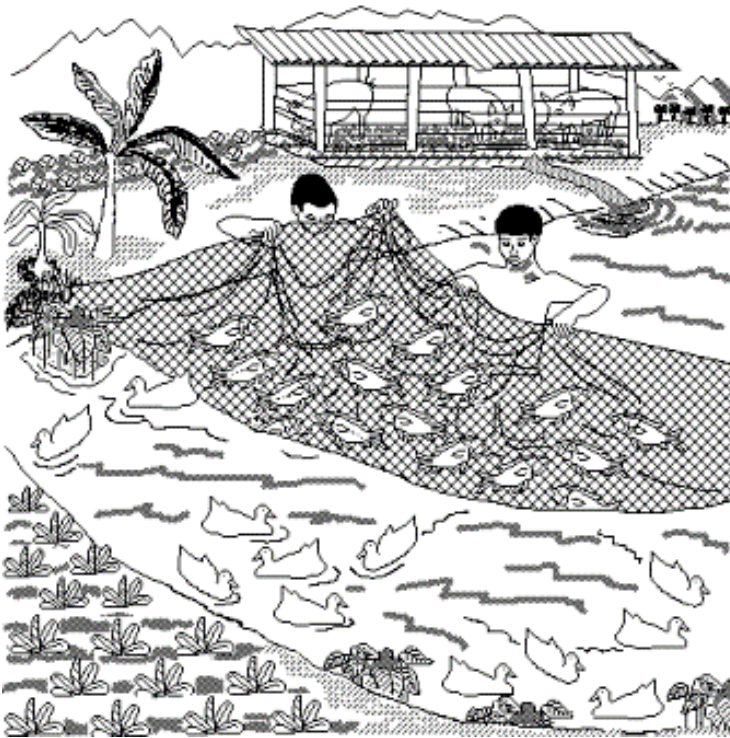
In Japan, growers used sections of bamboo, leaves still attached. The Japanese also invented “lantern nets,” accordian-like structures that expand and contract with the tides and allow easy separation of oysters by size. The Chinese invented “ear-hanging” for oysters and scallops, which involved punching a small hole in each live mollusk shell and stringing them in a chain. [<http://www.rodaloesorganiclife.com/food/history-oysters>]



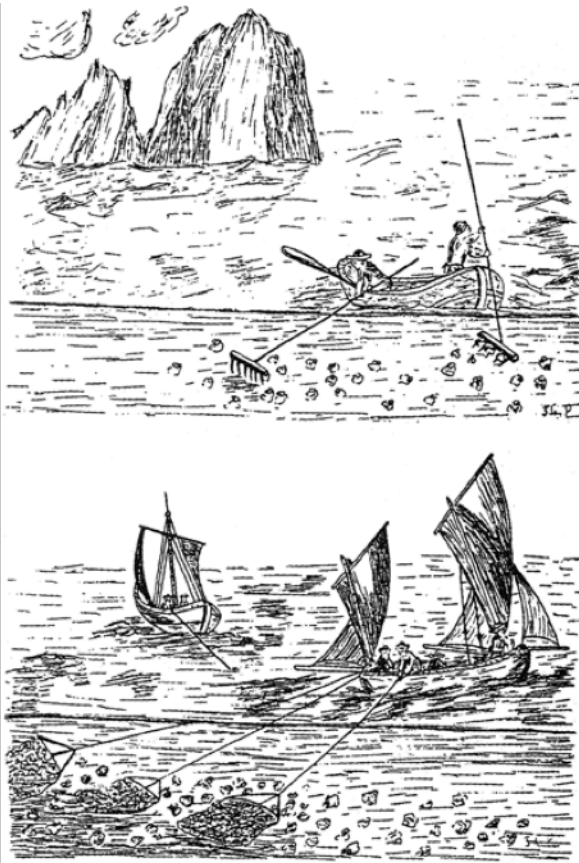
[<http://neho.com/niho/e>]

According to medieval literature, it is said that Japanese oyster farming started during the Tenbun Era (1532–1555). In those days, it was written that a “farming method was discovered in Aki Province during the Tenbun Era (source: Kusatsu Guide)”. The Ishimaki rocking method (Ishimaki: oysters attached to

small stones lined up on tidal wetlands and harvested through cultivation) and the Yaehibi method were employed. Before long with the technique advanced over time, the Hibitate method (oysters attached to wood or bamboo in place of small stones and then harvested) by which a greater number of oysters could be harvested was established.
[<http://www.kunihiro-jp.com/eg/about/index.html>]



The first true Hawaiian fishponds were probably built during the latter half of the fifteenth century. And increasingly thereafter as chiefs could command the labor necessary to transport the tons of rock and coral used in the enclosing walls. These ponds, which yielded several hundred pounds of fish per acre annually, were not only feats of engineering technology, but reflected chiefly power and were a major symbol of the intensification of agricultural and aquacultural production.
[<http://wesisland.blogspot.com/2010/09/ancient-hawaiian-fish-ponds.html>]



Oyster fishing, 1771 ["L'Encyclopédie" 1771]

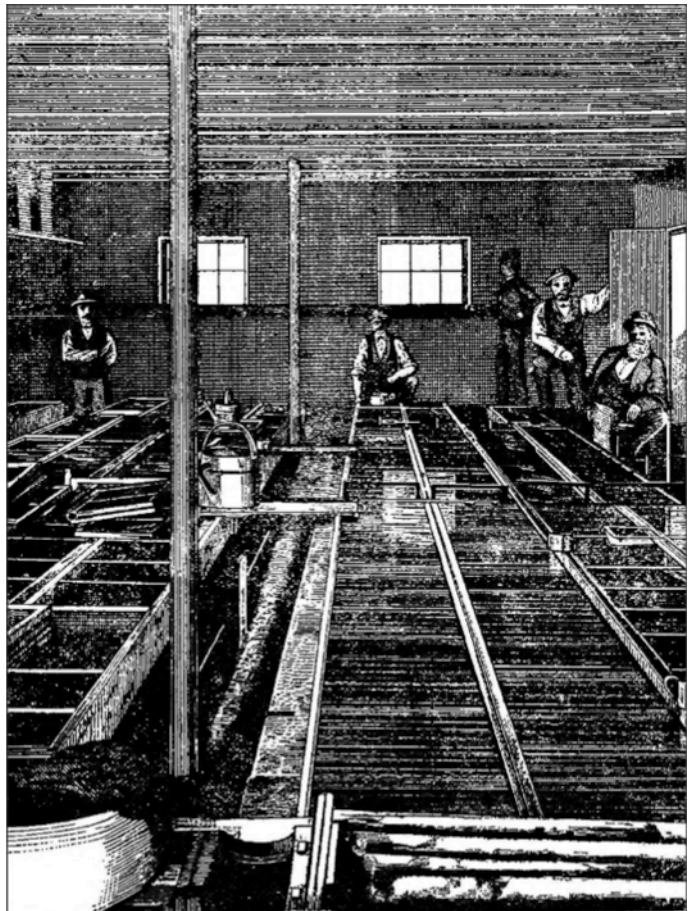
Oyster farming was practiced by the ancient Romans as early as the 1st century BC on the Italian peninsula.

[Higginbotham, James Arnold (1997-01-01). *Piscinae: Artificial Fishponds in Roman Italy*. UNC Press Books] With the Barbarian invasions the oyster farming in the Mediterranean and the Atlantic came to an end.

In 1852 Monsieur de Bon started to re-seed the oyster beds by collecting the oyster spawn using makeshift catchers. An important step to the modern oyster farming was the oyster farm built by Hyacinthe Boeuf in the Ile de Ré. After obtaining the rights to a part of the coast he built a wall to make a reservoir and to break the strength of the current. Some time later the wall was covered with spat coming spontaneously from the sea which gave 2000 baby oysters per square metre. [Toussaint-Samat, Maguelonne (2009-03-25). *A History of Food*. John Wiley & Sons.]

Two Cleveland physicians, Theodatus Garlick and H. A. Ackley, performed the first successful artificial fertilization of fish eggs in the United States in 1853. They later built the nation's first fish hatchery. Garlick published results of their experiments in 1857 in the "Ohio Farmer," spreading the knowledge for others to use. His treatise on artificial fish propagation and pisciculture encouraged others to begin artificially breeding fish. Aquaculture experts today sometimes call Garlick the "Father of American Fish Culture." Garlick and Ackley laid the foundation for the modern fish farming, or "aquaculture," industry. Aquaculture means raising aquatic animals or plants in a controlled environment for all or part of their life cycle. Most aquaculture is for commercial purposes, with the produce sold for use in recreation, food, or other products. Aquaculture's most popular fish include channel catfish, striped bass, rainbow trout, salmon, carp, and tilapia. Aquaculture also is a major source of water chestnuts, algae, water hyacinths, seaweeds, water lilies, and other wetland plants.

[<http://www.heartlandscience.org/agrifood/aquac>]



New York State Hatching House—Interior View (ca. 1879). Image source: Fish Hatching and Fish Catching, 1879, Page 41 (assessed from Internet Archive, original contributor Cornell University Library) by R.B. Roosevelt and Seth Green

Sustainable Ancient Aquaculture

<https://www.oceanfdn.org/sites/default/files/Sustainable%20Ancient%20Aquaculture%20mini-white%20with%20footnotes.pdf>

US Aquaculture History

<http://www.aces.edu/dept/fisheries/education/documents/HistoryofAquaculture.pdf>

Aquaculture History Timeline

http://www.aces.edu/dept/fisheries/education/documents/General_Aquaculture_Timeline.pdf

Fostering Shellfish Aquaculture Production in Maryland and Other States

http://dls.state.md.us/data/polanasubare/polanasubare_natresenvntra/Fostering-Shellfish-Aquaculture-Production-in-Maryland-and-Other-States.pdf

History of Oystering in the United States and Canada, Featuring the Eight Greatest Oyster Estuaries

<http://spo.nwr.noaa.gov/mfr584/mfr5841.pdf>

The State of World Fisheries and Aquaculture, 2016

<http://www.fao.org/3/a-i5555e.pdf>