

High hopes for Brazilian science

As President Lula prepares to leave office, researchers expect that innovation will invigorate the economy.

BRASILIA, BRAZIL

It is rare that a head of state ends a second term with approval ratings of around 80%. But when Brazilian President Luiz Inácio Lula da Silva took to the stage last month at a science-policy conference, his popularity was clear: more than 3,000 scientists, administrators and industrialists stood to applaud him and to cheer his science minister of five years, Sérgio Rezende.

With a government convinced that science is an essential part of a growing economy, Brazilian researchers have never known better times, and the 4th National Conference on Science, Technology and Innovation in Brasilia on 26–28 May was brimming with optimism for an even sunnier future. At the conference, Lula signed a series of bills that will help to sustain his legacy of science investment after he and Rezende leave office on 1 January 2011. The bills, if enacted by the National Congress, will increase funding for postdocs and establish three new biodiversity research centres, with the overall goal being to further reduce the country's brain drain and perhaps even reverse it.

The conference will deliver a consensus statement from Brazil's top scientific brass on where its research programme should focus over the next decade. The document is likely to be influential, says Luiz Davidovich, a director of the Brazilian Academy of Sciences

and a physicist at the Federal University of Rio de Janeiro. "The conference is the first time that those at the heart of science, and those tangentially involved, have all been brought together — and at a point when things are really taking off," adds Carlos Henrique de Brito Cruz, the scientific director of FAPESP, São Paulo's state research foundation. The consensus statement, due to be published in two months' time, will be sent to all of the presidential candidates.

One prominent suggestion expected to be in the statement is the fostering of centres of excellence. "We need to look after our Pelés as well as build more football pitches," says de Brito Cruz. "The current focus of funding is on new centres, but there is no specific programme to fund research stars." Another proposal is to provide more incentives for multinational companies to conduct research and development in Brazil.

These policies would build on a well-funded foundation. The Brazilian Ministry of Science and Technology says that after Lula took office in 2003, total public and commercial funding for science and technology soared from 21.4 billion reais (US\$11.4 billion) to 43.1 billion reais in 2008 (or from 1.26% to 1.43% of Brazil's growing gross domestic product; GDP) — due in part to Lula, and to policies implemented by former president Fernando Henrique Cardoso.

Publications by Brazilians in peer-reviewed science journals have leapt from 14,237 in 2003 to 30,415 in 2008, according to data analysts Thomson Reuters.

This is impressive not only in the context of Latin America but also compared with Russia, India and China, for example. In 2000, Brazil generated 43% of Latin America's peer-reviewed publications. Scientific output has since improved across the region, but in 2008, Brazilian publications made up 55% of the total. Brazil has particular strengths in agricultural science; for example, in 2000, a consortium based in São Paulo became the first in the world to sequence the genome of a plant pathogen, the bacterium *Xylella fastidiosa*, which destroys citrus crops.

Brazil spends significantly more per researcher than China or Russia, according to its science ministry. "I believe we have reached a point where the sector will grow organically," says Rezende. "So the next person in charge will not have to do much."

Science is also doing well at the level of individual states, which provide a significant source of public funding, although efforts to boost science are patchy. Many states are looking to emulate wealthy São Paulo, which has the strongest scientific tradition. "There is an article from 1947 in the constitution of the state of São Paulo," explains de Brito Cruz. "It says

Endangered-porpoise numbers fall to just 250

At the northern end of the Gulf of California, where the Baja peninsula joins the rest of Mexico, the world's most endangered marine mammal is inching closer to extinction.

With adults only 1.5 metres long, the vaquita (*Phocoena sinus*), a rare porpoise found only in these waters, epitomizes the plight of small cetaceans, which bear the brunt of pollution, ship traffic and fishing because they live in rivers and coastal areas. In China, the Yangtze river dolphin (*Lipotes vexillifer*) was last seen in 2007 and is now considered extinct. The vaquita — vulnerable to gill nets used by local fisherman — could be the next to go.

On the basis of data gathered in 2008 during an acoustic survey¹ researchers now estimate that only 250 individuals of the species remain, a drop of 56% in just over a decade. The finding was presented this week at a scientific meeting of the International Whaling Commission in Agadir, Morocco.

"This information shows we don't have a lot of time to save the vaquita," says Timothy Ragen, executive director of the Marine Mammal Commission in Bethesda, Maryland, which part-funded the survey.

First documented in 1958, the vaquita is an elusive and poorly understood species. Genetic



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The diminutive vaquita is found only in the Gulf of California.

analyses suggest that its ancestors were Southern Hemisphere porpoises that migrated north during the last ice age. Individuals travel in small groups and rarely attract attention by leaping or splashing.

In 1997, Tim Gerrodette, a marine

biologist at the Southwest Fisheries Science Center in La Jolla, California, led the first comprehensive survey of the vaquita, estimating the population to be 567 individuals². A decade later, another analysis³, based on



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Brazil's President Luiz Inácio Lula da Silva wants scientific investment to continue after his departure.

problem is probably the biggest challenge facing Brazilian science.

Early in its tenure, Lula's administration made it legal for the government to fund research by private companies, and afforded tax breaks to firms that invest in innovation. But the number of patented inventions coming out of Brazil has risen only slightly since these measures were passed. "The problem is that company directors have the option of putting money in the hands of their heads of finance to generate a return in the financial markets, or in those of their head of research and development, which is risky and expensive," says Eduardo Viotti of Columbia University in New York, who advises the Brazilian senate on science policy. "In the past, at least, it has seemed less risky to them to bet on the financial markets."

Commercial research and development is being boosted by the discovery in 2007 of large oil deposits off the coast of São Paulo and Rio de Janeiro. When oil does start flowing, Lula has promised that a proportion of the riches will be siphoned towards science. The exact percentage is still being debated, but it will be set before Lula and Rezende leave office.

The chances are good that scientists will get much of what they ask for on their consensus wishlist, even after Lula's departure. The frontrunners in October's presidential election are José Serra, a former governor of science-friendly São Paulo, and Lula's former chief of staff Dilma Rousseff, who is backed by Lula and is expected to continue his policies. These may include his plan to raise science spending to 2% of GDP by 2020.

Anna Petherick

that 1% of all revenues of the state go towards research. No other science-funding agency in possibly the whole world has that kind of financial security and autonomy [from the federal government]."

The benefits of having significant funding separate from federal sources were felt most keenly in the 1990s, when Brazil's government struggled with economic stresses such as hyperinflation. Science funding dried up elsewhere in the country, but researchers in São Paulo experienced much less disruption.

Recently, other states have copied this legislation. In addition, São Paulo's three large state universities receive 9.57% of the state's income from its lucrative sales tax, giving them a unique boost.

But even in São Paulo, the growth in published research has not been matched by growth in patented research, which is crucial if science is to invigorate the economy and provide a better quality of life for Brazil's 193 million inhabitants. Most scientists at the May conference agreed that solving this

porpoise population rates and numbers of vaquita caught by fishermen, suggested that the number had dropped to 150.

Fearing that the porpoise's population might become too small to survive, Lorenzo Rojas-Bracho, a marine biologist at the National Institute of Ecology office in Ensenada, Mexico, teamed up with Gerrodette and others in 2008 to undertake a new abundance analysis. The team used the research ship *David Starr Jordan*, operated by the US National Oceanic and Atmospheric Administration in Washington DC, and a small sailing boat, the *Vaquita Express*, sponsored by the Intercultural Center for the Study of Deserts and Oceans, in Tucson, Arizona, to count vaquita.

The vessels ran coordinated transects in different water depths, tallying sightings and, on some transects, towing hydrophones to catch the porpoise's distinctive communicative clicks. "Coordinating the paths of a sailboat dependent on the wind and a motorized ship was a bit tricky," says Rojas-Bracho.

The team combined the occurrence of vaquita clicks with the total area covered to estimate population size. Although the results show a precipitous decline in numbers since 1997, the findings are better than the earlier prediction. "We are encouraged, as it is not as bad as we feared," says Gerrodette. He and his colleagues were also encouraged by the sight of several newborn vaquitas. "But clearly, the

number is not good news."

Now the challenge is to protect the surviving group. In 2005, Mexico created a reserve and later followed this with a ban on gill nets in the area, which covers nearly 2,000 square kilometres in waters near San Felipe off the northern Baja peninsula. Vaquita easily become entangled in the nets and drown.

Rojas-Bracho hopes to introduce alternative methods of fishing that do not rely on the nets. He and his colleagues also plan to deploy an array of 60 acoustic devices on the sea floor to detect population changes on the basis of the frequency and pattern of clicks.

But because of the potential for vandalism by fishing supporters, the locations of these hydrophones

cannot be marked with floating buoys. Instead, the team needs to devise an underwater system for locating and releasing the hydrophones. If successful, the system could serve as a model for monitoring other cetaceans.

A more immediate challenge is to expand the protected area. "We need to get all the gill nets out of the water," says Ragen. But a broader ban would be a difficult economic and political challenge, pitting the vaquita against the livelihoods of local fishermen.

Rex Dalton

1. Dalton, R. *Nature* **456**, 431 (2008).
2. Jaramillo-Legorreta, A., Rojas-Bracho, L. & Gerrodette, T. *Marine Mammal Sci.* **15**, 957-973 (1999).
3. Jaramillo-Legorreta, A. *et al. Conserv. Biol.* **6**, 1653-1655 (2007).