

IOWA'S WATER

Ambient Monitoring Program

Intensive Watershed Investigations *at Iowa Beaches*

At state-owned beaches with chronically high levels of bacteria (10 beaches as of 2004), Iowa's Ambient Water Monitoring Program conducts intensive watershed investigations to determine the source(s) of fecal bacteria (Figure 1). Fecal bacteria exist in the intestines of warm-blooded animals (mammals and birds). Some common human and animal sources at Iowa beaches include dirty diapers, discharges from septic systems or sewage treatment systems, direct contribution from livestock or domesticated animals, manure runoff or spills, and storm water runoff containing wildlife or pet droppings.



Intensive monitoring at Beed's Lake State Park, Franklin County.

Understanding Bacteria Levels

Several factors may influence bacteria levels in a watershed, such as the amount of rainfall, number of swimmers at the beach, quantity of suspended sediments in the water, and the number and location of potential sources of bacteria. If bacteria levels tend to increase after rainfall events, this may signify a nonpoint source for the bacteria, meaning the bacteria are transported from many areas on the land surface. In contrast, bacteria levels from a point source, such as a leaking sewage lagoon, will typically decrease after rainfall due to dilution.

Each beach's weekly sample is a composite sample that is a mixture of water from nine points along the beach – three transects across the beach (center and two ends) and at three water depths (ankle-, knee-, and chest-deep). During intensive watershed investigations, water from the nine points is examined individually. Patterns in the bacteria levels at these points have been interpreted as a reflection of different types of bacteria sources that are affecting the beach. For instance, high bacteria levels in the ankle-deep water that diminish in the knee- and chest-deep water may indicate a source of bacteria close to the beach (such as swimmers or geese). In contrast, high bacteria levels in

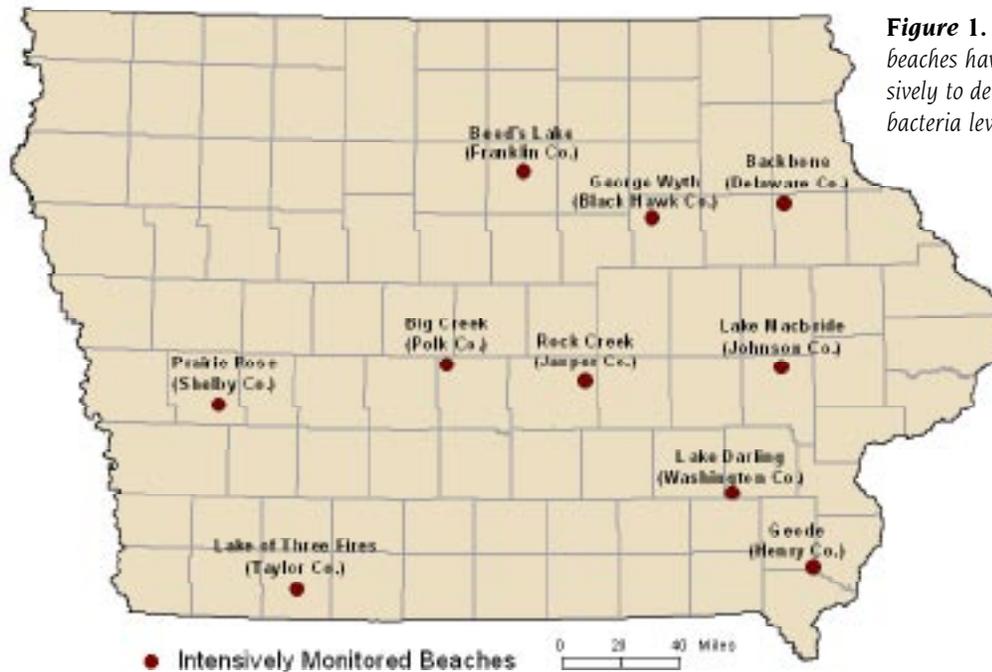


Figure 1. Ten of Iowa's state-owned beaches have been monitored intensively to determine the source(s) of high bacteria levels.

all nine points of the beach are believed to suggest a source coming from the lake toward the beach, which would most likely be a watershed source.

Analysis of Bacteria Sources at Beaches

After several years of intensive monitoring and based on the above interpretations, beaches have been categorized by Iowa DNR as dominated by different types of bacteria sources. Some beaches appear to be dominated by sources from the watershed, some seem to be influenced by sources closer to the beach, and others reflect a combination of both source types. Backbone Beach (Delaware County) is an example of a beach that is dominated by watershed sources. All nine sampling points monitored at this beach, as well as samples from the lake and in the watershed have higher bacteria levels after significant rainfall. Figure 2 compares *E.coli* and rainfall graphs for Backbone Beach, which is expected to have watershed dominated sources, to George Wyth (Black Hawk County), which is presumed to be dominated by sources close to the beach. Backbone Beach has higher *E.coli* (red line) levels during and after rainfall (blue bars), while George Wyth (Black Hawk County) has little to no change in bacteria levels after rainfall.

In Iowa, most of the watershed sources for fecal bacteria are nonpoint sources, where the bacteria come from many areas on the land surface. However, there are some point sources that may affect bacteria levels in Iowa's watersheds. For instance, a leaking sewage lagoon owned by the City of Strawberry Point has impacted Fenchel Creek in the Backbone Watershed. In 2003, an investigation was conducted on Fenchel Creek and the North Fork Maquoketa River to determine if the leaking sewage lagoon was having an impact on Backbone Beach. Monitoring revealed that the sewage lagoon did not substantially affect bacteria levels at the beach and that the primary cause of elevated bacteria levels was nonpoint sources throughout the watershed.

Beaches dominated by bacteria sources close to the beach typically have high levels of bacteria in ankle-deep water and lower levels in the knee- and chest-deep water. In Iowa, the usual source of bacteria close to the beach is geese. Bacteria levels for a sampling event on August 28, 2002, at George Wyth Beach show high bacteria levels in the ankle-deep water (west ankle = 2,200 Colony Forming Units/100 ml, center ankle = 2,100 CFU/100 ml) and lower levels in the knee- and chest-deep water (west chest = 10 CFU/100 ml, center chest = 40 CFU/100 ml) (Figure 3).

Several of the intensively monitored beaches appear to be affected by a combination of watershed sources and sources close to the beach. These beaches experience high levels of bacteria after rainfall and also have high levels of bacteria in ankle-deep water at times. Lake Geode (Henry County) and Rock Creek (Jasper County) beaches exhibit this combination of results. Monitoring will continue at these beaches to determine if one particular source overshadows the others.

Of course, there are some beaches that cannot be classified in this manner. In 2004, two beaches, Big Creek (Polk County) and Lake Macbride (Johnson County), had high *E.coli* levels after four years of low levels. While 2004 was a year with above average rainfall, bacteria levels at these beaches had not appeared to increase after rainfall events in the past. Additional investigation will yield more information on the bacteria sources into the lakes and at these beaches.

Discussion

To be able to draw conclusions about bacteria sources at a beach and within its watershed, consistent monitoring coverage is needed over the water body and its contributing tributaries. In addition,

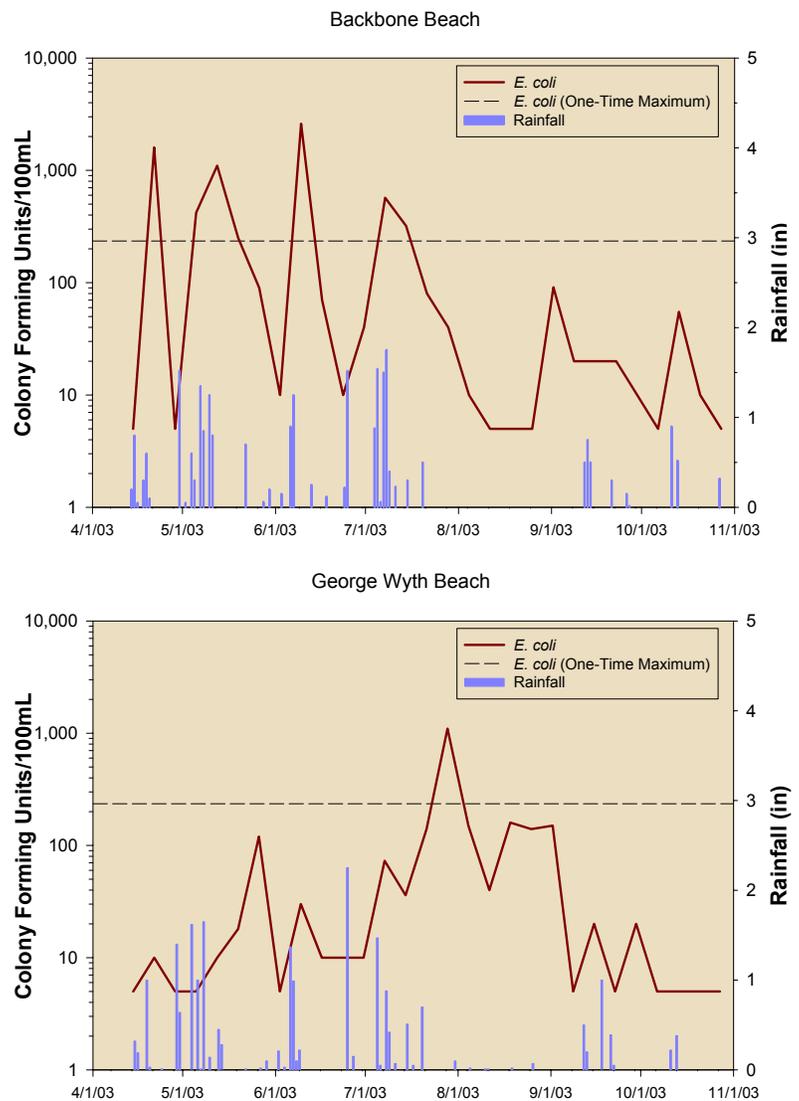


Figure 2. *E.coli* bacteria levels (red line) at Backbone Beach (Delaware County, top) increase after rainfall (blue bars), while bacteria levels at George Wyth Beach (Black Hawk County, bottom) do not increase after rainfall.

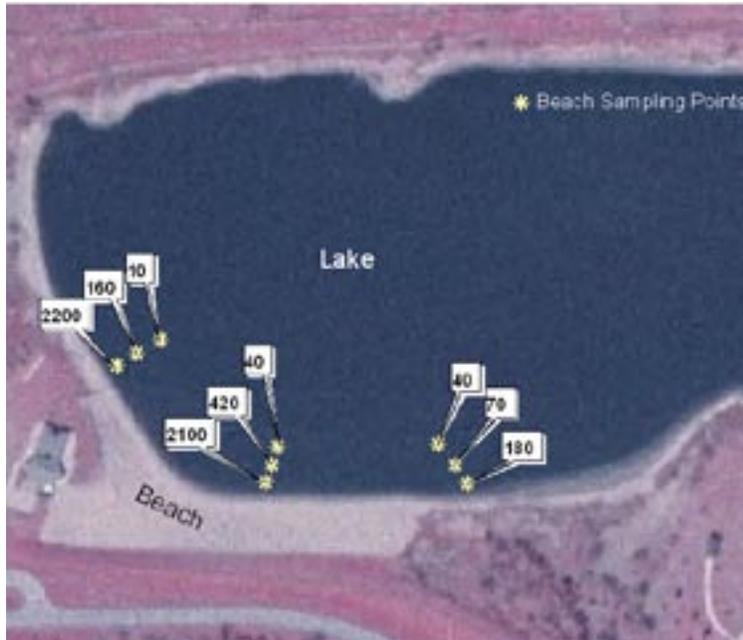


Figure 3. *E.coli* bacteria levels are higher in the ankle-deep water at George Wyth Beach (Black Hawk County) and decrease in the knee- and chest-deep water, as shown in this color-infrared, aerial photograph.

because bacteria levels in nature are variable, several sampling events are needed to identify areas in the watershed and lake with chronically high levels of bacteria. Finally, weather can influence bacteria levels at those beaches that are affected by watershed sources. In general, higher bacteria levels are found during years with higher levels of rainfall. Iowa's Ambient Water Monitoring Program incorporates all of these factors when designing intensive watershed investigations to characterize beaches according to the types of bacteria source(s) present. An understanding of these sources assists in controlling bacterial impacts on the water quality of Iowa's lakes and beaches.

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Beed's Lake photo by Jack Gilmore.

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Iowa Water Monitoring Program Web Site – wqm.igsb.uiowa.edu



Prepared by
Iowa Department of Natural Resources, Geological Survey
109 Trowbridge Hall, Iowa City, IA 52242-1319