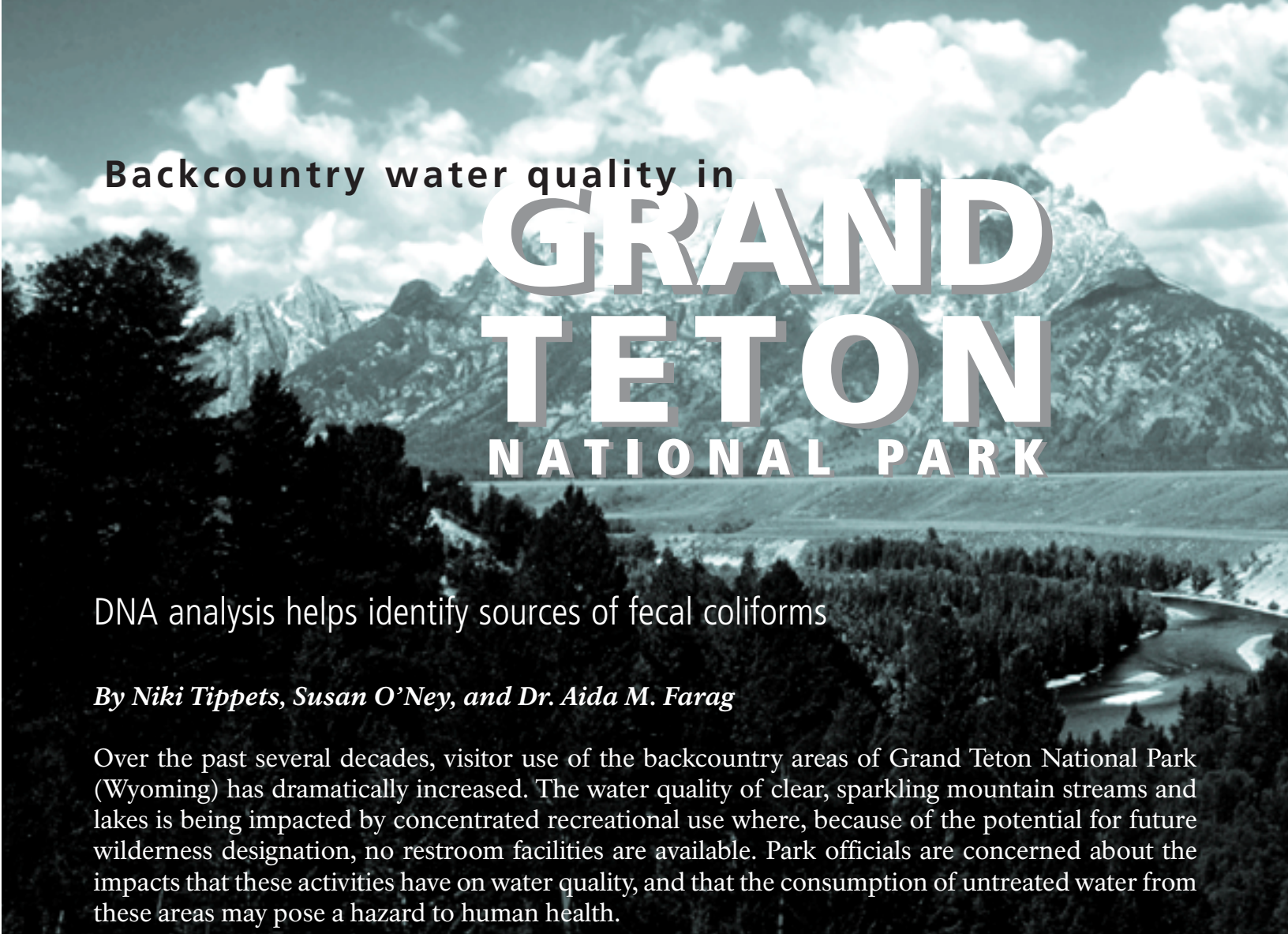




Backcountry water quality in

GRAND TETON NATIONAL PARK

DNA analysis helps identify sources of fecal coliforms

By Niki Tippetts, Susan O'Ney, and Dr. Aida M. Farag

Over the past several decades, visitor use of the backcountry areas of Grand Teton National Park (Wyoming) has dramatically increased. The water quality of clear, sparkling mountain streams and lakes is being impacted by concentrated recreational use where, because of the potential for future wilderness designation, no restroom facilities are available. Park officials are concerned about the impacts that these activities have on water quality, and that the consumption of untreated water from these areas may pose a hazard to human health.

Figure 1. Backcountry use of Grand Teton National Park, Wyoming, has dramatically increased in recent years, resulting in water quality degradation of creeks and streams and causing management concern.

BACKGROUND

Fecal coliforms reside in the intestines of warm-blooded animals, including humans, and are excreted in waste materials. The presence of high numbers of these bacteria in surface waters (creeks and streams) may indicate that unsanitary conditions exist that may pose human health concerns. Coliform counts and species of fecal streptococci were identified in water samples collected from the backcountry in Grand Teton National Park in the mid-1970s (McFeters 1975, Stuart et al. 1976). Similar studies in streams of the Sierra Nevada in California in the 1980s (Suk et al. 1987) detected decreased water quality in backcountry areas with extensive human presence when compared to other areas with minimal human presence. Grand Teton National Park personnel (Mark Magnuson, NPS, personal communication) also identified high concentrations of unknown bacteria in the early 1990s. This evidence led resource managers to the belief that the back-

country surface waters of Grand Teton should be evaluated more thoroughly by using recently developed techniques previously unavailable to the earlier investigators. The new techniques analyze DNA to determine the mammalian source of the fecal coliform (Samadpour et al. 1993, Samadpour et al. 1994). With this additional information, natural resource managers would be able to evaluate specific sources contributing to resource degradation (i.e., duck, bear, raccoon, human), and more effectively formulate policies and procedures to address the problem.

In 1996, Grand Teton National Park, the NPS Water Resources Division, and the third author cooperatively designed and initiated a backcountry water quality study in the park. Initial funding for this project was provided by the NPS Water Resources Division with later funding from the NPS Recreational Fee Demonstration Program. Because *Escherichia coli* (*E. coli*) is prevalent in nature, we used it to identify the source of fecal coliforms. While fecal coliforms are not





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Figure 2. Biological Technician Karin McCoy collects a water sample in Grand Teton National Park as part of a water quality study begun in 1996. The information from the study provides a baseline of park water quality and is helping managers design appropriate solutions to water quality problems.

necessarily pathogenic, they are frequently associated with and may indicate hazardous disease organisms. The Environmental Protection Agency developed water quality standards for levels of *E. coli* in recreational waters based on specific levels of risk of acute gastrointestinal illness. The recommended steady state geometric mean value is 126 *E. coli* per 100 milliliters of water (USEPA 1986). On a few occasions, Grand Teton's waters exceeded this limit, but on average they were well below this number. Our objectives for the study were to (1) establish baseline conditions of park backcountry surface waters to be used as a tool for measuring future changes, and (2) evaluate the effects that backcountry users may be having on the water quality of selected backcountry streams.

METHODS

We collected water samples following the methods suggested by Suess (1982). In the early years of the study, a local contractor completed the laboratory analyses. In 1999 the public health officer, John Collins, of the NPS Intermountain Region generously donated equipment to the park, allowing us to complete lab work on-site.

We filtered and incubated samples for analyses of fecal coliforms using the membrane filter (MF) procedure described in Standard Methods (APHA 1992). We selected positive fecal coliform colonies and sent them to Dr. Mansour Samadpour, University of Washington, for analysis of the *E. coli* isolates. He performed genetic fingerprinting using ribosomal RNA typing on each *E. coli* isolate. These patterns or DNA types, referred to as ribotypes, were then used to match specific strains of *E. coli* from water samples with ribotypes from known, potential sources. Dr. Samadpour maintains a ribotype database from source samples collected around the country. This facilitates the positive identification of the coliform source, especially human versus nonhuman origins.

THE STUDY

The third author implemented the study under contract during the summers of 1996 and 1997 (Farak 2001) with initial investigations focusing on surface waters of Avalanche, Garnet, and Cascade Canyons. In 1998, the first author assumed management of the project, expanding it into additional backcountry areas. The park has continued to collect data annually. In 2001, the second author took over the study.

In 1996 and '97, we found fecal coliforms in two of the three canyons investigated. Through DNA analysis (or source tracking) we determined that a variety of wildlife contributed fecal coliforms to the waters. In Cascade Canyon, some of the fecal coliforms were of human origin. In 1998, we also found human fecal coliforms in Paintbrush, Cascade, Bradley, and Avalanche Canyons. In 1999, as the study expanded, we found human fecal coliforms in Avalanche, Leigh, Upper and Lower Death, Lower Granite, and Hanging Canyons, at Guide's Wall and Hidden Falls, in Glacier Gulch, at Taggart Lake, and again in Cascade Canyon.

In 2000, we again detected human coliforms in Cascade Canyon, as well as an increase in the number of human coliforms identified in Granite, Death, and Open Canyons. Additional samples were collected near several grazing and boat launch areas within the park to

evaluate the impact of livestock and other activities on surface waters. We found a high number of bovine, bison, and horse coliforms at these additional sites, much as we expected.

IMPLICATIONS

Many of the waters in Grand Teton National Park are identified as Class I areas under the Clean Water Act of 1977 and therefore further water quality degradation is prohibited. The data collected in this study are helping

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to establish baseline coliform levels for backcountry water quality. They will also help managers determine the effects of increased backcountry use on the quality of park surface waters. This information can be used to guide

decision making related to the location of camping zones, limitations on backcountry use, and designing educational programs for park visitors.

Based on study results, resource managers at Grand Teton National Park have recommended that an evaporation-style toilet facility be installed at the base of Cascade Canyon. This site sustains intense use and is visited by an estimated 90,000 people per summer. Park management is currently evaluating the appropriateness, feasibility, and associated costs of this facility and other options, including area use limits. Grand Teton National Park utilizes a resource council to conduct preliminary reviews of proposed projects. The council will determine any additional planning required for compliance with the National Environmental Policy Act. The installation of a toilet facility in Cascade Canyon may be tiered to the development of a backcountry management plan, currently under review. Managers will have to weigh the concerns associated with human waste disposal in the backcountry in order to make their decision. These include human health problems as a consequence of either direct contact or contamination of drinking water, aesthetic concerns of visitors who find improperly disposed of human waste, and the conflict posed by the installation of structures in a wilderness management area. Once management has chosen and implemented a course of action, we will continue monitoring surface waters at Cascade Canyon to assess the effects of the action on water quality. 

ACKNOWLEDGMENTS

Karin McCoy has supported the study over the last two years by her dedication to sampling and laboratory analysis.

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