THE EFFECT OF DENSITY ON THE MANIFESTATION OF WHITE STURGEON IRIDOVIRUS DISEASE

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Previous investigations have reported the presence of the white sturgeon iridovirus (WSIV) in cultured white sturgeon Acipenser transmontanus from the lower Columbia River in Oregon, the Snake River in southern Idaho and the Kootenai River in northern Idaho (LaPatra et al. 1994). In Oregon, WSIV was consistently detected in young sturgeon that were progeny from Columbia River adults and cultured in river water but not detected in sturgeon cultured in well water. In Idaho, WSIV was detected in sturgeon that were progeny from wild Snake River and Kootenai River adults after being subjected to stressful conditions of low spring water flows and high fish densities (LaPatra et al. 1994). When densities were reduced and water flows increased, mortality subsided. These observations suggested that WSIV may occur in wild sturgeon and that the virus may be present in many Northwest populations due to the long life span of the species, migratory patterns, and continuity of the river systems. Additionally, since the disease appeared size(age)-specific and stress-mediated, fish culture management strategies could potentially be used to avoid or minimize epizootics.

A study was conducted at College of Southern Idaho (CSI) in Twin Falls to examine the effects of density on the manifestation of WSIV disease using the 1993 brood year Snake River white sturgeon (LaPatra et al. 1994). Replicate groups of sturgeon (mean weight 134 fish/lb or 3.4 g, 5 months old) were stocked at three densities in fiberglass aquaria with 11.1 ft^3 of volume and spring water flows of 8 gpm (Table 1).

Table 1. Total fish, cumulative weight, and loadings of sturgeon in duplicate groups cultured at three different densities.

Density Designation	**Low**	**Medium**	**High**
Number of fish	300	600	1,000
Total weight (Lbs)[a]	2.2 (1020 g)	4.5 (2040 g)	7.5 (3400 g)
Lbs / ft^3	0.2 (91 g)	0.4 (182 g)	0.7 (318 g)
Sturgeon / ft^3	27	54	90

[a] Lbs = pounds.

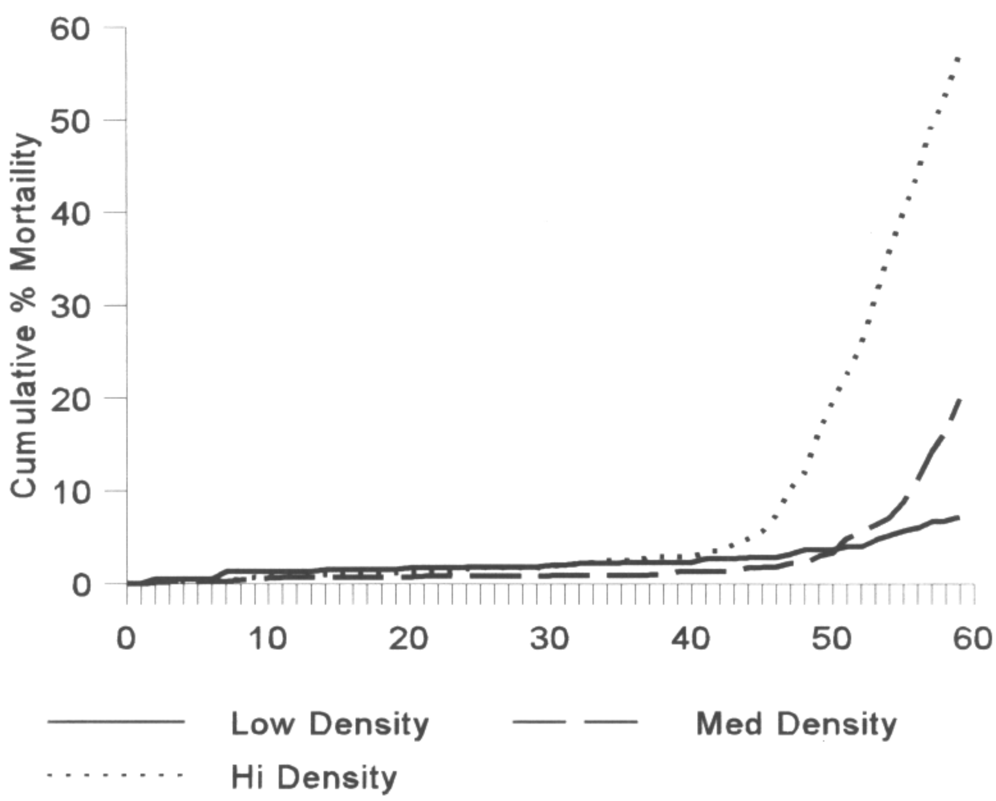
Sturgeon mortality was monitored daily and specimens were fixed in neutral buffered formalin for histologic analysis (Humason 1979). Additional morbid animals were collected when mortality increased and submitted for viral isolation. Mortality ranged between 1-4% during the first 6 weeks and densities increased as sturgeon grew (Table 2).

Table 2. Fish size, mortality, loadings, and densities in sturgeon after being cultured for 42 d.

Density Designation	**Low**	**Medium**	**High**
Mean weight	10.3 g	9.4 g	8.6 g
Cumulative mortality	2.7%	1.3%	3.6%
Lbs / ft^3	0.5 (227 g)	1.1 (499 g)	1.6 (726 g)
Sturgeon / ft^3	22	53	84

[a] Lbs = pounds.

In the following 17 d period WSIV was diagnosed in all groups and mean cumulative mortality increased to 7%, 20%, and 57% in the low, medium, and high density groups, respectively.



Cumulative percent mortality of the replicates was analyzed by analysis of variance on transformed (arcsin √percentage) data (Snedecor and Cochran 1967). No significant ($p > 0.05$) differences were observed among sturgeon held at different densities during the initial six week period. However, 17 d later cumulative mortality in the high density group was significantly ($p > 0.05$) different than mortality detected in the other treatments. The high and medium density groups were subsequently divided into additional aquaria in an attempt to alleviate stressful conditions and minimize mortality. Test groups were monitored for an additional four weeks. Cumulative mortality in the medium and high density groups increased to 64% and 94%, respectively. Mortality also increased in the low density groups that had not been divided but was less (26%). Although mortality did not subside in the medium and high density groups after the disease appeared and densities were reduced, sturgeon maintained at the lowest density throughout the test period exhibited substantially less mortality to WSIV. These results suggest that maintaining low sturgeon densities in fish younger than one year may be a prudent strategy for minimizing mortality caused by WSIV.

In cooperation with Idaho Department of Fish and Game and the Kootenai Tribe of Idaho another density study using a similar experimental design and protocol was initiated at the Clear Springs Foods (CSF) Research Laboratory using the 1993 brood year Kootenai River white sturgeon (Apperson and Anders 1989). Groups of sturgeon (mean weight 126 fish/lb or 3.6 g, 5.5 months old) were stocked at high (0.7 lb/ft^3) or low (0.2 lb/ft^3) densities, previously tested at CSI. Fish were cultured in aquaria that received ultraviolet-light disinfected spring water. Triplicate high density groups and replicate low density groups were tested. Sturgeon exhibited no signs of WSIV or abnormal mortality immediately after transfer from the Kootenai Hatchery. However, after 36 d mortality increased to 10 - 18% (7/69 - 14/80) and 14 - 18% (39/281 - 49/272) in the low and high density groups, respectively, and WSIV was detected in morbid fish examined from each treatment. The presence of the virus was confirmed by electron microscopy. Sturgeon left at the Kootenai Hatchery (Bonners Ferry, Idaho) showed no evidence of WSIV. Although fish density did not appear to effect occurrence of WSIV or cumulative mortality, the results again suggested that a stressor (e.g. handling and transport) in subyearling sturgeon may enhance manifestation of WSIV disease.

Five months later the remaining fish at the Kootenai Hatchery were moved to the University of Idaho Aquaculture Research Institute. Approximately 1,840 sturgeon (mean weight 151 fish/lb or 3 g, 10.5 months old) with no detectable WSIV or abnormal mortality were transported at 8°C and acclimated to 15°C upon receipt. These fish were divided into six aquaria on a recirculation system supplied with chlorinated - dechlorinated well water and cultured at very low densities (0.05 - 0.07 lb/ft^3). During the first 10 d mortality among the six groups ranged from 1-7% and cumulative mortality was 2.7% (50/1829). However, over the next 60 d temperatures ranged from 12 - 19°C and cumulative mortality increased to 58% (1,064/1,838). Morbid animals exhibited signs of abdominal distention and emaciation and were diagnosed as WSIV-positive. In this case, densities again did not appear to be a factor in predisposing fish to a WSIV epizootic but handling, transport, and temperature may have been involved. Temperature stress may also have been a factor in manifestation of WSIV disease in siblings studied at CSF. These fish were transported approximately 14 h at 2-6°C, acclimated to 14°C over a 6 h period, and cultured at a constant temperature of 15°C.

As observed in previous studies, subyearling sturgeon appear to be predisposed to WSIV disease by stressors including densities, adverse environmental conditions (e.g. acute temperature fluctuations), and handling (LaPatra et al. 1994). Results from these studies further substantiate the potential for egg-associated and waterborne transmission of WSIV. Although the pathogen may be present, disease may not occur until certain stressors at critical life stages are confronted. We suspect that in each case described in this and previous reports the source of virus infection in cultured juvenile sturgeon was wild sturgeon either caught from the river and used for broodstock or present in the hatchery water supply (Hedrick et al. 1992; LaPatra et al. 1994). However, definitive evidence supporting this hypothesis has yet to be obtained.

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