A Brief Overview of the History of Fish Culture and its Relation to Fisheries Science

Gary D. Sharp, Ph.D.
Center for Climate/Ocean Resources Study, Monterey, CA

Abstract. The brief historical occurrence of aquaculture introduces the science that evolved from the early studies on cod propagation in 1864, and the export of these concepts about stock enhancement through protection of early life history stages through what has always been considered the 'critical periods' during which the majority of natural mortality takes place. The next most important issues discussed are the why's and how's of fish culture, and where the habitat and feed comes from, and the related social and ecological enigmas.

Key words: aquaculture, stock enhancement, history, fisheries science

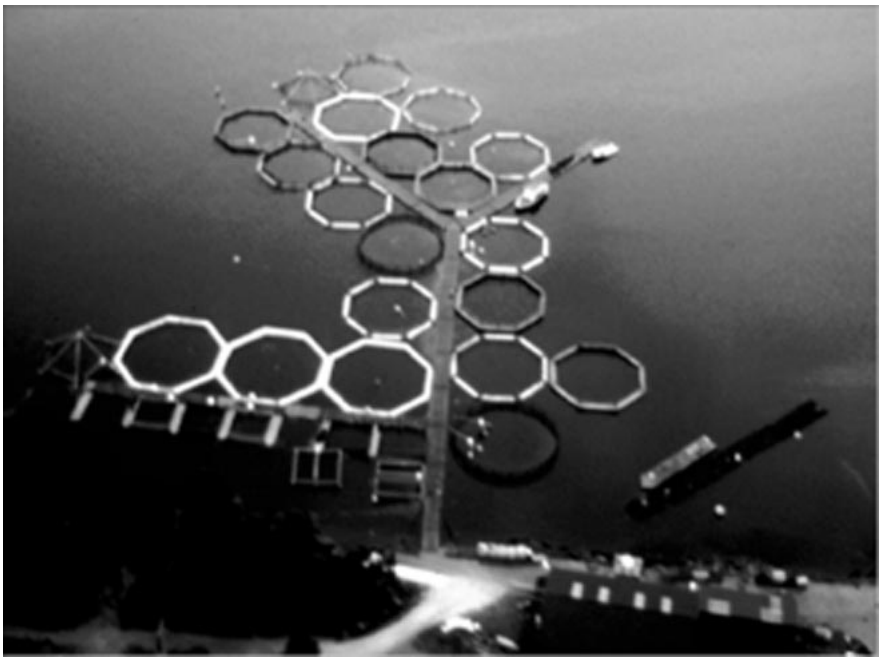

Figure 1. Modern aquaculture facilities provide options for many, around the world. Salmon pens (Norway), oysters and various ocean fishes (Italy) represent the fruit of many centuries of trial and error, evolving into modern fisheries science.

1. HISTORICAL PERSPECTIVES

Rice and fish culture has been a tradition in Southeast Asia for over 2000 years. Fan-Li wrote the first extensive treatise on fish culture in China about 800 BCE. The document resides in the British Museum. By 1368 CE, the Ming Dynasty began the promotion of fish farms to support the Live Fish markets, that even today, dominate Chinese fish sales. Romans cultured oysters At Baia, Italy from ~110BCE. Oysters, mussels, and many fish species are cultured for distribution to fish markets and restaurants as important components of every modern Italians' dietary and social life. In 1864 G.O. Sars developed artificial propagation of marine fish fry in Norway. Sars fertilized, hatched and released 67 million cod yolk-sac fry, starting modern fish hatcheries for restocking declining fish resources- as well as modern fisheries science.

In 1864 the first salmon canneries were built on the Columbia river, to provide for gold miners and railroad laborers in the west. Thus began the era of industrial fishing on these abundant resources. In 1871 the US Fish Commission was created. Spencer Baird was named its head. The next era in North America's history of fish hatcheries began in 1872 when the American Fish Culturists Association appropriated $17,000 for the Government to begin fish culture development. Also in 1872 Livingston Stone made the first salmon egg collection for artificial fertilization, at Baird Station on the McCloud River. On 10/23/1872 he shipped the first 30,000 chinook salmon eggs via rail, of which 700 survived to fingerling size. These survivors were planted in the Susquehanna River. There were no subsequent survivors to spawning ages/stages. In 1873 Stone had special fish tanks constructed for railroad baggage cars, and released 35,000 Atlantic shad into the Sacramento River, starting an era of transplantation of exotic aquatic species. In 1874 Stone also shipped American shad to Europe, for introduction. Meanwhile, the Baird Hatchery began shipping fertilized salmon eggs worldwide. Ironically, it is now under water due to building of Shasta dam. In 1877 the first salmon cannery was built in Klawok, Alaska. In 1879 Oyster propagation was begun by Major Ferguson, for the Maryland Fish Commission.

Meanwhile, in 1882 back in Norway, Capt. Gunder Dannevig founded Flødevigen hatchery at Arendal, Norway, beginning a century long cod enhancement program that closed only in the 1980s, because the hatchery staff never bothered to prove that the released codlings were caught in local fishery. Also in 1882 - Adolf Nielson, a Norwegian fish hatchery employee visited Newfoundland, on request, and helped create an initiative to build a fish hatchery; to refurnish the failing cod recruitment off Newfoundland.
In 1889 the Newfoundland Fish Commission founded the Dildo Island Hatchery, where cod fry were produced until 1896. In 1897 the hatchery at Dildo was sold, due to lack of funding for project - again no proof of recapture - although the local cod fishery was deep in cod four years after initial releases were made.

Fish hatcheries and invertebrate culture facilities sprung up along the northeast of North America, becoming the sites of various early marine science institutions. Along the west coast, from California to Alaska, salmon and trout hatcheries proliferated, and formed an entirely unique put-and-take fish economic activity. Most of the regions' once pristine lakes were soon stocked with alien species, never to be the same, again.

In 1981, the Norway's Svanøy Foundation sponsored a workshop on cod culture, to review the history, and ongoing activities in Norway, at which major effort was made by attendees to encourage a cultured cod juvenile tag and recapture study. The eventual results of the tag/recapture studies that ensued were more than encouraging, as within the first few years, up to 20% of the tagged fish were returned from the local fishery, proving, finally, the worth of cod culture. Of course, there were years when entire stocks of the young codlings were wiped out by blooms of various invertebrate predators in the grow-out ponds, before they were released, and other years when they were likely eaten by abundances of predators within the fjord system, before they got to sea. I, personally, wrote the workshop report, which outlined the progress, value, and future of this type of activity, for the funding of the needed work.

The major point that stimulated most of this early stock-enhancement activity is that there are no guarantees in Nature about year to year recruitment successes, or decade to decade population stability- hence the failure of stock forecast models based on "mean" expectations. The effort to culture fishes, and enhance natural populations is closely related to the transition from hunting and gathering in society, to herding, and farming.

2. RAISING FISH FOR MARKET INVOLVES MANY OPTIONS

Among the more popular approaches taken recently by the Japanese has been raising wild caught fishes in sea-pens, using their excess abundances of Japanese sardines, available along much of the coastline, and particularly since the early 1970s bloom occurred. In 1961 Japan's total net-culture production of "hamachi" – a *Seriola*, or yellowtail jack species - was 2,579 tons. By 1968, they produced 30,779 tons of hamachi for their sushi market, by scaling up their production, and controlling disease, particularly *Vibrio*, and various nematodes common to the species. Since the 1991 decline in recruitment of Japanese sardine, their fish culture industry depends on imports.

2.1 There are many reasons why fish culture is done:

For food; For restocking Nature or others ponds; In order to study life history development; and today, lets not forget for home aquaria.

In the late 1970s, the Asian Development Bank initiated an Aquaculture Development Program to encourage shrimp culture within the vast coastal environments of Southeast Asia. The results were spectacular, in the short term, but the increased expansion of farms created environmental and social disasters. Entire mangrove systems were removed - general environmental degradation ensued from pond effluents. Local fisheries were decimated, as mangrove- dependent fish production declined, and the intense pressure due to the need for shrimp post-larvae increased - to stock the ponds - and... The Competition for the "Commons" Created - Chaos!

Figure 1. Fishers for shrimp post-larvae to supply shrimp farms in Bangladesh, filtering their environment.

Except for a few herbivorous fishes such as carp and tilapia - or molluscs - most farmed fishes require other fish protein in their diet in order to thrive. Most fishes require between two and five times their own Biomass in other food fish species for growth, and fattening to market sizes. Today these fishes include sardines, anchoveta, sardinella, chub and jack mackerels, and an array of fishery by-products such as cod and capelin offal, from industrial fisheries. After capture as they migrate along standard routes, bluefin tuna are also raised in pens from early ages, until they reach both market sizes and high fat content (see Figure 2). They too, eat fish feed such as sardines, or herrings. Therefore, the first requirement for increased fish culture is an available fish protein resource. This, alone, explains much of the success of the recent Chilean salmon farming ventures:

1994 - Chilean "Atlantic" salmon Production = 70,000 mt
1999 - Chilean "Atlantic" salmon Production =154,000 mt

Chile exports a large proportion of its immense pelagic fisheries products to Asia for feeding other fishes and shrimp.

Figure 2 Bluefin tuna can arrive at Tsukiji, or other market floors from anyplace in the world, within 24 hours of being landed, or taken from any of many grow-out facilities around the world.

Asia's markets dominate the worlds fisheries.

Figure 3. We Buy Fish… Cultured Fish are Nice - With Sushi Rice, and Served Everyday for Lunch…

The Enigmas Remain:

If we do not manage ourselves:

Who Wins?
What Is Gained?
What Is The Ultimate Cost?
Can Anyone Predict The Long-Term Outcomes?

Has anyone looked back to see what we are creating?
Does anyone care to speculate?
Who or what will suffer, ultimately?

How is it possible to save Old Fishing Cultures from growing new markets … and Themselves?