Effect of Irrigation on Stream Depletion and Fish Habitats in an Eastern Colorado River

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1. Statement of the Problem
Agriculture in the western United States is a large water user, and has come under increasing criticism for its contribution to environmental degradation of fish and wildlife river habitats. The environmental concerns are not confined to Colorado alone but are truly inter-state in nature. To maintain mutually cooperative relationships with the public, federal, and state regulatory agencies, those utilizing irrigation techniques much look for management practices that will minimize their impact on the environment while maintaining a profitable operation. The extent to which irrigation has affected these habitats, as well as projected impacts of irrigation on these habitats in the future, must also be ascertained so as to create an atmosphere of trust and disclosure between environmental interests and irrigators.

2. Research Objectives
The overall goal of the research is to evaluate the effect which irrigation has upon the river flow and environment, so that the river ecosystems can effectively serve diverse societal needs. These needs include concerns for fish and riparian wildlife habitat and recreation on the river, in addition to the irrigated agriculture. The Arikaree River Basin in Eastern Colorado was chosen to evaluate the effect of groundwater pumping for agriculture on the river hydrology and its ability to support suitable habitat for fish and wildlife.

3. Results
The paper will report preliminary results of the on-going research for the past two years 2002-03. Stage height and discharge were measured throughout 2002 and 2003 along several points of the Arikaree River. A drastic drop in river depth was reported at all locations throughout June and July, with much of the river reduced to a series of disconnected pools by the end of July. Recovery of the river varied greatly in time from one point to the next along the river, generally occurring in September and October. Hydraulic conductivity of the streambed was also measured, and the data shows some possible link between time of stage recovery and higher hydraulic conductivities from point to point.

Representative farmers were interviewed in 2002 and 2003 regarding their cropping and irrigation practices. Corn was the most prominent crop grown for both years, although some farmers began switching to less water-intensive crops after the 2002 drought. For 2002, all farmers were found to be in deficit irrigation for every crop, meaning that the amount of water applied throughout the growing season did not equal the crop water requirement for a specific crop. Some farmers were able to meet crop water requirements in 2003, although others continued to show deficit irrigation for certain crops.
The stream depletion factor method (after Jenkins, 1970) was used to model the amount of water depleted from the stream for the 2003 irrigation season. Based upon this model, the western section of the river was predicted to be completely depleted by high-capacity wells, while sections further downstream were predicted to be depleted by less than 10% of the actual observed depletion by high-capacity pumping. However, the western section of the river did not lose an appreciable amount of water throughout the year, while those sections further downstream exhibited extreme stage depletion.

Observed stage heights at all sections along the river show significant declines at roughly the same time of year for both 2002 and 2003, even though interviews with the farmers showed that irrigation began a full month later in 2003 than in 2002. A very evident diurnal pattern also began emerging in the stage height as the season progressed. Cottonwoods and willows are present throughout the Arikaree valley adjacent to the river, and some stands are quite dense. Thus, it may be that these phreatophytes are also contributing to the river de-watering, as stage declines may be more dependent upon the growing season of these phreatophytes than the beginning of the irrigation season. It may eventually be found that both the vegetation and the high-capacity pumping are major factors in the drying of the Arikaree River.