

**MEASUREMENTS OF THYROID HORMONES, T₃ AND T₄, IN JUVENILE WHITE
STURGEON OVER THE ANNUAL CYCLE**

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Abstract

The potential roles of thyroid hormones in possible conditioning of juvenile anadromous sturgeon for seaward migration have not been investigated, although thyroid hormones have been implicated in the physiological and morphological preparation of juvenile salmonids for downstream migration and life in the sea. We measured blood plasma concentrations of T₃ and T₄ over the annual cycle for twenty-nine juvenile sturgeon, kept in holding tanks. The fish were 2-5 years old, of an age when wild white sturgeon begin to migrate downstream, and occur in saline estuarine waters. Plasma concentrations of thyroid hormones in juvenile sturgeon were generally lower than those reported for juvenile anadromous salmonids. The measurements of thyroid hormone concentrations in the plasma were examined for association with seasonal change during the year. There were clear changes in the concentrations of both T₃ or T₄ during the annual cycle. Concentrations of T₃ and T₄ changed synchronously, though the levels of T₃ were about twice those for T₄ in the plasma. Concentrations of both hormones were low in the fall through January, but increased to maxima during early spring, February - April.

Introduction

White sturgeon are anadromous, the adults live in coastal estuaries and marine environments along the west coast of North America. They migrate into large freshwater rivers to spawn. After several years of freshwater life, the juvenile sturgeon migrate downstream to estuaries and near-shore environments. Although the life histories of the chondrosteian fish have some similarities to those of the teleostean salmonids, these groups have long-separated evolutionary histories. Salmonids undergo an endocrine-controlled process, smoltification, which prepares the juveniles both morphologically and physiologically for life in the sea. Thyroid hormones have been implicated in this process in salmonids (Hoar, 1976; Wedemeyer et al., 1980; McCormick and Saunders, 1987).

We were interested in the potential role of the endocrine system in preparing juvenile white sturgeon for seaward migration and in making comparisons of the functions of thyroid hormones between anadromous chondrosteans and teleosteans.

Methods

To investigate potential roles of thyroid hormones, we measured plasma levels of T_3 and T_4 over the annual cycle. Twenty-nine hatchery-raised sturgeon, juveniles of 2 - 5 years old, were maintained in outdoor flow-through tanks in non-chlorinated freshwater at the University of California at Davis, Institute of Ecology aquarium facility. The fish were kept in a fiberglass tank (about 3 m x 6 m and 1 m deep), for longer than one year in the open, with natural photoperiod and temperature regimens. The fish were fed regularly with a prepared diet.

Individual fish were identified by attaching to the dorsal fin numbered, color-coded, Floy fish-tags. Using standard procedures designed to minimize disturbance of fish by handling (McEnroe and Cech, 1985), blood samples for thyroid hormone assay were collected monthly throughout the year.

Blood was taken by caudal venipuncture into heparinized syringes, centrifuged and samples of plasma were frozen. Plasma concentrations of thyroid hormones, T_3 and T_4 , were measured by radioimmunoassay, conducted by Dr. Richard Nishioka at the Dept. of Zoology, the University of California at Berkeley.

Results and Discussion

Over the year, blood plasma concentrations of T_3 varied from 0 to 6.9 ng/ml and T_4 from 0 to 3.6 ng/ml. These plasma levels were generally lower than plasma concentrations reported for juvenile anadromous salmonids (Dickhoff and Sullivan, 1987).

Annual cycle

Measurements of hormone concentrations, T_3 and T_4 , in plasma samples collected from individual sturgeons over the course of the year were examined for consistent change in concentration during the annual cycle. Significant changes in hormone concentrations were found during the year for both hormones and were synchronous. The annual changes are shown as monthly means, with standard deviations, in Figures 1 and 2, for T_3 and T_4 respectively. The average concentration of T_3 was usually about twice that of T_4 in plasma samples, although there was a wider variation in the blood of individual fish. Plasma concentrations of both hormones followed similar patterns of change, levels were low in the fall through January then increased to maxima in early spring, February - April. The synchronicity of change in plasma concentrations of these hormones suggested close interrelation, which could be expressed by linear correlation, Figure 3. The correlation coefficient, r , was 0.90 and the coefficient of determination, r^2 , 0.82.

Conclusion

In juveniles of the anadromous white sturgeon 2 to 5 years in age, we have found a clear cycle of change in thyroid hormones over the seasons. Nevertheless, the overall concentrations of thyroid hormones in sturgeon were consistently low compared with concentrations in juvenile salmonids, measured by the same methods.

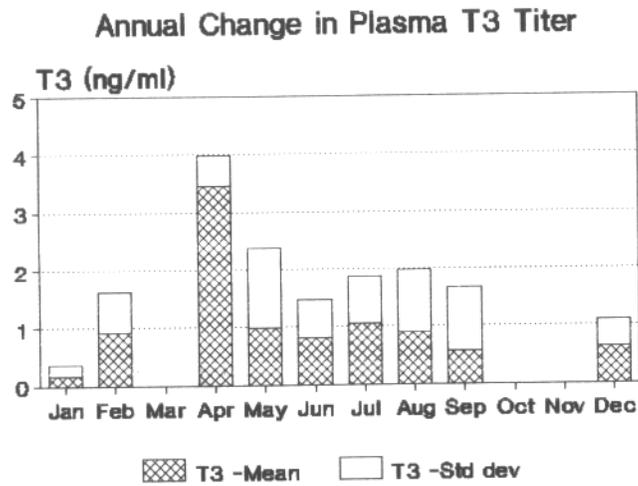


Figure 1. Monthly changes in the mean concentration (ng/ml) of T₃ in the plasma of juvenile white sturgeon over the year.

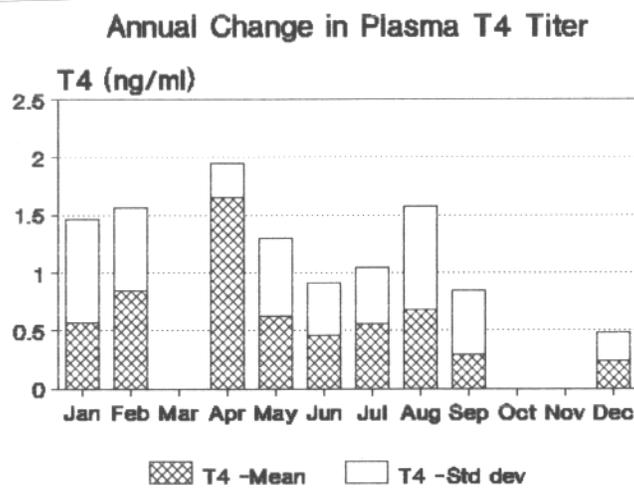


Figure 2. Monthly changes in the mean concentration (ng/ml) of T₄ in the plasma of juvenile white sturgeon over the year.

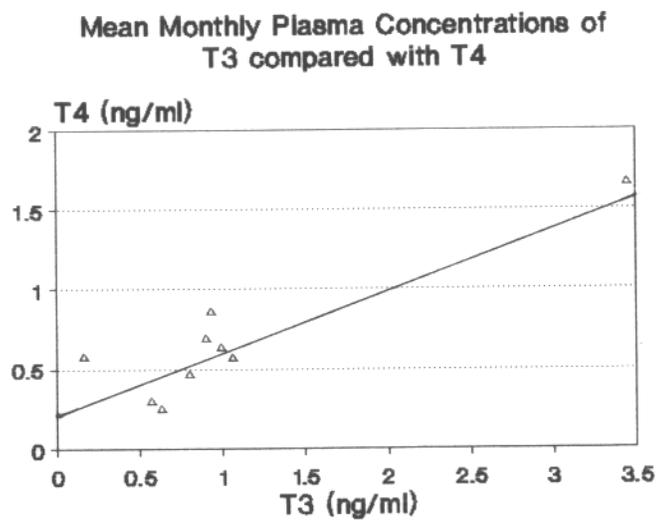


Figure 3. Relation between the monthly mean plasma concentrations of T₃ compared with T₄. The correlation coefficient, r , is 0.90.

References

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