HSWRI Aquaculture Program Research Report
**** February & March 2006 ****

First Spawning Events for 2006

Our California halibut (*Paralichthys californicus*) broodstock began spawning three months earlier this year than last year. The halibut took everyone by surprise when they began releasing over 2 million eggs per day in the beginning of February. In order to balance the sex ratio in this group, seven mature males were added to the pool in January. The broodstock now consists of 10 males and 21 females, and collectively they are spawning daily. Larval rearing tanks are stocked with approximately 15 ml (42,000 eggs) of disinfected eggs that hatch within 48 hours. At this time of year the larvae are developing more slowly due to colder water temperatures (14-17 °C), but survival to settlement (approximately 30 dph) has been excellent at >30% on average. This increased survival is largely attributed to conversion of the larval rearing system from flow through to recirculating during the "off" season.

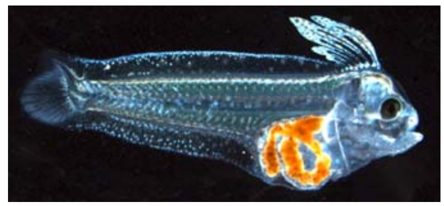

Figure 1. Pelagic larval halibut 27 dph.

February held other surprises for HSWRI researchers, as both cabezon (*Scorpaenichthys marmoratus*) and lingcod (*Ophiodon elongates*) spawned viable eggs. The cabezon broodstock produced more than 214,000 eggs in February-March but larval survival was poor (Figure 2). Lingcod held at SeaWorld released two aggregate egg masses; the first in February and the second in March. Egg masses averaged 5,780 g in weight, which equated to approximately 444,600 eggs per spawn. In late March the first eggs began hatching, which is consistent with a typical egg incubation time of 5-11 weeks for this species.

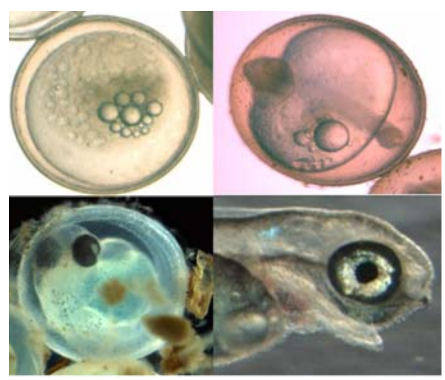

Figure 2. Early embryonic stages of cabezon.

White Seabass (WSB) Release and Recapture Update

The 2005 calendar year came and went quickly but not without new discoveries in the WSB program. Our release total of just over 100,000 fish for 2005 was disappointing compared to our 2004 releases, but we were able to identify critical areas to focus research. Foremost among these is the need to continue to maintain a comprehensive disease research program because a significant number of juvenile seabass were either euthanized or placed on quarantine following an outbreak of a herpesvirus (Figure 3). Although wild fish are suspected as the vector for the herpesvirus, the disease has not yet been found in wild fish, thus preventing the release of healthy, asymptomatic cultured fish that have an exposure history. Funding and research support are now being directed toward developing high-resolution detection tools for herpesvirus.

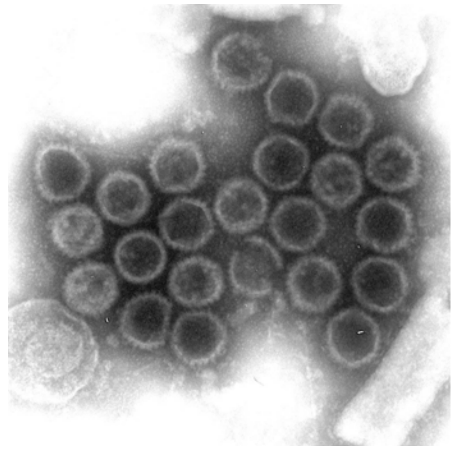

Figure 3. Transmission electron micrograph of semi-purified herpesvirus from the pyloric cecae of WSB.

In 2005 we recovered 224 tagged WSB from the wild. The majority (144) were caught in our gillnet sampling program. Periods at liberty for these individuals ranged from one to 25 months with a mean of 6.5 months. Another 65 individuals, with periods at liberty ranging from 6 days to 11 months, were entrained in coastal power generating stations. Fourteen individuals that recruited into the fishery were also recovered. Eight were caught by commercial gillnet fishermen and six were caught by hook-and-line fishers aboard commercial passenger fishing vessels. Two of the individuals caught by the commercial gillnetters were from the Tanner and Cortes Banks. These two offshore banks are approximately 100 nm due west of San Diego and surrounded by deep ocean basins in excess of 1,000 m. The fish recovered off Tanner Bank in late July was released in Newport Bay in June 2000. The seabass recovered off Cortes Bank, also in late July, was released from Santa Barbara in December 1994. This 10.6 year old fish, which was just over a meter in length and weighed 9.5 kg, is the oldest recovery to date. These two individuals represent the farthest from the mainland that we have recovered our tagged fish.

Gas Bubble Disease Research

In a recent series of experiments we exposed WSB and striped bass (*Morone saxatilis*) to four different oxygen saturation levels (140%, 120%, 110% and <100%) at two different temperatures (18°C and 23°C) to determine how these factors relate to gas bubble disease (GBD). The purpose of the study was two-fold. We know from previous experiments that WSB are highly susceptible to GBD at relatively low levels of total gas pressure (TGP),

Figure 4. WSB eye with typical GBD lesions.

especially at warmer temperatures (Figure 4). So, we first wanted to see if WSB are sensitive to supersaturated oxygen conditions as a component of TGP. Oxygen-supersaturated seawater is common in our raceways immediately after the low-head oxygenators, as well as during treatments with hydrogen peroxide. Secondly, we wanted to see if another similar culture species, striped bass (SB), is as sensitive to supersaturated oxygen conditions as WSB.

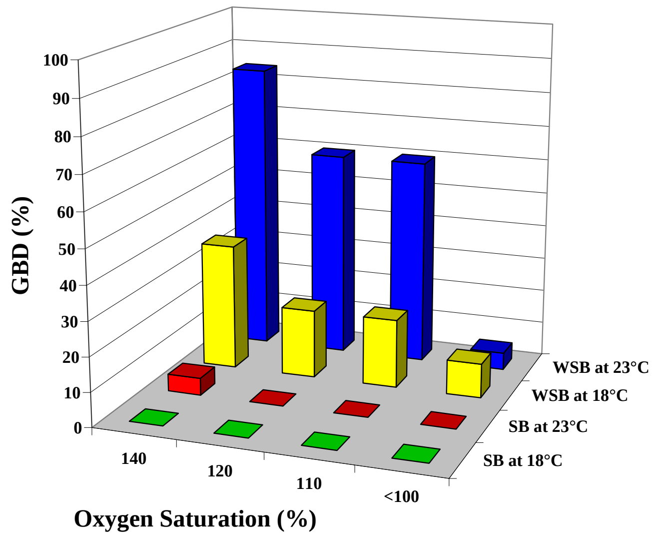

Figure 5. Relationship between oxygen saturation and prevalence of GBD in SB and WSB held at two temperatures.

In both temperature trials using WSB, eye lesions appeared shortly after the first day. The severity of lesions was five times greater at 23°C than at 18°C. By the end of the two week exposure period >80% of the juvenile WSB showed eye lesions at the 140% oxygen saturation level, 60% of fish exposed to 120% and 110%, and <5% of WSB at the control level of <100% saturation at 23°C (Figure 5). Striped bass fared significantly better than the WSB at each temperature and all oxygen saturation levels. No SB exhibited eye lesions at 18°C, and only one fish developed an eye lesion at the highest saturation level (140%) at 23°C (Figure 5).

The difference in susceptibility to oxygen supersaturation between WSB and SB could be due to a number of factors including the potential that WSB have: 1) more capillaries in the rete mirabile; 2) longer capillaries in the rete mirabile; 3) greater acid secretion by the pseudobranch; 4) more acid secretion by the retina; or 5) some combination of the above. Additional research will be required to elucidate this relationship.

Acknowledgements

This document reports on Aquaculture Research Projects supported by numerous grants, contracts and private contributions. It also represents the hard work of many dedicated staff and volunteers throughout southern California. This information was contributed by HSWRI staff, and compiled by Aquaculture Research Assistant, Lisa Goldie, under the direction of Senior Research Biologist and Aquaculture Program Manager, Mark Drawbridge.

The Aquaculture Research Program has been active for more than 20 years at HSWRI. The primary objective of this Program is to evaluate the feasibility of culturing marine organisms to replenish ocean resources through stocking, and to supply consumers with a direct source of high quality seafood through traditional aquatic farming. Please direct any questions to Mark Drawbridge at mdrawbr@hswri.org.

Aquaculture research at HSWRI is currently supported by these major contributors:

- The California Department of Fish and Game's Ocean Resources Enhancement and Hatchery Program
- Cabrillo Power/NRG
- The U.S. Fish and Wildlife Service's Sport Fish Restoration Account
- Chevron Corporation
- The Catalina Seabass Fund
- The Shedd Family
- The San Diego Foundation's Blasker Grant Program
- The San Diego County Fish and Wildlife Commission
- Darden Restaurants Foundation