nature

www.nature.com/nature

Vol 455 | Issue no. 7211 | 18 September 2008

The other North American election

As Canadian scientists work to maintain their international reputation, a little encouragement from the election candidates would be appreciated.

Canadians go to the polls to elect a new government on 14 October. Although the initial stages of the campaign focused on the environment (see page 268), the two major parties, Conservative and Liberal, have said little or nothing about science policy in general. This is a shame. Canada saw big boosts to its research funding from the late 1990s to 2000, including the creation of Canada Research Chairs, which brought good people into the country, and the Canada Foundation for Innovation, which pumped billions into infrastructure. Those investments have been maintained, and science funding is still on the rise. But the gains are vulnerable in a competitive international market, warns the prime minister's former science adviser, Arthur Carty: "We have to be careful, having reached the top of the mountain, that we don't slide down the other side very quickly."

Both parties promise to provide financial incentives to innovative companies, especially those involving green technologies. But broader questions of research funding have so far not come up in the campaign. This may reflect a lack of difference between the parties on the issue, or perhaps just a lack of urgency; with the exception of climate change, the general mood on science policy seems to be 'if it ain't broke, don't fix it'.

But many argue that it is broke. The retired right-wing politician Preston Manning slammed the system in the Canadian media last December after the recent shortage of nuclear isotopes. He lambasted Canada for its lack of a federal science department or ministry and the dearth of scientific or engineering training among parliamentarians. The office of the National Science Advisor was abolished earlier this year when Carty stepped down (see *Nature* **451,** 505; 2008). And the committee that now advises the prime minister on matters of science is packed with industrial as well as scientific experts.

Indeed, many Canadian scientists are seeing, and complaining about, an undue emphasis on commercially focused research over long-term basic research. Such complaints are heard in many other countries too. But in Canada the problem is compounded by the fact that the current government has channelled new science funds into four restrictive priority areas — natural resources, environment, health and information technology — and that scientists are often required to scrounge matching funds from elsewhere to top up their grants. Furthermore, the government this month defined sub-priority areas that mix in obvious commercial influences: alongside 'Arctic monitoring', for example, sits 'energy production from the oil sands'.

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The Canadian election's focus on climate, at least, is welcome. But one always hopes that research funding will warrant a mention in political manifestos. That hasn't happened yet in Canada — and it should. ■

Handle with care

Ecologists must research how best to intervene in and preserve ecosystems.

For many people — including many scientists — 'nature' is defined by a negative: it exists where people do not. Nature lies outside the urban and agricultural realms, in regions of Earth where natural processes are unimpeded. Nature is where fallen logs rot and acorns grow, wildfires turn woodlands into meadows, and barrier islands shift with the currents — all without human interference. By extension, this definition suggests that nature is best protected by keeping humans far away, so that it can continue to run itself.

But there is a serious problem with this view. If nature is defined as a landscape uninfluenced by humankind, then there is no nature on the planet at all. Prehistoric peoples changed their surrounding ecosystems, whether by installing orchards in the Amazon or — according to one increasingly accepted theory — by hunting many large mammals to extinction in North America. And modern humans are changing the global environment even more profoundly, whether through planet-wide climate change, or by the worldwide movement of synthetic chemicals through the food chain. Today there is no place untouched by man — a point made by environmentalist Bill McKibben as early as 1989 in the starkly titled *The End of Nature*.

Nature doesn't have to end if we stop defining it by humankind's absence. Humans prize natural spaces because they are historic, culturally significant, aesthetic and scientifically interesting — and, increasingly, because they have been recognized as providing essential services such as filtering water, ameliorating storm surge, providing fish, game and timber, and sequestering carbon. Ecosystems that are valuable for one or more of these reasons can be identified by quantifiable biological traits, such as the presence of certain key species or processes. In the Białowieża forest of eastern Europe, which has a long history of human activity, for example, one could cite the presence of European bison and of a large amount of dead wood as characteristics worth preserving (see page 277).

Retaining such characteristics takes more than the absence of active destruction. It is precisely because of humanity's pervasive influence that even the least changed ecosystems need help surviving in the future. Białowieża's core is so small that the dynamic processes that once drove its mosaic of different micro-ecosystems probably can't operate as they once did. Some of its large mammals are extinct. Many new species have arrived through human agency. And climate change is altering the seasonal timing and hydrological cycles of the forest.

The only alternative is proactive management — by humans. Already, conservationists in some forests set small fires to burn out underbrush before it reaches levels that could produce catastrophic fires. They shoot prey species whose populations are out of control because the top predators have been exterminated. And they have begun to control water flows into wetlands where the natural flow has been disrupted. In the future, as climate change takes hold, management may become even more radical. Some ecologists are beginning to talk about moving slowly dispersing plants and animals pole-wards or upslope to keep them in climates they can thrive in, or introducing non-native 'functional equivalents' in some ecosystems to play certain key roles.

Such talk will undoubtedly raise hackles among those ecologists for whom intervention in natural ecosystems is anathema. Yet our species' all-pervasive impact on this planet has already doomed that hands-off approach to failure.

Unfortunately, would-be managers of natural regions still know very little about how to save natural places without continuing *Homo sapiens*' legacy of destruction. Ecologists have conventionally studied the workings of intact ecosystems, but have focused much less attention on how to keep them intact. Scientific research on the best ways to manage natural ecosystems needs to become a much higher priority.

Meanwhile, economists, ecologists and ethicists need to seek ways to bring natural ecosystems into the economic system, instead of just assuming that they exist outside of or in opposition to economics. If nothing else, this will require continued research on how to put a fair economic value on ecosystems that provide humankind with services — a classic example being wetlands that absorb storm run-off and help prevent flooding — while not dooming ecosystems such as deserts and tundras that contribute in a less obvious way.

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For now, the custodians of Białowieża are letting the never-logged core area alone, even going so far as to prohibit entry to tourists except when accompanied by a guide. But the day may come when hands-off means waving goodbye. Will science know how to save Białowieża when that day comes? ■

Virtues of visualization

Mapping techniques, used with care, can offer fresh insights into data about the world around us.

Maps are powerful, but imperfect, visualizations of the world. They are never true in any absolute sense; rather, they express certain aspects of the truth in ways that are useful for the task at hand, using rules and conventions that have to be understood in context. No flat map of Earth's curved surface can preserve both area and angle; some aspect of the reality is always distorted. So geographers have invented a plethora of projections that allow them to choose the distortions judiciously. One projection might sacrifice the accuracy of shapes and areas to preserve bearings, for example, whereas another might facilitate precision measurements in a field survey. But even this panoply often falls short — and can be downright misleading — when it comes to representing more abstract forms of information.

A classic example is the use of maps to visualize scientific and social data about nations, states or counties. Mapmakers usually do this by simply adding, say, a colour scale to represent the value of indicators such as disease outbreaks. In addition, because this technique by itself is often misleading — it takes no account of differences in population density, for example — the data are frequently normalized to per capita values. But this means that the map loses crucial data — in this case, total incidences.

The cartogram technique, in which the sizes and shapes of geographical areas are distorted to represent the population or some other variable, can overcome these issues and preserve the full richness of the data (see page 270). Used correctly, it can free statistics from the shackles of geography, allowing richer visualizations of anything from election results, to census tabulations, to species biodiversity.

Cartograms have yet to be widely adopted, despite being the best choice for many sorts of data. One reason is that initially they can seem confusing, as most viewers' brains are more at home with the size and shape of countries and states as they appear in an atlas. Another is that efficient algorithms to create not only cartograms, but many other forms of visualizations, have generally been the preserve of a handful of specialized laboratories. That is now changing.

IBM's Visual Communication Lab in Cambridge, Massachusetts, for example, has created Many Eyes (www.many-eyes.com). This free site provides the public with tools to create visualizations such as network diagrams, which depict nodes and connections within networks, and treemaps, which display hierarchical data as groups of nested rectangles. Similarly, Google Earth and other virtual globes are providing scientists and non-scientists with unprecedented tools for geographical visualization of data. The obvious, and perhaps unexpected, enthusiasm of the public for such visualizations suggests that it is a rich vein for educators and scientists, both to explain their own work and as a means to engage young minds in critical analysis of data.

Visualizations are not a panacea. The adage 'rubbish in, rubbish out' still applies. But when used well — and, in the future, when combined with emerging surface-computing and other interactive displays — visualization can provide different views of data that force us to ask new questions, and generate fresh hypotheses.

The flood of data now coming online and the emergence of new forms — such as the data on social networks, e-mail and mobile-phone patterns that are rejuvenating the social sciences — means that visualization will be increasingly important for scientists. Such diverse windows on data should also strengthen civil society by giving scientists and citizens alike the power to sift through the data generated by governments and other institutions, and to challenge their and our own preconceptions of the world. ■