NEUROTRANSMITTER ACTIVITY IN THE FORE- AND HIND-BRAIN OF THE PALLID STURGEON, *SCAPHIRHYNCHUS ALBUS,* FOLLOWING ACUTE AND CHRONIC STRESS

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EXTENDED ABSTRACT ONLY – DO NOT CITE

In the United States, the pallid sturgeon (*Scaphirhynchus albus*) is a federally endangered fish of the Missouri River. Because of the loss of natural spawning habitat, fisheries managers are depending on hatchery-reared fish to re-establish populations. Hatchery managers require information regarding how pallid sturgeon are affected by stress in order to maximize their health, growth, survivorship, and reproductive capacity while in captivity. Previously these sturgeon were shown to have a reduced corticosteroid response to stress relative to teleosts. Thus, the objective of this study was to characterize fore- and hind-brain neurotransmitter responses to acute and chronic stress to determine if the low stress responsiveness of this species was also apparent at the central nervous system level.

Six neurotransmitters—epinephrine (Epi), 5-hydroxytryptophan (5-HTP), 3,4 dihydroxyphenlyacetic acid (DOPAC), dopamine (DA), 5-hydroxyindoleacetic acid (5-HIAA), and 5-hydroxytryptamine (5-HT, serotonin)—were measured in the fore-brain and the hind-brain using high performance liquid chromatography. The ratio of the concentrations of DOPAC to DA was calculated as an index of dopaminergic activity. The ratios of the concentrations

of 5-HTP to 5-HT and 5-HIAA to 5-HT were calculated as indices of serotonergic activity. DOPAC, DA, 5-HTP, 5-HIAA, and 5-HT were detected in the forebrain and Epi, DA, 5-HT and 5-HIAA were detected in the hind-brain.

In our first experiment, pallid sturgeon were subjected to a 30-s (acute) handling stressor. Fore- and hind-brain tissues were sampled from these fish immediately (0 h), 1, 3, 6, and 25 h after the application of the stressor. The acute stressor did not affect any of the neurotransmitters or their activity in either of the brain regions. Additionally, concentrations of DA, 5-HIAA, 5-HT and the ratio of 5-HIAA to 5-HT were significantly higher in the fore-brain than the hind brain throughout the experiment.

In the second experiment pallid sturgeon were subjected to a chronic density stressor. Groups of fish were held at high density (4.0 kg/m^2) or at low density (1.0 to 0.33 kg/m^2). Fore- and hind-brain tissues were sampled at 3, 7, 13, and 21 d during the confinement. A subset of sturgeon from both density treatments at 7, 13, and 21 d was subjected to a 30 s handling stressor before tissue sampling.

There were no significant differences in the concentrations any of the six neurotransmitters between sturgeon held at high and low density over the 21 d experiment. Again, throughout the experiment, the fore-brain exhibited significantly higher concentrations of DA, 5-HIAA and 5-HT as well as higher 5-HIAA to 5-HT ratios than the hind-brain. However, in chronically confined sturgeon subjected to an additional acute stressor, there were significant differences attributed to density in DA, 5-HIAA, and 5-HT concentrations. Fore-brain DA concentrations significantly increased during the periods from 7 to 13 d and from 13 to 21 d in fish held at high density whereas fore-brain DA concentrations remained constant in low density held fish (Figure 1). A similar significant trend was apparent in fore-brain 5-HIAA concentrations (Figure 2). There was a significant increase in fore- and hind-brain 5-HT concentrations from 7 to 13 d and from 13 to 21 d in high density held fish but fore- and hind-brain levels remained constant in those held at low density (Figure 3). These results suggest that pallid sturgeon chronically confined at high density exhibit different neurotransmitter responses to acute stress than do sturgeon chronically confined at low density.

Figure 1: Mean DA levels (pg/mg) in the fore- and hind-brain of pallid sturgeon held at two different densities for 21 d and then subjected to an additional 30-s net stress at 7, 14, and 21 d. Error bars indicate standard error of the mean. Shaded bars are fore-brain DA levels and open bars are hind-brain levels. Fore-brain DA concentrations significantly increased from 7 to 13 d and from 13 to 21 d in fish held at high density whereas fore-brain DA concentrations were constant in low density-held fish.

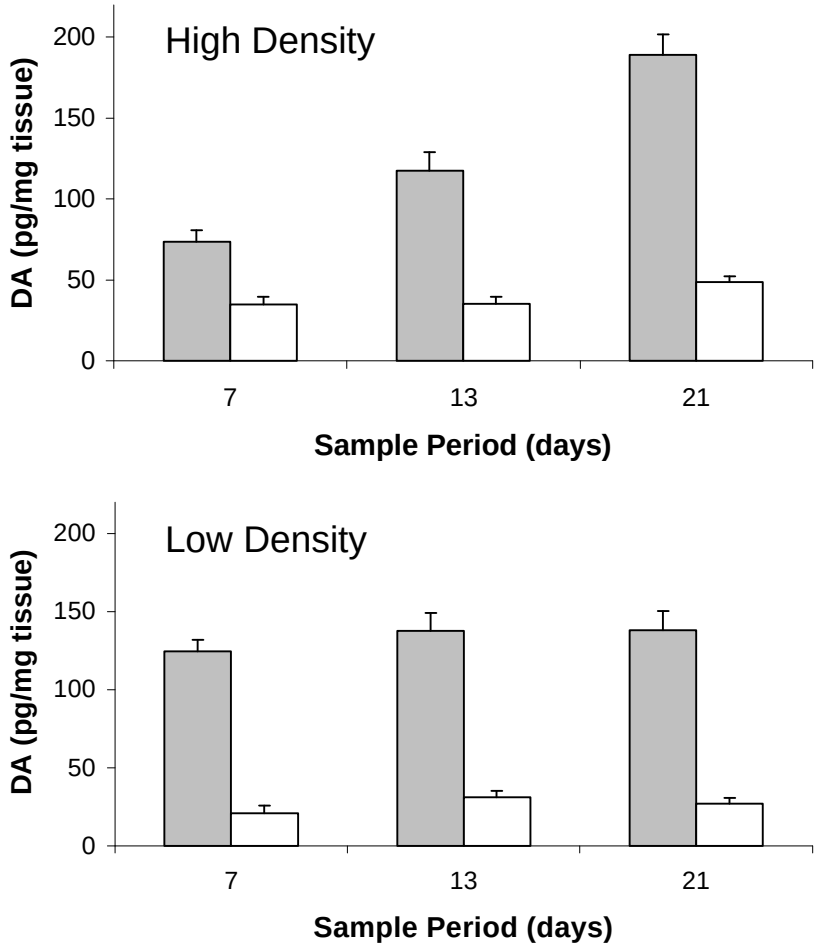
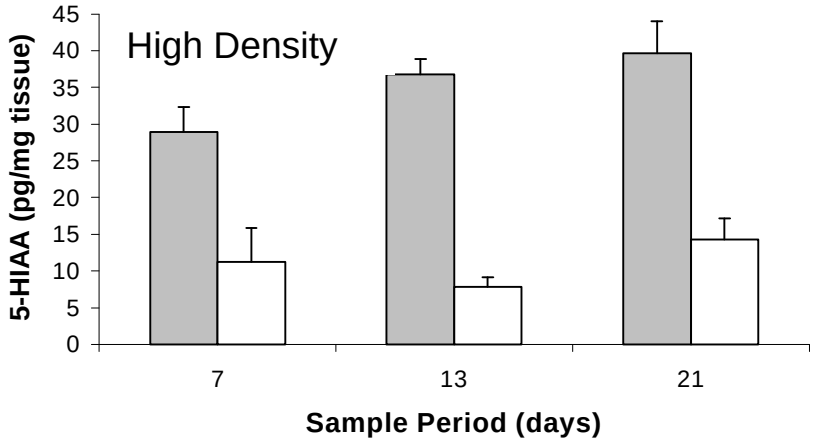


Figure 2: Mean 5-HIAA levels (pg/mg) in the fore- and hind-brain of pallid sturgeon held at two different densities for 21 d and then subjected to an additional 30-s net stress at 7, 14, and 21 d. Error bars indicate standard error of the mean. Shaded bars are fore-brain 5-HIAA levels and open bars are hind-brain levels. Fore-brain 5-HIAA concentrations significantly increased from 7 to 13 d and from 13 to 21 d in fish held at high density whereas fore-brain DA concentrations were constant in low density-held fish.



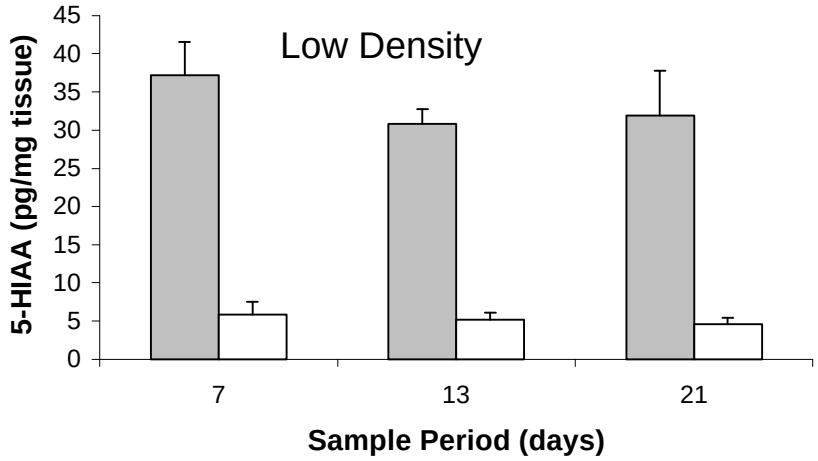


Figure 3: Mean 5-HT levels (pg/mg) in the fore- and hind-brain of pallid sturgeon held at two different densities for 21 d and then subjected to an additional 30-s net stress at 7, 14, and 21 d. Error bars indicate standard error of the mean. Shaded bars are fore-brain 5-HT levels and open bars are hind-brain levels. There was a significant increase in fore- and hind-brain 5-HT concentrations from 7 to 13 d and 13 to 21 d in high density fish but fore- and hind-brain levels remained constant in the low density-held group.