

# More storms. Bigger storms.

by Jennifer Hawks

**Y**ou may be in for a bumpy ride. Experts predict that more storms and bigger ones are on the way. And you can blame it all on global climate change.

David Rodenhuis is a senior scientist who specializes in meteorology at the University of Victoria in British Columbia. While he can't say with absolute certainty that global climate change will bring more storms, he says there's a definite possibility.

Already, we're seeing signs.

Rodenhuis believes that a warming climate equals a change in traditional weather patterns. Hurricane Katrina is one example. "There's a consensus now that yes, this is global change. With regard to Pacific storms, or Atlantic storms, there is conjecture...that the storms will be more intense.

"The North Pacific has always been bad for storms. Because the climate is changing, we have to be aware that the intensity of the storms could increase. Fishermen want to know if it's going to be worse or not. We don't know, but there are reasons to believe that the storms could be more intense."

Not only more wind but stronger wind.

"Storms that are bigger and more intense will likely bring more intense



*This Coast Guard rescue of fishermen in distress will become more common if meteorological conditions change as predicted by some analysts. U.S. Coast Guard photo.*

winds. Waves are a direct response of wind. If the winds are more intense, we can expect larger swells and larger waves."

Rough weather can be a nightmare for you, but does it also affect fish beneath the surface?

"Yes," says Eddy Carmack, senior climate research scientist at the Institute of Ocean Sciences in the Department of Fisheries and Oceans Canada.

Carmack is an expert on climate and oceanography who specializes in the Arctic region, especially north of the Bering Strait. How are fish affected by weather?

"In countless interacting ways. Men and women who have made fishing their profession could give example after example from their personal experiences, and this could prove invaluable if such experiences were documented. But, how does one four-day storm affect the four-year growth of a salmon? How does the timing of the onset of fall storms one year affect the early survival of that year's class of juvenile sockeye? These seemingly simple questions are very hard to answer."

Weather is not the same as climate. As Carmack explains, "Climate is just a whole bunch of weather averaged over



One of the most visible gauges of a changing climate in Alaska's Southeast is Mendenhall Glacier, shown here in 1962 and in 2004. U.S. Forest Service photos.

a long period of time. If weather brings more hot spells for a long period of time, then climate will likely show a warming trend. If weather brings more fall cyclones to a given spot on the coast, then climate will show increased rainfall. Over time, the accumulated effects of such events may change the ocean domains within which fish live. The domain may become more or less productive. Fronts, or the boundaries between domains, may shift, thus increasing or decreasing the size of a domain. On land, we can appreciate this because we can see, for example, forests expanding their northern limits."

Not all experts interpret weather events the same way when determining overall climate changes. "One thing that climate scientists do seem to be agreeing on is that climate warming will increase the frequency of certain extreme events. Is a mother-of-all cyclones good? Maybe for the fish who will benefit from the upward mixing of nutrients, but certainly not for men and women who go out in small boats to catch those same fish."

How future weather patterns will affect commercial fisheries remains to be seen. Carmack sums it up this way: "One thing is clear. No single skill set or interest group has the knowledge base to deal with this. Fishermen, fisheries scientists, oceanographers, and meteorologists, modelers, and policy types all have to get in the chowder." ■

## Glaciers in North America are melting Here's why you care

**G**laciers are melting. Big deal, right? Doesn't affect the fish. Sorry to break the news, pal, but the fish you catch need glaciers far more than most people realize.

Without them, a lot of fish swimming in the Pacific will be stewed before reaching home to spawn.

Garry Clarke is a professor of geophysics and is a glaciologist at the University of British Columbia in the Earth and Ocean Sciences Department. Clarke's research suggests that melting glaciers can significantly contribute to global climate change.

According to Clarke, "The vast majority of glaciers are receding."

Glacier melt increases the amount of precipitation in those areas. When temperatures are warm, that precipitation may form as rain. Unlike snowfall, rain doesn't increase or even maintain a glacier's size.

River systems affected by glacial melt are mostly located in Alaska and in Canada. Spawning salmon in the Yukon River and many other northern waters are nurtured on the way home by glacial melt.

Glaciers help buffer the summer heat, which tends to coincide with periods of low flow. Lower water levels are more susceptible to warmer air temperatures.

"Temperatures of some of these rivers are quite devastating to salmon habitat," Clarke said.

Glaciers also work as a kind of thermostat when their cool water is needed most.

"Glacial melt essentially puts cold water into these systems and therefore cools these streams and rivers in summer when they need to be cold."

Temperatures in British Columbia's Fraser River were high this year and in the recent past, and water levels were low. Large numbers of salmon typically return to the Fraser every year to spawn.

In 2006, the salmon arrival at spawning grounds was significantly lower than predicted. Many experts believe that

the Fraser's unusually high temperature essentially cooked the salmon.

"The streams and rivers are going to be the hottest in the middle of the summer," Clark said.

"Glaciers click in during those months, just when you need them, because they're melting at their greatest rate the same time that this problem is the worst." Glacier melt can prevent dramatic fluctuations between summer and winter water temperatures.



Giuseppe Zibordi

When do the glaciers stop melting? "It depends on the location of the glaciers, but mid-September is usually the end of the melt."

That's just when cooler winter temperatures kick in.

Of course, if the glaciers melt completely, the natural coolant that they provide will be gone forever. For the salmon that face a return trip through a river once cooled by glaciers, but cooled no longer because of climate change, the summer is long and possibly deadly.

And this death comes at the worst possible time: The salmon already have foraged in the Pacific, removing its share of feed — feed that no longer is available to other fish, or future generations of salmon.

The salmon also have escaped fishermen's nets, either through cunning or planned escapement. The fish are sexually mature, primed to reproduce.

Within the fish reposes the greatest investment by nature and fish managers.

And then it dies, perhaps only miles from its natal stream, because the glaciers are gone and the water is too hot. ■