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Research involving several Asia-Pacific countries led to a protection plan for Yellow Sea mudflats, a stopover for the eastern curlew.

Politics and the pandemic disrupt migration patterns in research

Researchers are watching how political and economic tensions between China and Australia will affect scientific collaborations. **By Catherine Armitage**

According to the University of Queensland (UQ), China's 2018 moratorium on coastal reclamation was prompted in part by its research collaboration into migratory shorebirds involving China, South Korea, Japan and four other countries.

By scrutinizing satellite images, UQ professor of conservation and biodiversity, Richard Fuller, and his colleagues discovered that due to development since 1950, two-thirds of the Yellow Sea intertidal habitat, where millions of

birds rest and feed en route to Australia from the Arctic tundra, had disappeared.

The species declining fastest in Australia, including the critically endangered eastern curlew (*Numenius madagascariensis*), are dependent on the annual Yellow Sea stopover. In 2015, the Australian government, citing UQ research, drew up an international plan for the eastern curlew, ratified by 22 countries. UQ is now advising China and South Korea on World Heritage listing for parts of the remaining Yellow Sea mudflats.

The migratory shorebird project, which started in 2002, is "one we're really proud of", says Bronwyn Harch, deputy vice-chancellor of research and innovation at UQ, one of Australia's Group of Eight (Go8) leading research institutions.

Such collaboration, especially with China, to solve a global problem that's also in the national interest, is exactly the kind of research story Australian universities are keen to tell. In the past year they have faced intense scrutiny for their strong research ties to China.

In April 2020, Australia's then-foreign affairs minister, Marise Payne, had called for an independent global inquiry into the origins of the coronavirus pandemic, asserting it was "clear that the virus originated in Wuhan".

Since then, universities have been caught in a row between Australia and its biggest trading partner, so serious that the prospect of China placing limits on joint scientific research is no longer remote.

A ban would chime with the Chinese Ministry of Education's June 2020 warning, repeated in February 2021, against travel to or study in Australia, citing safety fears over racist incidents. A freeze on research links would be among the growing list of official and unofficial Chinese sanctions against Australia, with restrictions in place on imports from Australia worth more than Aus20 billion (US\$15.76 billion) a year, including wool, coal, copper ore, beef, wine and timber.

Disentangling pandemic from political disruption is difficult, but any cooling of the scientific relationship is bad news for the Asia-Pacific region's entire research effort, because China is its engine for growth. "Thankfully, it is not happening to Singapore," says Tan Eng Chye, president of the National University of Singapore (NUS), referring to the Australia-China situation. "We are watching it very closely."

Since 2015, the Asia-Pacific region's share of global output tracked by the Nature Index has grown from 26.9% to 34.3%, with China responsible for more than 98% of the increase. Without China, the region's share of output would have declined slightly, in part due to the 2015-20 slide in Japan's contribution.

For collaborative research, the Chinese mainland is the partner in six of the ten most productive intra-regional pairs; it is Singapore's most important collaborator, and for Australia, Japan, South Korea and Taiwan, it is second only to the United States. The Australia-China relationship scores highest in the region. Between institutions, the NUS partnership with Tianjin University on organic chemistry research in materials science was strongest in the year to August 2020, with a collaboration score of 43.44.

UQ's global research leadership ambitions lend inescapable logic to partnering with Chinese institutions, given China's "phenomenal" R&D investment in the past decade, says Harch. "They were going to get places faster than us, so [the question] is how do you partner with them to make sure you go along with them?"

"They come to us for our specific know-how and expertise," she says, referring to "world-leading" UQ research in areas such as genomics, environmental sustainability and

TAIWAN TRAINS FOR THE FUTURE

The island's infrastructure and experienced workforce make partnerships attractive.

Taiwan, which lies inside the seismic zone known as the Circum-Pacific Volcano Belt, or 'Ring of Fire,' is accustomed to earthquakes. Between 1900 and 1990, the island experienced approximately 2,200 per year. It's also home to a well-oiled alert system that can give warnings 5-10 seconds before strong tremors occur, which is just enough time for a factory's computers to shut down production, or a surgeon to pause an operation. "We have too many earthquakes, so we have many chances to train our system," says Wu Yih-Min, a seismologist at the National Taiwan University in Taipei, who worked on the science behind it.

Wu and other researchers have helped the Philippines, Nepal and Bhutan to set up alert systems, as well as gauges to monitor rains that could lead to flooding. The project is one of several under an economic and trade initiative called the New Southbound Policy, announced in 2016 by the island's leadership. The policy aims to reduce reliance on the Chinese mainland, while boosting ties with Australia, New Zealand and 16 other countries in south and southeast Asia.

The majority of Taiwan's collaborations in the natural sciences, as measured by Nature Index's key metric, Share, are with the United States, followed by the Chinese mainland, Japan and Germany. With the

New Southbound Policy, Taiwan is trying to forge connections with developing nations, creating new opportunities for science. Wu says such nations are likely to appreciate opportunities to collaborate with Taiwan because of its deeper scientific infrastructure and experienced workforce.

Under the policy, Taiwan offers funds for graduate study, researcher collaborations and centres pairing Taiwan's universities with counterparts abroad, focusing on areas including agriculture, environmental sciences, medicine and semiconductors. One of Taiwan's universities, the National Tsing Hua University in Hsinchu City, has partnered with a Malaysia centre for clean water and sustainable energy and a Vietnam centre for plant conservation.

Vice-president of research and development, Tseng Fan-Gang, says that getting funding from Taiwan's government for some collaborations is harder than four or five years ago because of an intensified drive to protect sensitive intellectual property. At the same time, funding for south and southeast Asia collaborations is becoming much easier to get due to the New Southbound Policy, leading some of his university's previous collaborations to move to countries such as India and Malaysia.

Taiwan's Share in publications in the natural sciences has fallen by 27.2% since 2015. Ageing professors or drops in PhD students may be factors. But so could policies against over-emphasizing publication quantity for funding, awards and promotions, says Ju Sheau-Pyng, a science policy expert at the National Taiwan University of Science and Technology in Taipei. **Andrew Silver**



Taiwan's tremor warning system allows for crucial moments for preparation efforts.

KYODO NEWS STILLS VIA GETTY IMAGES

the brain. “Matched with their infrastructure, it’s a pretty good collaboration.”

It’s little wonder that collaboration with China is growing along with the quantity and quality of China’s research, says Tan. For NUS, opportunities to translate research into products for the huge Chinese market is a key attraction. He says the machinery of China’s innovation ecosystem is both fast and sophisticated.

But as China has become more authoritarian at home and more assertive abroad, tensions have risen over scientific collaboration. The United States, Japan, Australia and the United Kingdom are among countries that have sought to bolster national security protections in their international research relationships, although Australia has been at pains, at least officially, not to single out China.

The Go8 boasts that it was instrumental in helping to develop what it describes as the “ground-breaking” University Foreign Interference Taskforce guidelines that the Australian government issued in 2019 to “deepen resilience against foreign interference in the university sector”. But the Go8 now worries that Australia’s “example to the rest of the world on how both security and research outcomes can be balanced and maintained” is in jeopardy.

Its 2020 submission to an Australian parliamentary inquiry into national security risks affecting the university and research sector criticises an “overlapping and confusing maze” of legislation that “has created new uncertainties and risks positioning Australia as an undesirable partner”.

Brian Schmidt, vice-chancellor of the Australian National University, Canberra, and deputy chair of the Go8, says legislation enacted in 2020 imposes terms and conditions on research that “our colleagues around the world don’t have, and may well be seen as unacceptable”. An opaque decision-making process in relation to research grants deemed not to meet national security requirements, and the ability of a minister to “retrospectively pull a grant”, create a “chilling effect”, he says.

“People will quit putting grants in on areas of national interest just based on hearsay. We will have researchers leaving the country because they will find it unpalatable to be here,” says Schmidt.

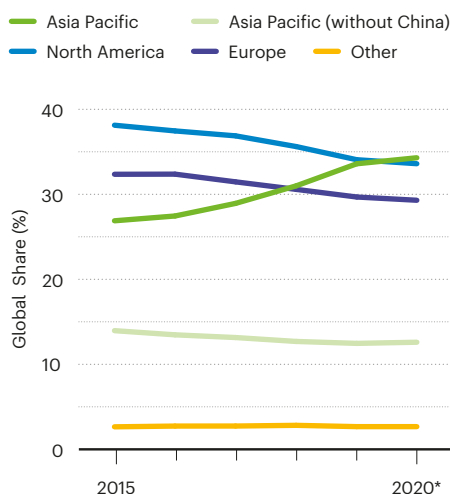
“The message is not that we should not work with China, but that we should make sure we do our due diligence,” says Harch.

Signs of cooling in the education and research partnership between the two countries are already present, such as reported long delays in obtaining visas, and Chinese students staying away. For example, 25% of UQ’s PhD candidates are from China, which in

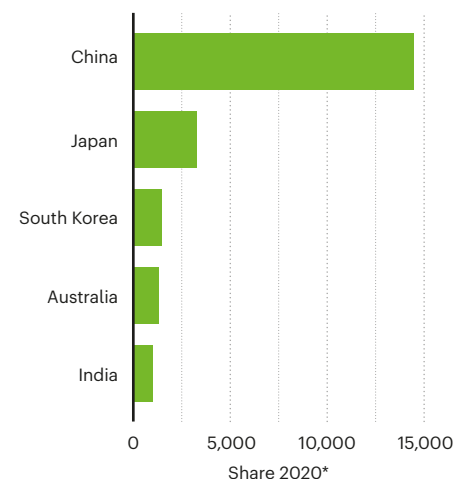
CHINA DRIVES ASIA-PACIFIC RISE

The rise in China’s proportion of regional Share from 48.1% to 63.2% since 2015 has resulted in a corresponding decline among leading Asia-Pacific competitors, especially Japan, whose regional share fell from 21.4% to 14.3% over the period. Seven of the top 10 most productive cities based on Nature Index Share are in China. Shanghai replaced Tokyo in the 2nd spot in 2018, the same year Nanjing displaced Seoul at 4th (see graph on page S25).

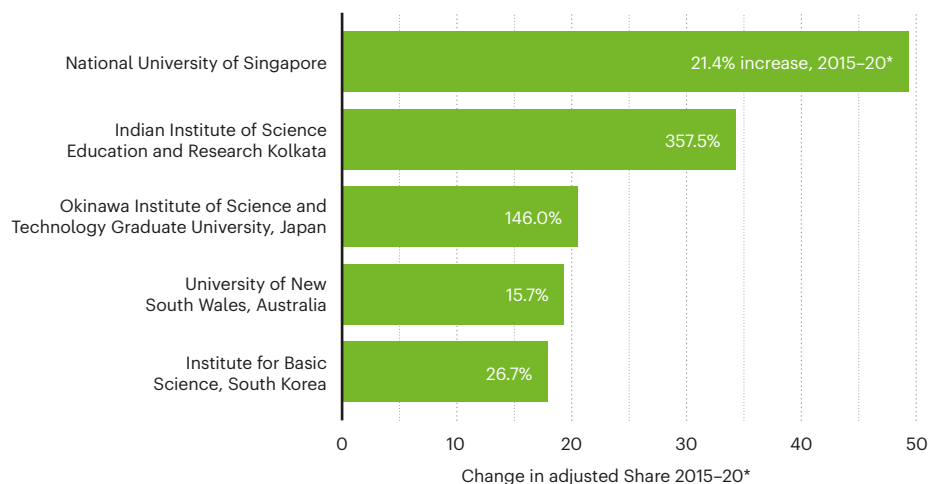
Asia Pacific vs other regions



Top Asia-Pacific countries



Asia-Pacific rising institutions outside China



*Data from the latest full year available at time of publication, September 2019–August 2020.

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2020 represented about 830 students. A UQ spokesperson says 60 have “international remote status”, but could not say how many chose to remain in China rather than start or resume their studies. Harch says UQ had kept their places, but travel disruption caused by the pandemic made it hard to interpret the numbers of absentees.

A June 2020 survey of 1,012 students in China

by a researcher at the Swinburne University of Technology, Melbourne, included 304 who had studied in Australia but could not return due to restrictions; less than half of those surveyed who had studied overseas planned to resume after restrictions lifted.

Jeffrey Reimers, director of the International Centre for Quantum and Molecular Structures at Shanghai University and a chemistry professor at the University of Technology Sydney, says four of the five international staff at the centre, including him, have been unable to return to China for more than a year. “The outlook for foreign academics working in China is very unclear. I think many are likely to be reconsidering their future there, and some of my friends

have already departed China permanently.”

Zhu Yanwu is a materials science professor at the University of Science and Technology of China, Hefei, whose contribution to collaborative graphene research between China, the United States and Singapore won an international award in 2017.

He says the most active partners in his field in the Asia-Pacific region are China, Australia, Japan and Singapore, and that most other countries in the region still have insufficient research infrastructure. Zhu sees great potential for China and southeastern Asian countries to advance their research collaboration, perhaps coordinated by Singapore and unified by a “common appreciation of Chinese culture”. China allocates 10,000 student scholarships a year to the 140 countries that signed up for the Belt and Road Initiative for trade and economic cooperation, of which 31 are in south and east Asia and the Pacific.

Zhu worries that increasing tension between China and Australia could frustrate further regional research collaboration. “I’ve heard many Australian scientists originally from China have tried to avoid getting involved in China-Australian collaborations, and funding for the two parties is not as active as before,” he says.

James Laurenceson, director of the Australia-China Relations Institute at the University of Technology Sydney and co-author of a 2020 report *The Australia-China Science Boom*, believes the risk of future action by China that deliberately stymies research links is low.

“Scientific success is at the heart of China’s development strategy, and China understands that international collaboration is fundamental to that. I think it would be very slow to use scientific collaboration as a tool in political disputes,” he says.

Cong Cao, an expert in China’s science policy at the University of Nottingham business school in Ningbo, China, agrees, saying China’s regional collaborations have become more important due to its rift with the United States, with scientific ties caught up in the Trump administration’s efforts to ‘decouple’ the US economy from China’s.

Despite its successes, China remains a follower in “many, many fields”, says Cao. “At the level of working research, they still want to work with the best scientists they can. Maybe the diplomatic relationship is kind of paused, but at the scientific level I don’t think the Chinese government wants to disconnect with the international scientific community,” Cao concludes.

Catherine Armitage is chief editor of Nature Index. Additional reporting by **Hepeng Jia**.



Nicole Khan and PhD student Howard Yu in the mudflats of the Mai Po Nature Reserve.

RESEARCH REACH DEPENDS ON FREEDOM

Hong Kong’s diversity is a key advantage in drawing collaborators.

Rising sea levels are expected to hit the Asia-Pacific region hard. Accelerated melting of ice sheets in Greenland and Antarctica, driven by increased global temperatures, could force mass relocations to higher ground in low-lying nations with densely populated coastlines, such as India, Japan, Thailand and Indonesia. Hong Kong, Shanghai and Guangzhou, three of China’s most important economic centres, are also highly susceptible to coastal flooding.

A project led by Nicole Khan, a US geologist at the University of Hong Kong (HKU), is digging into sea-level data in Chinese-language journals to inform risk assessment. Khan hopes that by integrating this information with international data sets, which have long been dominated by observations from North America and Europe, she and her colleagues will establish a record of global sea-level changes over the past 20,000 years. “There’s a lot of data that would be difficult to access if you weren’t a researcher in China,” she says.

Khan established the Sea Level and Coastal Change Laboratory at HKU’s Swire Institute of Marine Science (SWIMS) in 2019. Her research feeds into a wider collaboration between SWIMS and the Institute of Oceanology of the Chinese Academy of Sciences in Qingdao, which is focused on local marine ecosystems and strategies for

responding to environmental change.

Mangrove trees and shrubs, which protect coastlines against storms and erosion, are another focus for Khan’s team. In a 2020 study, Khan and her colleagues estimated a 90% probability that global mangrove growth will fail to keep pace with rising sea levels if greenhouse-gas emissions are not curbed (N. Saintilan *et al. Science* **368**, 1118–1121; 2020). “It makes me want to work more with engineers to develop solutions to changes we know are coming,” she says.

Researcher diversity in Hong Kong is a key advantage, says Khan. Whether this will be affected by China’s 2020 security law is yet to be seen. Criticized for its broad powers and ambiguous language, the law carries severe penalties for perceived acts of separatism, subversion, terrorism and foreign interference.

Sun Kwok, an astronomer at the University of British Columbia in Canada and former dean of science at HKU, is hopeful that academic freedom and access to funding will be unaffected, but says some researchers might see Hong Kong as less desirable than, say, Europe or the United States. “I don’t think universities will have problems recruiting, but they might not have the broad reach they had in the past.”

Gerard Postiglione, emeritus professor at the Consortium for Research on Higher Education in Asia at HKU, does not expect to see major impacts on researchers in Hong Kong. “It’s in the interest of current governments to retain what they have here,” he says. “Access to global knowledge networks propels the success of university research in Hong Kong.” **Bec Crew**

SUZANNE LEE/PANOS FOR NATURE