Conservation news

New report applies the mitigation hierarchy and deep-ocean science to determine risks and impacts of deep-seabed mining

The current urgent focus on deep-seabed mining is driven by two things: the argument that seabed minerals are necessary to decarbonize our economies and mitigate climate change (with a rush for minerals and metals used in technologies associated with renewable energy); and the International Seabed Authority's self-imposed 2020 deadline to complete the rules and regulations governing deep-seabed mineral exploitation in international waters, thereby enabling contracts for exploitation.

A report published in March 2020 by Fauna & Flora International responds to this critical issue, assessing the latest scientific evidence. The report highlights the extraordinary complexity of ocean ecosystems, providing a system-scale insight into the connectivity of ocean chemistry, ecological function, the role of oceans in climate regulation and primary production, and the interdependence of these processes to maintain a healthy, functioning and productive ocean system.

The report found different policy and governance regimes apply to national and international waters, and, overall, governance of marine mining is fragmented and inconsistent. Attempts to determine impacts of mining are hampered by a significant lack of knowledge of deep ocean biodiversity. Furthermore, different risks and impacts are associated with the various methods of deep-seabed resource extraction. Some ecosystems are naturally highly dynamic and may be resilient to perturbations and violent physical disturbances associated with plate tectonics and volcanic activity (e.g. metal sulphides associated with hydrothermal vents). However, research shows that most deep-seabed ecosystems are very vulnerable, comprising highly specialized biodiversity, with slow growing, long-lived species. Evidence from projects monitoring pilot excavations indicate that impacts to these systems are likely to be long-term (in geological time frames) and widespread. All deep-sea extraction methods require removal of entire substrates from the ocean environment (e.g. phosphates, seafloor massive sulphides, cobalt crusts and polymetallic nodules).

Emerging science describes the complexities of ecosystem function and the relationship between target mineral resources, the biogeochemistry responsible for their formation and the overall health and function of the ocean. Deep-seabed mining will result in large-scale loss of habitat (i.e. loss of substrates) and associated biodiversity, including the unknown diversity of macrofauna and microbial systems underpinning primary production, carbon dioxide and trace metal sequestration and cycling, and will produce sediment plumes that will disrupt ecological function and behavioural ecology of deep-ocean species, smothering fundamental ecological processes over vast (and difficult to predict) areas. We simply do not know enough about deep-sea ecosystems to predict impacts with any confidence. However, through application of a mitigation hierarchy approach, the report's assessment reveals evidence for significant and currently immitigable impacts of deep-seabed mining on biodiversity.

The report raises the importance of poorly understood biogeochemical processes that drive ocean chemistry and ecological functions and highlights recent science that builds a strong case for the important role of deep-sea biological systems in driving planetary carbon sequestration. Deep-seabed mining has the potential to cause disruption and potential collapse of these processes and could exacerbate our current crises of climate change and biodiversity loss. Combined with the considerable gaps in the knowledge of ocean complexity and how this relates to earth-system processes, there is no adequate basis on which to grant mining exploitation contracts.

Pippa Howard (orcid.org/0000-0002-2171-6951) *and Nicky Jenner Fauna & Flora International, Cambridge, UK*
E-mail pippa.howard@fauna-flora.org

Guy Parker Wychwood Biodiversity, Aveton Gifford, UK

Searching for *Vatica pentandra*, a tree endemic to Kalimantan and known only from a single collection in 1955

Vatica pentandra (Dipterocarpaceae) is an endemic tree found only in Kutai Kartanegara Regency, East Kalimantan Province, Indonesia. The species is categorized as Critically Endangered on the IUCN Red List using criteria A1c, C2a, D, which focus on population size and reduction (P. Ashton, 1998, dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T33455A9785565.en). The tree is known from only a single collection, made in 1955 along the Belayan River near Tabang District (P. Ashton, 1978, *Gardens' Bulletin*, Singapore, XXXI, 5–48). There has been no further record of this tree, and it is not known to be present in any ex situ conservation collections (BGCI, 2020, *PlantSearch* database).

To provide information for an updated assessment of this threatened species, we conducted a survey in February 2020 in a total of 14 localities along the Belayan River, within the villages of Sungai Lunuk, Umaq Dian and Gunung Sari in Tabang District and Long Beleh Village in Kembang Janggut District. We tried to survey as wide a range of habitats as possible: from hilly, upstream areas of Sungai Lunuk

Village to flat, downstream areas of Long Beleh Village. The elevation range of the surveyed areas was 12–123 m. Despite these searches, which included the likely type locality described on herbarium specimens, we did not locate *V. pentandra*.

We believe that extensive loss of forests, to oil palm plantations and coal mining, is the most likely reason for our failure to relocate *V. pentandra*. In addition, forestry companies are extracting timber from forests along the Belayan River. With these forests greatly reduced and fragmented, the areas we surveyed are some of the last remaining forested areas along this river.

Although we recommend further surveys for *V. pentandra*, especially in upstream areas of Belayan River, in the northern Tabang Regency where forests are still in relatively good condition, we are able to update the conservation assessment of this species. Based on the findings of our survey, we reassess *V. pentandra* as Critically Endangered based on criteria A2cd; i.e. with more than 80% suspected population reduction in the last three generations (A2) based on a decline in area of occupancy, extent of occurrence and/or habitat quality (c), and potential level of exploitation (d). The forests of Kalimantan continue to be affected by conversion and degradation, and our updated assessment of this endemic tree species is an urgent call for the conservation of this and the other species of these forests.

Jean Linsky (orcid.org/0000-0002-3657-9283) Botanic Gardens Conservation International, Richmond, Surrey, UK
E-mail jean.linsky@bgci.org

Iyan Robiansyah (orcid.org/0000-0002-0503-458X), Enggal Primananda and Dipta Sumeru Rinandio Research Center for Plant Conservation and Botanic Gardens, Indonesian Institute of Sciences, Bogor, Indonesia

Conserving the poorly known and threatened monkey-frogs of the Brazilian Cerrado highlands

Amphibians are the most threatened vertebrate group, with at least 32% of species categorized as threatened (*The IUCN Red List of Threatened Species, v. 2020-1*, iucnredlist.org). Of these, 86% are categorized using geographical distribution criteria (B1 or B2, or D2 for Vulnerable). These are also the criteria most commonly used for Amphibia in Brazil (ICMBio, 2018, *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção*). Therefore, adequate knowledge of geographical distributions and valid taxonomy are essential for accurate species categorization.

The genus *Pithecopus* (Phyllomedusidae) comprises 11 species, of which four are endemic to the highlands of the Brazilian Cerrado. They mainly occur in environments threatened by habitat loss caused by mining, silviculture, livestock, fires and unsustainable tourism (Silveira et al., 2016, *Plant and Soil*, 403, 129–152). *Pithecopus ayeaye* is categorized on the IUCN Red List as Critically Endangered, and *Pithecopus centralis*, *Pithecopus megacephalus* and *Pithecopus oreades* as Data Deficient. However, on the Brazilian Red List these species are categorized as Least Concern, except for *P. centralis*, which is categorized as Near Threatened. Being endemic, the global and national Red List categorizations for these four species should be identical. To rectify this, and to resolve uncertainties regarding geographical distributions and species delimitations, we obtained a research grant from the Critical Ecosystem Partnership Fund, implemented by Instituto Internacional de Educação do Brasil (International Education Institute of Brazil) to (1) investigate the species' geographical distribution, through fieldwork, (2) delimit species using genomic tools, (3) refine the species' Red List assessments, (4) characterize larval ecological requirements and (5) assess the impacts of water contaminants and landscape degradation on the species.

We conducted fieldwork during October 2019–February 2020, searching for the species in locations identified through a combination of ecological niche modelling and predictive distribution mapping (Silva & Alves-Silva, 2013, *Zootaxa*, 3609, 213–222). We recorded one new location for *P. megacephalus*, four for *P. ayeaye*, and 12 for *P. oreades*, and located 12 new populations that need further work for taxonomic assignment. Once this has been completed, we will be able to prioritize populations (for proposals of new private reserves), update Red List categorizations, and define priority areas for conservation. In addition to support from the Critical Ecosystem Partnership Fund and Instituto Internacional de Educação do Brasil, this project, which will finish at the end of 2021, involves a partnership between one non-governmental organization, five Brazilian universities, and several researchers, students and managers.

Rafael Magalhães (orcid.org/0000-0002-2059-1288) and H. Fátima Gorgulho (orcid.org/0000-0002-9557-6808) Universidade Federal de São João del-Rei, São João del Rei, Brazil

Silvana Campello (orcid.org/0000-0003-1298-6279) Instituto Araguaia de Proteção Ambiental, Caseara, Brazil

Fabrícius Domingos (orcid.org/0000-0003-2069-9317) Universidade Federal do Paraná, Curitiba, Brazil

Iasodhara Freire (orcid.org/0000-0002-4816-1669), Caroline Oswald (orcid.org/0000-0001-6866-9585), Daniela Santos (orcid.org/0000-0002-3753-0801), Tiago Pezzuti (orcid.org/0000-0002-1162-3954) and Fabrício Santos (orcid.org/0000-0001-9088-1750) Universidade Federal de Minas Gerais, Belo Horizonte, Brazil