Fishpond Farming and Aquaculture in the Pre-Modern Nordic Region: A Historical and Cultural Context

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Sammendrag

Dambruk og akvakultur i det pre-moderne Norden i en historisk og kulturell kontekst. Akvakultur som moderne industri er tuftet på erfaringsbasert kunnskap fra Romerrikets ekspansjon og Søreuropeiske kulturer. Kunnskapen ble overført til nordiske land gjennom klostre og tilhørende ordener i den Katolske kirke. Økende etterspørsel etter matressurser var en drivkraft for utviklingen av tidlig akvakultur. De mest vanlige fiskearter var karpe, karuss, suter, abbor og gjedde. Mindre vanlig var mort, ål og niøye. Den første lærebok i ferskvannsfiske, *De re rustica*, ble publisert av *Columella* ca 65 e.Kr. og bidro til etablering av akvakultur som sikret matforsyning og økonomisk stabilitet i romerske samfunn. Olaus Magnus ga ut bokverket *Historia de Gentibus Septentrionalibus* i 1555, der fiskerier i elver, vann og dammer ble beskrevet og illustrert. I 1582 kom Du Fouilloux med bokverket «*Neuw jag unnd Weydwerck Buch*». Boka ga en vitenskapelig og metodisk videreutvikling av akvakulturen og var til stor hjelp for datidens dambruk. Stephan Ludwig Jacobi var en pioner i systematiseringen av metoder for flere arter av ferskvannsfisk, og utga to artikler om akvakultur i 1763 og 1765 som ikke fikk mye publisitet. Remy og Géhin tok imidlertid tak i Jacobis arbeider og publiserte boken "*Anweisung zur künstlichen Fortpflanzung der Fische; oder die Kunst Fische zu säen wie man Getreide sät*" i 1851, der metoder for kunstig befruktning av fisk gjennomgås systematisk. Allerede i 1520 utarbeidet den svenske munken Petrus Magni et omfattende manuskript om akvakultur. Dette ble ikke publisert før på 1900-tallet, men det fikk likevel stor historisk verdi fordi det gir et unikt innblikk i tidlige nordiske akvakulturteknikker, inkludert tilpasninger til et kaldt klima. Klostrene og de tilhørende ordener i den Katolske kirken spilte en nøkkelrolle i utviklingen og spredningen av akvakultur. Karuss er den mest vanlige fiskearten som ble holdt i nordiske klostre, og dens utbredelse i Norge overlapper med klostrenes geografiske plassering. I nyere tid ble noen av de gamle fiskedammene brukt til produksjon av is til eksport.

Summary

Aquaculture as a modern industry is rooted in experiential knowledge dating back to the expansion of the Roman Empire and the traditions of Southern European cultures. This expertise was transmitted to Nordic countries through monasteries and their associated

Catholic orders. The growing demand for food resources served as key drivers for the development of early aquaculture practices. In its preliminary stages, aquaculture primarily involved species such as carp, crucian carp, tench, perch and pike. Less commonly, roach, eel, and lamprey were also cultivated. The first documented manual on freshwater fishing, *De re rustica*, authored by Columella around 65 AD, laid the foundation for aquaculture, ensuring food security and economic stability in Roman societies. In 1555, Olaus Magnus published *Historia de Gentibus Septentrionalibus*, which detailed and illustrated fisheries in rivers, lakes, and ponds. Later, in 1582, Du Fouilloux contributed *Neuw Jag unnd Weydwerck Buch*, which provided a scientific and methodological advancement of aquaculture practices, aiding the fish farming efforts of the time. A significant milestone in the systematic development of freshwater aquaculture methods came with Stephan Ludwig Jacobi, who published two articles on aquaculture in 1763 and 1765. Although these works did not gain widespread attention initially, they later inspired Rémy and Géhin, who published *Anweisung zur künstlichen Fortpflanzung der Fische; oder die Kunst Fische zu säen wie man Getreide sät* in 1851. This work systematically outlined methods for artificial fish fertilization. The Swedish monk Petrus Magni wrote an extensive manuscript on aquaculture. Though unpublished until 19th century, the manuscript holds significant historical value, offering unique insights into early Nordic aquaculture techniques, particularly those adapted to cold climates. Monasteries and their associated Catholic orders played a pivotal role in the development and dissemination of aquaculture practices. Among the fish species cultivated in Nordic monasteries, the crucian carp was the most farmed. Its distribution in Norway closely mirrored the geographic locations of these monasteries, underscoring their influence on the spread and adaptation of aquaculture in the region. In more recent times, some of the old fishponds were repurposed to produce ice for export.

Introduction

Over the past decades, modern aquaculture has emerged as one of Norway's most important industries. In this context, aquaculture refers to the farming, cultivation, and controlled storage of fish, such as in ponds and related facilities. Industrial-scale farming of Atlantic salmon (*Salmo salar*) began in Norway during the 1960s and has since grown significantly in scale (Asche et al., 2018). Economically, aquaculture has contributed to employment in coastal communities, creating value chains related to food and feed production, as well as technological innovation (Bjørndal & Aarset, 2000).

The cultivation of natural fish stocks in the Nordic region, particularly through fingerling production, represents another form of aquaculture with a history extending over 100 years longer. Such efforts began in the 1850s as private initiatives to mitigate the impact of increasing waterway interventions, particularly due to hydropower development. These methods involed capturing broodstock, fertilizing eggs, and producing fry, fingerlings and smolt of various ages for release into affected waterways. By the early 20th century, fish stocking practices became institutionalized, leading to the establishment of hundreds of state-run hatcheries across Nordic countries. Regulatory measures increasingly required hydropower operators to construct and manage their own fish-rearing facilities to compensate for the environmental damage caused by power production.

However, both modern aquaculture and hatchery-reared fingerlings and smolt production have created significant environmental challenges. Salmon farming for food production has led to severe issues such as the spread of salmon lice (*Lepeophtheirus salmonis*), genetic impacts on wild salmon populations, and nutrient discharge into fjords (Forseth et al., 2017; Taranger et al., 2015). Additionally, both voluntary and mandated fish stocking have resulted in genetic intermingling between wild and farmed stocks, disease transmission, and competition between stocked and natural populations, in some cases reducing the genetic diversity of wild stocks. Nevertheless, in certain

cases, fish stocking has positively impacted fish populations. These environmental issues have prompted questions about how aquaculture practices can be adapted to minimize ecological damage (see Thorstad et al., 2017; Lærdal, 2005).

The knowledge underpinning industrial aquaculture and hatchery fish production traces back to ancient Rome. A precursor to modern aquaculture, early pond farming developed in antiquity and the Middle Ages, initially in southern Europe and eventually in the Nordic region. This often involved the construction of inland fishponds for the systematic farming or storage of species like crucian carp (*Carassius carassius*) and common carp (*Cyprinus carpio*) for consumption and trade. This knowledge was further refined and adapted to Nordic conditions through the establishment of monasteries and aristocratic estates during the medieval period (see Bonow et al., 2016 for detailed accounts). Fishponds also evolved as status symbols, particularly following the Reformation and the dissolution of Catholic monasteries in the 1500s (Hoffmann, 1996; Foosnæs, 2006).

This literature review provides an overarching overview of the origins and developmental trajectories of modern aquaculture by means of combining freshwater biology and ethnoichthyology. It begins with the earliest known aquaculture activities involving freshwater fish in Europe and later in the Nordic countries, including Norway. The aim is to explore why and how this activity was established in Nordic regions due to influences and knowledge transfer from Southern European cultures and industries. The article also highlights early academic works related to aquaculture and their connections to the religious, economic, and cultural conditions of the time in the Nordic countries. Additionally, it discusses the later use of pond systems for ice production.

Environmental Degradation and Overfishing Created a Need for Aquaculture

Aquaculture expanded alongside the Roman Empire but declined after its fall. Interest in aquaculture resurged in the 11th century due to population growth, increased food demand, overfishing, and the degradation of aquatic ecosystems. Extensive fisheries and intensive exploitation of species such as salmon and sturgeon (*Acipenser sp*), combined with technological advancements and watercourse interventions, led to widespread construction of mills, fishponds, and wetland drainage. These developments contributed to the decline of many fish populations and their habitats. Although local regulations were implemented in some areas to protect fish stocks, they often had limited effectiveness due to the growing societal demand for fish (Hoffmann, 1996). This necessitated the construction of fishponds, particularly on estates owned by religious and aristocratic elites (Hoffmann, 1995). From the 12th century onward, common carp dominated aquaculture in Central Europe, but in northern Europe, the more cold-resistant crucian carp became the preferred species during the medieval period (Makowiecki, 2008).

Fish species used in early Nordic aquaculture are shown in Figures 1 (most common) and 2 (less common).

Early Academic Works on Aquaculture and Pond Farming

The practice of fish farming in ponds, known as pond farming, has deep roots in southern Europe. The Roman author and agronomist Lucius Junius Moderatus Columella produced the earliest known work on fish farming in the 1st century CE. His encyclopedic treatise on agriculture (*De re rustica*) comprises twelve books, with Book 8 detailing methods for raising fish in ponds as part of a self-sustaining farm system. Columella emphasized the role of water resource management and fish farming in ensuring food security and economic stability in Roman society. His writings reveal that aquaculture was already an integral component of sustainable resource management strategies in antiquity. His focus on efficiency and early sustainability principles makes his work one of the most comprehensive accounts of ancient aquaculture practices.

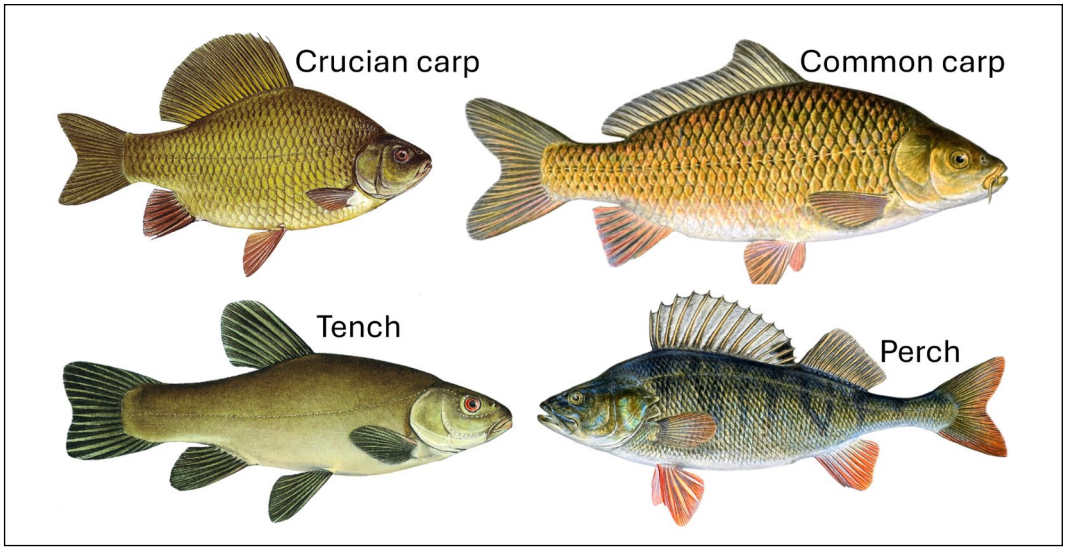

Figure 1. The most common fish species used in aquaculture and pond farming in Nordic countries were crucian carp, common carp, tench (Tinca tinca), and perch (Perca fluviatilis). (etter tillatelse fra illustratør Jan Fekjan)

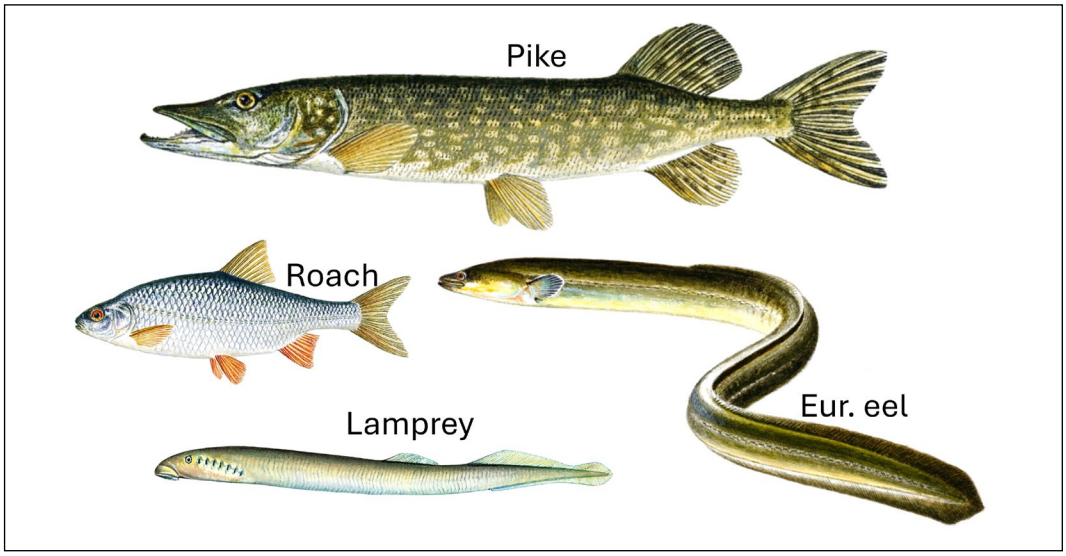

Figure 2. Less common fish species in Nordic aquaculture included pike (Esox lucius), roach (Rutilus rutilus), eel (Anguilla anguilla), and lamprey (Lampetra spp). (etter tillatelse fra illustratør Jan Fekjan)

The Swedish priest, historian, and cartographer Olaus Magnus (1490–1557) authored the extensive *Historia de Gentibus Septentrionalibus* (*The History of the Nordic Peoples*), published in Latin in Rome in 1555. Comprising 22 books and nearly 500 illustrations, it provides vivid descriptions of life and nature in the Nordic region during the 16th century, including collective fishing activities in rivers, lakes, and ponds (see Figure 3). The depictions exhibit clear influences from ancient fishing methods, framing freshwater fishing as both an economic activity and a cultural practice deeply embedded in Nordic identity. Olaus Magnus often described

fishing as a "gift of nature" and romanticized the harmony between people and their surroundings.

In 1582, a German textbook on freshwater fishing and capture methods titled *Neuw jag unnd Weydwerck Buch* was published (du Fouilloux, 1582). The book is one of the most detailed sources on fisheries in Germany and other European countries during its time. Authored by Jacques du Fouilloux, a German naturalist and practitioner of hunting and fishing, it systematically documented and described the technical aspects of freshwater fishing. The book was released during a period when hunting and fishing were essential skills for food provision, offering a scientific and methodological approach to these activities. It influenced practical techniques and was used by amateurs and professionals across multiple generations. *Neuw jag unnd Weydwerck Buch* provides valuable historical insights into how traditional fishing methods using traps, nets, and hooks were analysed and adapted to form the basis for practical aquaculture.

Pond farming reached its zenith in the 17th century, but as agricultural technologies advanced, fishponds were gradually replaced by more profitable agricultural ventures. One of the primary reasons for this shift was the lack of control over fish reproduction in ponds, leading to inefficient production and unpredictable yields (Muus & Dahlstrøm, 1978). Early pioneers like Stephan Ludwig Jacobi (1711–1784) addressed these challenges by developing methods for artificial fish egg fertilization, particularly for trout. Jacobi's work laid the foundation for modern aquaculture, showing that controlled reproduction was possible and could lead to more efficient fish farming practices.

Building on Jacobi's work, two French fishermen, Joseph Remy and Antoine Géhin, revitali-

Figure 3. Collective freshwater fishing using various methods in a pond. Illustration from Historia de Gentibus Septentrionalibus (The History of the Nordic Peoples), 1555.

zed and advanced artificial fertilization techniques in the mid-19th century. Operating in the Vosges Mountains, they addressed declining salmonid stocks in local waterways. Their experiments culminated in the successful hatching of large numbers of trout fry. In 1851, they published *Anweisung zur künstlichen Fortpflanzung der Fische* (*Instruction on the Artificial Propagation of Fish*), detailing practical methods for fertilization and early rearing. This publication reinvigorated interest in aquaculture across Europe and led to the establishment of numerous hatcheries in the Nordic countries, including Norway. The scientific groundwork laid by Jacobi, Remy, and Géhin fostered the rapid development of modern aquaculture techniques still in use today.

Aquaculture Technology Reaches Scandinavia

In Scandinavia, few archaeological traces of pond farming have been found prior to the late Middle Ages. However, historical records identify both clerical and secular landowners as owners of fishponds during this period (Svanberg et al., 2012). An early manuscript for an aquaculture handbook was prepared as early as 1520 by the Swedish monk Petrus Magni (ca. 1460–1534), predating the works previously discussed. Petrus Magni, a priest associated with Vadstena Abbey and one of Sweden's most learned people of the late Middle Ages, authored the manuscript *Bondakonst* in Old Swedish around 1520. Intended as a "manual" for farmers, this text was not published until the 19th century but survives in a few manuscript copies.

There are several reasons why this work remained unpublished. Many writings of the time existed only as manuscripts, as the printing press was still in its infancy. Furthermore, the manuscript was written in Old Swedish and targeted farmers, nuns, and monks involved in monastic activities. Such works had often limited appeal and were seldom prioritized for printing, especially during a period dominated by religious and political texts. Additionally, much of the manuscript was a translation and adaptation of the Roman author Columella's *De re rustica* (see earlier discussion), which may have further diminished its appeal for publication.

In addition to translating Columella's texts, Magni incorporated his own observations and experiences, particularly regarding aquaculture and pond farming. One chapter is dedicated to constructing and maintaining fishponds for raising and managing crucian carp and tench (*Tinca tinca*). This chapter provides insights into methods for building ponds with accompanying water systems, selecting suitable fish species, and practical advice for efficient operation. Magni's work represents one of the earliest known manuals on freshwater aquaculture in the Nordic region and reflects an advanced understanding of aquaculture techniques and environmental considerations of the time. Despite its unpublished status, the manuscript holds significant historical value as it offers a unique glimpse into early Nordic aquaculture (see further discussion in Svanberg & Cios, (2014)).

The domestication of common carp as a pond fish was most widespread in Southeast Europe during the Middle Ages, while crucian carp gained more popularity in the Nordic region due to its resilience to poor water conditions (Balon, 2004). This adaptability is highlighted in the above-mentioned academic works. Crucian carp holds a special status because it can survive under challenging environmental conditions, such as oxygen depletion in ice-covered ponds without water inflow. This hardy species was therefore more successfully managed than others, making it a crucial food resource in the Nordic region as well as in the Baltic states and Poland (Makowiecki, 2008).

The Early History of Aquaculture in Norway

The early history of aquaculture in Norway remains somewhat unclear, though a few archaeological findings of ponds and fish bones have been made (Rasmussen, 1959). During the Middle Ages, fishponds required both expertise

and investment. Over time, their function transitioned from producing food fish to serving as status symbols for the upper class (Hesthagen & Sandlund, 2007).

Common species in European fishponds included common carp, pike (*Esox lucius*), tench, and perch (*Perca fluviatilis*), but in Norway, carp species were predominant (Feddersen, 1881). Common carp were introduced to Norway in 1740 but became extinct during the 1990s (Kålås & Johansen, 1995). However, a close relative, the goldfish (*Carassius auratus*), persists in a lake in southeastern Norway (Mo, 1996).

The oldest Norwegian source mentioning common carp and crucian carp is Bishop Erik Pontoppidan's 1752 work. He described carp as rare but noted that crucian carp was common in lakes and ponds (Pontoppidan, 1753). Historical sources mention carp on the menu of Archbishop Olav Engelbrektsson in 1532 (Seip, 1936; Nordeide, 2003), though both species were often collectively referred to as crucian carp. Medieval findings of common carp bones are rare in Northern Europe, suggesting that the species was not widespread (Paul, 1977; Driesch, 1982).

Crucian carp colonized naturally to a few water systems in eastern Norway from Sweden 9,000–10,000 years ago (Huitfeldt-Kaas, 1918; Øksnevad et al., 1995). Archaeological evidence shows no crucian carp bones in western and northern Norway, where the climate was less favourable for the species (Holopainen et al., 1997). Its spread to coastal lakes is attributed to human activity, particularly through monastic institutions during the Middle Ages (Hommedal, 1999).

Fish bones from medieval Norwegian towns indicate that saltwater fish dominated diets, with freshwater fish being rare (Hufthammer, 2003). For example, freshwater fish represented only a small proportion of finds from the Archbishop's Palace in Trondheim (Hufthammer, 1999). Exceptions include Oslo, where eel (*Anguilla anguilla*) played a significant role in certain areas (Lie, 1991).

Freshwater fish were highly valued and consumed by elites or used in religious contexts (Currie, 1990). Pond systems often included breeding ponds (*vivaria*) and storage ponds (*servatoria*), enabling systematic management, sorting, and storage of fish for later consumption (Currie, 1984).

The Role of Monasteries

Monasteries of the Catholic Church played a pivotal role in developing and disseminating aquaculture in the Nordic region. Many monastery-maintained fishponds to ensure a steady supply of freshwater fish, particularly crucian carp (Fischer, 1964; Ekroll, 1996). Most monasteries were strategically located near abundant fishing resources, whether in fjords, lakes, or rivers. While Benedictine and Cistercian monasteries were renowned for their agricultural and aquaculture endeavours, Dominican and Franciscan monasteries, despite having fewer resources, also relied on local fisheries and ponds for sustenance.

The Benedictines, following the Rule of St. Benedict, emphasized self-sufficiency, and developed extensive agricultural and aquaculture practices. They are considered pioneers in establishing fishponds in Europe, often adjacent to their monasteries. Benedictine monasteries used fishponds to ensure a reliable supply of fish, particularly crucian carp, which became a dominant species in their pond farming practices (Hoffmann, 1996; Hayward, 1991). Norway's first Benedictine monastery, Nidarholm Abbey (Munkholmen), was established in Trondheim during the 12th century.

The Cistercians, a reformed branch of the Benedictines, are best known for their work in pond farming across France, Germany, and other parts of Europe. They combined advanced engineering skills with agriculture, creating extensive networks of ponds. Known for their expertise in hydraulic technology (Hoffmann, 1996) and architectural adaptations (Hayward, 1991), they developed methods to manage water distribution, regulate temperature, and optimize fish growth conditions. The Cistercians established monasteries at Lyse (est. 1146), Hovedøya and Tautra in Norway, spreading knowledge of

pond farming from these locations (Foosnæs, 2006). The ponds at these monasteries were often sophisticated, featuring separate breeding and storage ponds (Currie, 1990). Their most famous Norwegian monastery was founded on Hovedøya in Oslo in 1147.

The Augustinians also constructed fishponds, though on a smaller scale compared to the Cistercians. These ponds, as for all fish farming monasteries, often served both religious and economic purposes. Although documentation on their aquaculture practices is sparse, their contributions are acknowledged in broader studies of medieval aquaculture (Hoffmann, 1996). Notable Norwegian Augustinian monasteries include Reins Abbey in Rissa, Trøndelag (https://reinskloster.no/historien-og-dagens-drift/).

The Carthusians, known for their ascetic lifestyle, engaged in pond farming as part of their economic and self-sufficiency efforts. Their aquaculture practices reflected their need for sustainability in isolated environments (Hoffmann, 1996). Their pond systems were considered both advanced and practical (Hayward, 1991).

Dominican and Franciscan orders are less associated with aquaculture and pond farming, but some of their monasteries operated small fishponds for local use. Historical analyses of monastery economies document these practices (Hoffmann, 1996). St. Olav's Monastery in Oslo, founded in 1239 as a Dominican monastery, and the Franciscan Greyfriars Monastery in Oslo, established in the 13th century, are examples.

These monasteries served as centres of innovation in aquaculture and pond farming technology. Their extensive networks across Europe facilitated the transfer of experiences, innovations, and traditions related to fish farming and pond management from Southern Europe (Hoffmann, 1996). For instance, the robust qualities of crucian carp were leveraged to adapt fish species selection for the Nordic climate (Makowiecki, 2008). Monasteries also had economic incentives to practice aquaculture, as fish were used both as food and as a trade commodity, often in barter transactions (Hommedal, 1999).

Early aquaculture in Norway was closely linked to religious, clerical, and aristocratic power centres. Monastic connections with European societies introduced and refined aquaculture techniques. Archaeological findings indicate that freshwater fish were mainly reserved for specific societal groups. From the 18th century onward, carp farming also became associated with Renaissance gardens, originating in Italy in the 15th century and spreading throughout Europe in the 16th and 17th centuries. These gardens reflected Renaissance ideals of balance, symmetry, harmony, and human control over nature.

Technologically advanced water systems and ponds with visible carp species became central visual elements in such gardens, but the main purpose was still food supply. However, the tradition of farming crucian carp for food consumption persisted across the Nordic region. The coexistence of fishponds for food production and later elite demonstrations of abundance and control illustrates how aquaculture functioned as both a means of sustenance and a cultural symbol.

Fishponds in Norway

Historical sources from the Trondheim and Bergen regions provide early examples of fishponds. Lady Ingerd of Austrått (c. 1475–1555) managed crucian carp ponds in the 16th century (Ree & Wallem, 1916; Nordeide, 2000). Her estates encompassed extensive lands with fishponds, enabling access to fresh fish year-round, particularly during Lent, when meat consumption was prohibited. This privilege was largely reserved for the upper class. Archbishop Olav Engelbrektsson (c. 1480–1538) owned a pond at Steinvikholm (Nordeide & Hufthammer, 1993). Excavations at the Archbishop's Palace in Trondheim have uncovered remnants of a rectangular medieval pond constructed using traditional Norwegian timber framing techniques (Nordeide & Hufthammer, 2009).

In Bergen, Harris (1991) identified at least 23 ponds dating back to the late 17th century,

including Norway's first known saltwater pond near Bergenhus. These ponds served dual purposes: storing fish for household consumption and functioning as aesthetic landscape features (Moe, 2004). Other ponds, such as those at Milde Farm, likely functioned as reservoirs for kitchen use (Moe et al., 2006).

The dietary practices of the Cistercians at Hovedøya Monastery in the Oslofjord have been examined by Vedeler & Figenschou Simonsen (2024). The monks incorporated fishponds into their self-sustaining systems. These ponds were utilized either as *vivaria* for fish farming or as storage ponds (also referred to as *piscine*) for live fish intended for later consumption (Figures 4 and 5).

One preserved pond, which remained water-filled until 1957, was a circular depression excavated in moraine sediments. Measuring approximately 18 meters in diameter and 1–1.5 meters in depth, its edges were reinforced with a stone wall (Figure 4). Bony remains of roach and European eel (*Anguilla anguilla*) were found in this pond, but it is likely that the primary fish species known to be cultivated or stored in ponds elsewhere in the Nordic region. Such species included crucian carp, northern pike, and tench. Other species, such as, roach (*Rutilus rutilus*), and lampreys (*Lampetra* sp.), also thrived in muddy ponds. Crucian carp and tench reproduced effectively in ponds, while pike were typically kept temporarily between capture and consumption. Beyond their value as food, these fish had medicinal uses. For instance, carp heads were prescribed as a remedy for fever and burned pike bones were believed to heal injuries in both horses and humans.

At Olav Monastery in Oslo's Ruin Park, the Dominican Order used a smaller restored pond (*servatorium*). This pond likely stored fish

Figure 4. Fishpond managed by Cistercians at Hovedøya Monastery in the Oslofjord (Photo: Riksantikvaren).

Figure 5. Restored fishpond (servatorium) used by the Dominicans at Olav Monastery in Oslo (Photo: Margrete Figenschou Simonsen/Kulturhistorisk Museum, permission given 11.02.2025).

caught elsewhere for imminent preparation and consumption. It measured 12 x 4 meters with a depth of 0.4 meters (Figure 5).

The Link Between Medieval Monasteries and Crucian Carp Distribution

The geographic distribution of crucian carp in Norway closely aligns with the locations of medieval monasteries, supporting the theory that this species was introduced and farmed by monastic communities (Foosnæs, 2006). For instance, crucian carp were introduced to monastic sites in western Norway, far beyond the species' natural range in eastern Norwegian waterways.

Following the Reformation of 1536–1537, these traditions continued to be adopted by the aristocracy, who established Renaissance gardens with fishponds on their estates. These ponds combined practical and aesthetic functions, perpetuating monastic aquaculture traditions. Comparing the modern distribution of crucian carp in Norway to the historical locations of Catholic monasteries reveals significant overlap, underscoring the importance of this species in early Norwegian aquaculture (Øksnevad et al., 1995; Hommedal, 1999).

The dissolution of monasteries during the Reformation indicates that crucian carp was likely the first fish species utilized in early aquaculture practices in Norway and the Nordic region.

Other Cultured Fish Species and Pond Usage

Other fish, including pike, bream, and eel, were also kept in ponds, primarily in regions where they occurred naturally. By the 20th century, trout and eel were occasionally stored in drinking water wells to maintain water purity. Around Tyrifjorden, bream (*Abramis brama*) was traditionally stored in farm ponds, though this practice ceased around 1915 (Harsson, 2000).

From the early 19th century until approximately 1950, ice blocks were cut from old and newly established ponds across the Nordic countries (Madsen, 2014). Some of these ice ponds originally served as fish storage facilities while also supporting ice production. As demand for cooling increased, particularly for transporting food, beer, and fresh fish, using ponds dually for fish and ice became practical. Ice production declined in the first half of the 20th century with the advent of mechanical and electric refrigeration systems.

In Asker, Norway, approximately twenty ponds now appear as idyllic, partially overgrown tarns but bear witness to a once-thriving ice trade (Figure 6). Ice block exports created thousands of jobs, especially along the Oslofjord coastline. At its peak in 1898, Norway exported 500,000 tons of ice, making it the world's largest ice exporter at the time.

Conclusions

Aquaculture in the Nordic region developed early, evolving alongside societal needs and technological advancements. Catholic monasteries played a pivotal role in the dissemination and adaptation of aquaculture practices until the Reformation in 1537. These traditions, rooted in connections to southern Europe, were adapted to the Nordic environment and its native fish species. Crucian carp became a key species due to its resilience to the harsh Nordic climate, while carp was often kept in Renaissance gardens as a decorative and functional element.

Historical and zooarchaeological findings indicate that freshwater fish were primarily reserved for the elite, serving as both a food resource and a status symbol. This tradition reflects the economic, religious, and cultural priorities of the time. In later years, some fishponds were repurposed for ice production, demonstrating the adaptability of these facilities to changing societal demands.

Figure 6. Ice cutting on a pond in Asker, Norway (Source: https://www.askerbibliotekene.no/lokalsamlingen/det-gamle-asker224/istrafikken-pa-askerlandet/?utm_source=chatgpt.com*).*

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