LETTERS

Edited by **Jennifer Sills**

Beware silent waning of shark protection

On 2 October 2011, the Republic of the Marshall Islands (RMI) declared the world's largest shark sanctuary, adding 1,990,530 km² to the rapidly expanding shark sanctuary movement. News outlets praised the policy, citing its widespread local support and protection laws, the strongest to date (1, 2). Moreover, it was hailed a substantial victory because the government chose to protect sharks despite pressures from politically influential fisheries and other interest groups (3). However, in 2016, mounting pressure from those same fishing interests convinced members of the government to weaken the sanctuary law (4), and the global conservation community has taken no action in response. Conservationists should determine at what point a weakened sanctuary—or any weakened protected area—should lose its title.

Expansion of shark sanctuaries has paralleled rapid designation of large-scale marine protected areas (LSMPAs) (5). Both have been criticized for being established in areas where political expediency outweighs ecological importance (6) and capacity for enforcement (7). However, unlike LSMPAs, shark sanctuaries have traditionally included two rigid regulations: They ban commercial retention of sharks and, in most cases, prohibit possession of shark parts on industrial fishing vessels (8). Yet, on 14 November 2017, the RMI

Parliament amended regulations to allow vessels to possess shark parts obtained outside RMI (4), substantially weakening the potential for enforcement and the heralded benefits for sharks.

Advocates argue that governments protecting threatened species through either sanctuaries or LSMPAs should be publicly praised (9). They also argue for periodic, systematic evaluations of effectiveness after implementation (10–12). But if these evaluations, which are rare, reveal failures in real protection, we should publicly discuss these failures. Otherwise, we risk publicly accumulating square kilometers to meet conservation targets, while silently weakening progress and encouraging the belief that the work stops when the announcement is made.

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Marine protected areas: Just for show?

In March 2018, Brazil's government announced two sets of large marine protected areas (MPAs) in the open ocean (about 400,000 km² each). According to the government's ambitious plan (1), the total coverage of MPAs under Brazilian national jurisdiction will rise sharply from 1.5 to 25%, in line with an emerging global trend in designation of large MPAs (2). Although these new MPAs presented an opportunity to make progress toward biological priorities, the decision-making process instead reflected uninformed opportunism (3). Rather than meeting conservation goals, the proposed MPAs exemplify poor adherence to best practices in MPA planning in three ways.

First, large no-take MPAs—i.e., those that prohibit fishing and mining—were designated in areas where these activities are already unlikely or rare, rather than placed where they would be most useful to conservation (4). For example, Brazil will fully "protect" vast areas in depths below 5000 m, covering ecosystems that are already de facto protected by poor prospects for extractive activities, regardless of the level of management applied (4). Shallow seamounts with vulnerable habitats and high endemism (5, 6) will remain unprotected or within multiple-use zones, with ongoing extraction and negative impacts on marine biodiversity.

Second, unlike well-designed MPA networks, Brazil's MPAs fail to account for spatial dependencies between areas to ensure that they achieve their core ecological objective: the maintenance of biodiversity over time (7). For example, population persistence on the protected deep seamounts will depend largely upon larvae transported from unprotected seamounts closer to the continental shelf (6), which are likely to be under high fishing pressure. If populations on protected seamounts are not self-recruiting, or fail to receive enough larvae from fished areas, they will also decline, and may fail to persist.

Third, designing large MPAs in the open ocean to regulate fishing of mobile pelagic

Gray reef sharks swim through the waters of the Marshall Islands, home to the largest shark sanctuary to date.

PHOTO: DESIGN PICS INC./ALAMY STOCK PHOTO

species (such as tuna and pelagic sharks) has long been considered a challenge for conservation planning (8). To be adequate, MPAs should encompass the home range and territory of adults of targeted species (9). The maximum horizontal dimension of the new Brazilian MPAs is 740 km; this range would not meet the requirements for species that display high mobility, which have home ranges wider than 1000 km (9). The success of remote MPAs in managing

pelagic species also depends highly on compliance (10), which will require substantial resources devoted to enforcement. Brazil's government has committed such resources, but funding of management in already-established Brazilian MPAs is known to be inadequate (11).

Large MPAs can be flagships for meeting global conservation aspirations such as Aichi Target 11 (12) yet still fail to contribute to marine conservation, giving a false

sense of conservation achievement. We encourage Brazilian authorities to embrace biodiversity values as they work to meet policy targets, rather than merely protecting a certain percentage of the ocean.

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A marae (Māori meeting place) in New Zealand.

OUTSIDE THE TOWER

Sharing chemistry with Māori students

I am bubbling dry ice in a beaker of sea water, showing how global warming is affecting our oceans, in front of Waikawa marae (a Māori meeting place) in Waikawa Bay, New Zealand. Fifty 14- to 16-year-old Māori students watch the demonstration intently. I have traveled for 6 hours to stay on this marae and show the students of the local iwi (tribe) that science isn't always carried out in a lab with a white coat on. Science, I tell them, is all around us in our everyday lives and works alongside Māori traditional knowledge. By linking traditions of caring for the environment with modern science, I hope to encourage Māori students to become the scientists our country needs.

After the last experiment in the chemistry show, I sit down with the students and share some chemistry YouTube videos on my laptop. One student, a young girl who spends any spare moment trying to start a game of rugby, marvels at how much the university is paying to fly me to the marae and provide materials for the program. She asks, "Why pay all that money just to come and do science with us?"

"Your teachers believe in you, and we think you're worth it."

Silence.

By the end of the visit, 50 students, local teachers, and I have slept in the same room for nearly a week, shared the cooking and cleaning, and worked together to test the water quality of the local river. To me, the essence of the Science Wānanga program (a Māori learning forum that involves rich and dynamic sharing of knowledge; www.otago.ac.nz/science-wananga) is to show Māori students that they are worth investing in.

Although the program aims to inspire Māori students to take an interest in science, scientists such as myself learn a great deal during our stay. Māori traditions of caring for the environment have been passed on for hundreds of years, and through Science Wānanga I gained a great deal of respect for New Zealand's indigenous people. The Māori people's relationship with their environment makes clear that these students already have the background they need to be fantastic scientists. We simply must invest in their education.

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TECHNICAL COMMENT ABSTRACTS

Comment on "Maxima in the thermodynamic response and correlation functions of deeply supercooled water"

Frédéric Caupin, Vincent Holtén, Chen Qiu, Emmanuel Guillermin, Max Wilke, Martin Frenz, José Teixeira, Alan K. Soper
Kim *et al.* recently measured the structure factor of deeply supercooled water droplets (Reports, 22 December 2017, p. 1589). We raise several concerns about their data analysis and interpretation. In our opinion, the reported data do not lead to clear conclusions about the origins of water's anomalies.

Full text: dx.doi.org/10.1126/science.aat1634

Response to Comment on "Maxima in the thermodynamic response and correlation functions of deeply supercooled water"

Kyung Hwan Kim, Alexander Späh, Harshad Pathak, Fivos Perakis, Daniel Mariedahl, Katrin Amann-Winkel, Jonas A. Sellberg, Jae Hyuk Lee, Sangsoo Kim, Jaehyun Park, Ki Hyun Nam, Tetsuo Katayama, Anders Nilsson

Caupin *et al.* have raised several issues regarding our recent paper on maxima in thermodynamic response and correlation functions in deeply supercooled water. We show that these issues can be addressed without affecting the conclusion of the paper.

Full text: dx.doi.org/10.1126/science.aat1729

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