VIMS Student Marches with the Penguins

The documentary *March of the Penguins* helped millions of people around the world better understand the many dangers faced by Emperor penguins during their annual migration to Antarctic nesting grounds.

VIMS graduate student Heidi Geisz is studying a more insidious penguin danger— the long-term build-up in their tissues of persistent organic pollutants released by human activities thousands of miles away.

Her research is part of a larger study headed by faculty co-advisors Hugh Ducklow and Rebecca Dickhut (see *The CREST*, Spring 2001). Ducklow heads the Long-term Ecological Research site at Palmer Station, one of three U.S. research stations in Antarctica.

Persistent organic pollutants, or POPs, are chemicals found in insecticides, pesticides, industrial wastes, and flame-retardants. As their name implies, these chemicals resist breakdown, and thus persist in the environment, where they tend to accumulate in the fatty tissues of organisms high up the food chain. Many, including now-banned chemicals like DDT and PCBs, are highly toxic.

POPs accumulate in the Antarctic and Arctic via repeated cycles of evaporation and condensation as they move poleward through the atmosphere from the tropical and temperate zones where most are released.

Ducklow, Dickhut, and graduate student Amy Chiuchiolo began studying Antarctic POPs in 2001. Their initial focus was to investigate the mechanisms by which POPs enter the base of the Antarctic food web. Their studies showed clear evidence that POPs were moving from snow and sea ice into ice algae and krill.

That work naturally led to Geisz's current research—exploring how POPs move up the food web into penguins and other Antarctic seabirds.

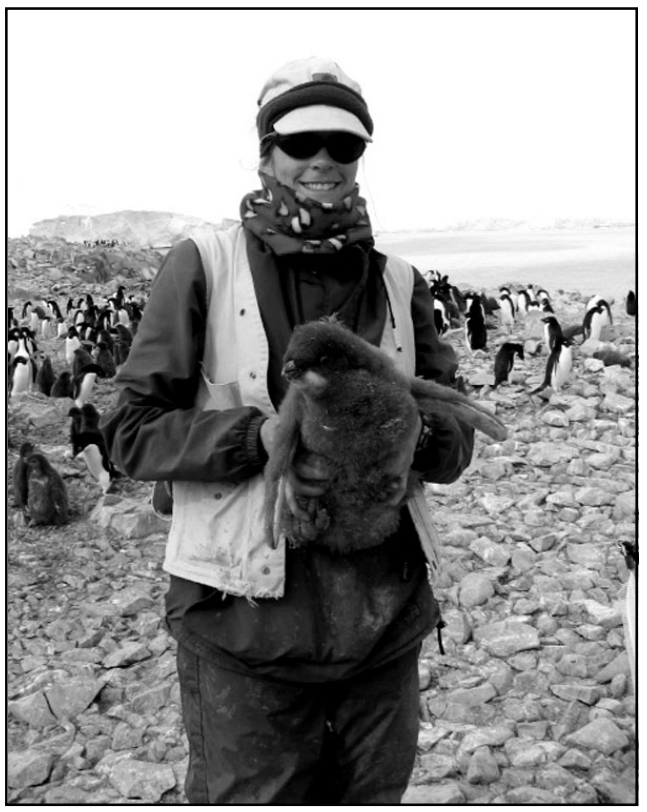
Geisz is studying POPs in Adélie penguins, south polar skuas, and southern giant petrels. Adélies, a smaller cousin of the Emperor, feed on krill and fish; skuas and petrels add the eggs and chicks of other seabirds to their diet. All three species thus risk biomagnification—the process by which contaminants become increasingly concentrated as the food pyramid narrows from the large number of primary producers at its base to the few predators at its peak.

Evidence from the other pole shows a clear link between elevated POP levels and declining health in arctic birds—POPs can cause cancer and are known to disrupt the endocrine system.

Although seabirds in Antarctica have been examined for POPs since DDT was discovered there in the mid-1960s, Geisz's study is one of the first to track POP levels in Adélie penguins. That's because these birds are highly protected and sampling for POPs typically requires invasive procedures to obtain tissue samples. Geisz avoids this concern by dissecting carcasses of Adélies that have already died from natural causes.

Even though the use of DDT is now banned in the U.S., production of other POPs, including the flame-retardant chemical BDE, has increased significantly during the last 20 years. Geisz will be on the lookout for this chemical (which Chiuchiolo found in her studies of plankton and krill), as well as a DDT derivative known as DDE. She will add her DDE data to a record that started when DDT was first discovered in Antarctic penguins in 1966.

To date, POP levels measured in Antarctic wildlife are not readily or obviously harmful, says Geisz. She cautions, however, that they are approaching and in some cases comparable to levels in the Arctic. "That makes new investigations really important," says Geisz.



VIMS graduate student Heidi Geisz holds an Adélie penguin chick.

Geisz began collecting samples for her current study during seasonal trips to Palmer Station in 2002, 2003, and 2004, when she worked with Dr. Bill Fraser, who heads the seabird component of the Palmer Long-Term Ecological Research (LTER) site. The Palmer LTER is one of 26 sites that make up the National Science Foundation's global LTER network, a system designed to investigate ecological processes over many years and across entire ecosystems.

It was at Palmer that Ducklow and Dickhut persuaded Geisz to enroll at VIMS. She began her studies in the School of Marine Science in fall 2004 and was awarded an EPA STAR fellowship for her research. Geisz is now collecting additional Adélie carcasses halfway across the Antarctic continent, working in her spare moments during a 2-month stint with VIMS researchers Walker Smith and Kam Tang, who are conducting a separate study at the U.S. research station in McMurdo.

Returning to McMurdo is a homecoming for Geisz, who began her Antarctic career there on the grounds crew. "I worked one summer at McMurdo shoveling snow for 3 bucks an hour and loving every minute of exposure to Antarctic science," she says.

When Geisz returns to VIMS in February, she will continue analyzing POP levels, both within the McMurdo birds and in those she collected earlier at Palmer.

Geisz's ultimate goal is to use satellite tagging and diet-sampling techniques that have long been part of the Palmer seabird study to explore how the POP levels she measures relate to the feeding habits of her three seabird species—all within the context of the Palmer Station's overall LTER program and the earlier contaminant studies by her VIMS colleagues.

On-going work by the seabird group at Palmer reveals that Adélies, south polar skuas, and giant petrels have different feeding habits. The skuas and petrels migrate equatorward during the austral winter (June-Sep) and return to feed along the ice edge in the austral summer (Dec-Mar). In contrast, Adélie penguins remain in Antarctica throughout the year, feeding close to breeding colonies in the summer and following the ice edge in the winter. That's a trait that Adélies share with their larger cousins the Emperors—they are the only two penguin species that never leave Antarctic waters.

Speaking of Emperors, did Geisz like the depiction of these birds in *March of the Penguins*? "I did," says Geisz. "Although there was a lot of anthropomorphic interpretation of the penguins' actions-words like 'love' and 'bereft'—I thought the natural history was right on. What a great example of highly adapted animals needing a specific niche to maintain a stable population."