

# 1 Salmonids

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## 1.1 Introduction

The modern salmon industry has had an explosive growth rate since the 1980s (Dunham et al. 2001), especially in Norway and the United Kingdom. Salmon and trout production requires cold waters with high oxygen content and low levels of pollutants, with a preference for protected coastal sectors far from big urban centers. So, even though cultured salmonid species originated in the Northern Hemisphere, close to 40% of the salmon produced in captivity today comes from the Southern Hemisphere, where they have been successfully introduced and cultivated.

## 1.2 History of Salmon Culture

### 1.2.1 Early History of Salmon Culture

The first attempts to artificially reproduce these species began in the middle of the fourteenth century in France. The French monk Dom Pinchon incubated trout eggs that he collected from the rivers where the fish bred. However, most authors attribute the development of artificial fertilization of trout and salmon eggs to Prussian Stephan Ludwing Jacobi (1711–1784) who published his experiences in 1763 in the “Hannoverschem magazinn” (Huet 1972). These findings were used in 1842 by Remy and Gehin in Vosges, France. They fertilized rainbow trout eggs

and developed fry and fingerling production in ponds to restock streams in the Moselle River basin. In 1848, the French Academy sent a scientific commission to corroborate the findings, and eventually professor Coste, a specialist in embryology, obtained support of the French government for the construction of a hatchery in Huningue (Alsace) in 1851 (Blanco 1995). In the United States, the first hatchery was inaugurated in Maine in 1871. A second US hatchery was constructed in 1872 on the McCloud River, a tributary of the Sacramento River in California. The first artificial incubation of salmonids in Japan began with a lot of 17,000 eggs obtained from the Nakagawa River in 1876. Experiments in artificial incubation and release into different rivers of the main Japanese island, Honshu, continued until 1888 but without great success.

France, Germany, England, the United States, and Japan led the efforts to establish artificial reproduction of salmonids. In addition, these countries made great efforts to transplant salmonids to other places and latitudes. First was England, which distributed salmonids to its colonies in New Zealand and Australia. Although salmonids did not naturally exist in the Southern Hemisphere, the English government, with the support of the United States, sent eggs of Pacific salmon to be released into the southern English possessions. Their persistence finally resulted in the introduction of salmon in a wild state in New Zealand, now recognized as the first successful introduction of salmon in the Southern Hemisphere. Beginning in 1870, and continuing for more than 60 years, the United States led efforts to introduce eggs of Pacific salmon to different countries in Europe and the Southern Hemisphere, including Chile and New

Zealand. These eggs were obtained from the McCloud River hatchery.

### 1.2.2

#### From 1890 to 1975

In 1890, Danish trout farmers began the development of trout culture in a system of earthen ponds, with freshwater flux through each fishpond. This system radically improved fish yield and reduced disease. This breakthrough led to the beginning of the commercial trout farming industry. Norway tried to implement the Danish system, but was not successful, due to the low temperatures of freshwaters in Norwegian winters. The seas around Norway are warmed by the influence of the Gulf Stream, which is an advantage for faster fish growth (Sedgwick 1988). In 1912, the Norwegians made the first attempts to cultivate rainbow trout in the sea. But it was not until the middle of the 1950s that the culture of salmon and rainbow trout in the sea began to grow. The industry became profitable and reached a production level near 500 MT in 1965 and 2,200 MT in 1974. The Norwegian system using floating cages to culture salmonids in sea water was adopted around the world (Willoughby 1999).

### 1.2.3

#### From 1975 to the Present Time

With the decline of capture fisheries for wild salmon and trout in the Northern Hemisphere, aquaculture of salmonid species became increasingly important around the world. The development of culture systems that reproduced the complete life cycle in captivity, and the incorporation of artificial dry pellet diets in 1964 (Halver 1972), allowed the culture of salmonid species to become industrialized. Chile and Norway now produce 76% of the world's aquaculture salmon and trout. Other relevant producers are the UK, Canada, Turkey, Denmark and the US (Table 1). From 1980 to 1991, world production of farmed salmon grew from 7,149 MT to almost 325,563 MT, an increase of 4,600% (FAO 2005). At present, the world salmon and trout aquaculture production is more than two million MT per year, having tripled with respect to production at the beginning of the 1980s (Fig. 1). Farmed salmon, which is recognized in the market for its homogenous quality and constant supply, represents more than two

**Table 1** Main salmonid producing countries in the world (Source: FAO global databases, Aquaculture production 2005a)

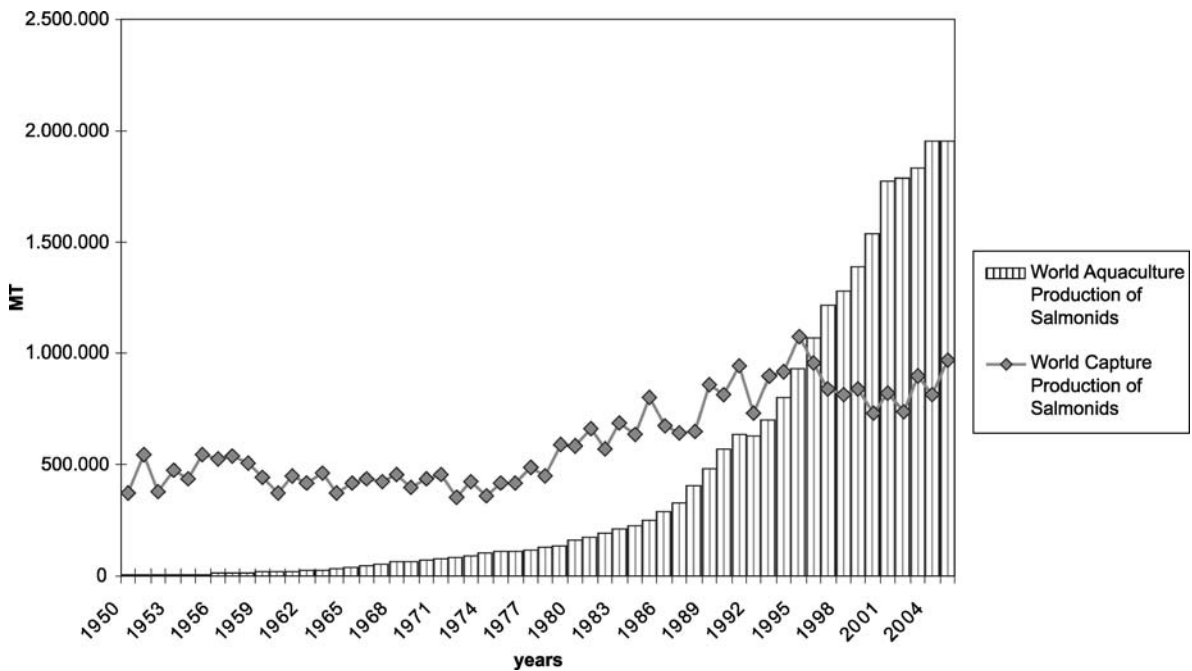
Country	Production 2005 (Metric Tons)
Norway	641,174
Chile	598,251
United Kingdom	142,613
Canada	103,164
Turkey	49,282
Denmark	37,001
United States of America	36,905
France	35,001
Iran (Islamic Rep. of)	34,760
Italy	30,564
Spain	26,132
Japan	24,461
Faeroe Islands	23,455
Germany	19,343
Australia	16,317
Poland	15,700
Ireland	15,378
China	14,507
Finland	13,713
Russian Federation	8,800
Other	64,057
Total World Production	1,886,521

thirds of the total. Atlantic salmon (*Salmo salar*) is the most important farmed species, followed by rainbow trout (*Oncorhynchus mykiss*) and coho salmon (*Oncorhynchus kisutch*) (Fig. 2).

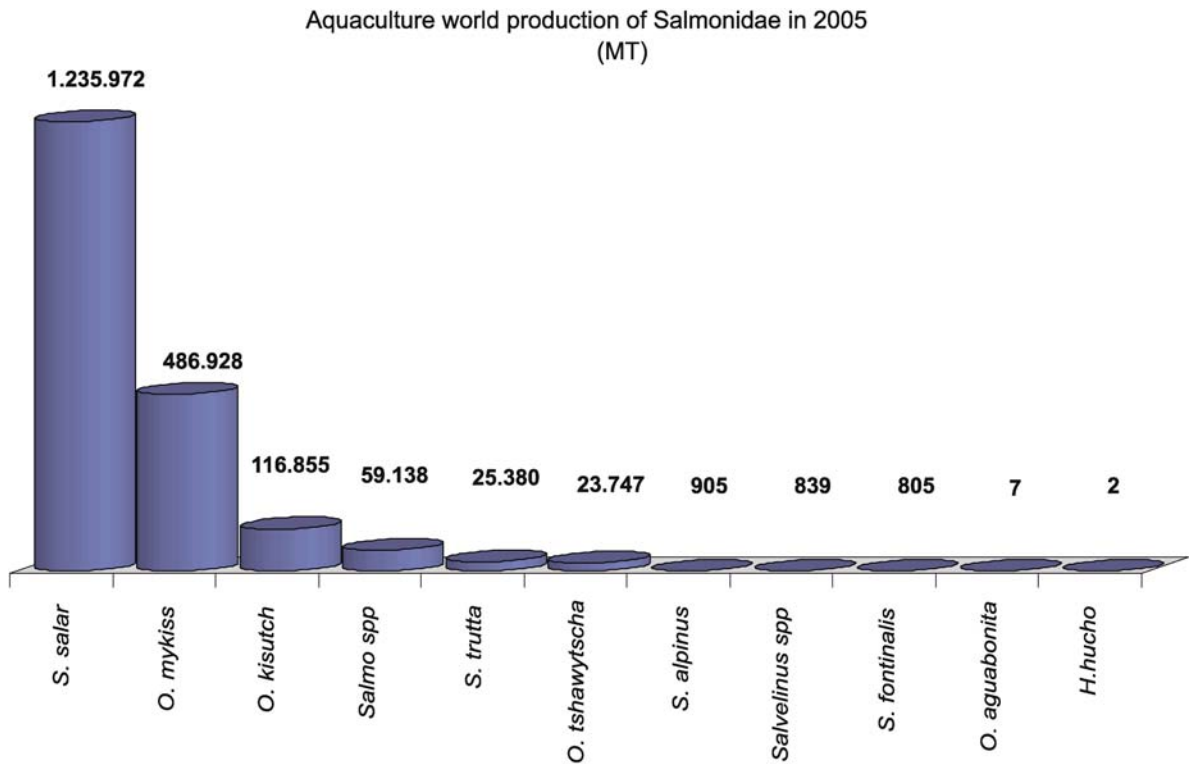
## 1.3

### Taxonomic Status and Distribution

Salmonids have a Holarctic distribution throughout Eurasia and North America (Scott and Crossman 1973) and are probably of freshwater origin, based on the evidence that all salmonids spawn in fresh water. Tchernavin (1939) suggested that ancestral salmonids were "small brightly colored fishes living in cool streams and lakes of the northern hemisphere. Using fresh water routes, they spread over a wide area. The environmental diversity of regions over which they spread favored the formation of numerous species" (Neave 1958). This suggests that a trout-like fish was ancestral to a salmon. Pacific salmon prob-



**Fig. 1** A comparison of the world capture production and world aquaculture production of salmonids. (Source: FAO global databases 2005a, 2005b: Aquaculture production: Quantities 1950–2005 and Capture production 1950–2005)



**Fig. 2** The main species of farmed salmon and trout in the world in metric tons (MT). (Source: FAO global databases: Aquaculture production 2005a)

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