



A. HAAG

A trip of a lifetime

Are research expeditions to far-flung destinations as glamorous as they sound? Amanda Haag joins a few research novices who gave up their holidays for science.

It is a cold, overcast May morning on a tiny island in the Gulf of Maine. Bill Clark and Karen Abbey are scrambling across algae-coated rocks, choosing their steps carefully to avoid seabird nests and poison ivy. One wrong move could send a protective gull parent into alarm mode, leaving the pair being screeched at, pooped on or, worse still, dive bombed.

Clark and Abbey have put themselves in this precarious position to measure eggs and to place chicken-wire cages over empty nests ready to catch a gull when it returns. When they secure a bird, it's over to Julie Ellis, an ecologist from Cornell University, Ithaca, New York, who coaxes the gull into a bag. With the gull tucked safely inside, the team takes blood samples and wing measurements, and fixes numbered identification tags to one of its legs.

I ask Clark if he has been dive-bombed yet this week. "I haven't been hit, other than this splotch here," he says, motioning to the smattering of well-placed gull dung on his back. "This is the adventure component of the trapping," quips Ellis. It might be an adventure, but for Clark this isn't his usual occupation —

remarkably, he has volunteered his time and money to be here.

Clark, 66, of Kresgeville, Pennsylvania, and Abbey, 39, of Harpswell, Maine, signed up to help Ellis with her research through a non-profit organization called the Earthwatch Institute in Maynard, Massachusetts. Clark is a retired school teacher, and the gull project is his second Earthwatch expedition. This makes him typical of most Earthwatch recruits, a third of whom are repeat volunteers. Abbey is also a high-school maths and science teacher and like many first-time volunteers has never done research before. She is using her trip as part of a programme to bring science to her students.

Public service

Earthwatch was founded by educators and scientists in Boston in 1971 as an alternative way to fund field-based scientific research. Since then, it has grown into an international organization that each year sponsors research to

the tune of some \$4 million, supporting more than 140 projects across 47 countries. It is a pioneer of what is now called 'citizen science' — when scientists involve members of the public in collecting their data. Every year, around 4,200 people from 80 countries volun-

teer for Earthwatch projects — and the scheme has helped to generate thousands of peer-reviewed publications over the years. A similar organization called Biosphere Expeditions, based in Britain, started up in 1999, and smaller programmes can be

found at some individual institutions, such as the University of California, Davis.

For researchers, citizen science is a way to promote public outreach while getting help with labour-intensive data collection. For the volunteers, each expedition, lasting one to three weeks, is an opportunity to contribute to meaningful research in interesting locations. Some volunteers attend the same expedition multiple times: the current record-holder has notched up 20 trips to South Dakota to exca-

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K. ABBEY vate the remains of mammoths. Clark is already planning his next Earthwatch expedition, this time with his wife, to Peru to look at the effects of ecotourism on macaws. Ordinary holidays have only limited appeal, he explains: "The beach holds no attraction for me. I like to be with people who are thinking and learning."

The research that Clark and Abbey are helping with, at the Shoals Marine Laboratory on Appledore Island, involves studying the impact of gull populations on coastal ecosystems. The number of gulls in New England fell dramatically during the 1800s because their showy plumage was popular for adorning women's hats and gowns, and seabird nesting colonies were raided for eggs. But since all seabird species became protected in the 1900s, gull numbers have risen to such an extent that they now have the potential to significantly change their surrounding ecosystem.

Watch and learn

For Abbey, the expedition is a way of bringing maths and science to life for her students. She has designed a website with a daily journal that her students can access while she is on the island. She also got her statistics class to draw up a model of gull population growth, and she says that she hopes to do more fieldwork with her students in the future.

Earthwatch projects cover a wide range of interests and locations. A quarter of them fall into the social sciences, including ethnobotany, archaeology and public health. The rest incorporate some aspect of conservation, sustainable development or environmental monitoring; but all involve basic research and education. Projects run the gamut, from counting butterflies in Vietnam to measuring methane from termite mounds in Namibia.

Because Earthwatch sponsors expeditions all over the planet, the uninitiated might be inclined to think of the trips as holidays. But the expedition briefings do not mince words



Duck and cover: Karen Abbey uses a plastic bag to protect herself from gull attacks.

about what will be expected of participants, who may have to pay between \$500 and \$3,500, depending on the location and the length of stay.

The web page for the Maine gull project carries a clear warning: "Volunteers should be stout of heart for deflecting gull attacks and moderately agile for clambering over slippery, algae-covered boulders." Blue Magruder, director of public affairs for Earthwatch, says that the organization is careful to encourage the 'right' volunteers — while deterring about half the people who make enquiries. "That's good — that's what you want to do," says Magruder. "Because it's no fun if somebody gets there and they're bored after three days."

Expedition scientists and volunteers agree that the trips don't qualify as ecotourism, adventure tourism — or any other kind of tourism. "You don't look at it as a vacation because you're going there to support the

research," says Clark. "Any vacation you get is very incidental." Some volunteers say that if they wanted to tour an area, they wouldn't choose an Earthwatch trip. Magruder recalls greeting one volunteer on his return: "I said, 'How was Ireland?' and he said, 'Well, my two-metre square was fascinating'."

Projects that are good candidates for citizen science usually involve labour-intensive or quantitative tasks, such as counting numbers of nests or logging data on zebra behaviour. In addition, the tasks must be fairly easy to learn. As a result, most expeditions tend to be field-oriented: working behind the bench in a molecular-biology lab wouldn't lend itself to recruiting many volunteers, or to data that can be collected reliably with little training.

Some expeditions, such as Rolf Peterson's moose and wolves project in Isle Royale, Michigan, are more physically demanding than they are scientifically intense. "The main thing is to get all those bones back," says Peterson, an ecologist at Michigan Technological University, who leads expeditions to collect the remains of moose killed by the wolves that share the island. Peterson's research involves backpacking for 16 kilometres a day through the backcountry with 2–4 kilograms of moose bones strapped to the volunteers' backpacks, on top of a week's worth of food and equipment.

Skilful display

Scientists from different projects agree that volunteers often bring with them unexpected skills. On this trip, Abbey, who has a background in computer programming, designed a database entry-form for Ellis to help her extract data and analyse them more easily. Ellis notes that as a lead scientist you have to be flexible in using the volunteers' skills. Last summer, she had one couple who were 75 and 88 years old on her team. "I was a little nervous about it," recalls Ellis. Rock climbing was clearly out of the question, but the woman was a retired mathematician and helped to devise new ways to organize Ellis's data, and the man, a retired zoologist, was a keen observer of gull behaviour.

Whatever the task, the scientists give careful consideration to quality control. Ellis remembers one volunteer whose data on gull behaviour she later threw out because "the minute I turned around, he got on his cell phone". Eric Brown, a marine ecologist with the National Park Service in Kalaupapa, Hawaii, who has led Earthwatch expeditions to coral reefs, has compared the data collected by his staff with those from volunteers. His team was trying to determine the percentage decline of fish species between pristine and disturbed reefs.

Brown found that, although volunteers identified fewer fish than professional staff, the percentage decline the volunteers recorded was comparable to that noted by staff. But Brown's study did illustrate the need to con-



Caught in a trap: a gull is snared pending measurements and tagging.

Underwater odyssey

Mark Patterson, now an associate professor at the Virginia Institute of Marine Science at the College of William and Mary in Gloucester Point, grew up on Jacques Cousteau documentaries. But he got hooked on coral-reef science when he won a high-school scholarship to take part in an Earthwatch expedition — at that time known as Educational Expeditions International — to the Bahamas in 1974.

Patterson describes his time in the Bahamas as magical. "It was great because we were diving all day long. It was a dream come true for me," he says. Patterson recalls Rick Chesher, the lead scientist on the expedition, being a good mentor: "He understood the aims of lay-person-driven science very well, and did an excellent job leading all these bankers, doctors and dentists." He also found time to talk to Patterson about what life in science was like. "I knew I wanted to be a marine biologist from the age of six. Now I knew I wanted to go to college and

become a coral-reef biologist," Patterson says. He went on to complete his undergraduate, master degrees and PhD at Harvard University and became an expert in coral-reef biomechanics.

Patterson also credits Chesher with encouraging him to pursue electronics as a means of making underwater instruments. Patterson first got into electronics when he was caught destroying metal-shop tools with a welder in seventh grade. As punishment, his teacher made him join the hand-radio club. But Patterson loved learning Morse code and got a licence for hand-radio operators, inspiring a lifelong interest in electronics.

"Chesher was talking to me about it at sea and said: 'You should really keep that up and not just concentrate solely on biology... you'll be able to do something that most marine biologists can't,'" recalls Patterson.

In the early 1990s, Patterson was working with underwater robots and decided he wanted to build an autonomous underwater vehicle



D. KESLING

Mark Patterson shows off the underwater vehicle he helped to design.

(AUV). He tried to get funding from the Navy, from the National Oceanic and Atmospheric Administration and from the National Science Foundation, but he says that because he was not a certified engineer, "they told me to go away". So he and a family friend, Jim Sias, a world-class industrial designer, put together their own AUV, dubbed Fetch, on Patterson's kitchen table. They founded a company in 1996 — Sias Patterson

— to commercialize their product.

Patterson is currently using AUVs to study oxygen dynamics over coral reefs and is designing underwater robots with customized sonar that can classify different species of fish. He has now notched up a total of 84 days living underwater, which he says, "would have never happened without having this formative exposure under Earthwatch back when I was in high school". **A.H.**

sider which tasks are amenable to volunteers and which require a professionally trained eye. Earthwatch designed its own project to evaluate the contribution of volunteers, and found that although volunteers made some recording errors during fieldwork, similar errors were made by experienced scientists (J. Foster-Smith and S. M. Evans *Biol. Conserv.* 113, 199–213; 2003).

Marie Studer, chief science officer for Earthwatch, says that the organization puts a tremendous amount of energy into helping scientists find constructive ways to integrate volunteers in their research. "We don't just accept or reject proposals," says Studer. "We see a good proposal that has value and potential, and we work very hard with the scientists to make it an Earthwatch project." The proposal process is much like any other funding request — it involves peer-review, and on average takes about a year, says Studer.

The scientists say that although most volunteers leave the excursions ready to return to their day jobs, 'conversions' do take place in the field (see 'Underwater odyssey', above). Andrew Russell, a glaciologist from the University of Newcastle Upon Tyne, UK, has led 25 Earthwatch expeditions to study glaciers in Iceland and Alaska, and knows of three volun-

teers who chose to pursue doctoral studies in Earth sciences. One volunteer who was on an Iceland expedition in 2002 is beginning his PhD work with Russell this autumn.

Earthwatch scientists always acknowledge the contributions of their volunteers in papers, posters and talks, although stewardship of the data remains solely with the lead investigator. But in the first summer of the Maine project, one of the volunteers decided to stay on for three more weeks to explore an interesting angle of the research. She later decided to pursue a graduate degree in ecology and will be a co-author with Ellis and her Cornell colleague Myra Shulman on an upcoming paper resulting from the work.

The degree of satisfaction among volunteers seems to be high. In a given year, probably only two or three — less than 0.1% — will leave the field early. And despite the rigours of data collection, few complain about being overworked, says Magruder. In fact, the most common complaints Earthwatch gets are from people who feel they haven't been worked hard enough or that their skills haven't been put to good use, she says.

But there is no shortage of work for the volunteers in Maine. For Clark and Abbey, Sunday is their day off, and brunch isn't until ten, but they are up and out the doors by 7:30,

determined to help tag as many gulls as possible before they eat. By mid-morning, it's raining relentlessly, so they return to base and take the opportunity to catch up on entering their data into the computer. "Julie told us we could take breaks whenever we wanted to, but we chose to just keep working," says Abbey.

It is clear that no one here is thinking of going home early. By the end of week one, Abbey and Clark were chatting with Ellis about her research with ease and authority. Both had become conversant in the intricacies of gull behaviour. "If she can get him to regurgitate something and she eats it, they'll probably mate," Abbey explains to me as we watch a gull pair from a distance. "That's their little dating ritual."

As Abbey's last day arrives, I'm preparing to leave too. Clark is staying on for a second week, and will soon be joined by a fresh team of volunteers. It is another bone-chilling, rainy New England morning, and after three nights in an unheated dorm, I'm ready to leave. I ask Abbey if she is pleased to be heading off — she's had only one shower all week and has been working until 10:00 every night. "I don't really want to go home — I wish I could stay," Abbey says, adding that once she started getting into the research, it was hard to walk away from it. "You just sort of take ownership of it," she smiles.

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