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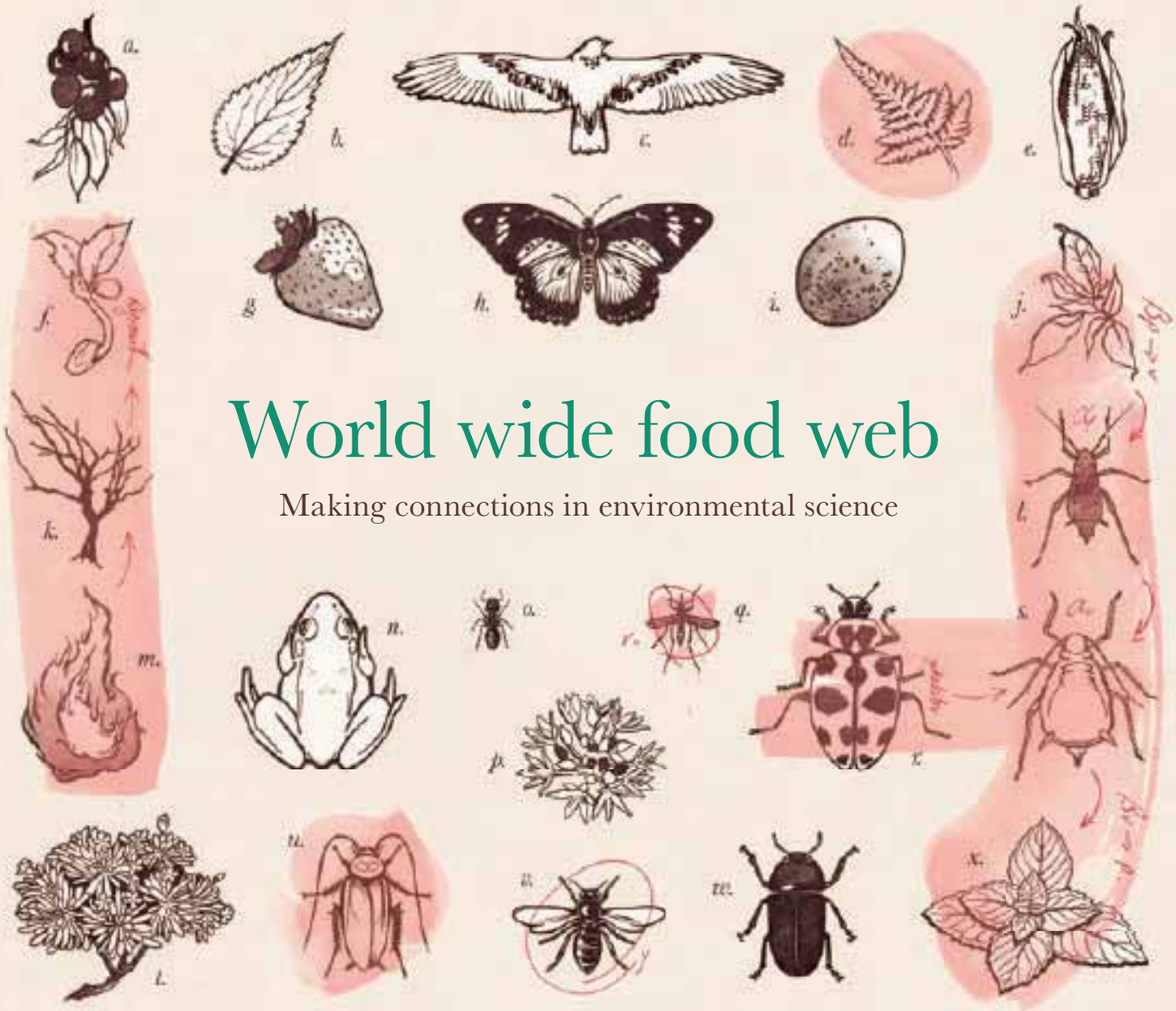

World wide food web

Making connections in environmental science

POLICY

Delving into how the **Food and Agriculture Organization of the United Nations** is developing solid relationships with stakeholders in North American food and nutrition security

PRACTICE

Past President Jill Baron and President David Inouye jointly reflect on the **Ecological Society of America**'s key outputs over the past century

RESEARCH

In this edition's **Research Roundtable**, a selection of contributors consider the importance of research impact in the US

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Exploring the GE agenda

The 27th Annual Conference of the North American Agricultural Biotechnology Council brought together a diverse range of experts to share different perspectives on the ecological, economic and societal dimensions of agricultural biotechnology. *International Innovation* caught up with a selection of speakers to broach the hotly debated topic of genetic engineering

IN THE ROUND

Dr Gregory Jaffe is Director of the Project on Biotechnology for the Center for Science in the Public Interest, and a recognised international expert on agricultural biotechnology and biosafety.

Michael Schechtman is Biotechnology Coordinator for the US Department of Agriculture-Agricultural Research Service, working as a senior biotechnology advisor with the office of the Secretary of Agriculture.

Lynn Clarkson supplies identity preserved corns and soybeans as ingredients to food companies and feeders through Clarkson Grain, which has been a player in the organic market since 1992.

Gregory Loberg is Manager of the West Coast Beet Seed Company in Oregon, and Vice-President and upcoming President of the Oregon Seed Association.

Dr Steve Pueppke is Associate Vice-President for Research and Graduate Studies at Michigan State University, and serves as Director of Global and Strategic Initiatives in the College of Agriculture and Natural Resources.

Dr Nicholas Storer is the Global Leader for Science Policy in the Biotechnology Regulatory Affairs group at Dow AgroSciences, based in the US.

Dr Richard Roush's expertise is in pest management and designing systems to delay or prevent insects and weeds from evolving resistance. He is Dean of the College of Agricultural Sciences at Penn State University.

What do you see as the most pressing issues on the North American Agricultural Biotechnology Council (NACB)'s agenda this year?

GJ: Current genetically engineered (GE) crops grown in the US have provided benefits to farmers and the environment, and products made from them are safe to eat. The introduction of those crops to our agriculture system, however, has had a number of impacts, including the development of resistant weeds and pests, and the unintended presence of low levels of GE crop in products that are organic or identity preserved non-GE. The asynchronous approval of GE crops between trading partners has also led to trade disputes and economic losses.

The priority for this year's NABC conference is to discuss those different impacts and set forth policy options that can reduce, limit or eliminate those adverse impacts either through stewardship, regulation or other means.

MS: The conversation within the US on the use of GE products has become louder and more polarised over the past few years, in part due to the increased diversification of production methods within agriculture, and the challenges of concurrent production using those methods. Reducing this polarisation and expanding the dialogue about the importance of such diversity is crucial to the success of American agriculture.

NS: This year, NABC brought together diverse stakeholders to enable the exchange of views and perspectives on many aspects of sustainability for agricultural biotechnology. Biotechnology has brought profound change to agriculture over the past 20 years, enabling more efficient and effective use of resources by farmers, while boosting yields to feed the growing global population.

Benefits are reduced when pest populations build resistance to the weed and insect management tools that biotechnology has created; to sustain these benefits, industry, farmers, public sector scientists and policy makers need to work together to devise new solutions that delay resistance development and enable farmers to manage these pests once resistance develops.

SP: Personally, I am most intrigued by the human element of these issues. We have made great progress with these new GE technologies, but are running into all sorts of complex and, in many cases, unanticipated challenges related to food preferences, cultural issues and global trade in food products.

From your perspective, how have GE crops impacted the US agricultural industry?

LC: GE crops have provided a new market distinction and enhanced farmer convenience and the potential for improved vegetable oil and ethanol friendly corn. However, in the process, GE introductions have made coexistence among farm neighbours far more challenging.

MS: The advent of GE crops has coincided with a number of other advancements and 'megatrends' within agriculture and agricultural policy, so it can be difficult to tease out the precise contributions of any one. From a broader perspective, the success of GE crops has improved the ability of farmers to address emerging crop production needs but has also increased the reliance of many farmers on new technologies. These new technology inputs have derived from a relatively small number of companies. It has also demanded increased communication between different elements of the food and feed production chain to address the challenges of integrating new technology into existing production and marketing systems.

SP: I grew up on a farm in North Dakota in the 1950s and 1960s, and spent many an hour on a tractor cultivating our corn fields to remove weeds. The process was labour-intensive, and our tractors burned lots of fuel, puffing greenhouse gases into the atmosphere. We sometimes had

to cultivate the same fields two or three times to keep down the weeds, and it was while I was going up and down those rows again and again that I started thinking that maybe it would be a good idea to go off to college! Herbicide-resistant corn hybrids, which were developed after I had headed off to Michigan State University, have made cultivation largely unnecessary. My brother is a farmer, and I once asked him why he plants GE crops (and is willing to pay a premium price for GE seed). He told me that it is all about saving time and reducing the need for labour. Based on personal experience, I understand; but I also realise that there are some farmers who would prefer not to use GE technologies. We need to ensure that this is allowed to happen.

Are there any surprising or exciting recent trends in agriculture that have caught your attention?

GL: I have noticed a new urgency among farmers to speak on their own behalf by moving into public roles of participation and leadership. Most have inherited a legacy of quietly and successfully producing food, feed and fibre. In their world-class productivity, these farmers have become an increasingly smaller minority of the population and have lost force in policy making. Many, however, are beginning to realise that the threat of various activist minorities is real and can result in damaging losses to their businesses.

GJ: First, in the US, new GE crops that were not developed by the dominant agricultural biotechnology companies have completed the regulatory process and will be marketed to consumers in the immediate future. They are non-browning apples and potatoes, the latter also being low bruising with low levels of acrylamide (a probable carcinogen). Second, field trials of GE crops in developing countries are increasing. If these crops are found safe and beneficial, they will be provided either for free or at a low cost to small-scale subsistence farmers.

RR: In the past 12 months or so, it has become widely recognised that the world's most important agricultural pest, the so-called 'old world bollworm', *Helicoverpa armigera*, has become established in South America and is spreading and anticipated to reach the US. This pest causes billions of dollars in losses and has evolved resistance to pesticides in China, India, Africa and elsewhere.

LC: I have seen sharply increased demand for verification of non-genetically modified organism status from the North American market. Also, demand for organic soy has far surpassed US domestic production.

The cultivation of GE crops has been controversial over the past 20 years. While they are used widely in the US, earlier this year nine countries in the European Union opposed their use entirely. Amidst the debate, many argue GE cultivation is necessary in order to feed a growing world population. Do you agree?

NS: There is no question that as the global population continues to grow as projected, and developing countries' dietary needs expand, farmers around the world will be required to produce more food with fewer inputs and on less farmed land than ever before. At the same time, global climate change will have profound impacts on agricultural productivity, to which farming will have to adapt. No approaches or technologies should be discarded in our urgent efforts to address these fundamental needs. The tools of modern biotechnology can continue to play an important role in protecting from pests, improving water and nutrient utilisation, advancing the health profile of staple crops and increasing yields. The past 20 years have shown that biotechnology can be applied to improve agriculture in ways that do not harm human health or increase risks to the environment.

GL: I fully agree. To quote Mark Twain: "Buy land; they're not making it anymore". Crop land per capita expanded globally from 1700 to 1950, but has declined ever since. Since 1980 only an incremental amount of land has been put into production, while the global population increased from 5 billion to 7 billion. We will not have more land with which to produce the food for a projected 9 billion people by 2050. All forms of agricultural technology will be needed to improve productivity per acre.

It's exciting to hear about ongoing improvements in agricultural technology. Early concepts in precision technology included variable rate applications of crop inputs based on detailed soil mapping, particularly nutrients, but now include irrigation water. GPS guided farm equipment continues to find applications, such as

eliminating the 'wasted space' in guess rows that are wider than necessary, or improving the combine header placement to maximise wheat harvest. More recent technology in planter design is creating the possibility of using multiple hybrids within a corn field to best capture productivity across soil types or slopes. Regulators are working to find ways to allow the development of drones for agriculture. Genetic engineering is yet another modern technology tool that offers countless opportunities for trait improvement and productivity.

Most of us don't understand and certainly can't predict the many technological innovations ahead of us

Limiting any of these technologies reminds me of initial scepticism in my lifetime about the cost effectiveness of computers in the office, then at home, or the cost effectiveness of mobile phones before large networks were in place, at a time when battery technology required a 'bag phone'. Most of us don't understand, and certainly can't predict, the many technological innovations ahead of us.

RR: The challenge is not simply whether we can feed a world population of 8-11 billion within the next 50 years (arguably needing more food than consumed in our entire recorded history). It is whether we can do so sustainably, without clearing even more of the world's forests; without worse soil erosion, greenhouse gas emissions, fertiliser and pesticide impacts; and without much input from an ocean that is being damaged and over-fished. Can we risk trying to do this without using all of the safer tools at our disposal, including the best and most sustainable of both organic methods and GE?

A primary advantage of GE crops to date has been to reduce the environmental and health impacts of agriculture, by reduced tillage that lowers both soil erosion and carbon emissions (by using one of the world's safest pesticides, glyphosate, to control weeds), and reduced use of insecticides. Virus-resistant crops protect yield even without insecticides to control the insects that spread viruses.

Drought-tolerant corn that protects yields has already been commercialised, and crops that require less fertiliser and can tolerate more salt have been tested.

One billion people are already malnourished. While it is true that more could be fed with better distribution of food and perhaps less consumption of meat, distribution of food in itself is a huge logistical and political challenge, and not really a substitute for assuring that most countries can meet most of their own needs locally. Most of the transportable food is in the form of relatively non-perishable grain, and only 8 per cent of world grain production is traded internationally.

bit.ly/nabc-27-stewardship