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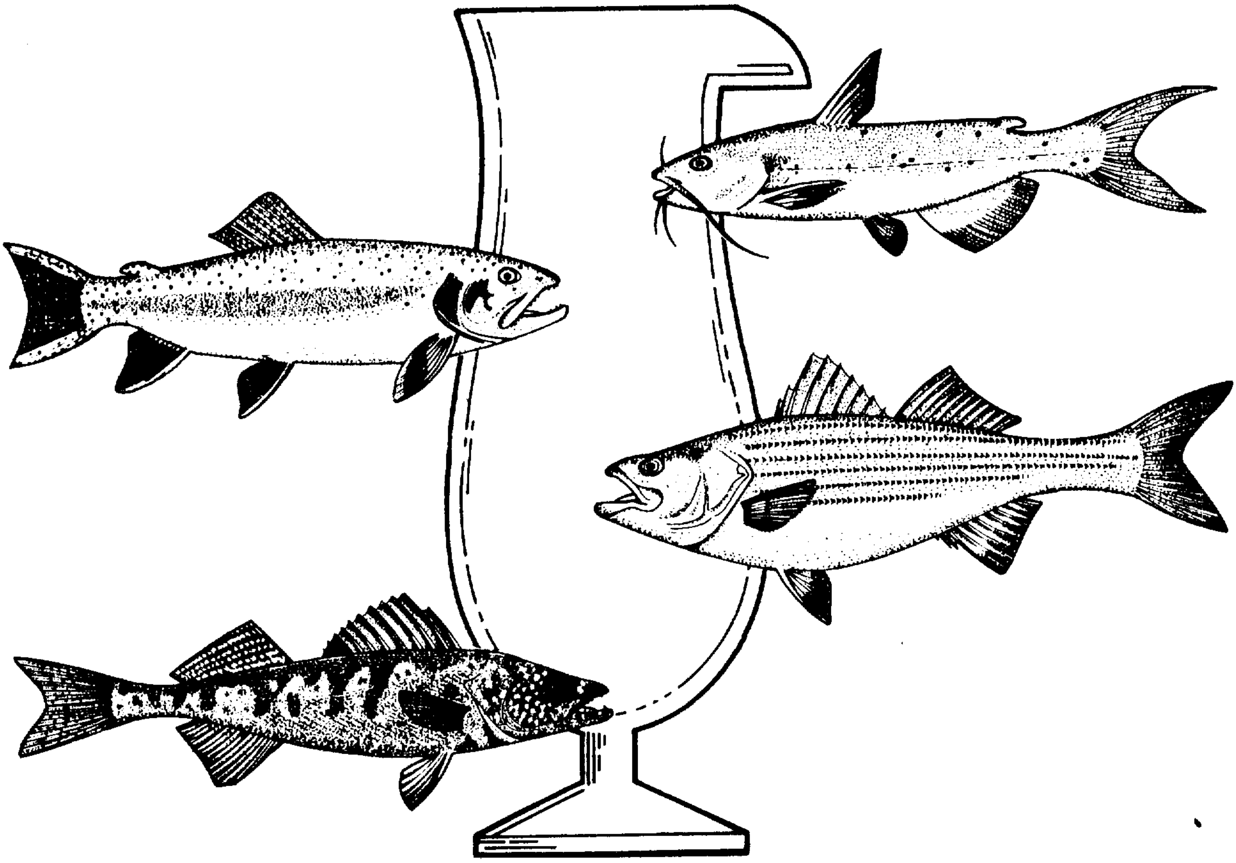

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Orangemouth Corvina Survival in Fresh Water

Orangemouth corvina (*Cynoscion xanthulus*), Pacific Ocean sciaenids, have created a substantial fishery in the Salton Sea, a landlocked saltwater lake in southern California (Whitney 1961; Calhoun 1969; Hanson 1970; Brocksen and Cole 1972; Lasker et al. 1972; Black 1974; Collins 1981). Although basic life history (Walker et al. 1961; Whitney 1961) and upper salinity tolerance (Hanson 1970; Brocksen and Cole 1972) information indicate orangemouth corvina can tolerate high salinity (57.5–62.5‰), little is known about lower salinity tolerance. However, a wide tolerance range is indicated by reports of orangemouth corvina moving into the Colorado River from the Gulf of California and congregating near mouths of rivers and other freshwater inlets in the Salton Sea (Whitney 1961).

Several closely related marine species in the Gulf of Mexico, including spotted seatrout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*) and black drum (*Pogonias cromis*), have been found to grow much faster in fresh water than in salt water and have been used as a fisheries management tool, stocked into freshwater reservoirs to control problematic forage fishes (Lasswell et al. 1977). The present study was conducted to determine if orangemouth corvina could tolerate fresh water and thereby be stocked into freshwater environments as a predator on overabundant forage species.

Seventy subadult orangemouth corvina were collected by hook and line from the Salton Sea, 27 October 1981. Means of total length (TL) and weight (W) with ranges in parentheses of 23 were 282 mm (11.3 in) (146–345 mm) (5.8–13.8 in) and 255 g (8.9 oz) (130–454 g) (4.5–15.8 oz), respectively. Fish were transported in two 2,180-L (567-gal) hauling tanks containing Pacific Ocean water (32–33‰ salinity) with oxygen (3–5 L/minute) (0.7–1.3 gal/minute) and nitrofurazone (0.5 mg/L) (0.5 ppm) added. Fish arrived at Heart of the Hills Research Station, Ingram, Texas approximately 33 hours after capture.

The research station is equipped with a 24,250-L (6305-gal) rectangular and six 1,700-L (442-gal) circular indoor aquaria constructed of opaque fiberglass with smooth gel-coated interiors. All aquaria have bacterial activated rock and gravel filters, to which crushed dolometic limestone was added to buffer pH. Artificial sea salt (Ocean 50 Sea Mix, Jungle Laboratories Corp., Stanford, Florida) was added to the station's fresh water to create and maintain various salinities. Salinities were measured daily with a temperature-compensated refractometer. Water temperatures were maintained at 22 ± 3 C (71.6 ± 5 F).

All fish surviving transportation (58) were placed into the 24,250-L (6305-gal) aquarium at 32.0‰ salinity. Mortalities (6) occurred during the 3 days after transport but remaining fish recuperated and began feeding. Orangemouth corvina were fed live goldfish (*Carassius auratus*) at a rate of 5% body weight/day offered 3 times/week. The aquarium was cleaned of large waste particles by siphoning once/week. As fish began to feed, buildup of metabolic wastes surpassed the capacity of the biological filter. It became necessary to flush the aquarium with new salt water in increasing amounts to maintain suitable water quality. Demand for artificial salt slightly surpassed availability which required adding increasing amounts of fresh water along with mixed salt water for the last 4 weeks of the 6-week post-haul period. This resulted in a slow salinity dilution (0.5‰/day); salinity at the end of the 6 weeks was 17.0‰.

After the 6-week post-haul period, 36 orangemouth corvina were removed from the large aquarium and placed into six 1,700-L (442 gal) aquaria at 17.0‰ salinity. Ten fish were placed in each of two aquaria; four fish were placed in each of the remaining four. All fish were measured (TL and W) as they were distributed in various aquaria. Feed and feeding rates remained the same as described for the large aquarium. Large waste particles were removed by siphoning once/day. Salinities were immediately reduced to 0.2 ± 0.1‰ (fresh water) at rates of 2–4‰/day in five aquaria and 10‰/day in one aquarium by continuously adding a small amount of fresh water. Water in these six aquaria remained fresh for 6 months. Salinity in the large aquarium (used as control) was immediately increased 0.5‰/day until back to 32.0‰ since the biological filter was able to handle the reduced load.

All orangemouth corvina survived conversion to fresh water. After conversion to fresh water was initiated fish became more excitable and did not feed for the first 5–7 days: then feeding returned to normal. Fish remained excitable for approximately 8 weeks to the point that any movement over aquaria would cause fish to dart across the aquarium and often crash into the sides. Black plastic sheets were then installed over half of each aquarium to give fish an area to hide, but occasionally fish still became excited. Mortalities (20) occurred 4–11 weeks after freshwater conversion and were, in all but two cases, apparently related to injury and resulting fungus (*Saprolegnia* spp.) infection after fish hit aquarium sides. The other two mortalities were the result of fish jumping out of aquaria. During the eleventh week after freshwater conversion all small aquaria were treated twice (Monday and Friday) with malachite green (0.1 ppm)/formalin (25 ppm) mixture for 2 hours. For the remainder of the study period fish exhibited calmer behavior and mortalities ceased. The malachite green/formalin treatment was not administered during the twelfth or thirteenth weeks but was used every week thereafter. No difference was seen in mortality occurrence in different freshwater aquaria. No mortalities occurred in the control aquarium. Fish measurements (TL and W) recorded at the end of the study showed an average growth increment of 22 mm (0.9 in) and 52 g (1.8 oz) in fresh water and 44 mm (1.7 in) and 83 g (2.9 oz) in salt water over the 6-month period.

Orangemouth corvina obviously experienced stress when converted to fresh water as indicated by increased excitability, possible increased susceptibility to fungus infection, slower growth and higher mortality. Brocksen and Cole (1972) found orangemouth corvina growth, food assimilation and respiration adversely affected by salinity extremes below 29 and above 45‰. However, their study

maintained salinity ...
less. Orangemouth corvina mortalities did not occur from 12 weeks after freshwater conversion to the end of this study, which was after fish behavior had calmed. These results indicate orangemouth corvina can tolerate fresh water and that even with a probable decreased metabolic efficiency these fish might still be successfully added to a freshwater fish community.

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Survival of Lake Michigan Chinook Salmon Eggs and Fry Incubated at Three Temperatures

One of the primary environmental factors affecting the growth and survival of salmonids is temperatue. All salmonids have a species specific optimum temperature range in which growth and survival can be maximized. Outside this range growth and survival will decrease.

Upon hatching, the chinook salmon (*Oncorhynchus tshawytscha*) rely on the energy available in the yolk sac to provide their nutritional needs until exogenous feeding begins. Growth during the period of yolk dependence is an important determinant of later survival because larval size and condition