SECTION FOUR
BACKGROUND INFORMATION

4.01 Background Information

Extensive ocean-ranching salmon aquaculture is practiced by non-profit private (PNP) sector corporations in Alaska for the purpose of enhancing the common property fisheries (CPF). These efforts are currently producing large numbers of hatchery salmon for harvest, especially in Prince William Sound (PWS) and Southeast Alaska (SE).

The PNP hatcheries in Alaska annually take 1.8B eggs, release 1.5B juveniles, and provide 45M adult salmon to the harvest, primarily of pink salmon in PWS and of chum salmon in SE (White 2011). In 2008, the wholesale value of hatchery fish harvested in the commercial sector was nearly $200M in PWS and $100M in SE (McDowell Group 2010a, b). In some years and in some areas, Alaska hatcheries have provided harvest opportunity to the fishing industry when wild stocks could not.

The scale of the Alaska hatchery programs has raised concerns that hatchery fish may detrimentally impact the productivity and sustainability of wild stocks of Alaska salmon. Others have demonstrated that hatchery releases have supported the recovery of declining populations (Heard et al., 1995; Brannon et al., 2004) and can enhance fisheries without impacting wild stocks (Bachen and Linley, 1995, Heard et al., 1995; Wertheimer, 1997). Biologists have long recognized risks to natural populations posed by hatcheries, including genetic (consequences of interbreeding between hatchery-bred and wild salmon), disease (introduction or amplification of pathogens), ecological (competition for resources), and harvest mortality. These risks have been recently reviewed by Naish et al. (2007). In evaluating this work we will also consider potential benefits to wild salmon; for example, whether consistent hatchery production, derived from local stocks, supports those smaller local wild stocks by consistently adding broodstock to the wild stocks.

The potential for detrimental effects of hatchery production on wild stocks was recognized by policy makers early in the development of the State's hatchery programs (reviewed by McGee 2004; Heard 2011). In contrast to the mitigation hatcheries of the Pacific Northwest, which were built to replace wild production that was diminished or even extirpated by widespread habitat degradation and damming of many major salmon-producing rivers, the Alaska hatchery program was developed to supplement and enhance fisheries that otherwise depend on wild production. To avoid some of detrimental impacts associated with lower-48 hatchery programs, Alaska established policies and practices in the 1980s to ameliorate risks from the expanding ocean-ranching programs. These policies included the State's Genetic Policy (Davis et al., 1985; Davis and Burkett, 1989), Disease Policy (Meyers et al. 1988; McDaniel et al., 1994), and Fish Transport Regulation (5 AAC 41.005, in effect before 1988). The policies require such considerations as siting hatcheries at a distance from significant wild stocks, using only stocks endemic to the region in broodstocks, and strict fish health regulation. These policies have been generally successful over more than 3 decades, preventing introductions of exotic stocks or fish pathogens and allowing increased harvest of hatchery stocks while minimizing the risk to wild fish.

While policies and management strategies have been implemented to reduce risk to wild stocks, the scale of the Alaska enhancement programs makes it likely that wild stocks will be impacted by enhanced fish to some degree. The effects of hatchery fish on wild stock productivity are often assumed to be negative, although the potential for positive effects exists, such as reducing harvest pressure, or strays contributing to escapements in rivers that are chronically below optimum escapement levels.

The type and degree of impact on wild stocks must be considered in the context of the potential risk to future natural production, the benefits from enhancement programs, and resolutions that can be applied to harvest management. In PWS, it has been argued that hatchery stocks have simply replaced the productivity of wild stocks of pink salmon, so that there is no net gain realized (Hilborn and Eggers 2000). However, Wertheimer et al. (2004) estimated that an annual average production of 24 million hatchery pink salmon in PWS was associated with a yield loss of 1 million wild fish. Harvest and escapement indexes of wild stocks in PWS and SE have been consistent with historical levels during more than 30 years of large-scale hatchery production, indicating that the enhanced production has been compatible with sustained wild stock productivity (Wertheimer et al., 2001).

The consequences of interbreeding of hatchery fish with wild con-specifics have received particular attention recently. Both direct genetic studies of populations and retrospective studies of productivity of hatchery-influenced populations in the Pacific Northwest have demonstrated loss of fitness in steelhead, Chinook, and coho (Araki et al. 2008, 2009; Chilcote et al., 2011). Evidence from pink or chum salmon hatchery programs (in which salmon are artificially cultured only until they are fry) is sparse. One pertinent study (Berejikian et al. 2009) on reproductive success (fry per adult) of chum salmon of hatchery broodstock ancestry found that, while the relative success of hatchery-bred males was 3% higher than that of natural-origin males and the relative success of hatchery-bred females was 28% less than that of natural-origin females, these differences were not statistically significant.

Hatchery programs in Alaska have pioneered the use of otolith thermal marks for mass-marking hatchery production to facilitate evaluation and management. These marking programs have also made possible the detection of hatchery-bred salmon on the spawning grounds of wild salmon. Recent studies have demonstrated large proportions of hatchery-bred salmon in some wild-spawning populations in Alaska (Eggers and Heinl 2008). These observations have raised several important questions:

(1) Are hatchery-bred salmon interbreeding with wild salmon to the extent that fitness and productivity of these stocks are being diminished? If so, does any loss of fitness and productivity continue through subsequent generations? Is a temporal loss of fitness compensated by the addition of spawning stock?

(2) Is the annual assessment of wild stocks (which is in part based on visual observation) so biased by the presence of hatchery salmon that excessive harvest of wild fish is being allowed or that escapement goals are difficult to set and difficult to assess? Or, if the additional enhanced fish have an overall positive effect on the escapement, should they be simply counted as part of that escapement?

(3) Do density interactions diminish the productivity of wild salmon?

In general, the proportion of strays detected in wild spawning populations has been higher in streams closer to hatchery release sites (ADF&G unpublished data). However, the sampling designs used to date have not been adequate to estimate the actual extent of straying at the level of the harvest management system, e.g., the district level for PWS pink salmon or the sub-regional level for SE chum salmon. Because of evidence of straying and uncertainty about its extent and effect, the Alaska Department of Fish and Game (ADF&GADF&G) generally acts cautiously and has denied some requests from hatchery corporations for permit alterations.

Because of the value of hatchery production to industry's harvest and its place in the international market, and the mandate that hatchery production be compatible with sustainable productivity of wild stocks, ADF&G and the PNP hatchery corporations have recognized the need for a research program addressing the concerns about escapement assessment and genetic and ecological interactions between hatchery and wild stocks. In July, 2011, ADF&G convened a Science Panel composed of current and retired scientists from ADF&G, University of Alaska, PNP Aquaculture Corporations, and the National Marine Fisheries Service. The Panel members have broad experience in salmon enhancement, management, and wild and hatchery interactions.