Global warming is evaporating Arctic ponds, new study shows

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High Arctic ponds -- the most common source of surface water in many polar regions -- are now beginning to evaporate due to recent climate warming, say two of Canada's leading environmental scientists.

John Smol (Professor of Biology at Queen's University and holder of the Canada Research Chair in Environmental Change) and Marianne Douglas (Professor of Earth and Atmospheric Sciences and Director of the Canadian Circumpolar Institute at the University of Alberta) will publish their startling conclusions next week in the on-line Early Edition of the prestigious journal, Proceedings of the National Academy of Sciences (PNAS).

"The final ecological threshold for an aquatic ecosystem is loss of water," says Dr. Smol. "These sites have now crossed that threshold."

Since 1983, Drs. Smol and Douglas have been regularly sampling the water quality and biota of about 40 ponds on Cape Herschel, east-central Ellesmere Island, in the Canadian High Arctic. Polar ecosystems such as these are very sensitive to the effects of climatic and other environmental changes, they note in their paper. "In many respects, they are like the 'miner's canaries' of the planet, showing the first signs of warming."

But this new discovery by the Canadian researchers has surprised even them. In the 1990s they were alarmed when they began to recognize a trend of declining water levels and changes in water chemistry. When

they arrived to begin another field season in July of 2006 (the warmest year on record for that portion of the Arctic), some of the ponds were dry, and others had dramatically reduced water levels.

“This study shows the value of long-term monitoring programs,” says Dr. Douglas. “Had we just arrived at Cape Herschel last year, we would have surmised that these were naturally temporary ponds. But we know instead that this was not the case – these had been permanent water bodies for millennia.”

As well as monitoring the ponds for 24 years, the researchers have also reconstructed ecological trends over the past several thousand years in some of the ponds, using paleoecological techniques. In a controversial 1994 paper published in the journal Science, they showed that the ponds existed for millennia, but that, beginning in the 19th century, they underwent marked ecological changes, consistent with warming.

“We had a bit of a rough ride with that paper for a few years, but now there is almost universal scientific consensus concerning our 1994 conclusions,” says Dr. Douglas. In 2005, she and Dr. Smol, along with 24 co-authors, used similar techniques to document widespread ecological changes, consistent with warming, across the circumpolar Arctic.

However, the ecological changes recorded in the 1994 study pale in comparison to those noted in the current paper, where some sites had completely dried up by July.

While some subarctic lakes have recently disappeared because the permafrost that formed a largely waterproof barrier has melted, this is not the case here, say Drs. Smol and Douglas. Instead, the high Arctic ponds are evaporating due to warming. By measuring changes in water quality over their 24-year sampling window, they have shown that the concentration of salts has been steadily increasing.

Using the analogy of a pot of soup simmering on a stove, Dr. Smol explains: ”If you take the lid off, it is similar to what we are observing in these ponds. The soup will slowly decrease in volume and it will get saltier and saltier as the water evaporates, leaving the salts behind.” The same process is happening with the Cape Herschel ponds, he continues. Water levels are declining and the remaining water is more concentrated with evaporation due to warming.

Another disturbing finding was the drying-up of neighbouring wetlands. In the 1980s, portions of their study region were also characterized by water-saturated wetlands, where the team would need to don hip waders to sample the surface pools of water persisting throughout the summer. However, in 2006, the wetlands had dried to such an extent that they could easily be ignited with a lighter. “The ecological consequences of shifting wetlands such as these from carbon sink to potential carbon sources are frightening,” they say.

Ponds, the dominant source of surface waters in many Arctic regions, are “hot spots” of biodiversity, as well as habitat for many birds, insects, and other organisms, the researchers point out. The resulting ecological changes will likely cascade throughout the ecosystem.

“In the past, researchers like us have sometimes been accused of being alarmist when we discussed climate warming,” says Dr. Smol, winner of the 2004 NSERC Herzberg Gold Medal as Canada’s top scientist or engineer. “We now think we have been overly optimistic – the speed and magnitude of environmental changes are worse than even we imagined!”

Source: Queen's University