30 × 30 target. While Biden's executive order has reduced some of the ambiguity associated with his original 30 × 30 promise (Middleton and Brashares 2020), greater clarity is urgently needed. Even so, the outlook remains promising, with the Biden administration's latest report documenting progress being made to deliver a "locally led campaign" for the 30 × 30 target, inclusive of diverse stakeholders and conservation actions (DOI 2021). Ultimately, finding synergies and consensus across diverse components of the 30 × 30 agenda will be a challenge within and across nations. By immediately resolving the questions of what objectives matter, what actions count to achieve them, and who gets to decide, governments can use this agenda to ensure that meaningful and durable outcomes can be delivered within the next decade.

Data Availability Statement

No data were collected for this letter.

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Science denialism limits management of invasive hippos in Colombia

Illicit crop economies and the so-called "war on drugs" strongly impact natural habitats, ecosystem services, and associated livelihoods in Colombia by promoting deforestation, as well as through aerial fumigation of coca (*Erythroxylum* spp) and poppy (*Papaver somniferum*) plantations with herbicides (Rincón-Ruiz and Kallis 2013). An additional legacy of drug trafficking poses another ominous threat to the country's environment: the geographic spread and demographic explosion of a large invasive mammal. In the 1980s, infamous drug lord Pablo Escobar smuggled various African animals into Colombia for his private zoo, including one male and three female hippopotamuses (*Hippopotamus amphibius*). Following Escobar's fall, hippos escaped confinement and invaded floodplains in the Middle Magdalena River basin. Ample suitable habitat and the absence of natural enemies have allowed the hippos to proliferate, which are now having overt impacts on social and ecological systems throughout the region (Subalusky *et al.* 2019; Shurin *et al.* 2020).

Aside from existing impacts observed in Colombia, research on hippos in their native distribution range in Africa indicates that these animals are ecosystem engineers that mobilize nutrients from terrestrial to aquatic systems, thereby substantially affecting biogeochemical cycling and ecological function (Dutton *et al.* 2020). In addition, especially when hippo populations are dense, they are aggressive animals that pose direct threats to humans (Dunham *et al.* 2010). Therefore, scientific inference and the precautionary principle clearly point to a need to control hippo populations in Colombia. Nonetheless, despite ecologists warning that hippo populations could reach 1,500 individuals and extend over an area exceeding 13,000 km^2 in less than four decades (Castelblanco-Martínez *et al.* 2021), and despite the International Union for Conservation of Nature urging that countermeasures be taken, the response of the Colombian government to this looming problem has been timid at best. What should be done to contain such an unprecedented biological invasion? Why have decisive, evidence-based policies and management actions yet to be adopted to mitigate the situation before it gets worse?

Population control via culling has been controversial ever since the government killed a hippo in 2009 following complaints by local communities, which outraged animal rights activists and Colombian society at large. Moreover, notwithstanding attacks on humans, some inhabitants of the Middle Magdalena region have developed strong emotional ties to the hippos, and hippo-based tourism provides short-term benefits to the local economy (Figure 1). Colombia thus faces a mismatch in the

science–policy–society interface: evidence points to an urgent need to control the hippo invasion, yet decision makers avoid effective actions because they could be politically damaging. The paralysis is such that hippos are not yet even recognized as an invasive species by the Colombian Ministry of Environment, which implies that these animals are protected by law and cannot be sacrificed. Management to date has been limited to tepid attempts at sterilization and confinement of a few individuals, actions that are both inefficient and likely ineffective in the long term. For example, demographic models suggest that to contain the hippo population within the next 10–12 years via sterilization alone would require sterilizing at least 30 individuals (15 females, 15 males) per year and continuing to do so over many years, requiring that substantial logistical hurdles be overcome (Castelblanco-Martínez *et al.* 2021).

The hippo invasion in Colombia is occurring within a highly transformed landscape (Correa Ayram *et al.* 2020). Cattle (*Bos taurus*) and buffalo (*Bubalus bubalis*) ranching, oil-palm (*Elaeis* spp) plantations, and damming of rivers have been responsible for much of the destruction and ecological degradation of dry and humid forests, floodplains, and wetlands of the Magdalena Valley. Consequently, multiple species in the region are under threat (Forero-Medina and Joppa 2010), many of which are important to local communities. For instance, several fisheries in the Magdalena have nearly collapsed over the past 40 years, jeopardizing livelihoods of around 157,000 people in the basin (Valderrama 2015). Some participants in public debates in Colombia have argued that hippos are a minor problem in the Magdalena Valley as compared to the large-scale processes of habitat transformation; although this proposition is hardly debatable, it does not help in solving the particular challenges posed by the biological invasion by hippos. Given that the increasing population and expanding range of invasive hippos may result in synergistic and cumulative negative effects on both biodiversity and vulnerable human communities, there are no rational arguments for avoiding effective control measures.

Considering the difficulties of implementing and maintaining long-term conservation practices in Colombia, and that hippos are long-lived animals that would have continued impacts even if they do not breed, several Colombian scientists have advised that a mix of sterilization, confinement, and culling would be the most practical and cost-effective strategy for controlling populations. However, as with other societal problems, such as the COVID-19 pandemic and climate change, political inaction in the face of the hippo invasion in Colombia hinges largely on science denialism: various participants in public discussions misrepresent the work and opinions of scientists, and question their ethics and motives. In addition to emphasizing the necessity of and confidence in science-based action, we stress a need to engage in discussions about ethical concerns, overcoming false dilemmas. The "compassionate conservation" worldview valuing the rights and interests of individuals of a charismatic alien species cannot prevail over (1) the rights and interests of individuals of native species and (2) the conservation of populations, ecosystems, and services

Figure 1. The ongoing expansion of invasive hippopotamus (*Hippopotamus amphibius*) populations in the Middle Magdalena River basin entails complex interactions with local human communities. The proximity of hippos and people in the basin (a) has potential for conflict, but also favors emerging activities, such as tourism, and (b) modifies local social perceptions and valuations of this invasive species.

those native species provide (Driscoll and Watson 2019; Griffin *et al.* 2020). Without decisive action by national environmental authorities, which should involve a variety of measures (including culling under humane animal welfare standards), hippo populations will continue to expand at the expense of ecosystems that support vulnerable human communities. We must not lose sight of lessons from tragic stories of initially valued invasive species, which, when left unchecked, took a heavy toll on native biodiversity and human well-being (Pejchar and Mooney 2009).

Data Availability Statement

No data were collected for this study.

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