The Antarctic Sun

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January 9, 2005

Photo by Bob Pitman / Special to *The Antarctic Sun*

A killer whale mother and calf rise out of the Antarctic waters. They are a smaller type of killer whale that lives in thick pack ice and eats fish. Scientists are trying to determine if these whales constitute a distinct species.

Search for species

By Emily Stone
Sun staff

Three distinct types of killer whales live in Antarctic waters. They look different, eat different foods, and live in different parts of the ocean. The question is, are they different species?

This is what Bob Pitman is trying to find out. He and three other scientists traveled to Antarctica to research the question by taking tissue samples and aerial photographs of whales here.

"Our interpretation is you're looking at different species of killer whales," said Pitman, of the National Oceanic and Atmospheric Administration Fisheries, Southwest Fisheries Science Center.

The distinction would mean more than simply doling out a couple new Latin names. The existence of two or three species of whales versus just one has implications for how Antarctic marine resources are managed, Pitman explained.

Current literature on the whales here says they are opportunistic

See Whales on page 11 and related story on page 4

Small is big in biology

Techniques using DNA lead the way

By Emily Stone
Sun staff

In the world of Antarctic biology, the very large — whales, seals, penguins — would win a popularity contest. But it's the very small — tiny strands of DNA — that may hold the key to the future of biology.

Scientists are using genomics to do research in Antarctica and will likely increase their use of this tool greatly in the coming years.

A genome is an organism's complete set of DNA. Genomics is a catch-all phrase for the different types of analysis that scientists can conduct using a DNA set. The most widely known component of genomics is the work on the human genome. Antarctic scientists are using this same technology and knowledge to study polar organisms.

Genomics can be used to compare the genome of one organism to another to see how they have evolved differently. This can answer, for example, what genes a cold-water species of algae or fish uses compared to a close cousin in a warmer environment. Or scientists can hone in on a single gene held by a number of similar organisms to determine the diversity of organisms in an ecosystem.

"The era of 'genome-enabled' biology is upon us, and these new technologies will allow us to examine polar biological questions of unprecedented scope and to do so with extraordinary depth and precision," reads a 2003 report by the National Academy of Sciences, titled "Frontiers in Polar Biology in the Genomics Era."

Biologist David Caron is using DNA to identify the types of single-celled organisms living in the Ross Sea. He hopes to be able to start using the organisms' full genome for comparative

See Genomics on page 10

QUOTE OF THE WEEK

I think marriage is like a tattoo. I would want it to go away as soon as I got it.

— Pole winterer in a discussion about body art.

INSIDE

Ross Island Chronicles By Chico

Cold, hard facts

Powering Mactown

Fuel delivered by ship to McMurdo annually: **34 million liters**
Cost to buy and ship fuel to McMurdo: **$13 million**
Amount of fuel per summer participant: **7,500 liters**
Fuel used just for electricity: **4.5 million liters**
Fuel shipped to South Pole: **11 million liters**
Fuel used to fly one liter of fuel to South Pole: **1.5 liters**
Amount of carbon dioxide created by burning fuel: **82 million kg**
Value of tanks, pipes and other fuel hardware: **$12 million**
Value of power plant, lines and transformers: **$20 million**
Cost of a light left on all year: **$2/watt**
Cost per minute of shower time: **$1**
Cost per season of 5-minute shower every day: **$675**

Source: Raytheon Polar Services Co. Energy Engineer Peter Somers

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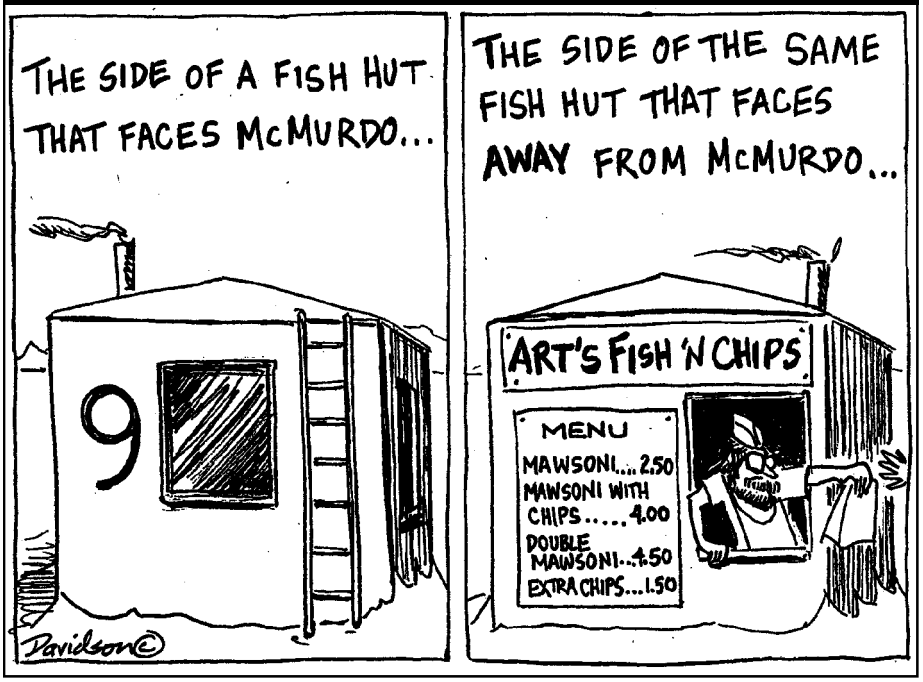


McMurdo rallies for tsunami relief

Group raised more than $12,000 in one week

By Emily Stone
Sun staff

Nancy Farrell hadn't finished setting up the table in front of the McMurdo Station dining hall when people started lining up to put money in the tsunami relief donation jars.

"People were waiting to give," she said. "They were standing there with their $20s."

That was Dec. 29, three days after the deadly tsunami tore across southern Asia, killing more than 150,000 people. A week later, Farrell and a group of McMurdo residents had raised more than $12,000 for the AmeriCares charity. Farrell said it's the largest amount of money ever raised at McMurdo for a single cause.

The group manned the donation jar in front of the dining hall at lunch and dinner for the week. They also put jars in the bars at McMurdo and Scott Base, ran a coffee booth at the New Year's Day Icestock festival, and held a charity bingo game. Other ideas sprang up independently around station, such as the raffle that hairdresser Anita Menezes held to win the opportunity to shave her head. She raised $405 and now sports a buzz cut.

Photo by Brien Barnett / *The Antarctic Sun*

Kim Serrano, lead janitor at McMurdo Station, buzzes barber Anita Menezes' hair after a raffle to raise money for AmeriCares to help victims of the Asian tsunamis.

Photo by Emily Stone / *The Antarctic Sun*

Scientist Akira Yamamoto makes a donation to AmeriCares at the table manned by Tober Schorr in front of the McMurdo Station dining hall. Schorr was one of many volunteers who staffed the table during lunch and dinner for a week to raise money for tsunami relief.

Like people around the world, Antarctic workers struggled to get their minds around the death and devastation in Asia. But, because Antarctic residents also tend to be world travelers, the events half a world away felt more personal to many.

"Some of the places that got hit, I'd been to and had met people there," said Michael Lamb, a dining attendant who helped organize the fundraising. "Even if it was just a brief connection, I made a connection with them. It hit me hard when this happened."

Lamb and his coworkers brainstormed about ways to help. Karl Horeis, a fellow dining attendant, said they talked about the news while reading the *New York Times* digest over their group meals.

"Usually we're this loud, obnoxious group in blue shirts," he said. "With the death toll rising from 50,000 to 80,000 to 100,000, we were just dumbfounded."

Lamb, Horeis and company met at the Coffee House after work on Dec. 28 to come up with fundraising ideas. They learned that Farrell and her friends were doing much the same thing, and the two groups joined forces. They started by setting up the mealtime donation jars. The other ideas soon followed.

Farrell, the work order supervisor for the facilities, engineering, maintenance and construction department, said the idea of raising money grew out of a discussion at the end of a "stitch and bitch" knitting group. People felt helpless and wanted to figure out some way to be useful, she said. Farrell, who is the co-organizer of the annual Women's Soiree fundraiser, had some ideas about how to collect money at McMurdo.

Aside from giving money, some people on station want to go to Asia to volunteer with relief organizations at the end of the season. A dozen people gathered last week to discuss the idea. They decided it was too early to get a good sense of the opportunities and needs there and will continue to research the plan.

Amy Pashov came up with the idea to raise money by selling coffee drinks at Icestock. She sent out an e-mail asking for donations of coffee and coffee presses. Within five minutes, she said someone was at her door, coffee press in hand.

"Everyone just wanted to be able to help somehow," she said. The stand raised nearly $1,000 in the first hour and a half at the show.

Tina Pacheco, who works with Pashov and Farrell, had a donation jar at her chili cook-off stand at Icestock.

"We had something that we could do, however indirect," Pacheco said. "When I talk to my grandchildren about the greatest disaster in my lifetime, I want to be able to say I did something."

Rare whale spotted from icebreaker

By Bob Pitman
Special to The Antarctic Sun

Photo by M. Hall, © Museum of New Zealand, Te Papa Tongarewa / Special to *The Antarctic Sun*

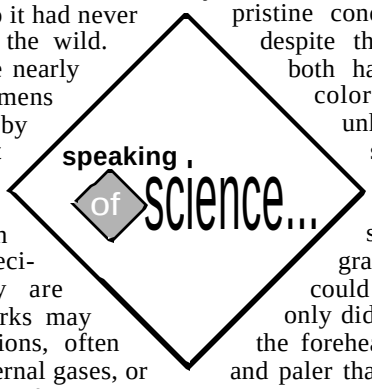
A very rare Shepherd's beaked whale found dead on a New Zealand beach. Notice the long beak and distinctive pattern. Bob Pitman saw three Shepherd's beaked whales swimming last month as he rode the Polar Star *icebreaker from Hobart to McMurdo.*

We were in transit to McMurdo Station, Antarctica, aboard the USCG icebreaker *Polar Star*. My colleague Erik Eilers and I were doing National Science Foundation-supported research on killer whales in Antarctica. We decided to do an informal whale and dolphin survey on the way to the Ice from Hobart, Tasmania, because of the unexpectedly good weather we were having. (The "Roaring 40s" were taking a couple days off.)

Around midday on Dec. 12, we saw a group of three suspiciously small whales rolling at the surface about a kilometer ahead. As we approached at 28kph, they surfaced several more times. Something about them was not quite right. Then, as they all arched up fairly high for their final dive, I got a clear view of one animal's beak and an unusual color patterning. Tasmacetus! After my 30 years at sea and 13 trips to Antarctica, they finally stepped out from behind the curtain.

The Shepherd's beaked whale (*Tasmacetus shepherdi*) was unknown to science until 1937 when it was described as a new genus and species of whale from a beached specimen in New Zealand. Since then, a total of 30 stranded specimens have been found on scattered beaches. From these we know that it probably lives in temperate, offshore waters around the world in the Southern Hemisphere.

Up until two years ago it had never been identified alive in the wild. This was mainly because nearly all of the stranded specimens were in such bad shape by the time a whale expert got to them. Most whales that wash up on beaches don't look much like healthy, living specimens. Sometimes they are starved or diseased, sharks may have left some impressions, often they are bloated from internal gases, or they get beaten up in the surf.



And worse, after just a couple of hours on the beach, color patterns dissolve to uniform black as the skin starts to peel and blister — especially on a sunny day.

So 65 years after discovery, no one had seen a live *Tasmacetus* and we still did not know what they looked like. And this was no pocket gopher we were looking for: although a little small by whale standards, it was still 6.7m long and weighed in at about 3.5 tons.

In the 1990s, two separate stranded specimens were collected in New Zealand by Anton van Helden, curator of marine mammals at the Museum of New Zealand, Te Papa Tongarewa, in Wellington. Both animals were males (a juvenile and an adult), and both were in pristine condition. Most amazingly, despite the age differences, they both had the same, distinctive color pattern, a pattern unknown among the 20 or so other species of beaked whales.

When Anton showed me the photographs, I knew this animal could be identified at sea. Not only did it have a long beak, but the forehead (or melon) was steep and paler than the back. Most importantly, it had a broad white swath that came up from the belly, passing behind, then above the flipper. In the water, the top of the swath would look like a white patch above the flipper — a mark that no other beaked whale would have, and a mark I saw from the *Polar Star.*

Beaked whales are the least known of all the whales and dolphins. Several species have never been identified alive in the wild, including one known only from three partial skulls. They are deep divers, able to stay submerged for an hour or more. And they are shy of vessel traffic — they don't like attention and they don't like company. Consequently, they are not seen often and are rarely identified when they are spotted, even by trained observers.

The only previously confirmed live sighting of a Shepherd's beaked whale was in 2002 at Gough Island, in the South Atlantic. Like many other species of beaked whales, it isn't known if Shepherd's beaked whales are really rare or just rarely identified. They inhabit some of the stormiest oceans in the world, so we may never know the answer to that question.

At least now we know what the whale looks like and that means we have a better chance of learning more about it in the future. Although I am probably still only slightly less likely to see a plesiosaur in the Southern Ocean, at least the prospects are better that I won't have to wait another 30 years to see my next Shepherd's beaked whale.

NSF-funded research in this story: Bob Pitman, National Oceanic and Atmospheric Administration Fisheries, Southwest Fisheries Science Center

around the continent

SOUTH POLE

New Year's weekend

Compiled from reports by Brenda Everitt and other sources

South Pole Station rang in the New Year in style, with a party featuring four volunteer bands and an energetic crowd in the garage. Bands "Speed Carrot," "Construction Debris," "Fingie Lickin' Good," and "Squeaky Meat" rocked until after 3 a.m. A go-go cage, constructed especially for the party by Chris Getz, was filled with dancers for most of the evening.

On New Year's Day, the 2005 South Pole marker was installed in a brief ceremony. Because of the motion of the ice sheet over the South Pole, the geographic pole location shifts by about 10m a year. The 2005 marker was designed by Dehlia Sprague and fabricated by Allan Day, both of whom wintered at the South Pole in 2004. The underside of the copper and brass marker was signed by the wintering crew as is the tradition with all of the South Pole markers.

An open house for the IceCube neutrino detector was held Jan. 2. After a brief presentation about the science project, participants were able to tour the construction site and view facilities and equipment that have been put in place this season to support drilling operations.

This season's goal is to drill the first four holes of the experiment in the ice using hot water. Each hole will contain a "string" of 60 optical modules. The modules will be located in a gridded area that covers the surface for about a square kilometer and from about 1.4km to 2.4km below the surface, in the clear ice zone. Eventually, the network of modules will cover a cubic kilometer. The optical modules detect light in the form of Cherenkov radiation given off by a secondary particle called a muon after the subatomic particle called a neutrino collides with an atom of ice. The main goal of the IceCube experiment is to map high-energy extraterrestrial neutrino sources in deep space.

The New Year's weekend also brought mild weather with sunshine and temperatures slightly above zero. Station residents played impromptu games outdoors including kickball, ultimate Frisbee and capture the flag. More outdoor activities are planned for the upcoming weekend, including volleyball, badminton, croquet, Frisbee golf, and horseshoes.

A group of Russians have been working on the Antonov 3T airplane, which was stranded at Pole three years ago. A replacement engine was installed and various systems were repaired. The biplane performed a successful test flight on Jan 4.

The Chilean South Pole Scientific Expedition completed its return trip from the South Pole to Patriot Hills, arriving on New Year's Eve. The International Trans-Antarctic Scientific Expedition-affiliated traverse team reported it was able to achieve their scientific goals, including taking glacial snow samples at every 2 degrees of latitude, gravity measurements every 20km, and GPS and snow accumulation radar records. They also expressed thanks for the hospitality.

Photo by R. Schwarz / Special to *The Antarctic Sun*

The 2005 marker relocation ceremony was held on New Year's Day. The South Pole sits on a moving ice sheet and the marker must be moved each January. Chris Danals moved the American flag for the ceremony.

PALMER

LTER cruise begins

By Kerry Kells
Palmer correspondent

The sea ice departed, allowing for research and even a little recreational boating on our New Year's holiday. Friday was a spectacularly sunny and warm day to get off station.

We welcomed the research vessel *Laurence M. Gould* on a windy Sunday evening. All 37 residents of Palmer Station greeted the ship wearing bright orange T-shirts from our station store.

The ship brought several important principal investigators to Palmer Station, including a new research team.

Many of the researchers will be back on board the ship for the Long Term Ecological Research Cruise, LTER, in which the ship follows a grid pattern south as far as Avian Island, more than 300km south of Palmer Station. The seabird researchers will camp on the island for

See Continent on page 6

the week in weather

McMurdo Station
High: 39F / 4C
Low: 21F / -6C
Max. sustained wind: 33mph / 54kph
Windchill: -4F / -20C

Palmer Station
High: 43F / 6C
Low: 29F / -2C
Max. sustained wind: 38mph / 61kph
Precipitation: 18mm

South Pole Station
High: -4F / -20C
Low: -14F / -25C
Peak wind: 21mph / 34kph
Max. Physio-altitude: 3114m

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five nights. Avian Island is just south of Adelaide Island where the British Antarctic Survey research station, Rothera, is located. During the cruise, each group will collect samples for their component of LTER along the grid.

The new arrivals include Richard Lee, a principal investigator from Miami University's Department of Zoology. Lee was in Antarctica in 1979 and 1980 to document the ability of the Antarctic midge, *Belgica antarctica*, to tolerate different stresses. *Belgica antarctica* is the largest and most southerly insect that undergoes a complete metamorphosis. Lee is here with a team of five — David Denlinger, Scott Hayward, Joseph Rinehart and Lucas Sandro — to further the research in an ecological context. They will research how the midge survives in different microclimates and with different micro-inhabitants. Their research will look at the possibilities of protective molecules gained from macroalgae, a primary food source of the midge. At this time of year, the larvae experience snowmelt, summer warming and occasional drying. The research will take the team to several locations near Palmer: Bonaparte Point, Norsel Point and the Torgerson and Humble islands, which have high populations of the midge larvae.

Photo by Jackie T. Samuel / Special to *The Antarctic Sun*

The U.S. Antarctic Program's resupply vessel, the American Tern*, leaves Port Hueneme, Calif., Jan. 6, on its way to McMurdo Station.*

SHIPS

American Tern

Compiled from reports by Jackie Samuel
Port Hueneme Operations

The U.S. Antarctic Program resupply vessel *American Tern* is on its way to McMurdo Station, loaded with more than 4.5 million kg of cargo.

The *Tern* left its dock at Port Hueneme, Calif., Jan. 6. It's estimated the ship will arrive in New Zealand on or around Jan. 24, before it heads south to McMurdo.

The ship arrives once a year with all the food, materials and most of the science cargo used to supply McMurdo and South Pole for the coming year.

Learn more about the *Tern:* http://www.msc.navy.mil/inventory/ships.asp?ship=americantern&type=ContainerShip

NBP

Compiled from reports by Alice Doyle

The *Nathaniel B. Palmer* started the new year collecting various kinds of samples in the Ross Sea. The scientists on board are primarily studying phytoplankton, particularly a common Antarctic variety called *phaeocystis antarctica*. They were able to use satellite images to locate areas with the highest concentrations and will remain in those areas for six days to take samples.

The weather held for most of the week, with sunny skies, fair winds and warm temperatures. On Dec. 31 the sun was still shining, but the temperatures began dropping.

The ship's crew and scientists celebrated the New Year at midnight New Zealand time, even though they were on the east side of the dateline.

LMG

Compiled from reports by Andy Nunn

The *Laurence M. Gould* left Punta Arenas, Chile, on Dec. 29, after a weeklong port call. During the port call repairs were completed on the sonar window, baltic room boom and main crane, and a new fairlead head was installed on the knuckle crane.

The weather improved as the *Gould* continued south into the Drake Passage. The ship arrived at Palmer Station on Jan. 2.

Polar Star and other ships

By Lt. Cmdr. Don Peltonen
Ship operations

The U.S. Coast Guard icebreaker *Polar Star* completed its initial cut of 130km to McMurdo and moored at the ice pier the evening of December 30. The fuels group pumped approximately 1.5 million liters of fuel to the ship on December 31. That same day crew on the *Polar Star* discovered small hydraulic oil leaks on the hubs of her port and then starboard shafts. Temporary patches were installed and effectively minimized the oil leaks until permanent repairs are made. *Polar Star* and McMurdo Station have jointly addressed cleaning up the oil from the water and ice around the ship. *Polar Star* will remain at the ice pier while a commercial dive team travels to McMurdo to retorque bolts on both hubs. The permanent repair is expected to take the divers approximately six to eight days. The unexpected repair to the *Polar Star* adds an additional challenge in preparing the ship channel.

While *Polar Star* is moored, McMurdo residents can take tours of the ship.

Other ship news:

On Jan. 3 the *Kapitan Khlebnikov*, a private tourist ship not associated with the U.S. Antarctic Program, transited *Polar Star*'s initial cut and stopped off Cape Royds to conduct visits to Cape Royds and Cape Evans. The following day they brought visitors ashore to McMurdo Station via helicopter.

The fuel tanker *Paul Buck* is scheduled to depart Brisbane, Australia in the next few days and is projected to arrive at the fast ice edge Jan. 20.

The Russian icebreaker *Krasin* is underway en route to the Ross Sea from Vladivostock, Russia to provide additional support.

Wind, sun keep field camps buzzing

By Brien Barnett
Sun staff

Conservation in Antarctica reached a milestone last month with the installation of a solar array and a wind generator at New Harbor.

New Harbor, across the sound from McMurdo Station, was the latest of the U.S. Antarctic Program's permanent field camps in the area to be equipped with alternative energy sources, said Renewable Energy Specialist Joe Yarkin, who works for Raytheon Polar Services Co.

Fuel generators at the permanent field camps now backup the solar and wind systems. It makes for a quieter, more efficient operation at the camps while meeting the U.S. Antarctic Program goal to conserve energy and become less dependent on fossil fuels.

Yarkin said the New Harbor installation was the fifth Dry Valleys camp to get either solar or wind systems or both. Besides New Harbor, camps at sites in the Taylor Valley that got installations included Lake Bonney, Lake Hoare, Lake Fryxell and F6. Another permanent camp at Cape Crozier and temporary camps at Cape Royds and the Penguin Ranch on the sea ice also have solar or wind power to supplement fuel-powered generators. Telecommunications equipment on Black Island have been powered by wind turbines for many years.

Peter Somers, Raytheon energy engineer, said the improvements at the permanent camps lead the way in reducing McMurdo Station's use of fossil fuels.

A preliminary report issued in November raised the possibility of adding a wind farm on a ridge above McMurdo Station. If the initial findings pan out, the station could get 10 percent to 20 percent of its power from wind, Somers said. The new system could be paid for with fuel cost savings in less than two years, the report said.

Somers, who has 20 active projects on a list of 400 ideas to reduce energy usage or improve energy efficiency, said wind power would add power diversity to the mix and help the station be less reliant on the annual visit from a fuel ship. The station uses 4.5 million liters of fossil fuels each year just to heat the station. For now, simple actions that emphasize energy awareness, from turning off outside lights in the summer to turning down the thermostat in storage areas year round, are helping move the program toward its goal of reducing energy usage by 5 percent.

At the field camps, reliance on fossil fuels already has been minimized. The Taylor Valley wind and solar sites are capable of supplying 2kw to 4kw of power, enough to power lights, heaters and lab equipment such as centrifuges that researchers use to spin samples.

Until the solar panels and wind generators were installed, the camps had to rely on fossil-fuel-powered generators that provide 6kw to 12kw of power when turned on. Power, though essential, was wasted. For example, if a carpenter needed to power a drill or a scientist wanted to turn on an instrument, they also had to run other things to soak up the extra power or the generator wouldn't work properly.

"They had to plug in heaters and other stuff to use it," he said.

At the New Harbor site, riggers recently erected a 10m tower about 30m from the huts. At the top of the tower, the riggers mounted a 2m wind turbine sporting three blades. The electricity generated by the wind turbine is channeled back to a shack. Next to the shack and about a meter off the ground, a solar array is pointed at the sun. Both units send power to batteries inside the shack. The batteries are connected to a wall unit that inverts the power from direct current to 110-volt alternating current — the same current in a regular wall outlet — and is fed to the camp and lab huts.

"It's power on demand now," Yarkin said.

The system cuts back on generator run time and offers a cleaner, quieter environment for researchers and camp staff.

The solar units at the camps average about 2.5m square and produce about 2kw to 4kw of power. Each array has eight standard solar panels. The panels produce electricity as photons interact with the material and knock off electrons, which are channeled to the batteries. With nearly six months of continuous daylight, solar power is a good choice for the Antarctic summer, Yarkin said.

Nearly constant wind year-round means even on cloudy days when solar panels are weakest, most camps will have some alternative power available.

In addition to constant daylight and

See Power on page 8

Photo by Brien Barnett / *The Antarctic Sun*

Riggers place a wind turbine at the top of a 10m tower at New Harbor on Dec. 24.

> "We're trying to make it more effective and efficient for further energy savings."
>
> ***— Joe Yarkin, renewable energy specialist***

Photos by Brien Barnett / *The Antarctic Sun*

Left, Joe Yarkin, renewable energy specialist with Raytheon Polar Services Co., wires a box behind a solar panel at New Harbor. Below, a rigger assembles a tower for a wind generator at New Harbor, across the sea ice from McMurdo Station.

Power

From page 7

consistent wind, Antarctica offers another advantage, Yarkin said. As long as the batteries are kept insulated, it seems the low temperatures increase the overall efficiency of the systems he's installed.

"We can get more power out of the system," he said.

Antarctic conditions also have a drawback. Commercially available "auto-trackers" — small motors used to keep the panels facing the sun — are used in the United States and other temperate regions, but they haven't stood up to Antarctica's cold and dusty conditions, Yarkin said.

To keep the solar arrays on target with the sun, someone has to move them about every four hours. The freely rotating design also reduces windstorm damage.

The field camps are vacated near the end of summer before the winter darkness sets in. Yarkin and others will spend a week closing the camps and stowing the solar panels and wind turbine blades in the shelters. It will all be reassembled the following summer. Once the solar and wind generators are set up, the camp staff or scientists can watch a series of gauges and manage their own power needs. Units in the system track power data for Yarkin.

On days when power requirements are light, the wind power alone may be enough to keep things operating. If more is needed, the batteries are there to draw on. If there's no or little demand, the solar array and wind turbine charge the batteries. The fuel generators need to be turned on only on very cold days or when extra power is needed for research or emergencies.

"We're trying to make it more effective and efficient for further energy savings," Yarkin said.

Continental Drift

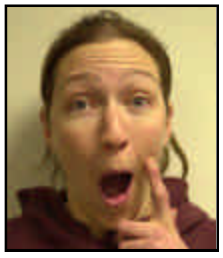
What new thing have you learned or tried in Antarctica?

"Krill sushi."

Cara Sucher,
Palmer
lab supervisor,
from Denver, Colo.,
Seventh season

"I got to groom snow in a Challenger with Jules Uberuaga."

Hunter Slaton
McMurdo
dining attendant
from New York City,
first season



"I've learned that Polie R&R in McMurdo makes you appreciate how good you have it at Pole."

Kelly Siman,
South Pole
cargo,
from Hiram, Ohio,
third season

Tiny sea creatures thrive in cold

By Emily Stone
Sun staff

Rebecca Gast wants to understand why a group of single-celled organisms living in frigid Antarctic waters not only tolerates the extreme cold, but seems to thrive in it.

"They like to grow in the cold," said Gast, an associate scientist at Woods Hole Oceanographic Institution in Massachusetts. "They may not grow really fast, but they like to grow in the cold."

Gast and David Caron, a biology professor at the University of Southern California, are principal investigators on a project to study Ross Sea protists. Protists are single-celled organisms like algae and plankton that make up one of the first and most important levels of the ocean food chain.

"If you don't have the plankton, you don't get to see the whales and the seals," Gast said. "Not a lot of attention is paid to the microbial world sometimes, but they're very important."

Gast and Caron want to know how these Antarctic protists have adapted to the cold water. How have specific genes adapted to allow the protists to survive? How does their growth rate and metabolism compare to similar organisms living in temperate waters?

This research could be useful in understanding the effects of global warming on Antarctic marine ecosystems. If the protists have developed specific genes that allow them to live in the cold, but cause them to die in warmer waters, what will happen to the ecosystem if global temperatures rise and the massive phytoplankton bloom is weakened?

Two scientists are now on the *Nathaniel B. Palmer* collecting water, ice and slush samples for the project. Great care is taken to keep the samples cold on their trip to Woods Hole and USC. If the samples warm too much, the group of protists that can survive only in cold water are killed. These are the protists that most interest the scientists. Many of the organisms the group has isolated die if the water gets above 10C, Gast said.

The group, which is in its second season in the field, was surprised to learn about the distribution of species within water versus ice, Gast said. Instead of finding similar species in water and ice samples from the same spots, they found that the protists living in the samples were quite different. However, the species in water samples or in ice samples taken from different testing locations in the Ross Sea are fairly consistent.

The Ross Sea is a more diverse microbial community than scientists expected for such a cold environment, Caron said. And it is thriving. The annual phytoplankton blooms are among the biggest in the world. The blooms are the initial step in transferring carbon up through the food chain. They feed small marine animals, which in turn feed the large ones.

The scientists also have identified a new genus of dinoflagellate that blooms in the Ross Sea pack ice region. People had seen the organism before, but didn't know what species it was. Gast said they've submitted a paper on this, though it has not yet been published.

In their current work, the scientists want to better understand the diversity of the protist communities. They've started using DNA to do this. They hope eventually to use genomics to compare the Antarctic DNA to DNA from similar protists in warmer waters to identify the genetic differences between them.

"Can we see changes in gene function that relate to their adaptation to specific environments?" Caron asked.

Although their work is focused on understanding the basic biology and ecology of protists, it also has some practical implications, Caron said. For example, they may discover an enzyme that functions particularly well in the cold. This knowledge could be used in every day life.

"If you've got detergent enzymes that work at exceptionally low temperatures, you don't have to heat up your washing machine," he said.

Photo by Astrid Schnetzer / Special to *The Antarctic Sun*

Rebecca Gast and Bob Sanders hook up the water filtration system on the Nathaniel B. Palmer *last year.*

Photo by Astrid Schnetzer / Special to *The Antarctic Sun*

Bob Sanders of Temple University hooks up a water filtration system on the Nathaniel B. Palmer *last year, where a group of scientists took water samples to study single-celled organisms.*

NSF-funded research in this story:
Rebecca Gast, Woods Hole Oceanographic Institution, and David Caron, University of Southern California,
http://www.whoi.edu/science/B/protists/,
http://www.usc.edu/dept/LAS/biosci/Caron_lab/

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research within a few years.

Caron studies algae and protozoa. One of his goals is to understand the diversity of these organisms. Traditionally, this work was done by counting organisms under a microscope. This is far from ideal for polar work.

"As soon as you put a sample in the microscope, it warms up and things start to die," said Caron, a biology professor at the University of Southern California.

He has begun using DNA sequences instead. He extracts the DNA from all the organisms within a water sample and then performs a series of tests to determine how much diversity exists within the sample.

He hopes to start using the entire genome of these organisms in his work. First the genome needs to be sequenced — something scientists rarely do themselves. Instead they ask the government agencies and private foundations that fund genomics to prioritize a particular organism for sequencing. He hopes the sequences for his Antarctic work are done in a few years.

Then, Caron will be able to compare an Antarctic organism's genome to a close relative in a temperate zone. He will look for differences in gene function between the two cousins, specifically whether certain genes have adapted to tolerate cold versus warm water.

"The response of an organism in the environment to changes in the environment is fundamental,"he said.

Bess Ward has used a genomics process to identify the diversity of bacteria in waters around the world and plans to start using it soon on samples taken from Lake Bonney in the Dry Valleys.

Ward studies denitrifying bacteria, which are the bacteria that take nitrates out of an ecosystem. Her research focuses on the relationship between the diversity of denitrifiers in an ecosystem and their function within that ecosystem. For example, she wants to understand if it makes a difference if a body of water has 10 species or 1,000 species of denitrifiers living in it. Does increased diversity make for more efficient denitrification? Does it better protect an ecosystem from environmental harm?

Ward, a geosciences professor at Princeton University, has studied this question in bodies of water such as the Chesapeake Bay and the English Channel. In that work, she uses a genomics process to identify the number of species of bacteria in water samples. This process is quicker and less expensive than the one she used to use. She plans to start using the same technique with her Antarctic samples when she returns to Princeton this month.

Photo by Brian Lanoil / Special to *The Antarctic Sun*

Members of the McMurdo Dry Valleys Long Term Ecological Research Limnology team and the McMurdo Dry Valley Lakes Microbial Observatory team drill into Lake Vanda earlier this season to sample for bacteria to use in DNA work.

First, she takes a water sample and uses a process called polymer chain reaction (PCR) to extract all the different varieties of a single gene that she's specified. She uses a functional gene approach, which means she focuses on genes that help perform a biochemical process, or as Ward puts it, "do something of interest." In this case, she hones in on a gene used in denitrification. Different species of bacteria have slightly different genes for the same function. So if she ends up with 100 different varieties of the denitrifying gene, then she knows she has 100 different species of bacteria.

Once she has all the different varieties of the gene, a machine carefully places a single strand of DNA from each gene onto a one- by three-inch glass slide. This slide is called a microarray.

She then takes a new water sample and uses PCR to extract all the varieties of the same denitrifying gene. She puts a glow-in-the-dark chemical in the new sample and puts that sample on the microarray. If the DNA from the new sample matches the DNA on the microarray, it lights up. Ward then knows that certain species of bacteria are present in her new sample.

"I can see which of those dots light up," she said. "It's very gratifying."

She can keep using the same microarray with each new water sample. Previously, she had to catalog the genes using a much slower process that had to be repeated with each new sample.

The information she gets from this work tells her about the diversity of bacteria in a body of water and lets her compare it against other bodies of water, or other parts of the same water. She can learn what effect pollution has on the number of denitrifiers within the water, and can see if the "healthier" water has species of bacteria that are missing in the polluted water.

Ward plans to start using microarrays with water samples from Lake Bonney. The lake appears to have little diversity among its bacteria. Microarrays will let Ward explore this, and compare Lake Bonney's diversity to other lakes.

She will also be able to compare the denitrifiers from the east and west sides of Lake Bonney. Something appears to be wrong with the denitrifying process on the east side of the lake, Ward said, though scientists aren't sure why.

Brian Lanoil of the University of California-Riverside, is studying the microbial life in the Dry Valleys lakes and is using PCR as well. Like Ward, he uses it to determine the diversity of microbial life in the lakes.

"Usually when you do ecology, you do it in kind of a black box way," he said. "You measure certain activities: respiration, photosynthesis. You don't really care who's doing the photosynthesis, who's doing the respiration. What we're trying to do is break down those black boxes and find out who's in there."

Scientists don't know anything about more than 99 percent of the world's bacteria because they can't figure out how to grow it in a lab, Lanoil said. Getting their DNA from field samples can help remedy this.

"You can tell who they're related to," he said, "and who their cousins are and who their second and third and 15th cousins are."

NSF-funded research in this story. David Caron, University of Southern California, and Rebecca Gast, Woods Hole Oceanographic Institution: www.whoi.edu/science/B/protist; Bess Ward, Princeton University; Dr. John C. Priscu, Montana State University, Bozeman, and Brian Lanoil, University of California-Riverside, http://www.mcm-dvlakesmo.montana.edu

Photo by Bob Pitman / Special to *The Antarctic Sun*

A killer whale surfaces near Beaufort Island last month as seen from the U.S. Coast Guard icebreaker Polar Star. *Scientists rode to McMurdo Station on the ship to take tissue samples and aerial photographs of killer whales to help determine if there is more than one species of the whales in Antarctic waters.*

Whales From page 1

eaters, switching from seals to fish to other whales as they travel. But, if the three types exclusively eat three separate types of prey, then what happens if one of their prey is reduced or killed off?

"This one form of killer whale might not have the opportunity to switch prey," Pitman said.

The three types of killer whales are: larger ones that live in the open ocean and eat minke whales; a smaller type that lives in loose pack ice and eats mainly seals; and another small type that lives deep in the pack ice and eats fish, primarily *Dissostichus mawsoni*, commonly called Antarctic cod. All three have different eye patches. Scientists have discovered consistant genetic differences between the groups.

These distinctions alone aren't enough to deem the groups separate species, Pitman said. After all, plenty of groups of humans look different, live in different places, eat different meals and have slightly different genetic make-ups. But we're still all the same animal.

Pitman says the main criterion is whether the groups interbreed. And the whales don't seem to be.

"If you put people who are remarkably different together, they would still interbreed," he said.

The Antarctic whales aren't the only ones to be separated into different types. Killer whales in the North Pacific also appear to live in three groups that coexist, but eat different foods and don't interbreed. Research in Antarctica could translate to those Pacific whales, and could yield information about how to manage ecosystems there so the whales are better protected.

> "If you put people who are remarkably different together, they would still interbreed."
>
> *— Bob Pitman, whale researcher*

The whales in the North Pacific seem to be less different from each other than the ones here. The smaller Antarctic whales are about 6m to 7m long, which is about 1m to 1.5m shorter than the large, open-water whales. The fish-eaters travel in a different school size than the other small whales, which sets them apart.

"Clearly in the North Pacific and in the Antarctic, killer whales are on the road to diversify, and they seem to be farther down the line here," Pitman said.

Pitman rode into McMurdo Station on the U.S. Coast Guard icebreaker *Polar Star*. His plan was to use a small boat to go out to groups of whales as they were spotted from the ship. He uses a crossbow and a dart with a hollow tip to take a tissue sample from the whales. The dart pops out of the whale and floats in the water until it can be retrieved with a net.

Pitman wasn't able to do any such sampling on his trip from Hobart because of other priorities on the ship. He's looking into getting onto another ship for a bit to do some sampling. This is the first year in his two-year project, so he will have a chance to do more sampling next year.

He was able to make one helicopter trip off the *Polar Star* to take aerial photographs of the whales. The camera is hooked up to the altimeter, so the scientists can figure out the whale's exact measurements to within a centimeter from the pictures. Pitman's team plans to fly by helicopter out of McMurdo Station while they're here to take more pictures.

Some people think the second two types of whales are smaller because their diet is different from the larger whales. Measuring differences in body proportion will shed light on this, Pitman said.

Pitman was in Antarctica in the 2001-2002 summer season collecting the same type of data. Based on that information, the consensus among the scientific community is that more than one species of whale likely exists, but more evidence is needed. That's why Pitman is here again.

Geneticists have found differences in the whale's genes, but they aren't sure what genes to focus on to determine if the differences constitute a whole new species, Pitman said

"The genetic work is still a work in progress," he said.

The photographs are easier to understand and given the right conditions, are easier to get. Obtaining a couple hundred photos would make for a successful season, Pitman said. The fish-eating whales travel in packs of a hundred or so. Finding a couple such packs would be ideal.

"We could hit it out of the park in one afternoon," Pitman said.

NSF-funded research in the story: Bob Pitman, National Oceanic and Atmospheric Administration Fisheries, Southwest Fisheries Science Center.

Pitman will be giving a science lecture Wednesday at 7:30 p.m. in Crary Library.

Profile Lucky break led to career on Ice

By Kristan Hutchison
Sun staff

Photo courtesy of Nelia Dunbar / Special to *The Antarctic Sun*
Nelia Dunbar, center, walks past ice structures built up around volcanic vents on Mount Erebus with other researchers.

Nelia Dunbar trained for her Antarctic field work in the African desert.

As a teenager, she had no idea her family forays into the western Sahara were preparing her for a much colder desert. In fact, after seeing Roman ruins and prehistoric paintings on cave walls, she entered college expecting to become an archaeologist.

Her first semester at Mt. Holyoke College in Massachusetts, Dunbar discovered she actually didn't like archaeology.

"It just seemed kind of intrusive or something, digging up people's bones and things," Dunbar said.

What she really enjoyed was her geology course, partly because of the professor.

"Some professors can really interest and motivate you," Dunbar said. "It can really change your life."

Geology became Dunbar's major, her masters and eventually her Ph.D. thesis at New Mexico Institute of Mining and Technology. She went there because she planned to go into economic geology, helping mining companies find profitable deposits. That was before another twist of fate landed her in Antarctica in 1983.

A scientist scheduled to go to Antarctica with Phil Kyle's group to study the Erebus volcano suddenly got sick, and Kyle asked Dunbar to go along as a replacement. Since she wanted to do a thesis in New Zealand, on the explosive eruption of the Taupo volcano on the North Island, she agreed.

That season was one of bonding with Antarctica. She did some work on the islands near McMurdo Station, then flew to the top of Mount Erebus. It was her first time on an active volcano, and the volcano played up its part.

"Right when we got up there, there was a big eruption and bombs rolled down the hill," Dunbar said. "The bombs were still hot and steaming and I thought 'Wow!'"

Dunbar completed her thesis on Taupo, but the southernmost continent became her career. That first year, she discovered her rugged travels as a youth had left her well-suited for field work.

"You're living in circumstances that are often a little different than you're used to. Everything's a little bit harder. You have to make all your water and you're not very clean and you're living in a tiny space," she said. "All those things make you physically a little uncomfortable, but if your enthusiasm for what you're doing counterbalances that, then you're someone who likes working in the field."

Photo courtesy of Nelia Dunbar / Special to *The Antarctic Sun*
Nelia Dunbar and her husband, Bill McIntosh, rest in an ice cave on Mount Erebus.

She had the enthusiasm, and her upbringing made her adaptable. Her father was in the foreign service and the family moved to Iran when she was 6 months old, Afghanistan a few years later and then to North Africa when she was 11. When Dunbar went to boarding school in the U.S., at age 16, she had been to three times as many countries as U.S. states.

Antarctica was her fifth continent, and she continues to travel between field seasons, including returning to Morocco for the first time since she lived there as a 13 year old. She was surprised how strong her memories still were, and how familiar things she'd forgotten seemed, like the taste of harira, a chickpea tomato soup she hadn't eaten for 20 years.

"It was so good." Dunbar said. "The things that you do when you're that age, between 10 and 18, they become part of you."

Dunbar has spent 18 seasons working in Antarctica. Her second season was the most formative. She was sent to Cape Crozier and the Dry Valleys with one other graduate student to look for green rocks called xenoliths, which volcanic eruptions bring up from within the Earth's crust. They were both about 22 years old and Dunbar was in charge of organizing the camp logistics.

"It gave us both a good taste for seeing new things and exploration," Dunbar said.

In following years Dunbar went further afield, to explore mountains and outcrops in West Antarctica. Often she's the first one to land on a particular mountain or outcrop. The bits of rock sticking out of the ice plateau are mostly volcanic. Dunbar likens it to the Pacific Northwest if it were buried beneath 1,500m of ice, leaving the top of Mount Rainier and the Cascades sticking out. The exposed rock helps date the ice, as does ash left from previous eruptions. The last big eruption was about 8,000 years ago.

"It's great when everything falls into place and you can see what's going on," Dunbar said.

This season she was on Erebus again, where she has spent about a third of her Antarctic field seasons. The active volcano is unique because it exists in such a steady state, with its lava pool exposed to scientists. It is also the only volcano in Antarctica that is still actively erupting, though three others are considered active — Mount Melbourne, Mount Berlin, and Deception Island.

She often works in Antarctica with her husband, Bill McIntosh, whom she met on her first trip to Erebus. Between Antarctic seasons, they live on a 20-acre farm near New Mexico Tech where they grow hay and board horses. Dunbar is eager to get home and ride her three horses.

"When you have a very intellectual job, it's nice to have something you do that's very physical."