dow, and so forth. Over the summer some ... city stations were recorded, located in a rough ... Trenton, Owen Sound and Simcoe.

One of the ... confirmed ... guide to the ... stream, it was ... water temperature ... taken around 4:00-5:00 p.m. was just a significa... and easier to obta... than comprehensive, long term temperature logs taken with maximum/minimum thermometers or data loggers. Christine will be crunching the numbers over the winter to come up with the computer model.

Steve and I got a good look at both extremes of stream environments. The morning station was cool and shaded, with a variety of pools and small log jams. It yielded a good variety of forage fish, speckled, rainbow and brown trout. The afternoon station was shallow, warmer, and "chub city". The only thing that Christine's various stations ... in common was that they ... on private ... where the owners did not permit anglers. The point of ... that was to eliminate ... habitat ... hoping to see many ... keys ... out of this work. ... for ... ❑

AN ECONOMIC ANALYSIS OF RECREATIONAL FISHING IN SOUTHERN ALBERTA

by W.L. Adamowicz, P.C. Boxall and D.O. Watson

What is the value of sport-fishing? to the angler? to the economy as a whole? How does it stack up against other values in our lives? our need for food, water, energy? These are questions that were never asked when, back in 1985, the province of Alberta decided to proceed with the construction of the Oldman Dam.

Economic analysis has typically excluded the value of recreational activities like fishing from its domain. Most environmental amenities, because they do not have market prices, have not been included in economic impact assessment or benefit-cost analysis. Recently, techniques have been developed that attempt to reflect the value of activities like recreational fishing in economic decisions. These techniques should lead to better decisions; decisions that consider the value of the environment in the economy.

It has long been known that fishing generates considerable expenditure on goods and services in the province. However, expenditures are not the whole story. While expenditures are important for measuring regional impacts of monies spent on recreational fishing, they do not indicate the economic value of fishing. There are many direct benefits to anglers associated with fishing which are not represented by expenditures. These are called non-market benefits by economists since they do not have an actual market price. These non-market benefits are the correct measures to be considered in economic analysis.

To address the issue of the value of recreational fishing, a study was undertaken by researchers at the Department of Rural Economy, University of Alberta, to assess the effect of environmental quality changes on the non-market benefits of recreational fishing in the upper Oldman River basin. This study focused on the flooded portions of the three rivers and was designed to determine if the amount and quality of available fishing sites changed due to the construction of the dam. It also looked at the net loss of recreational fishing values in the region. Economic models were constructed to examine the loss to the anglers. These models were also used to predict changes in visits to each site in the region after environmental changes were introduced. Finally, the impacts of the province's mitigation efforts to compensate for lost fishing habitat were examined.

Data Collection:

The data for this study were obtained through a mail survey conducted jointly by the University of Alberta and the Alberta Fish and Wildlife Division, then of the Department of Forestry, Lands and Wildlife. Trout Unlimited Canada also assisted in the survey process.The survey was conducted in the winter of 1990/91 regarding the 1990 fishing season. The survey concentrated on 77 of the most important sites in southern Alberta. Those surveyed provided information on what they considered important quality attributes for selecting a site. They were also asked to provide information about their typical fishing trips. The most important section of the survey was the detailed diary that the respondents were asked to complete. This recorded site, date, species sought and fishing success of their trips. A final section of the survey asked for demographic information such as residence, age, education and occupation.

Modelling:

According to the survey, the four most important attributes of a fishing site were scenic value, water quality, privacy and a chance to catch fish. Using information from these surveys, various statistical models of angler site choice were constructed. These models were then used to determine the impact of the fishing site changes on economic benefits.

Results:

The results of all the models found that the construction of the Oldman River Dam resulted in a loss to anglers using the region. This **annual** loss ranged from $50,469 to $96,239, depending on the model used.

These losses were also used to evaluate the success of mitigation programs currently being implemented to repair the effects of the dam on fisheries habitat. Calculations were carried out for three different mitigation success levels: 25%, 50%, and 75% success, which represent the degree of success of the mitigation program in developing quality habitat for fish. The study found that there does appear to be some benefit from habitat mitigation efforts, but this depends on the success level of the mitigation structures. However, the actual success level of the mitigation structures is still subject to debate.

This study illustrates how the actual economic costs associated with the dam and the benefits and costs of the mitigation work can be derived. For example, the estimated total losses to recreational anglers due to the construction of the dam ranged from $500,000 to $2,000,000 when annual losses are considered over a number of years. The mitigation efforts appear to lead to increased fishing benefits if they are successful enough. However, these benefits must be compared to the costs of the mitigation work in order to evaluate the economic implications of the effort.

Conclusion:

The study confirmed that losses occurred to recreational anglers due to the construction of the Oldman River Dam. Furthermore, these losses may or may not be compensated for by mitigation work. The analysis of the economic benefits of the mitigation effort raises some interesting issues. Mitigation efforts are typically intended to replace lost habitat with equal amounts of new habitat ("no net loss"). The effectiveness of the mitigation effort is judged on a physical or biological basis. However, the effectiveness of this new habitat could also be judged on the success in providing a quality recreational fishing experience. This experience depends not only on the physical or biological aspects of the site, but also on the location of the new habitat and the attributes (scenery, etc.) of the mitigated site. Economic analysis of these mitigation efforts provides a measure of how attractive the mitigated sites are to anglers. Perhaps these factors should also be considered when judging the success of mitigation efforts.

It must be recognized that this study did not attempt to study who was affected most by environmental changes, but rather presented a snapshot of the overall effects. The study also did not examine other probable losses for different recreational activities, such as hunting, hiking and wildlife viewing. As well, values such as intrinsic value of the wild rivers were not included. Only direct effects on recreational fishing were measured. The measurement of these other benefits are projects for future research.

This study demonstrates how economic models can be used to predict changes in visits resulting from environmental quality changes. The economic impact of such changes on recreational fishing can be better determined and included in the decision making process. Projects such as this one are attempts to expand economic analysis to include the benefits of environmental amenities, like recreational fishing. Our fishery resources are valuable. This value needs to be included in the information provided to decision makers.

For further information, see: *An Economic Analysis of Recreational*

Fishing and Environmental Quality Changes in the Upper Oldman River Basin, Project report No. 93-01, by D. Watson, W. Adamowicz, and P. Boxall, Department of Rural Economy, University of Alberta, Edmonton, Alberta, 1993. ❑

RAM RIVER CUTTHROAT TROUT RADIO TRACKING STUDY
by Richard Brown and Ron Manz

Richard Brown, University of Alberta graduate student, and his research assistant, Slav Stanislawski, have recently finished the second year of field research on the North Ram River. Their work involved tagging and radio-tracking cutthroat trout during the spring spawning period and during the fall and winter, when the fish move to overwintering habitat. They have also been examining the habitat used by trout during these times of year.

In early June, 1992, redd surveys were completed with help from Central Alberta Chapter of Trout Unlimited members: Tony Blake, Dean Baayens, Terry and Darren Frizzell, Tom Kelly, Michael Loewen, Matthew Mitchell and Evan Ritchie. The majority of redds were found in the lower gradient sections of the tributaries, Nice Creek, Joyce River and Cripple Creek, with most of the large redds being spotted in the side channels of the North Ram River and the lower stretches of Cripple Creek. Since larger trout make larger redds, indications are that the majority of the larger fish spawn in these areas.

In late April, 1992, radio transmitters were implanted in 11 cutthroat trout. The trout were captured by electrofishing with help from Alberta Fish and Wildlife personnel, Larry Rhude and Steve Herman. The radio-tagged trout were then monitored every other day to determine the extent of their spawning movements. The trout were tracked to spawning areas in Nice Creek, Cripple Creek, and the main and side channels of the North Ram River. Pre-spawn migrations of up to eight kilometers were observed. Once in the spawning areas, trout made many small movements within an approximate 400-meter area, with male trout attending a number of different redds. Post-spawning migrations of up to 11 kilometers were noted as trout moved to their summer habitat.

During late September, 1991, Brown found that large numbers of trout began grouping in pools. In early October, 1992, Brown and and Stanislawski returned to these same pools where trout had again aggregated in large numbers; they implanted 22 fish with radio transmitters. In order to avoid the stress of electrofishing, the cutthroat trout were angled and quickly landed by willing volunteers: Matt Mitchell, Terry and Darren Frizzell, Robert

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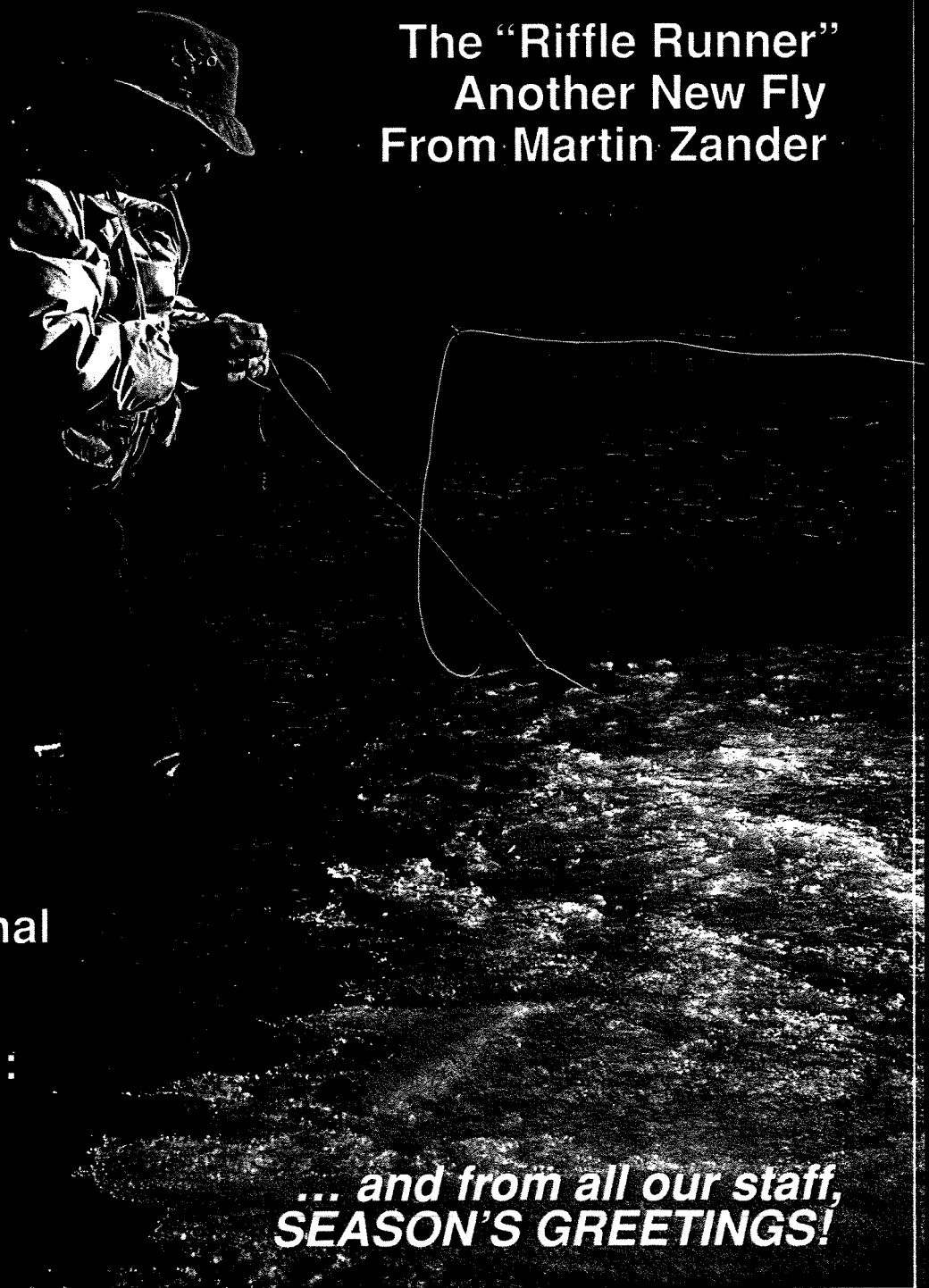

The "Riffle Runner" Another New Fly From Martin Zander

A Guide to Fishing America's Oldest National Park

The Kootenai: Montana's *Other* River

... and from all our staff, SEASON'S GREETINGS!