

**F-80-R-2, Michigan
Study 654**

654. Name of Study: Evaluation of brown trout and steelhead competitive interactions in Hunt Creek, Michigan.

- A. Problem:** Steelhead are regarded as potential competitors with resident brown trout in coastal Michigan streams. There is both hard data and anecdotal information which suggests that competition between these species has resulted in reductions in abundance and growth of resident brown trout in Michigan rivers. Fish passage decisions that need to be made as part of the FERC licensing process are hindered by a lack of empirical data on potential competitive interactions between resident and anadromous fish species. It is also of interest to know if fish carrying the bacterial kidney disease organism will transmit this disease to resident trout. A good empirical test of the effect of an introduction of steelhead into a resident wild trout population is lacking. We need quantitative information on impacts of potamodromous fish on resident species. Moreover, additional information on mechanisms of interactions between these species is badly needed to guide fish passage and management decisions.
- B. Objective:** To determine if the introduction of steelhead into a stream where they presently do not exist will affect the abundance, survival, growth, or disease status of resident trout species. To determine if population dynamics of resident trout species differs between streams supporting populations of steelhead and other potamodromous salmonids and streams inaccessible to Great Lakes salmonids.
- C. Justification:** Both resident brook and brown trout and anadromous steelhead are highly valued sportfish species in Michigan. Some managers and anglers are very concerned that proposed increases in fish passage at dams, which are proposed in many FERC relicensing packages, will have adverse impacts on resident trout fisheries through competition or by transmission of disease. Many believe that real or perceived declines in abundance of resident trout species in coastal streams were caused by competition with anadromous fish species. On the other hand, if anadromous salmonids are not found to have significant adverse impacts on resident trout, then streams could produce more benefits to anglers if more anadromous fish are given access to them. In this case there could be benefits from an angler fishery for anadromous adults in the streams and export of smolts to enhance fisheries in the Great Lakes. An opportunity exists to make a good empirical test of the impact of the introduction of adult steelhead into a stream containing resident brown and brook trout. The study stream is representative of the many small to medium sized trout streams that could be impacted by fish passage decisions. More detailed understanding of quantitative impacts of steelhead introductions will allow us to make better management decisions on fish passage of this species.
- D. Status:** There is a perception that resident brown trout in some coastal Michigan rivers have declined as a result of competition with steelhead and Pacific salmon species. Kruger et al. (1985) reported a significant decline in the importance of the once famous brown trout fishery in the Pere Marquette River. Reduced growth rates for brown trout less than 200 mm total length and above average growth of brown trout larger than 200 mm total length in the Pere Marquette River reported by Kruger (1985) suggested that competition between steelhead parr and brown trout might be occurring in this river. The Michigan DNR has supported several studies to analyze competition between river anadromous salmonids and brown trout. Ziegler (1988) reported that sympatric juvenile steelhead and brown trout utilized the same food and space resources in the Little South Branch of the Pere Marquette, Little Manistee, and

Boardman Rivers but these overlaps in habitat and diet did not appear to affect the growth of young-of-the-year fish of either species. Ziegler concluded that competition for food resources did not appear to occur because food habits of brown and steelhead trout were not different when the species were allopatric versus sympatric. However, because brown trout over 200 mm total length were more abundant in allopatry than in sympatry her study suggested that competition with steelhead may adversely affect abundance of brown trout. Kocik (1992) examined competition between pre-smolt (age-0 and age-1) steelhead and brown trout and reported no measurable impact of steelhead on juvenile brown trout abundance, survival, or size. However, his experimental introductions of steelhead fry resulted in populations of age-0 steelhead near the lower end of the range of densities generally found in Great Lakes tributaries having anadromous steelhead runs and age-1 densities were well below values reported by Seelbach (1986). Hence the level of competition between brown trout and steelhead in his study stream were not a good simulation of competition levels in streams such as the Pere Marquette or Little Manistee Rivers where populations of steelhead juveniles are much higher.

A number of investigators have suggested that dense populations of anadromous fish could reduce the abundance of brown trout by dislodging or damaging them at young life stages by digging up their redds in streams where available gravel spawning areas are limited (Seelbach 1986; Kocik and Taylor 1991). Hayes (1987) reported that redd superimposition by rainbow trout reduced brown trout spawning success by 94% in an experimental section of a New Zealand stream. This potential interference competition mechanism needs to be studied in Michigan streams.

In summary, although there is considerable data that suggests that steelhead and brown trout compete, the design of studies conducted to date has not clearly defined the impact of relatively dense steelhead populations on resident trout species. Further, no good information on the probable magnitude of steelhead impacts on resident trout species presently exists. This study will empirically test the effect of introducing adult steelhead into a resident trout population where they presently are not found. After 3 years of baseline data collection adult steelhead will be introduced into a treatment zone for 5 consecutive years at levels projected to produce high densities of age-0, age-1, and age-2 juveniles. Hunt Creek, a tributary to the Thunder Bay River, has been selected as a study site due to its relatively abundant brown trout population and because a man-made barrier will block upstream steelhead movement from the treatment section into a reference zone. Moreover, electrofishing efficiency in this stream is relatively high and hence the precision of population estimates will improve the chances of detecting any change in populations that may result from the treatment. In addition, if there is an adverse effect of steelhead on the resident trout population these populations will be able to recover after the experimental manipulation is terminated because barriers on the Thunder Bay River system will prevent steelhead from returning to the stream. Past introductions of domestic rainbow trout into Hunt Creek disappeared from the system within about 3 years.. A second reference zone will be established in Gilchrist Creek to provide increased statistical rigor (larger reference population sample size, and replicate reference zone). Gilchrist Creek is an adjacent stream approximately the same size as Hunt Creek and is also a tributary to the Thunder Bay River. This duplicate design will also provide a back-up reference zone if the barrier on Hunt Creek does not block all steelhead movement.

Resident trout populations have been estimated in Hunt and Gilchrist Creeks for 5 consecutive years (1995-98). Steelhead stocked into the treatment zone of Hunt Creek in 1998 and 1999 reproduced successfully. In the year 2000, three year classes of steelhead pre-smolts will be present in Hunt Creek to interact with resident trout. The study would be enhanced if streams were sampled at a broader spatial scale during the time period when a full complement of steelhead cohorts are present in Hunt Creek (2000-02). Therefore, we propose to amend the

study to include sampling of additional Michigan streams at sites having both steelhead and resident trout species and at sites having only resident species. Population estimates will be conducted at these sites from 2000-02. This will allow estimation of abundance and mortality and growth rates of sympatric and allopatric populations at a broader spatial scale while controlling for temporal effects.

This study is being amended in 2000-01 to extend the study one additional year. This will allow for the Michigan Department of Natural Resources, Fisheries Division's editing and finishing process.

Literature Cited:

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- Kruger, K. M. 1985. Pere Marquette River angler survey and brown trout evaluation. M. S. Thesis, Michigan State University, East Lansing.
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- Seelbach, P. W. 1986. Population biology of steelhead in the Little Manistee River, Michigan. Doctoral dissertation. University of Michigan, Ann Arbor.
- Ziegler, R. L. 1988. Stream resource utilization of sympatric and allopatric juvenile brown (*Salmo trutta*) and steelhead trout (*Salmo gairdneri*). Michigan Department of Natural Resources, Fisheries Research Report 1987, Ann Arbor.

E. Procedure:

- Job 1. Select treatment and reference zones on Hunt and Gilchrist Creeks. Electrofishing data collected at stations on these streams during past years will be examined to determine how long treatment and reference zones must be to give 95% confidence limits precise enough to detect a 20% change in population point estimates. We are planning for both treatment and reference zones being a minimum of 3 kilometers in length.
- Job 2. Monitor water temperature in treatment and reference zones. A minimum of 4 electronic thermometers will be placed in the study streams. Water temperatures will be recorded once each hour throughout the study. Temperature data will also be collected in other streams in Michigan's Lower Peninsula where trout population estimates are made.

- Job 3. At a minimum, we will continuously monitor water stage near the upstream boundary of the Hunt Creek study section between 1-April and 30-June throughout the study. This time period was selected because previous studies have indicated that the size and timing of flood events occurring during early life history periods can reduce survival of young-of-the-year salmonids. Thus, the timing of floods may alter the outcome of interactions between species. Stage height may not be recorded continuously at other times of the year, particularly during colder months, because of complications related to ice formation and recorder operation during cold weather. However, a staff gauge will be installed in a location where ice effects are minimal and will be read 3 times per week. Periodic discharge measurements will be made to establish a water stage/discharge relationship.
- Job 4. Determine the extent of gravel areas and other substrate types, undercut banks, overhanging vegetation, emergent or submergent aquatic vegetation, large woody debris, mean water depths and velocities across transects within each 100-m section of the treatment and reference sections. These data can be tested for correlation with population data from 100-m sections to test the "value" of different sections occupied by salmonids.
- Job 5. Mark and map redd locations of resident trout species in both the treatment and reference sections. We will measure redd size, water depths and velocities in the vicinity of redds, substrate size, and distances of redds from cover or the stream banks.
- Job 6. Collect biological data on abundance, mortality, and growth of salmonid species. A minimum of 30 scale samples, and total weights, will be collected from each trout species for each 2.54-cm total length group collected from each 1-kilometer section of the treatment and reference zones. The entire length of treatment and reference zones will be electrofished from late August-October and populations will be estimated by mark-and-recapture techniques. Population data will be kept separately for each 100-m subsection. The exact time when electrofishing is conducted will depend upon availability of assistance from district personnel.
- Job 7. Collect data on presence/absence or incidence of bacterial kidney disease (BKD) and other diseases in resident trout populations in Hunt Creek. BKD infected brook trout were stocked into Hunt Creek in the distant past (G. Alexander, Michigan Department of Natural Resources, Personal communication). It is not known if this disease is present in the contemporary wild populations. However, if the disease is absent, it is of management interest to know if the disease will be introduced into resident salmonid populations when steelhead are stocked. From 12-15% of steelhead sampled at the Little Manistee River Weir during 1992 were infected with the BKD organism. Approximately 60 resident trout (150 mm or longer) will be tested for BKD each fall during the course of this study. These fish will be collected from waters immediately downstream from the treatment zone to minimize the potential effect of their removal from trout populations within the study area.
- Job 8. Evaluate introduction of adult steelhead into the treatment section of Hunt Creek during the month of March. Adult steelhead will be obtained from the DNR's Little Manistee River Hatchery. We will stock a total of 150 adult steelhead (half male and half female) during 5 consecutive years. We anticipate that this number of steelhead will provide sufficient recruitment to provide densities of juvenile steelhead comparable to those found in good quality coastal Michigan steelhead streams.

- Job 9. Mark and map steelhead redd locations in the treatment section. We will measure redd size, water depths and velocities in the vicinity of redds, substrate size, and distances of redds from cover or the stream banks. These data will be analyzed to estimate the probability that steelhead superimpose their redds upon brown trout redds dug the previous fall.
- Job 10. Analyze data and write progress and final reports.
- Job 11. Estimate populations of resident trout and steelhead in additional streams. We will select additional sampling sites based, in part, on existing data on salmonid populations. The general strategy will be to select pairs of sites having similar habitat features but different species complexes i.e. with or without steelhead. Populations will be estimated during July and August. Scale samples will be collected and processed. General habitat features of sampling sites will also be recorded to facilitate comparisons between sites.
- Job 12. Publish report through the Fisheries Division's editing and finishing process for Research and Technical reports.
- G. Geographical Location:** Hunt Creek and Gilchrist Creek areas and various trout streams in Michigan's Lower Peninsula. Hunt Creek Fisheries Research Station, Lewiston, Michigan.
- H. Personnel:** Andrew J. Nuhfer, Todd C. Wills and Troy Zorn Research Biologists; Tom Adams Fisheries technician; Short term workers; Research Administrative personnel, and contract editor.