

Introduction

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Artificial propagation of aquatic organisms is increasing globally and currently accounts for approximately 32% of total world fishery production (Vannuccini, 2004). Between 1970 and 2000, aquaculture production of salmonids has grown from less than 200,000 metric tons per year to over 1.5 million metric tons (Tacon, 2003). In 1995, the number of Atlantic salmon (*Salmo salar*) far exceeded the carrying capacity of salmon in the wild but over 94% of all adult Atlantic salmon were in aquaculture environments (Gross, 1998).

Since the 1970's, concerns have arisen about interactions of hatchery and wild produced salmonids in native habitats. In response, research has addressed concerns about domestication and genetic impacts (Reisenbichler and McIntyre, 1977; Hindar et al., 1991; Waples, 1991; Clifford et al., 1998a; Fleming et al., 2000, 2002; Hard et al., 2000), transfer of disease and parasites (Johnsen and Jensen, 1994; Bakke and Harris, 1998), behavior of spawning adults (Fleming and Gross, 1992; Fleming et al., 1994; Økland et al., 1995; Youngston et al., 1998), differences in fitness traits and life history (Jonsson et al., 1991; Thodesen et al., 1999; McGinnity et al., 2003), and behavioral interactions between hatchery and wild juvenile salmon (Swain and Riddell, 1990; Jonsson et al., 1996; Clifford et al., 1998b). Much of this research has been driven by concerns about the impacts of escaped farmed Atlantic salmon in the North Atlantic Ocean (Hansen et al., 1991). Studies of the interactions between hatchery and wild salmonids, with few exceptions (see Myers et al., 2000), have primarily focused on interactions in freshwater environments.

Interactions between hatchery and wild fishes in estuarine and marine environments have not received the same attention, but may have significant impacts on wild populations. To address this issue, we organized a symposium held at the 2003 annual meeting of the Western Division of the American Fisheries Society in San Diego, California. The session was titled *Interactions of Hatchery and Wild Fishes in Marine and Estuarine Environments* and included nine presentations. All but one presentation focused on salmonids. This Special Issue of *Reviews in Fish Biology and Fisheries* includes five papers that were submitted to the symposium.

These papers present a range of studies concerning hatchery produced salmonids and realized or potential impacts on wild populations. Zaporozhets and Zaporozhets provide an historical review of hatchery salmon production on the east coast of Russia and briefly describe studies concerning interactions with wild populations. Sweeting et al. review the formation of crystalline (vateritic) otoliths in hatchery and wild coho salmon (*O. kisutch*). Vateritic otoliths have been used to identify hatchery produced lake trout in the Great Lakes (Bowen et al., 1999) and may be useful in studies of wild and hatchery coho salmon when other marks are not available to identify hatchery or wild progeny. These studies indicate the need for historical reconstruction of hatchery production and methods to identify hatchery and wild produced salmon in marine waters.

The impact of hatchery salmon on productivity of wild salmon is a key question. Wertheimer et al. examined the role of environmental variables and hatchery releases of pink salmon (*O. gorbuscha*) in

Prince William Sound, Alaska, and found that large-scale production of hatchery pink salmon has contributed to the decline in body size of wild pink salmon. They conclude this is because of density dependent growth in the Gulf of Alaska. Similarly, Ruggerone and Nielsen review the role of hatchery produced pink salmon as competitors with wild salmon in the North Pacific Ocean and find that pink salmon can affect growth, age at maturation, and distribution of sockeye salmon (*O. nerka*), chum salmon (*O. keta*), coho salmon, and chinook salmon (*O. tshawytscha*). Orsi et al. used a bioenergetic model to identify potential impacts of hatchery produced chum salmon in nearshore waters.

The papers presented in this issue identify the growing importance of our understanding of interactions between hatchery and wild fishes in the marine environment. We are beginning to realize that there are limits to the productive capacity of the world's oceans (Pauley et al., 1998; Azumaya and Ishida, 2000; Ruggerone et al., 2003). No longer can we assume that marine and estuarine environments have infinite capacity for growth and production of fish. Based on the findings reported here, we predict that there will be many more publications identifying impacts on wild salmonids from the ever increasing production of hatchery fish and their overlap with wild stocks in saltwater environments.

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