

Structure and Function of Fish Communities in Streams on Fort Riley Military Reservation

by

Michael C. Quist

B.S., University of Idaho, 1996

M.S., Kansas State University, 1999

ABSTRACT

Instream habitat is important in determining fish community characteristics; however, few studies have been conducted to assess the influence of physicochemical habitat on fish community structure and function in tallgrass-prairie streams. In addition, the effects of large-scale disturbance on soil characteristics and plant communities are well documented, but little is known about the influence of military activities on soil and vegetation and the effects on instream habitat and fish community characteristics in small lotic ecosystems. The purpose of this study was to provide baseline information on the relationships among physicochemical habitat and fish community structure and function on Fort Riley Military Reservation and to assess the influence of large-scale disturbance from military activities on instream habitat and fish assemblages. Sampling sites were selected from headwater, middle (mid), and lower reaches based on drainage area. Physical habitat and fish communities were sampled with each macrohabitat (i.e., pools and riffles). Analysis of variance was used to determine differences in habitat and fish community characteristics among reaches and relationships among abiotic and biotic variables were analyzed using correlation and regression techniques.

Water chemistry variables (e.g., dissolved oxygen, reactive phosphorous) were similar among reaches; whereas, physical habitat (e.g., depth, width) increased longitudinally. Percent disturbance within the watershed and percent silt were highest in headwater reaches. In general, large substrate (e.g., cobble, pebble) was most abundant in mid and lower reaches. Aquatic vegetation and woody debris were the most common forms of cover in all reaches and macrohabitats.

Percent disturbance within a watershed was positively correlated with percent silt in pool macrohabitats from headwater and mid reaches. Percent canopy cover was negatively correlated with aquatic vegetation in all reaches and positively correlated with area of woody habitat (e.g., bank root, rootwad) in headwater and mid reaches. In addition, woody-riparian vegetation was negatively correlated with mean daily, maximum daily, and maximum daily range in temperature in mid reaches. In riffle macrohabitats, percent disturbance was negatively correlated with mean depth, width, and velocity for headwater reaches.

Percent disturbance from military activity was associated with high catch per unit effort (C/f) of tolerant species and trophic generalists. Despite high percent silt in headwater reaches, percent disturbance and percent silt were rarely correlated with fish community characteristics. Headwater sites that were dominated by silt substrate generally had few species; whereas, a minimal increase in habitat heterogeneity (i.e., increased percent gravel) was associated with higher species richness. The increase in species richness was due to the addition of trophic generalists and tolerant species. Species richness and diversity were positively correlated with percent disturbance in mid-reach watersheds and was reflective of increased abundance of omnivores and tolerant species. In riffle macrohabitats, percent disturbance was negatively correlated with C/f of benthic-insectivores in headwater reaches and positively correlated with C/f of tolerant species in mid reaches.

Riparian area variables (e.g., canopy cover, bank root) in pool macrohabitats were positively correlated with trophic guild diversity, C/f of benthic-insectivores, generalized-insectivores, omnivores, and intolerant species among reaches. Similar relationships were found in riffle macrohabitats where riparian area variables were positively correlated with C/f of benthic-insectivores and omnivores and negatively correlated with C/f of tolerant species. In addition, mean back-calculated lengths at age for central stonerollers *Campostoma anomalum*, creek chubs *Semotilus atromaculatus*, red shiners *Cyprinella lutrensis*, and green sunfish *Lepomis cyanellus* were positively correlated with area of woody habitat. The proportion of age-0 central stonerollers and creek chubs was positively correlated with habitat characteristics associated with poor-quality habitat (e.g., low percent canopy cover, shallow depth, small substrate). Few biotic interactions were found in headwater and lower reaches; however, growth of central stonerollers, creek chubs, red shiners, and green sunfish was negatively correlated with their abundance-- suggesting that density-dependent factors influenced growth.

These results indicate that habitat and fish communities in streams from the Flint Hills exhibit similar longitudinal patterns as other ecosystems. They also suggest the importance of large-scale disturbance and woody-riparian vegetation to instream habitat and fish community structure and function. In addition, riparian areas provide an important link between land-use and instream process. However, riparian areas apparently failed to filter surface runoff and decrease sedimentation in streams on Fort Riley. This is likely due to the presence of numerous stream crossings which disrupt riparian continuity and provide access of silt to streams.