NEWS

In Briefs

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European Environment Agency recommends new methods to assess water quality The European Environment Agency published a report on 23 July that provides tools for effectively monitoring chemical changes in rivers and lakes. The report, "Assessing water quality in Europe using stratification techniques—Results of a prototype application using French data," uses an approach whereby specific water catchments are monitored to determine how agricultural activities, urban pollution, and natural events translate into differences in water quality. With this technique, pollution reduction from specific European Union environmental legislation, such as regulations for nitrate emissions and urban waste water treatment, can be more readily evaluated. To read the report, see http://reports.eea.europa.eu/technical_report_2007_10/en.

Funding authorized for U.S. science and technology education The "America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act," a bill that authorizes $33.6 billion for science, technology, engineering, and math education, was signed into law by U.S President George W. Bush on 9 August. The bill, sponsored by the U.S. House Science and Technology Committee, will distribute these funds to programs supported by the federal government over the next three fiscal years. Aimed at strengthening teacher preparedness in primary and secondary schools, equipping high school students for technologically oriented jobs, and enhancing higher-level academic research programs, the bill sets the budgets at the National Institute of Standards and Technology, the National Science Foundation, and the Department of Energy on a path toward doubling within the next decade. For more information, see http://science.house.gov/legislation/leg_highlights_detail.aspx?NewsID=1938.

Online Arctic mapping feature unveiled The Arctic Research Mapping Application (ARMAP), a Web portal of interactive maps and services, can now be used in conjunction with Google Earth. The new feature allows users to readily interface between satellite images, road and political maps, and other baseline information. ARMAP (see http://armap.org) supports Arctic science with special emphasis on promoting the current International Polar Year and is funded by the National Science Foundation's Office of Polar Programs.

—MOHI KUMAR, Staff Writer

FORUM

Specialization Versus Diversification: A Trade-Off for Young Scientists?

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Owing to the inherent links between the fields of study that make up the environmental sciences (e.g., terrestrial, aquatic, and atmospheric branches), and because of the growing need to better understand how human actions translate into global change, there is increasing demand for interdisciplinary research where Earth scientists with different academic training or backgrounds come together and approach projects in novel ways. In theory, interdisciplinary research teams are composed of researchers with complementary skills and are thus able to tackle larger research questions or problems. In this essay, we discuss the perceived trade-offs that young scientists face when specializing or diversifying their research programs to best prepare for participation in such interdisciplinary research.

An effective member of an interdisciplinary team should have expertise in at least one discipline. For a young scientist at the start of his or her career, a period of specialization is necessary in order to be perceived as an expert by potential collaborators. At the same time, the success of an interdisciplinary collaboration may be enhanced by an individual's ability to understand and communicate about subject matters outside of his or her immediate area of expertise. For a young scientist, this implies that one should also broaden the scope of one's field of expertise and diversify. Thus, young scientists may prepare themselves for participating in interdisciplinary research projects by either specializing or diversifying their research programs, although a potential trade-off between both may exist.

This article presents ideas that arose from a working group held at the DIALOG VII Symposium on Dauphin Island, Alabama (http://www.aslo.org/phd.html), where young scientists discussed their intentions to specialize or diversify during their careers. DIALOG stands for Dissertations Initiative for the Advancement of Limnology and Oceanography. The symposium brought together 43 recent Ph.D. graduates (6 months to 2 years post degree) across the biologically oriented aquatic sciences whose expertise ranged from freshwater to marine ecosystems, basic to applied research questions, and fieldwork to simulation modeling. Eleven countries were represented (by order of abundance, United States, Australia, Canada, Germany, Japan, Austria, Denmark, France, Mexico, and Spain).

One topic of debate that quickly arose was the perceived trade-off between specializing and diversifying at an early stage of one's scientific career, when one might be searching for, or may have recently landed, a first job. Thus, costs and benefits associated with specialization and diversification as they relate to participating in interdisciplinary research teams were discussed.

By choosing to be more specialized, scientists may become experts in their fields. This might increase their attractiveness as partners in an interdisciplinary project. However, overspecializing may inhibit communication with scientists outside of one's discipline, and it may limit potential funding and collaborative opportunities. By choosing to become more diverse, one may be exposed to a broader scientific community, which may foster collaborations and the development of novel ideas. In contrast, being overly diverse puts one at risk of becoming a 'jack of all trades, master of none,' which may give the impression to others—including tenure committees, grants panelists, and potential collaborators—that one lacks focus.

In working group discussions, symposium participants perceived specialization and diversification as achievable in three ways: via the techniques scientists use, the systems they work in (e.g., ponds, estuaries, oceans, etc.), and the research questions they ask. Most participants felt more inclined to diversify with respect to techniques and systems rather than with research questions. While it may be beneficial for young scientists to acquire new research tools, and to become exposed to alternative study systems during their postdoctoral tenures, addressing different research questions may better be left to a later career stage when a scientist becomes more established within his or her discipline. It was generally perceived that such diversification was better postponed because the additional resources (time, energy, financial support, etc.) it takes to address new research questions might detract from attaining short-term career goals (e.g., promotions based on publications, etc.), and because funding agencies might be more willing to support 'exploratory, higher-risk' research proposed by

established scientists with good funding track records.

Additionally, the decision to specialize or diversify one's research program may be related to the type of employment a young scientist obtains. For example, one symposium participant who had recently accepted a faculty position at a liberal arts college noted that he could view two scenarios occurring with respect to specialization: "(1) The fact that the school has a smaller faculty than at a 'Research 1' university will necessitate my developing more diverse research interests to accommodate more short-term undergraduate projects. (2) My time for research will be limited, and I will need to specialize and focus on several key questions/methods."

The degree to which young scientists specialize or diversify in their research programs may also depend on the funding situation in their country of residence. One participant noted, "Given the lack of research positions within Australia (and funding to do research), it pays to be flexible. Without some willingness to adapt research methods to new systems and research questions, and without a large number of skills in one's toolbox, it would be virtually impossible to find employment within academia."

Therefore, while young scientists may be inclined to diversify during the early stages of their scientific careers, the extent to which this is realized may depend on external conditions. Given the current trends of funding interdisciplinary science, however, symposium participants believe that the careers of many young scientists will benefit from 'keeping some irons in the fire' and developing a diverse research program.

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MEETINGS

Interdisciplinary Intercomparison of Black Carbon Analysis in Soil and Sediment

Analysis and Characterization of Black Carbon in the Environment, Vienna, Austria, 18–19 April 2007

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Last April, a symposium was held to discuss new aspects of the rapidly growing field of research focusing on black carbon in soil, sediment, and the atmosphere. About 70 scientists attended the 2-day session during the European Geosciences Union General Assembly, in Vienna. Part of this symposium included a workshop on chemical reference materials, where results of an interdisciplinary intercomparison of black carbon (BC) measurements in different environmental matrices were released.

BC is the product of incomplete combustion of fossil fuels and biomass and is also called elemental carbon in the atmospheric sciences. BC moves between the atmosphere, oceans, and soils, in the process affecting human health, the Earth's radiative budget, ocean carbon cycling, and soil carbon storage. However, a lack of standards common to atmospheric scientists, oceanographers, soil scientists, and ecologists has made it challenging to assess the role of BC in the carbon cycle. In particular, quantification of BC in complex matrices has proven to be problematic, as was made clear in a recent intercomparative study of BC in soils, where BC concentrations measured by a range of techniques differed by 2 orders of magnitude. BC exists as a chemical continuum of combustion products, and some methods may be ideal for detecting only a fraction of the total BC pool (e.g., soot). Other methods may detect non-BC materials in some types of samples, and some may fail to detect BC in other sample types.

As a consequence, an international BC intercomparison project created a set of BC benchmark materials spanning the combustion continuum and considering the needs of soil scientists, oceanographers, and ecologists. This collection of standards was used in an international intercomparision study reported on during the April symposium.

The intercomparison is the first multimethod, multilaboratory, multisample study to include methods used for soil and sediment BC studies. While there have been many atmospheric intercomparisons, this is the first one additionally including sediment and soil, environments where BC plays important roles. The 12 recommended BC reference materials were quantified by 17 laboratories from different disciplines, using seven different methods. One major goal of this ring trial was to provide a basis on which to choose between the different BC quantification methods in soil and sediment studies.

A clear outcome is that there is no ideal BC method applicable to all scientific questions and all matrices. Instead, it is important to consider the strengths and weaknesses of each method carefully during project planning. Another major conclusion is that future projects that analyze BC in soils and sediments should include the common set of BC reference materials analyzed in the intercomparison, thereby anchoring new data to a larger body of literature. Without the anchor of standards, it will not be possible to compare BC data sets or construct global BC inventories. Further details are given by K. Hammes et al. (Comparison of quantification methods to measure fire-derived (black/elemental) carbon in soils and sediments using reference materials from soil, water, sediment, and the atmosphere, *Global Biogeochemical Cycles*, doi:10.1029/2006GB002871) and at the Web site http://www.geo.uzh.ch/phys/bc.

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