PHYSIOLOGICAL RESPONSES OF STRIPED BASS TO ANGLING: EFFECTS OF PLAYING TIME AND SUPPLEMENTAL FEEDING

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An increase in catch-and-release fishing has stimulated interest in the physiological stress and mortality associated with the practice. The physiological responses of juvenile striped bass to angling were observed in two studies beginning in summer 1994. The first study investigated the effect of playing time on physiological responses, and the second study investigated the role, if any, of supplemental feeding on the physiological responses to angling.

Methods

In the first study, about 600 tagged striped bass (serially numbered, internal anchor tags, model FD-68, Floy Tag and Manufacturing Company, Seattle, Washington) were stocked into each of two aerated, 0.04 hectare culture ponds. Fish were fed a commercial trout diet (38% protein) to satiation daily.

Fishing trials occurred over a two week period in August when water temperatures were 26-32 C and in November when water temperatures were 16-19 C. Fish were caught with ultralight fishing rods, 1.8-kg test line and artificial 3.5 g spinner-type lures fitted with a single barbed treble hook. Playing time was varied from 6.0 s to the point at which the fish ceased resisting ($\leq$6.05 min).

For each captured fish, tag number, total length (TL), playing time, and water temperature were recorded. Fish hooked in the gills were removed from the study. Blood samples were collected from 82 fish in the summer and 50 fish in the fall. In addition, 94 fish in the summer and 70 fish in the fall were placed in adjacent ponds immediately after capture, measuring, and recording tag numbers. Thirty-one to 43 d later, these fish were recovered after emptying the ponds and used to estimate the effect of angling time on mortality.

Blood was collected from the hemal arch with hypodermic needles and evacuated collection tubes. The tubes contained either sodium heparin or sodium fluoride/oxalate (for collecting blood used in lactate assays). Plasma cortisol was determined by enzymatic immunoassay, plasma glucose and lactate were determined by enzymatic spectrophotometric assays, and plasma osmolality was determined by vapor pressure osmometry.

In the second study, four ponds were each stocked with approximately 150 fish. Fish in all ponds were fed to satiation daily for several months prior to the beginning of the study. On June 1, 1995, supplemental feeding was stopped to the fish in two of the ponds while feeding was continued to the fish in the remaining ponds. This practice was continued for approximately 90 d. Ten fish were captured from each pond by angling during the first weeks of June, July, August and September. Five of the fish captured from each pond each month were landed as quickly as possible. The remaining five were played for 3 min before landing. Fish were bled as soon as they were landed. Details of the fishing gear, blood collection procedures, and assays are similar to those of the first study except that some blood from each fish was collected in tubes with no preservative (for determining serum rather than plasma cortisol) and the enzymatic immunoassay kit used for cortisol determination was from a different manufacturer.

Results

In the first study plasma cortisol concentrations increased with playing time in summer but not in the fall (Figure 1). In summer, cortisol concentrations remained near control levels (1.35 ng/mL, estimated from y intercept) for the first 2.5 min of play and then increased rapidly to a peak value of 117.9 ng/mL. Similarly, plasma glucose levels increased with playing time in the summer (control levels, 84.1 mg/dL) but not in the fall; however, control levels were higher in the fall (121.9 mg/dL). Plasma lactate concentrations increased during both summer and fall from baseline levels of 1.0 and 4.2 mg/dL, respectively. However, the increase was more rapid in the summer than fall. Plasma osmolality increased rapidly during both seasons from baseline values of 340.3 and 338.3 mmol/kg, respectively. Mortality was 11.7% in the summer and 5.7% in the fall and was not related to playing time.

In the second study, the group of fish receiving supplemental feed grew in total length, and increased weight over the four sampling periods. In contrast, the fish not receiving supplemental feed lost weight, and their condition factors and relative weight decreased. Serum cortisol concentrations did not differ between long and short play groups or fed and not-fed groups (Figure 2). Plasma glucose and lactate concentrations and plasma osmolality all were higher in the fish played for three minutes as compared to control fish. No differences between fed and not-fed fish were observed.

Discussion

Fish in the second study may not have been played long enough to allow serum cortisol concentrations to increase. Results of the first study indicate that levels do not begin to rise until after 2.5 min. The increase in osmolality in played fish observed in both studies is the opposite of what is expected in stressed, freshwater fish. Apparently, high intracellular lactate concentrations caused water movement from blood into cells resulting in a temporary increase in plasma osmolality (Wood 1991).

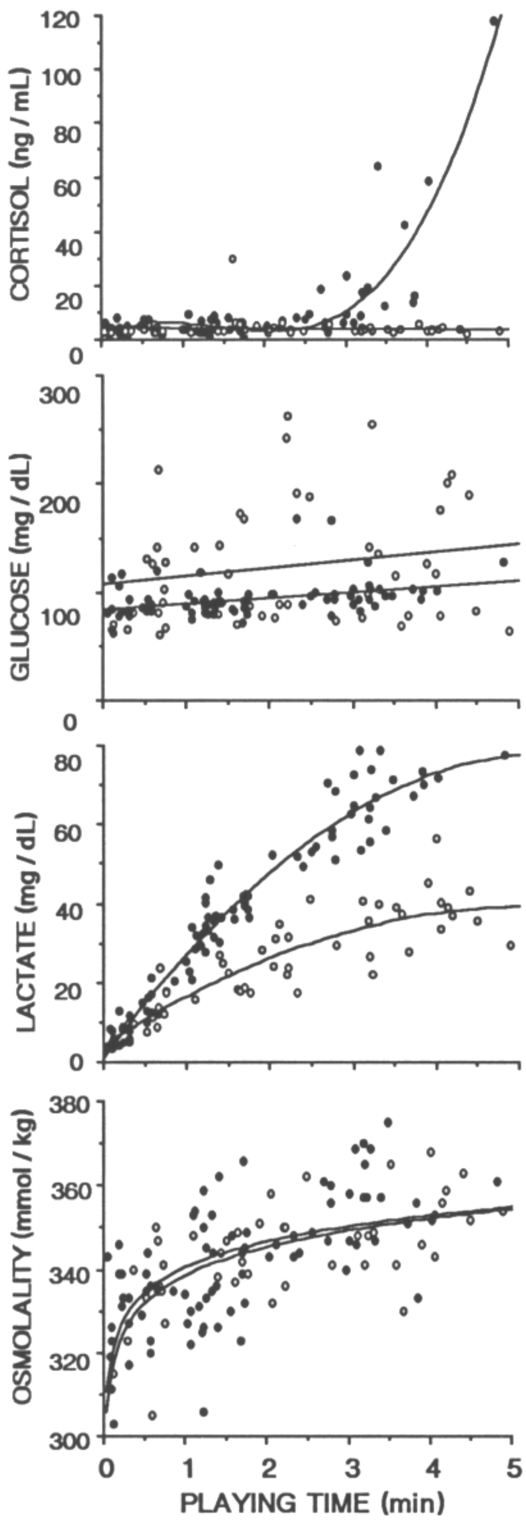

Figure 1. Relationship of hematological characteristics to playing time for striped bass angled in freshwater. Summer-caught fish are represented by solid circles and fall-caught fish are represented by open circles.

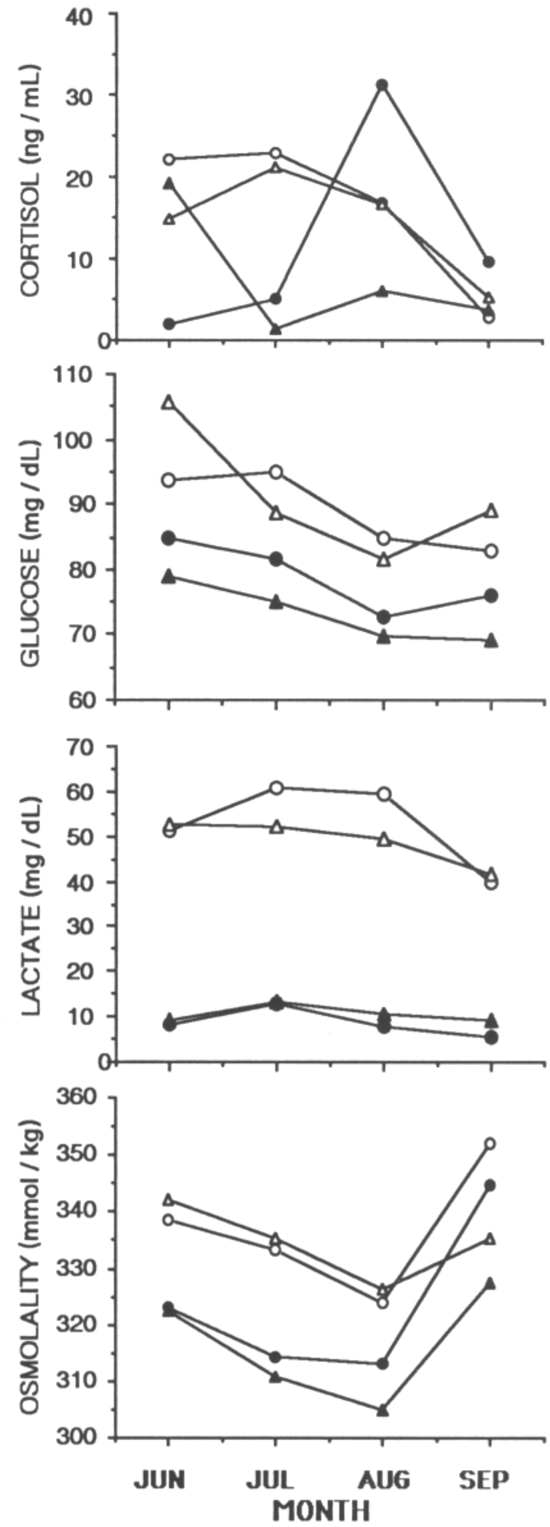

Figure 2. Hematological characteristics of striped bass played for as short a time as possible (solid symbols) or three minutes (open symbols) over a three-month period. One group of fish was fed daily (circles) and the second group was not fed (triangles.)

These studies clearly demonstrate that striped bass are severely stressed when captured by hook and line; however, little insight is gained into the question of why striped bass appear to have high mortality rates (Harrell 1988, Hysmith et al. 1993) when angled and released in the field. Four possible reasons for angling-induced mortality in the field come to mind:

1) Fish die of wounds inflicted at the hooking site,

2) Fish die from water and ion imbalances and other physiological dysfunctions as a result of the stress and exhaustion associated with the angling event,

3) Fish in the field are nutritionally deprived (especially in the summer) due to crowding in limited habitats and may not be strong enough to survive an angling event,

4) Fish in the field are often angled from deep water and suffer from complications of rapid decompression as well as the stress of angling.

We intentionally did not investigate the effects of hooking-site wounds by removing gill-hooked fish from the survival part of the first study. Previous studies have shown that hooking site does affect mortality (Muoneke and Childress 1994). The first study did indicate, however, that healthy fish angled for a variety of times did survive. Our second study attempted to address nutritional deprivation as a possible reason for high field mortality rates. We were, however, limited to sublethal indicators which showed that nutritionally-deprived fish responded in a manner similar to well-fed fish. Our next step will be to investigate, under controlled conditions, the interaction between angling time and depth when hooked in an effort to determine the effect of deep-water fishing on stress and survival.

Acknowledgments

Funding for this project was provided, in part, by a donor who wishes to remain anonymous. Fish were provided by the South Carolina Department of Natural Resources. D. Ashe, W. Boltin, C. Dickey, C. Kempton, and A. Kraham assisted in the collection of data.

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