The great outdoors

Field stations offer sophisticated facilities and opportunities for large-scale research.

BY ROBERTA KWOK

Noah Whiteman’s 2011 field season was tough. He and his team spent two summer months in the Rocky Mountains studying whether bacterial infections made plants more vulnerable to herbivores. They wanted to isolate bacteria from collected leaves to infect plants in the field, but the station at which they were working, the non-profit Rocky Mountain Biological Laboratory (RMBL) near Crested Butte, Colorado, did not have the equipment to support sterile laboratory work.

So two to three times every week, the team drove an hour each way to Western State Colorado University in Gunnison to autoclave nutrient media and pour it into Petri dishes ready for growing bacteria. They were grateful for the facilities, but the process “was really cumbersome”, says Whiteman, an ecological geneticist at the University of Arizona in Tucson. “We were exhausted.”

But by Whiteman’s 2012 field season, the RMBL had built a new research centre — with Bunsen burners, microfiltered water and fume cupboards for chemical work — mainly with funding from the 2009 stimulus package from the US federal government. The facilities got even better in 2013, when funding from the US National Science Foundation (NSF) and private donors allowed the station to add an autoclave, a shaking incubator, a polymerase-chain-reaction machine and a −80°C freezer. The team could now store more plant and bacteria samples and process them much more quickly.

Many field stations used to offer biologists little more than access to the land, basic equipment such as microscopes and a place to sleep. But over the past decade or so, stations around the world have begun adding more sophisticated features: molecular-biology equipment, Wi-Fi, Global Positioning System (GPS) devices and features ranging from towers that allow researchers to monitor the forest canopy to facilities for conducting large-scale lake experiments. The upgrades, often funded by government grants, are driven partly by the falling cost of technology. Meanwhile, there is growing scientific interest in complex, large-scale research questions — including projects on the effects of climate change, invasive species and pathogens across entire regions. To support this work, programmes such as the...
studies can be confident that they are returning to the same spots year after year, instead of relying on physical markers that might be moved or buried by wildlife.

Some field stations have installed especially sophisticated experimental facilities. In 2008, with NSF funding, the La Selva Biological Station in northern Costa Rica, managed by the non-profit Organization for Tropical Studies in Durham, North Carolina, completed 3 towers between 33 and 41 metres high that were equipped with electricity and Wi-Fi, allowing easy access to the forest canopy. The towers were constructed to make the station more attractive to researchers and educators, says station director Carlos de la Rosa. A robot shuttles between towers on cables and collects data on surface reflection, solar radiation and sound; weather stations gather meteorological data at various heights. Researchers can study differences between ecosystems on the ground and those high above the forest floor, such as variations in the types of beetle present. One team, says de la Rosa, is considering recording butterflies with cameras at different levels, then streaming the footage to the Internet. The researchers could then recruit members of the public to watch the videos and help to identify species, saving researchers many hours of viewing time.

**WATER WORK**

Studies of aquatic ecosystems are also benefitting from better equipment. Last year, the Leibniz Institute of Freshwater Ecology and Inland Fisheries in Neuglobsow, Germany, set up its LakeLab facility to improve studies on the effects of climate change. Funded mainly by a grant from the Federal Ministry of Education and Research, the system consists of 24 cylindrical enclosures in Lake Stechlin, inside which scientists can simulate changes in the depth of the upper level of warm water, and measure the effects on flora and fauna. Researchers from Germany and Hungary are studying how these changes affect ciliates and algae, for example. The enclosures are large — about 20 metres deep and 9 metres wide — reducing the influence of the walls and allowing experiments to better mimic natural conditions, says Mark Gessner, director of LakeLab.

The advantages offered by modern field stations go beyond technology: researchers stand to gain from many years of collective wisdom. Ecological studies that began in the 1960s and 1970s have laid the groundwork for a new generation of researchers, says Ian Billick, director of the RMBL. Today, field stations provide accumulated intellectual capital: decades of original data sets, archived research plans, specimen collections and oral history that can prove invaluable to young investigators. A researcher who wants to know the best place to find a particular flower species can easily get tips from a field-station staff member or a colleague who has worked at the site, instead of sifting through published papers. “That background information is critical for allowing new scientists to get projects up and running quickly,” says Billick (see ‘Planning is the key to success’).

**GOING BIG**

Field-station directors often coordinate with each other and share data, allowing scientists to conduct large-scale studies. Over the past 10–20 years, the non-profit Organization of Biological Field Stations (OBFS) in Woodside, California, has worked for increased communication, says Oktay, who is secretary of the organization. Directors are also keen to support individual researchers. For example, if a scientist approaches the OBFS with an interest in studying a moth parasite in New England, the organization will e-mail all field-station...
Fast-tracked talent

Encouraging and facilitating mobility among scientists helps both the researcher and the country thirsty for talent. Indeed, the success of the €70.2-billion (US$95-billion) Horizon 2020 European Union (EU) research programme, set to be launched on 11 December, hinges on bringing researchers to Europe from around the globe. And yet obtaining a visa, the key to being mobile, can be a major challenge. Ireland’s experience with smoothing the visa process shows one way to make the system more efficient while maintaining border security.

The EU has 28 member states, and negotiating their immigration procedures can be difficult. Eliminating differences has been a core part of European Research Area policy, and in 2005 Europe-wide legislation was introduced to ensure fast-track immigration for international researchers through the ‘scientific visa’.

All EU countries except Ireland, the United Kingdom and Denmark were obliged to implement this fast-track visa, but the system has been put in place with varying levels of enthusiasm and effectiveness. Ireland recognized the potentially positive impact of the scientific visa and voluntarily introduced it in 2007 to attract more researchers.

Ireland’s largely successful system can serve as a model for other nations. Although Ireland aspires to be a research hub, its economy remains fragile, and science funding is tight. Ireland cannot afford to stymie the movement of talent with cumbersome visa protocols.

We use a secure online verification system that links immigration services with embassies around the world, and we have a simple application procedure to reduce bureaucracy. The online system means that after applicants obtain research jobs in Ireland, they can get visas for themselves and their families within days, rather than the previous six to eight weeks for the scientists and up to a year for their families. Scientists used to have to pay €1,000 (US$1,300) per year for a work permit; it is now free. Ireland implements the visa through its EURAXESS office — one of 200 offices across Europe providing advice and support for mobile scientists — based in Dublin, at the Irish Universities Association (of which I am the research director).

Over the past 6 years, 1,750 researchers from 80 countries have come to Ireland using the fast-track scientific visa. Half of them came from China, the United States and India. How do we know that the changes have made a real difference? In March, EURAXESS Ireland carried out a survey of more than 300 researchers with scientific visas, the first such survey by any European country participating in the scheme. Of those surveyed, 84% were still working in Ireland; 27% had found employment in the areas of information and communications technology, and 26% in computer and life sciences.

Fifty-three per cent of the respondents said that the fast-track visa was very important when deciding to proceed with a job in Ireland. The survey also revealed that 23% of researchers would definitely not have come to Ireland if the fast-track visa scheme had not been in place.

Policymakers and those keen on building a nation’s scientific reputation often assume that facilities and staff are the crucial factors for drawing in researchers. However, our survey shows clearly that the immigration process is key to decision-making. The story is likely to be the same for other countries that are working to increase their scientific excellence by attracting researchers.

Competing for international scientific talent is a challenge. Nations such as Ireland that have invested heavily in science only in the past decade have to compete against international leaders including the United States and the United Kingdom. Providing an easily accessible, fast-track visa can make a real difference.

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