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SELLHEIM ENVIRONMENTAL

CONSULTANCY FOR NATURE AND CULTURE

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CONTENTS

EDITORIAL

Eco echoes: Latest updates, insights and foresights

Welcome to the first issue of *The Conservation & Livelihoods Digest* in 2024. First of all, we wish our readers a healthy and peaceful year ahead, which will be marked by important meetings that contribute to shaping the future of our planet. Towards the end of 2023, the 28th Conference of the Parties (CoP28) to the United Nations Framework Convention on Climate Change (UNFCCC) has yet again demonstrated the difficulties of reconciling different views on how to find means and ways to tackle global warming — an issue which affects us all.

The importance of finding means and ways to halt, or at least slow down, ice loss in the Arctic, the Antarctic and the 'third pole' — the Himalayas — is best demonstrated by the continuously decreasing state of the world's ice caps, as our first contribution shows. While scientific findings speak a rather clear language, the outcomes of CoP28 demonstrate yet again the difficulties of how to move forward amidst the plethora of different views and perspectives on this issue. Whether or not Hollywood can contribute to making the world a habitable place for future generations remains to be seen.

These diverging views are exemplified in our second contribution. The article discusses Norway's decision to engage in deep seabed mining and the lack of comprehensive regulations from the International Seabed Authority. Norway, along with other countries, is leading this practice despite concerns about its severe ecological impacts on marine life. The European Union opposes deep seabed mining and calls for an international moratorium. The article suggests implementing strict environmental impact assessments to minimise harm, but doubts remain about the true extent of the environmental footprint, particularly concerning seafloor massive sulfides and their role in benthic ecosystems.

But as our third contribution, a Review Article, demonstrates, overexploitation and environmental harm are not of recent origin. The article deals with a study published in *Nature Communications* that examines the impact of human expansion on bird species since the late Pleistocene (i.e. approximately 126,000—11,700 years ago). Using fossil records and statistical modelling, the researchers estimate that approximately 1430 bird species have become extinct globally during this period, with around 55% of these extinctions remaining undiscovered. The study identifies three major waves of extinction triggered by human arrival and subsequent global activities like habitat destruction. These findings highlight the concept of "extinction debt" and emphasise the need for urgent conservation efforts to prevent further biodiversity loss and protect remaining bird species.

In order to effectively produce and use reliable data, pure reliance on publicly available sources is not necessarily sufficient. In our fourth contribution, written by our new fellow Gerald Zojer, the significance of tourism in Finnish Lapland's regional economy, particularly highlighting Muonio's claim of having the world's purest air as a marketing strategy is discussed. The article points out limitations in air quality data due to sparse monitoring stations. It suggests citizen science projects utilising devices of the Internet of Things (IoT), and open-source hardware and software to bridge this data gap. These projects enable individuals and communities to build their own environmental monitoring systems, contributing to more sensitive decision-making processes and democratising environmental monitoring.

The review of the book *The United Nations' Declaration on Peasants' Rights*, edited by Mariagrazia Alabrese, Adriana Bessa, Margherita Brunori, and Pier Filippo Giuggioli, discusses the significance and implications of the United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas (UNDROP), adopted in December 2018. Unlike the UN Declaration on the Rights of Indigenous Peoples (UNDRIP), the UNDROP did not receive widespread support and was signed by 121 countries, with 8 voting against and 54 abstaining. The review highlights the challenges and controversies surrounding the declaration, including concerns from developed nations such as Sweden regarding the inclusion of new rights like the right to seeds and food sovereignty. Despite criticisms, the UNDROP is gaining traction and being referenced in international conservation initiatives.

On *Sellheim Environmental*'s own behalf, we also introduce the CITES Resolutions Depository, a comprehensive database developed by *Sellheim Environmental*, which addresses the need for access to historical Resolutions adopted during the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Conference of the Parties (CoPs). With 301 Resolutions shaping the course of CITES' functioning over 19 CoPs, this repository offers researchers and stakeholders invaluable access to historical Resolutions, aiding in-depth analysis of the Convention's trajectory.

In parallel, Gerald Zojer, a mechanical engineer turned doctoral candidate at the University of Lapland, joins as a new fellow, bringing expertise in the interplay between technological advancements and societal progress, particularly focusing on energy politics, environmental politics, and the nexus of digitalisation and power politics. Zojer's entrepreneurial venture, *KaamosCreations*, further contributes to ethical digitalisation, aligning with his broader research interests.

Finally, once again we provide three translated news articles from the German media. Artificial intelligence (AI) emerges as a crucial tool for understanding and preserving biodiversity, as Patricia Preis highlights its potential in species conservation efforts. Preis discusses how AI aids in comprehensively observing ecosystems, addressing the urgent need for conservation due to declining biodiversity. Through initiatives like the BirdNet app and the use of audio recorders in forests, AI assists in identifying species interactions and ecosystem dynamics. Similarly, Matthias Vahl's work with AI in river ecosystems exemplifies its effectiveness in studying endangered species like sea trout and understanding the impact of human infrastructure on their habitats. In a separate article, researchers from the University of British Columbia report the discovery of a new orca ecotype off the US west coast. This finding underscores the importance of ongoing research and conservation efforts to protect marine biodiversity. Additionally, Lower Saxony's implementation of a fast-track shooting procedure to address wolf attacks on livestock sparks controversy among conservationists, highlighting the complex balance between wildlife conservation and human-wildlife conflict management.

If you wish to contribute to *The Conservation &*

Livelihoods Digest, please feel free to contact the editorial office at info@sellheimenvironmental.org. We wish to stimulate discussion on all aspects relating to conservation and sustainable use.

— *Dr Nikolas Sellheim*

March 2024

ARTICLE

The state of the world's ice caps

Introduction

In 2015, the world's governments came together once again to tackle the challenges of climate change. In what is now know as the 'Paris Accord' or the 'Paris Agreement', the 21st Conference of the Parties (COP21) to the UN Framework Convention on Climate Change (UNFCCC) adopted groundbreaking emission goals to limit the rise in global temperature to well below 2°C towards the end of the century, with efforts to limit it to 1,5°C.

Contrary to its predecessor, the 1997 Kyoto Protocol, the Paris Agreement enjoys almost universal adoption: 195 out of 198 Parties to the UNFCCC have adopted the Agreement whereas 192 countries are parties to the Kyoto Protocol. The United States has never ratified Kyoto, did so, however, with the Paris Agreement, withdrew from it under Donald Trump's presidency and rejoined again under Joe Biden.

In December 2023, the Parties to the UNFCCC came together in Doha, United Arab Emirates, for COP28, deciding on further steps to curb greenhouse gas emissions and to combat climate change. COP28 concluded with a groundbreaking agreement signalling the beginning of the end of the fossil fuel era, emphasising a swift, equitable transition bolstered by significant emissions reductions and increased financing. The conference commenced with a historic decision on the operationalisation of funding mechanisms for loss and damage, including the establishment of a dedicated fund under the UNFCCC, resulting in immediate commitments exceeding USD 600 million. Parties also reached consensus on targets for the Global Goal on Adaptation and its framework, outlining the necessary resilience measures against climate change impacts. Furthermore, the COP witnessed unprecedented recognition of the interconnectedness between climate and biodiversity crises, highlighting them as integral parts of the triple planetary crisis. Additionally, the Global Climate Action platform facilitated collaboration among governments, businesses, and civil society to showcase practical climate solutions. Notably, negotiations on the enhanced transparency framework laid the groundwork for implementing the Paris Agreement, with UN Climate Change developing reporting and review tools showcased and tested at COP28, slated for release to Parties by June 2024 (United Nations, 2023).

Towards the end of the COP, however, the so-called *First global stocktake* was adopted, a deal that aims to reach the goal towards the end of the century. Whether or not this adoption can be considered a success or a failure very much depends on the vantage point (Sellheim Environmental, 2023).

The sea ice situation in 2023

One of the best indicators for global temperature rise can be found in the sea ice of the polar regions. In the Arctic, the maximum sea ice extent can usually be found in mid-March, whereas the lowest sea ice extent is usually measured in mid-September. While changes in the global temperatures do not cause linear responses in the Arctic and also current and weather conditions along with natural fluctuations have an impact on sea ice extent, in the past 35 years it has become clear that rising temperature levels have dramatic effects on the Arctic's sea ice extent and thereby on a multitude of factors associated with it, such as precipitation, changes in biodiversity e.g. through invasive species, permafrost thaw or the overall condition of the sea-ice dependent thermohaline circulation, also known as the Gulf Stream.

Towards the end of 2023 it had become apparent that the sea ice situation in the Arctic continues to be dire. While it was 'merely' the 6th lowest on record, scientists also found that the 17 last minimum sea ice extents measures in September between 2007—2023 have indeed been the 17 lowest on record, compared with the average extent since 1979. In other words, the melting of the Arctic's sea ice continues unabated (see Fig. 1).

The situation in Antarctic is very similar. Typically, the lowest sea ice extent can be found in March — the end of the Antarctic summer — while the greatest extent can be found in September, the end of Antarctic winter.

Antarctic sea ice is crucially important for both regional and global climate regulation. As also in the Arctic, it helps maintain stable global temperatures by reflecting sunlight with its bright surface, a phenomenon known as the 'sea ice albedo' effect. Additionally, it contributes to ocean currents by influencing the formation of bottom water in the ocean. Changes in Antarctic sea ice affect atmospheric patterns, impacting weather patterns in distant regions. Sea ice acts as a buffer, protecting glaciers and ice shelves from damaging waves, thus limiting Antarctica's contribution to rising sea levels. Changes in

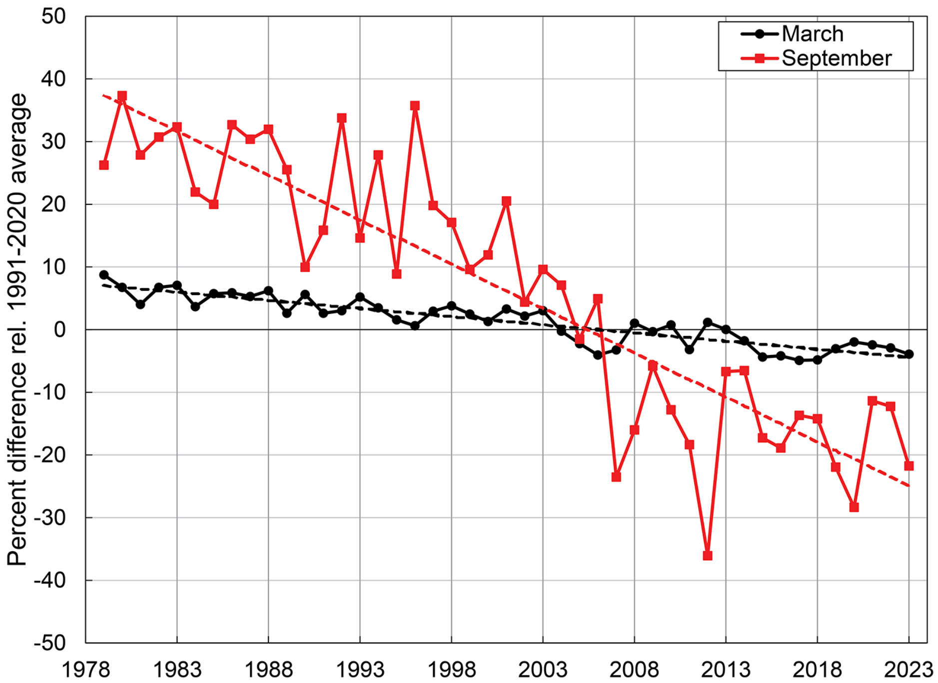

Fig.1 Monthly sea ice extent anomalies (solid lines) and linear trend lines (dashed lines) for March (black) and September (red) 1979 to 2023© Meier et al., 2023

sea ice also affect precipitation, evaporation, and temperature, potentially impacting the balance of ice on the continent. The Southern Ocean, covered by sea ice, is crucial for marine life, serving as a breeding ground for animals like emperor penguins and supporting significant ecosystems. Therefore, the loss of Antarctic sea ice has far-reaching consequences, affecting global climate, ocean heat and carbon absorption, sea level rise, and ecosystems.

The extent of Antarctic sea ice undergoes significant variations over the course of the year. Figure 2 depicts its annual cycle spanning from 1979 to 2023, illustrating individual years through thin green/turquoise lines, highlighting the 1981–2010 climatology in bold, and emphasising 2023 data (up to August 31) in purple. The climatological minimum and maximum extents, typically occurring in late February and mid-September, are recorded at 2.88 million square kilometres and 18.57 million square kilometres, respectively. This seasonal expansion leads to a sixfold increase in the area of the Southern Ocean covered by sea ice.

While Antarctic sea ice has undergone shifts and has experienced a state of great extents from mid-2007 onwards, this started to change in mid-2016 when "Antarctic sea ice rapidly transitioned to a new, low sea ice state" (Purich & Doddridge, 2023).

The shift to a low-extent state of Antarctic sea ice can be attributed to various factors related to atmospheric circulation. For example, in the spring of 2016-17, a particular type of air flow called "meridional circulation" that is related to a specific pattern of air movement called "zonal wave number three" was linked to changes in sea ice. Also, the influence of a strong Amundsen Sea Low circulation — a semi-permanent low-pressure system that typically forms during the austral winter months (June to August) and persists into spring (September to November) — in spring 2021 and the phase of the Southern Annular Mode (SAM), the north-south movement, or oscillation, of a belt of strong westerly winds that typically encircle Antarctica, alone cannot explain the recent low sea ice extents.

Historically, the positive phase of the SAM, forming a contracted belt of westerly winds, resulting in stronger westerlies closer to Antarctica, and weaker westerlies further north has correlated with colder sea surface temperatures and increased sea ice extent. However, anomalies observed during recent record sea ice minima in 2022 and 2023 suggest a breakdown in this relationship, with sea ice reaching record lows despite surface temperatures close to the climatological mean and a positively anomalous SAM. This suggests that Antarctic sea ice may have entered a new regime, where previously significant relationships no longer drive sea ice variability. One consistent factor across these recent low sea ice summers is the presence of a warm subsurface ocean, indicating its crucial role in influencing the observed changes in Antarctic sea ice (Purich & Doddridge, 2023).

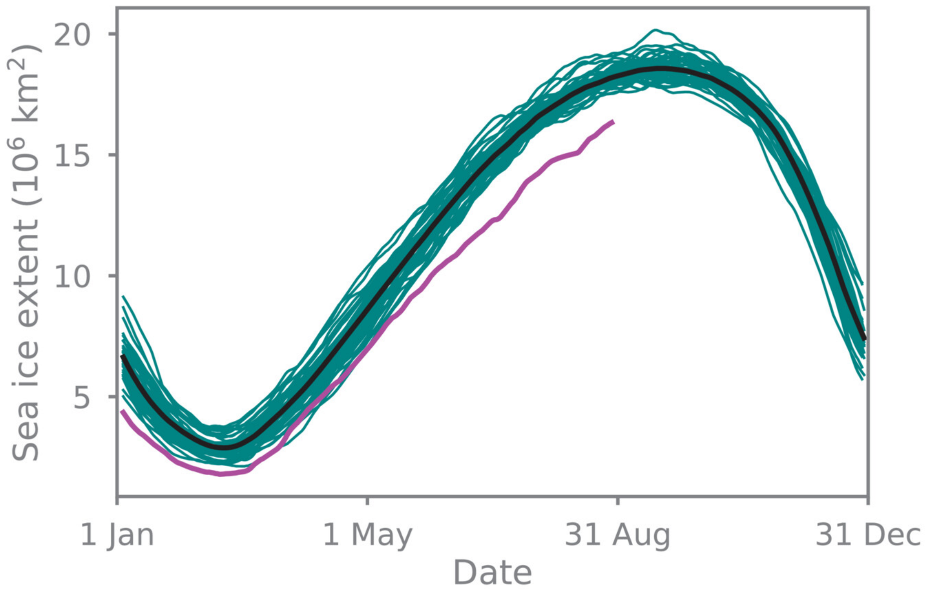

Fig. 2: Annual five-day running mean Antarctic sea ice extent in millions of square kilometres between 1979 and 2023 as observed by satellites. The 1981–2010 climatological mean is shown by the thick black line and the thin turquoise coloured lines are individual years. Antarctic sea ice extent for 2023 (up to 31 August 2023) is shown by the purple line © Gilbert, 2024.

The subsurface waters of the Southern Ocean are getting warmer, which Purich & Doddridge (2023) consider to be connected to the current situation of low sea ice, and might have led to a shift in how Antarctic sea ice behaves. The warming of the Southern Ocean since the mid-20th century can directly be related to more greenhouse gases in the atmosphere, with the reduction of ozone playing a smaller part. Some of the warming might also be due to natural changes in the ocean, but this alone cannot explain all of the observed warming.

While climate patterns may have contributed to low sea ice coverage in recent individual years, when averaged over the seven years of the current period, a decline in sea ice is observed around Antarctica. This decline coincides with warming of subsurface waters. Importantly, the ocean warms *before* the reduction in Antarctic sea ice. This is particularly important since Purich & Doddrige (2023) were able to observe this happening in the same locales, therefore being able to establish a relationship between warm anomalies at 100–200 m depth in 2015 and subsequent negative sea ice anomalies in 2016, indicating a potential causal relationship between ocean warming and changes in sea ice distribution over time.

The sea ice in both the Arctic and Antarctic regions is experiencing significant declines, which have profound impacts on global climate and ecosystems. Rising temperatures are driving these changes, leading to shifts in sea ice extent and patterns. While natural variability and atmospheric circulation patterns also play a role, the warming of the oceans beneath the surface appears to be a key factor driving the observed changes in sea ice.

This warming of the Southern Ocean, attributed primarily to increasing greenhouse gases, is causing a reduction in sea ice levels, with implications for weather patterns, biodiversity, and the stability of polar ecosystems.

The state of the 'third pole', the ice-caps of the Himalayans, is comparably worrying. The Hindu Kush Himalaya (HKH) region encompasses portions or entireties of four globally recognised biodiversity hotspots: the Himalaya, Indo-Burma, Mountains of Central Asia, and Mountains of Southwest China. These glacier- and snow-covered mountains serve as crucial water sources for 12 river basins, including 10 major rivers that traverse multiple countries in Asia. These rivers, such as the Amu Darya, Brahmaputra (Yarlung Tsangpo), Ganges, Indus, Irrawaddy, Mekong (Lancang), Salween (Nu), Tarim, Yangtse (Jinsha), and Yellow (Huang He), provide freshwater services to approximately 240 million people within the HKH region and an additional 1.65 billion people downstream.

A study released in July 2023 by the Nepal-based International Centre for Integrated Mountain Development (ICIMOD) paints an extremely worrying picture. The report found that recent advancements in monitoring and analysing glaciers in the HKH region reveal notable changes in glacier mass and snow cover extent. Glacier mass loss has accelerated by 65% across the HKH, with some areas experiencing a transition from mass gain or stability to mass loss. The rate of glacier mass loss increased significantly between the 2000s and 2010s, particularly in the eastern HKH. Additionally, the Karakoram region, previously known for stable mass balances, has shown slight wastage in recent years, marking the end of what has been known as the 'Karakoram Anomaly'. Snow cover extent has exhibited a negative trend since the early 21st century in the HKH, with exceptions in the Karakoram. There has been a significant decrease in seasonal snow cover during both summer and winter months, indicating a shift in seasons. This decline is particularly pronounced at lower elevations, with an average loss of five snow cover days per decade. Projections suggest that snow cover will continue to decrease, especially under different levels of global warming in the future (ICIMOD, 2023).

Accelerated glacier melt in the HKH region is projected to lead to 'peak water' by around mid-century in most river basins, with overall water availability expected to decrease by the end of the century. While higher elevations may experience increased water availability due to more melt or rainfall, significant variability exists between basins, and uncertainty in future precipitation projections limits confidence in estimates of future discharge. The changing climate has made the mountain hazard landscape more complex, with various slow- and fast-onset hazards occurring simultaneously and often in a cascading manner. This complicates efforts to implement early warning and adaptation measures, with medium confidence in a likely increasing trend in hazard frequency and intensity. Water sources in high mountains are crucial for local livelihoods as well as downstream areas heavily reliant on meltwater for agriculture, domestic, and industrial purposes. Glacier and snowmelt serve as a buffer for downstream irrigation demand, with increasing dependency expected in the future (Ibid.).

The cryosphere of the HKH region plays a vital role in sustaining ecosystem health, biodiversity, and ecosystem services. This biodiversity-rich area, with 40% under protected area coverage, features interconnected and diverse ecosystems, with 60% of the region characterised by seasonal cryosphere elements like snow, glaciers, permafrost, and glacial lakes, which are crucial water sources and ecosystem service providers. However, multiple drivers of change, notably climate change, are exerting significant impacts on the delicate HKH ecosystem and cryosphere, leading to widespread shrinkage of the cryosphere, glacier mass loss, reduced snow cover, permafrost degradation, altered hydrology, and increased natural hazards. These changes are cascading across ecosystems, affecting species distribution, habitat suitability, and ecosystem services flow, thereby increasing vulnerabilities and impacting human well-being. Future scenarios project heightened ecosystem vulnerability, reduced ecosystem services, and disruptions to social-ecological resilience due to more extreme events and imbalances in ecosystem functions, further exacerbating societal vulnerability.

Improvements in the quality of life for mountain communities have often been linked to increased accessibility and economic development. However, despite these advancements, the marginalisation and vulnerability of these communities have seen little improvement, and in many cases, have worsened due to climate change and associated changes in the cryosphere. Mountain societies reliant on agriculture, livestock, and medicinal plants are particularly affected by these cryospheric changes, with significant implications for their livelihoods and well-being. As cryospheric changes intensify alongside population growth and infrastructure development in mountainous regions, communities are increasingly exposed to cryosphere-related hazards, with future disasters projected to be more unpredictable, costly, and deadly. The perception of risk among mountain communities is crucial in determining how these hazards are addressed and prioritised. Adaptation efforts in mountain communities have largely been autonomous and incremental, mainly at the household and community levels. However, there are significant gaps between the adaptation needs of these communities and the support available to them, with both soft and hard limits to adaptation further exacerbating vulnerability to cryospheric changes.

The (imagined?) future

Against the backdrop of the above it becomes clear that urgent needs for action are imminent. However, it is difficult to look overly optimistically into the future. After all, the European Earth Observation Programme (Copernicus), which provides climate change data on Europe and the entire globe, has released new information on the state of the world's climate (Copernicus, 2024a):

- 2023 was the warmest year on record;
- In 2023, the global average temperature reached 14.98°C, marking an increase of 0.17°C compared to the previous highest annual temperature recorded in 2016;
- 1,48°C warming compared to preindustrial levels;
- Every month from June to December in 2023 experienced higher temperatures compared to the same months in all preceding years;

In addition, Copernicus has found that the average global temperature over the last twelve months (March 2023 to February 2024) has set a new record, surpassing previous highs. It stands at 0.68°C higher than the 1991-2020 average and 1.56°C higher than the pre-industrial average from 1850 to 1900 (Copernicus, 2024b). It seems, therefore, that the goal of the Paris Agreement to limit global warming to 1,5°C compared to preindustrial levels is further away than ever before.

It is difficult to imagine what the future looks like if the warming trend continues. Generally speaking, rising global temperatures are associated with a host of detrimental impacts across various domains. First, there is an increased frequency and severity of extreme weather events such as heatwaves, storms, floods, and droughts, leading to widespread devastation in communities, infrastructure, and ecosystems, also in regions where these events have not occurred frequently. The intense flooding in northern Germany starting at around Christmas 2023 is a case in point (DW, 2023).

Additionally, the continued warming of the planet accelerates the melting of polar ice caps and glaciers, resulting in rising sea levels that pose significant threats to coastal communities through flooding, erosion, and saltwater intrusion. This phenomenon can and is likely to displace millions of people and cause substantial economic losses. Moreover, rising temperatures disrupt ecosystems, causing habitat loss, species extinction, and alterations in species distributions, thereby jeopardising biodiversity and essential ecosystem services like pollination, water purification, and carbon sequestration, ultimately affecting human well-being and livelihoods.

Furthermore, climate change impacts agricultural productivity, resulting in crop failures, reduced yields, and food shortages, while changes in precipitation patterns exacerbate water scarcity, further compromising food and water security for billions worldwide. The health of populations is also at risk due to increased air and water pollution, the spread of infectious diseases, and heightened vulnerability to heat-related illnesses, particularly among vulnerable groups.

Lastly, climate change can exacerbate poverty, inequality, and social unrest as communities grapple with the consequences of extreme weather events, loss of livelihoods, and displacement, with significant economic sectors such as agriculture, tourism, and fisheries facing substantial losses, thereby straining global economies.

What a future marked by climate change could look like has been explored on several occasions. Of course, David Guggenheim's *An Inconvenient Truth* (2006) or Ron Bowman's *Six Degrees Could Change the World* (2008; freely available here) are documentary-type films about the causes and effects of climate change on the world's ecosystems and societies. Especially *An Inconvenient Truth* has led to public recognition of the problems related to global warming.

But also Hollywood has not been silent about the issue. For instance, Adam McKay's *Don't Look Up* (2021), with Jessica Lawrence, Leonardo di Caprio, Cate Blanchett and Mery Streep acting in the main roles, addresses the inaction of human decision-makers despite knowing of the impending destruction of world — in this case exemplified by a comet threatening Earth.

The most elaborate and most recent Hollywood adaptation is the eco-drama anthology series *Extrapolations* (2023) by Scott Z. Burns, streamed on AppleTV+. With several interwoven stories progressively taking place in the near and subsequently advancing future, the series addresses different aspects of climate change and its effects on the globe. Of course, the binary existence of and adverse relationship between capitalists and eco-savers characterises the red thread of the series, with the capitalists being the ruthless cause for environmental destruction who are ultimately to blame for ecological catastrophe — indeed, which is the content of the final episode of this series: a case before the International Court of Justice (with the judges being digital beings so that *all* cultures in the world are adequately represented), adjudicating ecocide.

Extrapolations cast is indeed impressive: Meryl Streep, Sienna Miller, Edward Norton, Kit Harington, David Schwimmer, Forest Whitaker, Diane Lane or Heather Graham all participate in this series that is so impressively superficial and naive, but appears to be so much based on science, that this can almost be considered dangerous. If this is what people start to connect with global warming and/or global environmental governance, the world indeed is in dire need of help. Lucy Mangan of The Guardian has captured the essence of this series best, which "finds itself stuck at the student debate level set in the first episode when a protester who is about to deliver a speech on the failure of the 2015 Paris agreement, via a giant hologram, is asked if there's anything she needs. 'Yes,' she says. 'For people to listen!' Elsewhere there is anthropomorphic schmaltz, unlikely reactions and sometimes both at the same time, as when Rebecca sabotages her company's project when she finds it requires lying … to a whale" (Mangan, 2023).

While Hollywood disaster-narratives are simplified at best, the current developments and most recent findings cannot hide the fact that urgent action is necessary. After all, the impacts of climate change on the socio-ecological systems of this world are dramatic. As the example from the Himalayas has shown, billions of people are directly affected by melting glaciers, in all likelihood leading to migratory movements caused by water shortages in the not-so-far future. Rising sea levels caused by melting Antarctic ice and a potentially slowing-down Gulf Stream by melting Arctic ice are possibly less of a threat for the current generations, but will cause massive changes for future generations. The Paris Agreement is therefore merely a small step, but a more giant leap for humankind, to paraphrase Neil Armstrong, is required.

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ARTICLE

Norway's controversial decision to open its seabed to mining operations

Glossary

arthropod	*group of invertebrate animals that make up the largest phylum in the animal kingdom, known as Arthropoda, including insects, arachnids (spiders, scorpions), crustaceans (crabs, lobsters, shrimp), and myriapods (centipedes, millipedes).*
benthic	*the ecological and environmental zone at the bottom of a body of water*
benthopelagic	*the ecological zone or organisms that inhabit the water column just above the seafloor or bottom of a body of water, typically in deep ocean environments*
infauna	*organisms that live within the substrate or sediments of a body of water, such as the seafloor, riverbed, or lake bottom, adapted to life within the sediment, burrowing or dwelling in the spaces between particles*
meiofauna	*tiny aquatic organisms that live in the interstitial spaces of marine and freshwater sediments, ranging from 45 micrometers to 1 mm in size*
macrofauna	*relatively large, often visible, multicellular organisms that inhabit the benthic (bottom) regions of aquatic environments, e.g. worms, crustaceans, mollusks, and small fish*
nanofauna	*microscopic or very small aquatic organisms that are part of the plankton community, invisible to the eye*
nematode	*type of unsegmented roundworm belonging to the phylum Nematoda.*
pelagic	*the open-water region of a body of water, such as the ocean, away from the coast and the bottom*
seafloor massive sulfides (SMS)	*mineral deposits found on the ocean floor that contain high concentrations of sulfide minerals.*
sulfide	*a chemical compound containing the element sulfur, in the context of marine environments and geology, often referring to minerals or compounds that contain sulfur combined with metals, such as iron, copper, zinc, or lead*

Introduction

9 January 2024 marked a turning point in the history of resource exploitation. For it was on that Tuesday when the Norwegian Parliament, the *Stortinget*, was the first one to vote for an opening of deep sea mining explorations on its Arctic continental shelf (see Fig. 1). News outlets from all over the world have reported on this landmark decision (e.g. Bryant, 2024; Gilbert, 2024; Hivert, 2024; Lipton, 2024; Pie de Pagina, 2024; SpiegelOnline, 2024). In many instances, news outlets highlighted the opposition that has come with the decision — especially by environmental groups — since it neglects scientific uncertainties and accepts potential negative effects to the marine environment.

And, indeed, the meeting record of *Stortinget* from this memorable day shows that despite some opposition to the plan, it was decided by a vote of 80 for and 20 against that:

"I —The Storting asks the Government to clarify that national security considerations will be a criterion when awarding production licences; II — The Storting asks the Government to submit the first plans for the extraction of seabed minerals to the Storting as a proposition before the Ministry approves the extraction plan pursuant to section 4-4 of the Seabed Minerals Act; III —

The Storting asks the Government to ensure that the Norwegian Petroleum Directorate obtains input from other affected government agencies, including the Norwegian Environment Agency and the Institute of Marine Research, in connection with the preparation of its proposed work programme for the Ministry" (own translation; *Stortinget*,

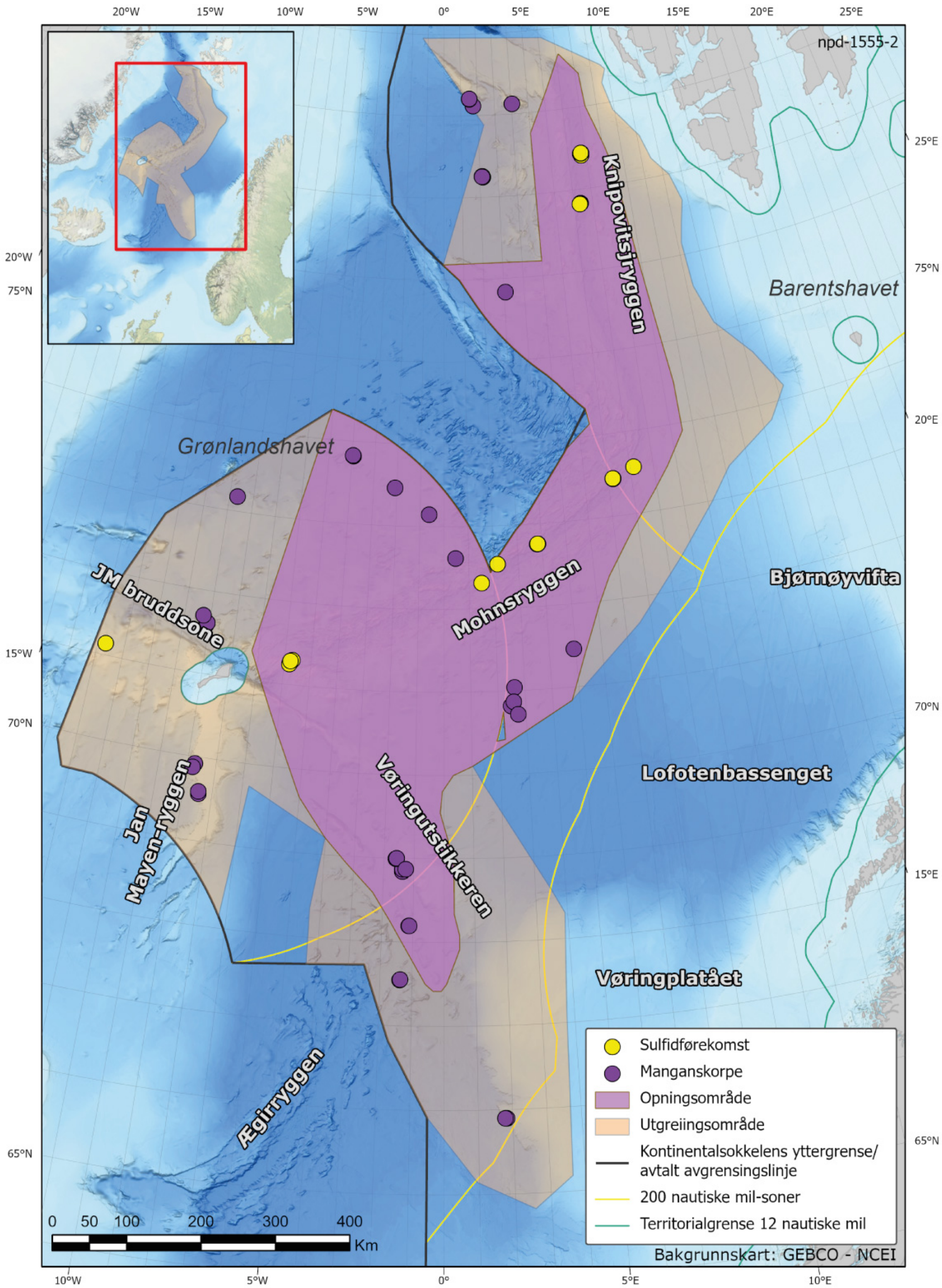

Fig. 1: Detected sulfide and manganese crust deposits © University of Bergen and the Norwegian Petroleum Directorate, Undated.

2024).[1] Prior to this decision, the Socialist Left Party, Red Party, Liberals and the Green Party tabled several proposals that aimed to place the Arctic under stricter protection, and to put on hold or even restrict deep sea mining on the continental shelf. These were voted down with 81 against and 19 in favour, however (ibid.).

International stances on deep sea mining

Norway's plan to open up its continental shelf to deep sea mining is not new and already in December 2023 it became clear that the Norwegian government would allow deep sea mining once *Stortinget* approves (Klesty, 2023) despite the environmental concerns that go along with the practice, as discussed below. One of the main reasons for Norway to allow deep sea mining stems from the assumption that with the sulfides extracted, Europe would become more independent from China in regard to minerals needed for electric vehicle batteries, wind turbines and solar panels (Klesty & Adomaitis, 2023) — an argument also Sweden brings forth in the debates surrounding the discovery of rare earth materials in its environmentally and socially sensitive North (Sellheim, 2023).

Generally, according to the provisions of the UN Convention on the Law of the Sea (UNCLOS), deep sea mining in areas beyond national jurisdiction ('the Area') is regulated by the International Seabed Authority (ISA) while all seabed and subsoil areas within the 200 nautical mile Exclusive Economic Zone (EEZ) and on the extended continental shelf are subject to the regulations of the coastal state. For 'the Area', ISA has thus far adopted three regulations pertaining to polymetallic nodules (2000 and revised in 2013), polymetallic sulphides (2010) and cobalt-rich ferromanganese crusts (2012). In 2014, ISA has begun its work on the development of exploitation regulations (ISA, Undated), aiming to have these regulations adopted by the ISA Council in 2025 (IISD, 2023).

The United States has not ratified the UNCLOS and its 1994 Implementation Agreement. It is therefore merely an observer to the ISA and essentially sits on the sidelines of its decision-making processes. This raises the question whether this position is beneficial or of disadvantage to the United States' deep seabed mining ambitions.

Willaert (2021) explores the legal consequences of the United States' non-ratification of the UNCLOS and its Implementation Agreement, highlighting complications in the context of deep-sea mining. He concludes that the drawbacks of non-ratification outweigh any benefits. In the international arena, the United States faces limitations on unilateral mining activities, and its non-membership in the International Seabed Authority impacts prestige and influence. On the continental shelf, the lack of ratification poses challenges in achieving international recognition for an extended zone. He suggests that accession to the UNCLOS is essential for the United States to effectively protect its national interests in deep sea mining.

[1] Norwegian: "I — Stortinget ber regjeringen ved utlysning av areal tydeliggjøre at hensynet til nasjonal sikkerhet vil være et kriterium ved tildeling av utvinningstillatelser. II — Stortinget ber regjeringen legge frem de første planene for utvinning av havbunnsmineraler for Stortinget som proposisjon før departementet godkjenner utvinningsplanen etter havbunnsmineralloven § 4-4. III — Stortinget ber regjeringen sørge for at Oljedirektoratet innhenter innspill fra øvrige berørte statlige etater, herunder Miljødirektoratet og Havforskningsinstituttet, i forbindelse med utarbeidelse av sitt forslag til arbeidsprogram til departementet."

Given its absence from decision-making, the United States has created its own law pertaining to deep sea mining — the Deep Seabed Hard Mineral Resources Act —, allowing its National Oceanic & Atmospheric Administration (NOAA) to issue exploration licences. While these first licences for already issued in 1984 to Lockheed Martin Corporation, they were prolonged in August 2022. In the US' Federal Register, however, NOAA remarks that these "licenses do not authorize mining" and that "no at-sea activities may be conducted pursuant to these exploration licenses without further environmental review and additional prior written authorization by NOAA" (FRN, 2022). Trainer (2022) notes, however, that despite these licences, Lockheed Martin is "hesitant to begin DSM [deep seabed mining] operations — citing a lack of international recognition".

Both India and China are considered pioneer investor nations in deep seabed mining, with both initiating exploration around the same time. However, China's advancements in DSM have far surpassed those of India. While India has focused its research on the Indian Ocean Region (IOR), China has obtained five exploration contracts globally from the International Seabed Authority and is poised to be the first country to commence exploitation when ISA promulgates the rules. China's expanding technological capabilities and deployment of assets in the IOR raise security concerns for India which enjoys exclusive patronage in the Indian Ocean due to its geographical position. India's approach has been non-confrontational, and this is unlikely to change. China's increasing focus on maritime power, driven by the demand for raw materials and energy, involves capacity and capability building. China's presence in the Indian Ocean, with naval, research, fishing, and commercial vessels, aligns with its strategic interests. While this may unsettle established countries like India, international avenues for questioning China's rise are limited. Deep seabed mining, therefore, may carry significant geopolitical implications (Agarwala, 2021).

Contrary to other actors, the European Union has positioned itself clearly against deep seabed mining. In its Resolution on *A sustainable blue economy in the EU: the role of fisheries and aquaculture*, the European Parliament even calls for a moratorium on deep seabed mining. It "[s]tresses that the deep sea is home to the greatest diversity of species and ecosystems on earth, providing critical environmental goods and services, including long-term carbon sequestration, and that it is characterised by environmental conditions that make it highly vulnerable to human disturbance; calls on the Commission and Member States, therefore, to support an international moratorium on deep seabed mining" (European Parliament, 2022, para. 120). Not surprisingly, the European Commission has expressed its concerns over Norway's decision while 119 Members of the European Parliament sent an open letter to their Norwegian colleagues, urging them to vote against deep seabed mining (EU Reporter, 2024).

What is deep seabed mining?

Deep seabed mining involves the extraction of valuable mineral resources from the depths of the ocean floor. Knowledge about the existence of mineral deposits in the deep ocean has been available for over a century, but recent efforts have been directed towards a more thorough understanding of their origin, geographical distribution, and potential resources. Traditionally, economic interest in deep-sea mining around the world has centred on minerals such as Nickel (Ni), Copper (Cu), and Manganese (Mn) for nodules, Cobalt (Co), Nickel (Ni), and Manganese (Mn) for crusts, and Copper (Cu), Zinc (Zn), Gold (Au), and Silver (Ag) for seafloor massive sulfides (SMS). However, ongoing research in the past few decades has unveiled the possibility of extracting additional metals, including rare earth elements (REEs) like Lanthanum (La), Cerium (Ce), Praseodymium (Pr), Neodymium (Ne), Europium (Eu), Gadolinium (Gd), and Yttrium (Y), as byproducts from the mining of the more conventional target metals. These metals, found in abundance in marine deposits especially around hydrothermal fields (see Fig. 2), are crucial for various high-tech and green-tech applications, playing a pivotal role in the global energy transition.

Proposed seabed mining operations share a common structure, employing a seabed collector, a vertical riser system, and support vessels for ore processing and transportation. The envisaged seabed collection systems predominantly utilise remotely operated vehicles equipped with mechanical and/or pressurised water drills to extract deposits directly from the seabed. Once extracted, the material is transported to a surface support vessel for onboard processing. Wastewater and sediment are then returned to the ocean, while the ore undergoes further processing upon reaching the shore.

Compared to land mining operations, seabed mining offers the advantage of minimal overburden, eliminating the need to remove extensive materials to access the desired ore. Furthermore, marine-based mining sites do not require permanent infrastructures such as roads, buildings, water/power transport systems, or waste dumps commonly associated with terrestrial mines. Deep-sea mining is driven by the presence of multiple metals of interest within a single marine mining site, reducing the amount of ore needed to yield a specific quantity of metal compared to terrestrial mining. Additionally, deep-sea mining circumvents issues such as acid mine drainage, stream/soil contamination, displacement, exploitation of local populations, deforestation, and large-scale depletion of groundwater resources typically linked to terrestrial mining (Frölicher & Saccard, 2023).

The environmental impacts of deep sea mining

The extraction of sea floor substrate, whether for mining activities or other anthropogenic purposes, exerts a multifaceted impact on marine ecosystems. One significant consequence is the direct removal of benthic fauna, disrupting the delicate balance of species within these underwater habitats. Additionally, the process induces changes in sediment composition, altering the physical characteristics of the sea floor. This, in turn, contributes to habitat loss and degradation, further exacerbating the challenges faced by the resident marine life.

The repercussions extend beyond the immediate habitat disturbance, encompassing the entire ecosystem's functionality and the services it provides. Nutrient cycling, a crucial ecological process, is disrupted, affecting the nutrient balance essential for the sustenance of marine life. Circulation patterns, which play a key role in maintaining the health of the marine environment, are also influenced by sea floor extraction. Furthermore, benthic habitats, both in the pelagic and benthic zones, experience stress induced on fauna due

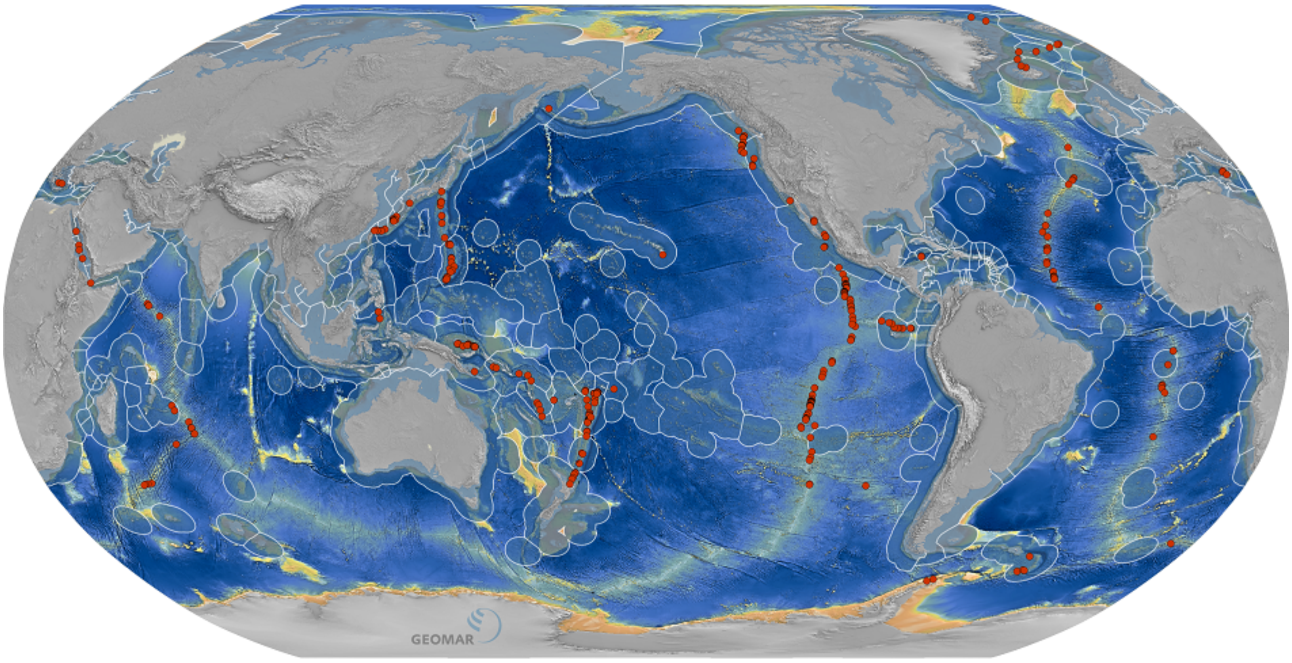

Fig. 2: World map of known submarine hydrothermal fields © GEOMAR, 2023

to the extraction processes. This stress can manifest in various forms, including altered behaviour, reduced reproductive success, and even population decline.

The ecosystem services provided by these habitats, including chemosynthetic production and secondary production, are significantly impacted. Chemosynthetic processes, which contribute to energy production in the absence of sunlight, may be compromised. Similarly, secondary production, involving the generation of biomass through the consumption of organic matter, faces challenges as the extraction disturbs the natural flow of materials and energy within the ecosystem.

The extraction plume, a consequence of sea floor substrate extraction, engenders a range of detrimental effects on benthic ecosystems. The plume, comprised of suspended sediments and disturbed particles, causes substantial loss or damage to benthic species. Micro- and macroorganisms inhabiting the sea floor are particularly vulnerable, as the plume can lead to their smothering, disrupting vital ecological processes. In addition to physical impacts, the extraction plume induces behavioural changes in marine animals, further complicating the ecological dynamics. Alterations in sediment composition, resulting from the disturbance, have cascading effects on the physical structure of the sea floor. This can lead to changes in seabed morphology, impacting the overall habitat structure and function. Moreover, the extraction plume negatively influences bioremediation and detoxification services provided by benthic ecosystems. The ability of these habitats to naturally process and detoxify pollutants is hampered, impacting the overall resilience of the marine environment to anthropogenic stressors.

These alterations in benthic ecosystems have far-reaching consequences on the regulating services they provide. Carbon sequestration, a critical process for mitigating climate change, is affected as the disturbed sediment may release stored carbon into the water column. The plume also disrupts biological regulation, which involves the intricate balance of species interactions that maintain ecosystem stability. Biological habitat formation, crucial for the survival and reproduction of various marine organisms, is compromised due to changes in sediment structure and seabed morphology.

The dewatering plume, a byproduct of certain industrial processes or activities, inflicts a series of adverse effects on marine ecosystems. As this plume is released into the aquatic environment, it precipitates the clogging of vital feeding, sensorial, or breathing structures within marine organisms. The obstruction of these essential structures impairs the physiological functions crucial for the survival of diverse marine life forms.

In addition to causing mechanical damage to tissues, the dewatering plume induces stress in various marine habitats, spanning from the pelagic zone to benthic environments. The mechanical damage to tissues further exacerbates the challenges faced by marine organisms, potentially leading to impaired health, reduced reproductive success, and compromised overall fitness. The stress imposed on pelagic, benthopelagic, and benthic habitats disrupts the delicate ecological balance within these zones, with potential ramifications for the entire marine ecosystem.

The intricate web of interconnected relationships in these habitats means that the repercussions of the dewatering plume are not confined to a single aspect of marine life. Rather, the adverse effects ripple through feeding chains, impacting the abundance and distribution of species.

The introduction of underwater noise and light into marine environments generates disturbances for aquatic animals, with far-reaching consequences on ecosystem functions. The auditory and visual disruptions experienced by marine life due to underwater noise and light can lead to behavioural changes, affecting essential activities such as feeding, communication, and reproduction.

Beyond the immediate effects on marine fauna, the disturbances caused by underwater noise and light have implications for vital ecosystem services. The provisioning of carbon dioxide (CO2) storage, a critical process for mitigating climate change, can be affected as disruptions in marine life may influence carbon sequestration capacities. The disturbances also extend to fisheries, potentially altering the behaviour and distribution of target species, with subsequent impacts on fishery yields. Moreover, the presence of underwater noise and light can disrupt natural product formations, impacting the production of compounds and substances that contribute to the biodiversity and ecological resilience of marine environments. Oceans North Kalaallit Nunaat (ONKN), a Greenlandic non-governmental organisation dedicated to the sustainable use of marine living resources and marine protection, has expressed grave concern over Norway's plans exactly for these reasons, noting that deep seabed mining might have "worrying implications for how deep-sea mining could affect not just the ecosystem, but also people who depend on the ocean for their livelihoods" (ONKN, 2023).

A study (Washburn et al., 2023) examining the impacts of deep-sea seafloor massive sulfide (SMS) excavation carried out in the Okinawa Trough, overseen by the Japanese government, has shown that the extraction of a small substrate amount over a brief period resulted in physical, chemical, and biological impacts within approximately 30–40 meters of the disturbance site. Physical impacts included re-sedimentation, and chemical impacts involved elevated concentrations of metals such as Cd, Pb, Hg, Zn, Fe, and Cu. The direction of currents and slope appeared to influence the extent of these impacts. While elevated metal concentrations can indicate the spatial extent of mining impacts during and immediately after activities, they may not fully capture the footprint within 1–2 years.

Different size classes of benthic communities responded differently to the mining experiment. Nano-faunal abundances were largely unaffected, with an increase observed at the unimpacted site post-mining compared to impacted locations. Meiofaunal arthropod abundances and nematode community structure were impacted almost immediately, while changes to meiofaunal nematode abundances occurred several weeks later. Meiofaunal abundance and nanofaunal communities may have mostly recovered within 1–2 years, but nematode community structure remained altered at the heavily impacted site three years later. In contrast, macrofaunal communities were impacted almost immediately, with possible persisting impacts at 3 years, even at moderately impacted sites.

Findings from this mining disturbance test indicate that while heavy metal toxicity is a significant risk from SMS mining, re-sedimentation is likely to have a larger areal footprint. The study suggests that larger benthic components are more susceptible to mining impacts. It underscores the importance of extensive spatial and temporal sampling to distinguish mining impacts from natural variability in highly heterogeneous sulfide habitats. Washburn et al. (2023) therefore suggest that future studies should explore the natural variability of SMS habitats, the effects of currents and seafloor slope on re-sedimentation after mining, the bioavailability of metals released during SMS mining, the tolerance of deep-sea infaunal communities to different metals and sediment burial, species-level changes in benthic communities due to mining, and mechanisms of community recovery. The research emphasises the significance of current direction and topography on mining impacts, provides data on metals likely to be elevated from sulfide mining, and underscores the need for monitoring beyond 50 meters. As nematode community structure and macrofauna are affected for longer periods, focusing on these parameters in future studies may aid in determining complete recovery timelines.

The need for proper environmental impact assessments (EIA)

Against the backdrop of the drastic impacts of deep sea mining on the benthic environments, environmental impact assessments (EIA) are crucial in order to understand the specificities of impacts that might occur at a given site. Already since the 1970s, deep sea mining simulations have been carried out by United States, Germany, Japan, India in the Pacific and Indian Oceans. Based on these studies, Sharma (2015) proposes several concrete steps to limit environmental impacts:

The collector device should be designed with the objective of minimising its interaction with the seafloor environment to maintain a disturbance-free state. An essential consideration in the design is to ensure that the separation of minerals from sediments or other debris occurs as close as possible to the seabed. This approach aims to limit the impact on the water column, ensuring that only the necessary area is affected by the discharge.

In the mining process, a strip-wise approach is recommended. This involves carrying out mining activities in a manner that leaves alternate strips of undisturbed seafloor. The purpose of this strategy is to allow for the repopulation of organisms from adjoining areas to the mined strips. By leaving portions of the seafloor undisturbed, there is a potential for the recovery and regeneration of the marine ecosystem in the affected regions. This method acknowledges the importance of mitigating the environmental impact of seafloor mining activities and supporting the sustainability of marine ecosystems.

Surface discharge should involve the distribution of discharged material over a considerable expanse, facilitating its dilution without significant delay. To promote photosynthetic activity, it is essential to minimise sediment discharge at the surface, ensuring that an adequate amount of sunlight can penetrate the water column. In managing bottom waters and debris discharge, a key recommendation is to release them at various levels within the water column, rather than solely at the surface. This approach aims to achieve a uniform distribution of the discharge throughout the entire water column, contributing to a more balanced impact on the marine environment. An important consideration in the discharge process is maintaining an optimal concentration of the discharged material, as it can yield positive effects such as artificial upwelling.

In the context of at-sea processing, ore transfer, and transport, it is imperative to implement proper procedures for waste disposal prior to discharge. The treatment of waste should prioritise the use of biodegradable methods, aligning with environmentally friendly practices to minimise the impact on marine ecosystems. During the crucial phase of transferring ore from the mining or transport vessel to the ore carrier, careful handling is essential to prevent spills. This precautionary measure not only safeguards the valuable ore cargo but also helps prevent environmental contamination that may arise from accidental spills. In addition to the careful handling of ore, it is equally important to monitor and address the potential risks associated with oil spills from these ships. Implementing effective monitoring measures can contribute to early detection and mitigation of any oil spill incidents, thereby reducing the environmental consequences and supporting the overall sustainability of at-sea processing and transportation operations.

To effectively predict and control the potential negative impact of offshore mining, careful consideration of specific environmental factors is paramount. These factors encompass the proportion of the total area that will be affected in relation to the overall extent of the water body. Additionally, understanding the influence of surface and subsurface currents during various seasons is crucial for assessing the potential dispersion of mining-related impacts. Furthermore, it is essential to evaluate the distance between coastal belts and inhabited areas in relation to the designated area of influence. This assessment aids in gauging the proximity of human populations and ecosystems to potential mining disturbances. Additionally, taking into account the existence of fishing potential or any other commercial activities within the area of influence is vital for recognising and mitigating potential conflicts and impacts on existing economic activities.

Based on the environmental impacts of deep sea mining, Durden et al. (2018) have developed an EIA process. The process is framed within the context of established policies and strategic environmental objectives, ideally formulated by the regulator. The proponent of a project is responsible for defining specific environmental goals aligned with existing policies and plans. The International Seabed Authority (ISA), the sponsoring state, and the contractor all contribute to shaping the environmental goals for a project. The contractor's internal environmental policies, documented in its environmental management system, provide additional context for the EIA, outlining aims, responsibilities, procedures, resources, policies, and targets.

The EIA is a crucial component within the broader framework of environmental management for a project, fitting into the appraisal phase of overall management activities. It should be conducted once an initial environmental assessment has been made, and project planning has advanced sufficiently to identify environmental risks and mitigation options. Information for the EIA is derived from existing data, expert input, and synthesized strategic objectives. The mine planning process should be forward-thinking, encompassing exploitation activities, rehabilitation, and closure, while considering environmental aims, thresholds, and plans for adaptive management.

Screening is the initial step in determining the necessity of an Environmental Impact Assessment (EIA) for a specific activity at a particular location and time. This process involves a preliminary risk assessment based on project characteristics and environmental knowledge of the location. Establishing a threshold for significant adverse change is crucial for reliable risk assessment, as it influences whether an EIA is required. The screening process helps identify whether projects, including modifications to ongoing projects, necessitate an EIA based on their scope, magnitude, and deviation from the original plan. Given the potential for material changes in deep sea mining projects, particularly novel, complex, and long-duration ones, the screening process is essential. Additionally, adaptive management may lead to modifications in the EIA based on monitoring and review, requiring a re-screening step.

Scoping is a crucial phase in the Environmental Impact Assessment (EIA) process, determining the scope of coverage based on screening outcomes. This phase identifies key environmental issues related to the project and establishes boundaries for the subsequent EIA. Scoping involves a qualitative environmental risk assessment, considering project details, environmental setting, regulatory requirements, and stakeholder input. It may exclude certain issues based on robust evidence and dismiss some project alternatives. The scoping phase promotes ongoing dialogue between the contractor and the International Seabed Authority (ISA), ensuring clarity on the EIA process and facilitating the risk assessment of planned and potential impacts. A robust scoping process emphasises the documentation of data certainty, mining plans, and their interpretations.

The EIA follows the scoping phase and is a comprehensive process that involves referencing identified risks and impacts. This phase includes gathering necessary information and preparing an EIA report, which is a resource-intensive undertaking since the EIA process can take several years and incur significant costs. The EIA process encompasses the identification of impacts, evaluation of alternative activities, and the design and assessment of mitigation measures following the mitigation hierarchy. This involves various processes such as data review, interpretation, ecological risk assessment, and mitigation and management planning. Key components of the EIA report include the purpose and justification of the activity, the development of the EIA, impacts and mitigation descriptions, and a synthesis of information for impact evaluation, considering interrelationships, cumulative effects, and comparison against regulatory criteria and thresholds. The EIA report undergoes a review process, including stakeholder and regulatory input, before the preparation of the final report.

An Environmental Management Plan (EMP), also known as an Environmental Management and Monitoring Plan, outlines the environmental management strategy throughout a project's lifespan. It details the practical implementation of mitigation measures identified in the EIA within the framework of the contractor's environmental management system, project environmental goals, and regulations. The EMP explains how environmental objectives, regulations, and thresholds will be met and verified. It includes specifics of the environmental monitoring plan and outlines preliminary plans for rehabilitation and long-term monitoring based on proposed mining activities and mitigation measures. The document delineates the roles and responsibilities of all parties (ISA, state, contractor, and subcontractors) and anticipates continued communication between the proponent and regulator. In the case of deep sea mining, the EMP addresses adaptive management requirements and associated actions and decisions. The EMP, submitted with the EIA as part of an exploitation application, undergoes iterative amendments and reviews until stakeholders are satisfied. Periodic reviews and re-evaluations occur once the project is underway.

The external review phase in the EIA process involves both expert review and stakeholder consultation. Expert review is typically conducted by a body of independent experts commissioned by the regulator or proponent, covering various disciplines relevant to the project, such as environmental science, policy, economics, ethics, and law. This review assesses the adequacy of information and the justifiability of conclusions based on available evidence. Stakeholder consultation is a crucial component of transparent environmental management, providing an opportunity for interested parties, including the public, environmental groups, fisheries, tourism, shipping, or scientists, to contribute input to the EIA process. The social license to operate may be sought from stakeholders, recognising the broad definition of the public, as deep-sea minerals are considered part of the common heritage of mankind.

Upon completion, the final EIA report and EMP are submitted to the regulator, often involving a public hearing. The review process can be time-consuming, taking up to 9 months. The regulator, following examination, decides whether to approve the EIA and EMP, granting operational approval for the project. In some cases, an independent expert scientific review may be commissioned to ensure objectivity and avoid conflicts of interest.

Approval typically comes with conditions, mandating adherence to the EMP, periodic audits, monitoring, reporting, and acceptance of imposed measures in cases of non-compliance. Financial instruments like performance bonds may be required, as per environmental regulations. Conditions for deep sea mining projects should also address adaptive management, specifying types of change requiring action and the appropriate procedures. Periodic reviews of the EIA and monitoring results, aligned with Best Environmental Practices (BEP) and regulations, are recommended. While some jurisdictions may allow EIA and EMP validity for the entire project, the dynamic nature of ecosystems and evolving technologies may necessitate adjustments at intermediate timescales.

Summary and conclusion

This article provides insights into deep seabed mining based on Norway's decision to open up its continental shelf to this practice. While the International Seabed Authority is currently in the process of developing exploitation regulations for 'the Area', these are far from complete. Therefore, Norway, along with the United States, China and India has become a forerunner in this regard. While the Norwegian government claims that exploitation follows high environmental standards, the ecological impacts of deep seabed mining are severe with repercussions for all spheres of marine live — impacted directly and indirectly in close proximity to the excavation site, but also going far beyond. For this reason, the European Union has clearly positioned itself against deep seabed mining, even calling for an international moratorium.

In order to ensure minimal environmental impacts, a stringent environmental impact assessment (EIA) process is necessary. Following the suggestions provided by Sharma (2015) and by Durden et al. (2018) might ensure that the marine environment suffers least from deep seabed mining operations. However, it appears unrealistic that these operations leave merely a minor environmental footprint, especially given that it is unclear what role — if any — seafloor massive sulfides (SMS) play in the benthic ecosystems. Since their reformation takes decades, their exploitation may generate impacts of unknown dimension (see also GEOMAR, 2019).

To this end, it is not surprising that Norway's decision was faced with significant opposition. Only time will tell whether resource independence from China justifies an activity with potentially dramatic effects on the life-sustaining ecosystems of the ocean.

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REVIEW ARTICLE

Humankind's 'war' against birds

Introduction

For many decades, humans have enjoyed the benefits of globalisation: economic growth, a seemingly unlimited availability of different foods from all over the world and associated cultural exchange, or the limitless possibility to travel into countries, regions or continents with all their possibilities. Globalisation certainly has its perks, but as with all perks, there are also downsides, such as growing economic inequality, economic degradation or cultural homogenisation. As Kathryn Yusoff has so impressively shown in her treatise *A billion black Anthropocenes or none*, globalisation with all its perks also came at a huge human cost that is oftentimes neglected or even forgotten (Yusoff, 2018).

What is also often forgotten are the tremendous environmental impacts of globalisation — even in its most primitive sense: the spread of human populations in regions of the world where they have not been before. And it is one of these costs that a recent study in *Nature Communications* has tackled: the impact of humankind on the world's bird species in a time period that lasts from the late Pleistocene (approx. 126,000 to 11,700 years ago) to the present (Cooke et al., 2023).

The methodology

In this study, the authors sought to estimate the number of bird species that have become extinct since the Late Pleistocene without leaving any trace or being discovered yet. The primary focus was on modelling the number of extinct bird species based on fossil records from various island groups. To achieve this, the authors gathered data on fossil bird species from a comprehensive database.

In addition, the authors compiled information on 14 factors that could potentially influence the number of undiscovered extinct bird species. These factors encompassed aspects such as the amount of research effort in each area, the isolation of the islands, the surrounding landmass, elevation, temperature, precipitation, and the presence of native rodents, among others. The authors formulated expectations regarding how each of these factors might impact the likelihood of discovering extinct bird species.

For instance, the authors anticipated that islands with greater research effort would exhibit a higher probability of discovering bird fossils. Similarly, islands characterised by greater isolation might harbour fewer species overall but could be more susceptible to global extinction due to their prolonged isolation from mainland predators.

The analysis was conducted using various statistical methods and software tools, including R and ArcGIS. By examining these factors and their interrelationships, the study aimed to enhance understanding of the patterns of bird extinctions and the underlying factors contributing to them since the Late Pleistocene.

The study employed a statistical approach to understand the factors influencing bird extinctions since the Late Pleistocene. They used a linear model to analyse the relationship between various predictors and the number of extinct bird species. These predictors included factors like island size, research efforts, and environmental conditions.

To ensure the accuracy of their analysis, the authors tested two different types of models: a linear model and a generalised linear model — a flexible framework used for modelling relationships between a dependent variable and one or more independent variables. They found that the linear model performed better in predicting extinction rates, providing more reliable estimates.

By conducting cross-validation tests, the authors confirmed the effectiveness of their linear model in predicting bird extinction rates. They observed that research effort had the strongest influence on extinction rates, followed by factors like human arrival on the islands and geographical isolation.

Overall, the linear model explained a significant portion of the variance in bird extinctions, highlighting the importance of research efforts and other factors in understanding and predicting extinction rates.

The authors used the linear model (LM) to predict the number of extinct bird species for each archipelago. They did this by extrapolating based on the research effort needed to uncover all extinct bird species in Aotearoa New Zealand. Essentially, they estimated how many extinct birds each archipelago would have if they had the same level of research effort as Aotearoa New Zealand.

This approach has several advantages. First, it ensures that the total estimated number of extinct birds per archipelago is equal to or greater than the observed number, which is biologically realistic. Other methods might mistakenly predict fewer extinctions than observed, which is biologically impossible. Second, using Aotearoa New Zealand as a reference point ensures consistency, as its extinction rates are well-documented and less subject to uncertainties related to incomplete detection.

The authors calculated the total number of extinct birds for each archipelago by considering the difference in research effort compared to Aotearoa New Zealand, while accounting for other factors such as total area. They then subtracted the number of known fossil extinct birds from this total to estimate the number of undiscovered extinct birds.

To convert their predictions into whole numbers of species, the researchers used probability-based rounding. For example, a value of 1.7 might be rounded up to 2 if there was a higher probability of there being 2 extinctions rather than 1.

After the authors were able to determine the number of bird extinctions globally, they proceeded to estimate the timing and rate of these extinctions. For fossil bird extinctions, they used a model based on truncated exponential decays, assuming that species were most vulnerable shortly after human arrival, with extinction rates decreasing over time. This model varied for different regions, with adjustments made for factors like size and historical context. For Madagascar, a longer extinction window was applied due to its unique characteristics. Extinction dates for observed species were based on the last confirmed sighting, with statistical methods used for species with unavailable data. The study also considered possibly extinct species, incorporating their likelihood of extinction into the analysis. Generally, extinction rates were calculated by generating multiple potential scenarios for each region, considering variations in extinction numbers, human arrival times, and statistical uncertainties.

The study considered observed extinctions by using the date of the last reliable record available for each species. For species with unavailable data, extinction dates were estimated using statistical methods based on truncated exponential distributions, assuming a half-life of 100 years following human arrival.

Additionally, the study accounted for possibly extinct species identified in previous research. These species were incorporated into the analysis by considering their reported mean extinction probability. For each of the 1000 extinction estimates generated, the study randomly sampled from a binomial distribution based on the species' probability of extinction, resulting in up to 46 additional estimated extinctions per scenario. The date of the last reliable record was used as the extinction date for these species.

The overall extinction rate was calculated by generating 1000 potential extinction chronologies for each archipelago, taking into account variations in the number of extinctions, timing of human arrival, and the decay pattern of extinction events. Extinction rate was expressed as the number of extinctions per species per year, calculated from 124,050 BCE to 2019 CE, with a rolling mean of yearly extinction rates computed using a 100-year window. The study focused on reporting extinction rates on the natural scale but provided a rough conversion to extinctions per million species years (E/MSY) for context. The assumption was made that humans contributed to all bird extinctions, except for a few rare natural extinctions, which were still included in the analysis to avoid underestimating extinction rates.

Results

The authors found that since the Late Pleistocene, there have been about 1430 bird extinctions worldwide, with a 95% chance that the actual number falls between 1327 and 1544. With around 10,865 bird species existing today, this means roughly one in nine bird species, or 11.6%, have disappeared over the last 126,000 years. Human activities are thought to be responsible for most of these extinctions. Surprisingly, about 55% of these lost bird species, estimated to be around 788, are still unknown. This means human-driven extinctions are likely even higher than what we see in the fossil and observed records alone. Specifically, in the Pacific region, there have been an estimated 875 bird extinctions, with about 554 of them still not discovered. This means the Pacific area is accountable for 61% of all bird extinctions, with 70% of those being species still unknown.

Over time, the rate of bird extinctions has fluctuated, showing three major waves since the Late Pleistocene. The first wave, around 840 BCE, was mainly due to humans settling on islands like the Mariana, Tongan, and Fijian Islands, as well as the Canary Islands. Species like the Fiji Teal and New Caledonian Cockatoo were lost during this time. The second wave, reaching its peak around 1300 CE, was the most severe, with a rate 80 times higher than the background extinction rate. This was caused by humans arriving on islands in the Eastern Pacific, such as Hawaii and the Marquesas Islands, and bringing with them animals like pigs and dogs, which threatened native birds. Species like the High-billed Crow and Sinoto's Lorikeet were lost during this period. The ongoing third wave is driven by global human activities like habitat destruction and invasive species, leading to extinctions across various regions, including species like the ʻĀmaui from Hawaii and Lyall's Wren from Aotearoa New Zealand.

Evaluation of the results

Previous studies assessing bird extinction rates, which typically focus on observed extinctions post-1500 CE, miss significant extinction waves. Although observed high extinction rates have been deemed unprecedented, earlier waves of extinction were actually more substantial in scale, a hypothesis that has not been proven until now. These previous assessments also overlook the fluctuating extinction rates between these waves. Typically, extinctions happen rapidly after humans arrive in new areas, but then slow down as more resilient species remain. Therefore, the steady increase in extinction rates observed since 1500 CE might not accurately reflect the true dynamics of the current biodiversity crisis. Instead, the study reveals the varied spatial and temporal patterns of human-driven extinctions.

The concept of "extinction debts" suggests that we might be moving towards a present-day bird extinction rate even higher than any seen since the Late Pleistocene. Extinction debts refer to the projected extinctions of species that are still extant but are expected to become extinct in the future due to various ongoing threats and pressures. The concept is used in conservation biology to describe the time lag between the onset of detrimental factors affecting a species and its eventual extinction. Essentially, it represents a future loss of biodiversity that has already been "committed to" due to past and present human activities, such as habitat destruction, pollution, and introduction of invasive species (Kuusaari et al, 2009).

Extinction debt can take centuries to manifest, and ongoing projections predict a significantly elevated bird extinction rate in the coming years. This indicates that up to one in six bird species could eventually be lost, including those that are currently considered extant. The incomplete knowledge of bird extinctions underestimates the true scale of species loss. The study provides a conservative estimate of undiscovered bird extinctions, taking into account various assumptions.

The study also sheds light on the intense extinction wave across the Eastern Pacific around the 14th century, marking the largest human-driven vertebrate extinction wave ever recorded. These extinctions have profound implications for avian species richness, ecological diversity, and evolutionary history. Many of the extinct bird species likely played critical roles in their ecosystems, and their loss could have irreversible impacts on ecosystem functioning. Urgent conservation efforts are needed to protect remaining native biotas and prevent a contemporary extinction wave of even greater magnitude.

Summary

The study published in *Nature Communications* investigates the impact of human expansion on bird species since the late Pleistocene. Employing fossil records and sophisticated statistical modelling, the researchers estimated that approximately 1430 bird species have become extinct globally during this period, with around 55% of these extinctions remaining undiscovered. Notably, the Pacific region has borne the brunt of these extinctions, with 61% occurring there. Through meticulous analysis, the study identifies three major waves of extinction triggered by human arrival and subsequent global activities like habitat destruction. These findings underscore the concept of "extinction debt," suggesting a higher present-day extinction rate than previously acknowledged. Urgent conservation efforts are imperative to prevent further biodiversity loss and safeguard remaining bird species.

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ARTICLE

Digitalisation and the democratisation of environmental monitoring

— *by Gerald Zojer*

Tourism is one of the main drivers of the regional economy in Finnish Lapland. The region is marketed for its pristine nature, the scenic and long winters, as well as the numerous hiking possibilities it offers during the polar day. In Muonio, in the north-western part of Finnish Lapland, having on offer the purest air in the world has become a marketing pitch (Muonio Tourism Association, 2023). The slogan is indeed based on facts, indicated in particular by data that has been collected by the World Health Organization (WHO) which allows the comparison of air pollution measurements around the globe (FMI, 2018; WHO, n.d.). However, the comparison can also be scrutinised: the local measuring station in Muonio is located on the summit of Sammaltunturi, a fell in the Ylläs-Pallas National Park. While the Sammaltunturi measuring station is placed at an elevated position, in a windy place, and somewhat remote from inhabited places and motorised routes, most other stations listed in the WHO statistics are in populated areas. Furthermore, the density of measuring stations in Lapland is extremely sparse. There are only two further measuring stations in Finnish Lapland, one near the shore at the Gulf of Bothnia (ca. 250km south), and one near the Russian border (ca. 180km east). While visitors of the Ylläs-Pallas National Park may have a good chance of experiencing relatively pure air, because of the sparsity of measuring stations, the existing data cannot answer the question what air quality people living in the area experience in their everyday life.

Digitalisation as opportunity

In the absence of a tight network of official environmental monitoring, citizen science projects can contribute to closing the gap in data collection. Digitalisation and in particular the rapid development of IoT (internet of things) devices have made it possible also for private individuals or small organisations to take part in environmental monitoring. The development of IoT has been strongly driven by numerous open source projects, both in terms of hardware and software.

When the computer era started, computers where available mainly at state-owned or research facilities, and the source code of the software running on them was considered part of academic knowledge. Only in the 1980s and with the emergence of the personal computer software was unbundled from the hardware and transformed into a commodity through utilising intellectual property rights (Ceruzzi, 1999; Holtgrewe & Werle, 2001). This development has been criticised as a privatisation of public knowledge. To establish an alternative, copyleft licenses have been established, which utilise copyright conditions to secure public access to the source code, which allows others the free use, repair, modification, or update of the source code (de Laat, 2005; Haff, 2018). Hence, an open source approach is well suited for user innovation and to adapt or co-develop inexpensive and case tailored appliances (von Hippel, 2005; Zojer, 2019), which makes open source a favourable approach for community driven projects.

Community projects for air pollution monitoring

Similarly to software there are also numerous hardware projects that utilise copyleft licenses to share plans and instructions or to co-develop various forms of equipment. In combination with open source software this approach allows ordinary citizens to combine suitable pieces of hardware and software to build their use-case specific appliances. Several communities were established that team up for developing inexpensive and easy to use environmental monitoring systems, including those that measure air pollution. For instance, the project *sensor.community* (https://sensor.community) lists over 11.000 stations worldwide (though very Europe-centric) to monitor mainly particulate matter (PM). The community also provides part lists, firmware, and the instructions for people to build their own monitoring stations. For less tech-savvy individuals, complete kits (also with installed software) can be ordered from some sources. Similarly *World's Air Pollution: Real time Air Quality Index* or *openSenseMap* — as well as numerous other projects provide instructions or sell inexpensive and ready-to-use equipment. While the quality or accuracy of the measuring equipment of community driven projects may be inferior to professional equipment, the quantity (not at last due to the limited costs) can help in increasing the resolution of the monitoring and in closing the gap of the sparse and less locally specific monitoring from conventional data collection and consequently could be used in contributing to more sensitive fact based decision making processes (e.g. Fraisl et al., 2022; Mahajan et al., 2022).

Example: Citizen science air pollution monitoring

Basically to build a sensor it requires a) a microcontroller unit (MCU) that can can read, process, store or transmit the data of b) sensors. Several different sensor can be combined and connected to one controller. For example, air pollution sensors (most commonly for measuring PM) are very often combined with a temperature and humidity sensor, which creates additional data that can help evaluating the quality of the air pollution data (as cheap sensors may be limited in their temperature or humidity range). To power the MCU and the sensor c) a power supply is required, which can be an old phone charger or a small solar panel since the power demand is usually small (for some sensor kits the power demand may be below 1 Watt).

An exemplary configuration, based on the sensor.community project could consist of a NodeMCU ESP8266 controller unit with an integrated WIFI module, a SDS011 PM sensor, a BME280 pressure, humidity and temperature sensor, and together with small parts (cables etc.) can be purchased for less than 50€. While such a set-up can be powered with a phone charger, it is also possible to power it with a small 5 or 10 Watts solar panel, combined with a charging controller and a battery, which can be purchased for another 50€. Adding a casing for outdoor use, it is thus possible to build an air pollution measuring station for less than 150€, and which can be operated independent from external power sources (see Fig. 1 and Fig 2).

Fig. 1: Citizen science air quality measuring station powered with a solar panel © Gerald Zojer, 2024.

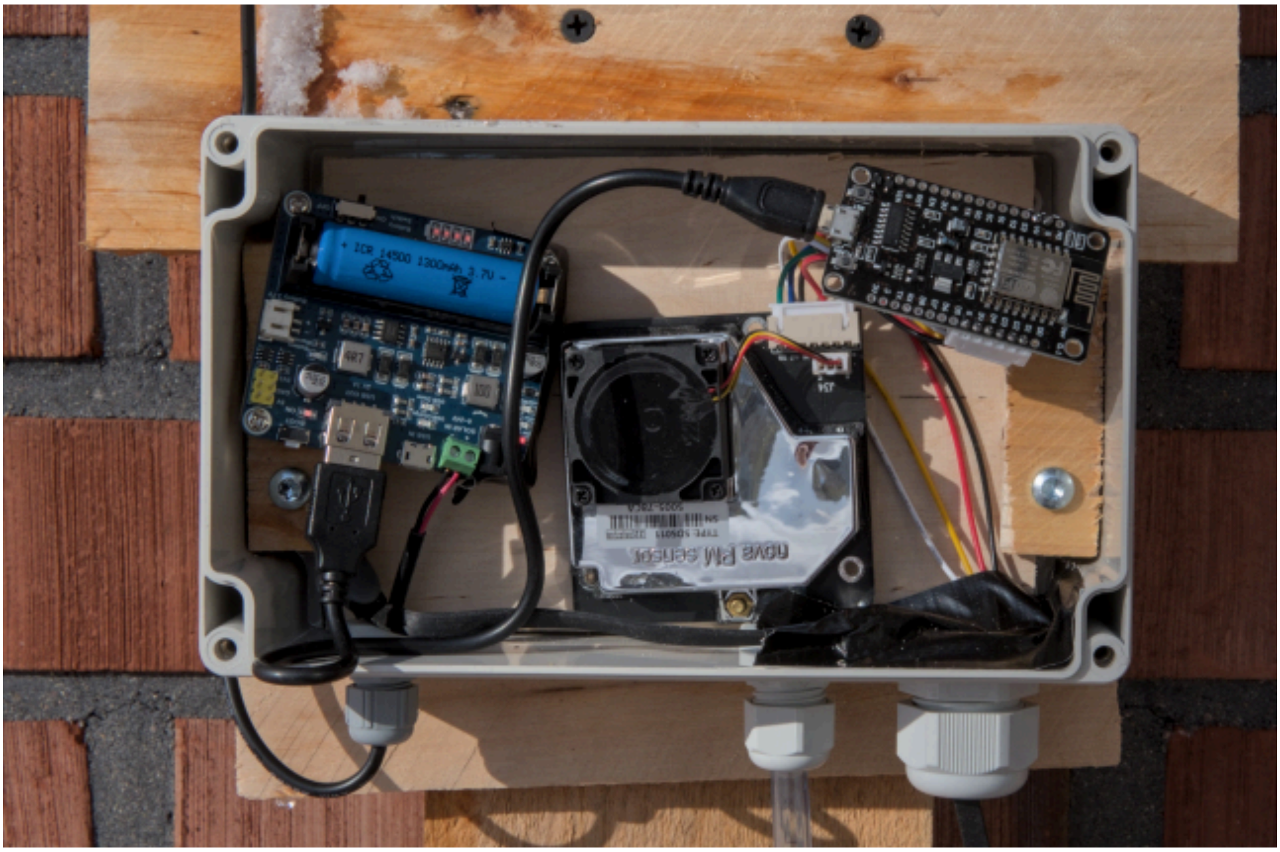

Fig. 2: Citizen science air pollution measuring station with a NodeMCUv3 (top right), a SDS011 PM sensor (middle), a BME280 pressure, humidity and temperature sensor (not visible) and a solar charging controller with a small Li-Ion battery (left) © Gerald Zojer, 2024.

Open data

Most community projects also operate online platforms with a publicly available Application Programming Interface (API) to allow easy collection of the produced data, to make it publicly accessible and to visualise the measuring results on a website. Together with a large quantity of measuring stations, hotspots with low air quality can be mapped, and decision makers can be supported in identifying areas where additional measures need to be taken to promote health. Furthermore, there are several community driven software projects that can be used for individuals or organisations to run their own data collection and or data visualisation tools. This can be helpful in collecting data offline, locally, or to create specific widgets to visualise only certain data or for embedding it in particular (web) applications (see Fig. 3).

Digitalisation as an opportunity to democratise environmental monitoring

Conventional environmental monitoring often leaves large areas uncovered, which raises the question of whether it is sufficient to provide an accurate picture of the amount of pollution and the state of health of the environment. The rapid technological advancements in the last few decades and in particular digitalisation has laid the ground for the creation of small, low-energy consuming and affordable equipment. Developing hardware and software with an open source approach allows individuals and communities

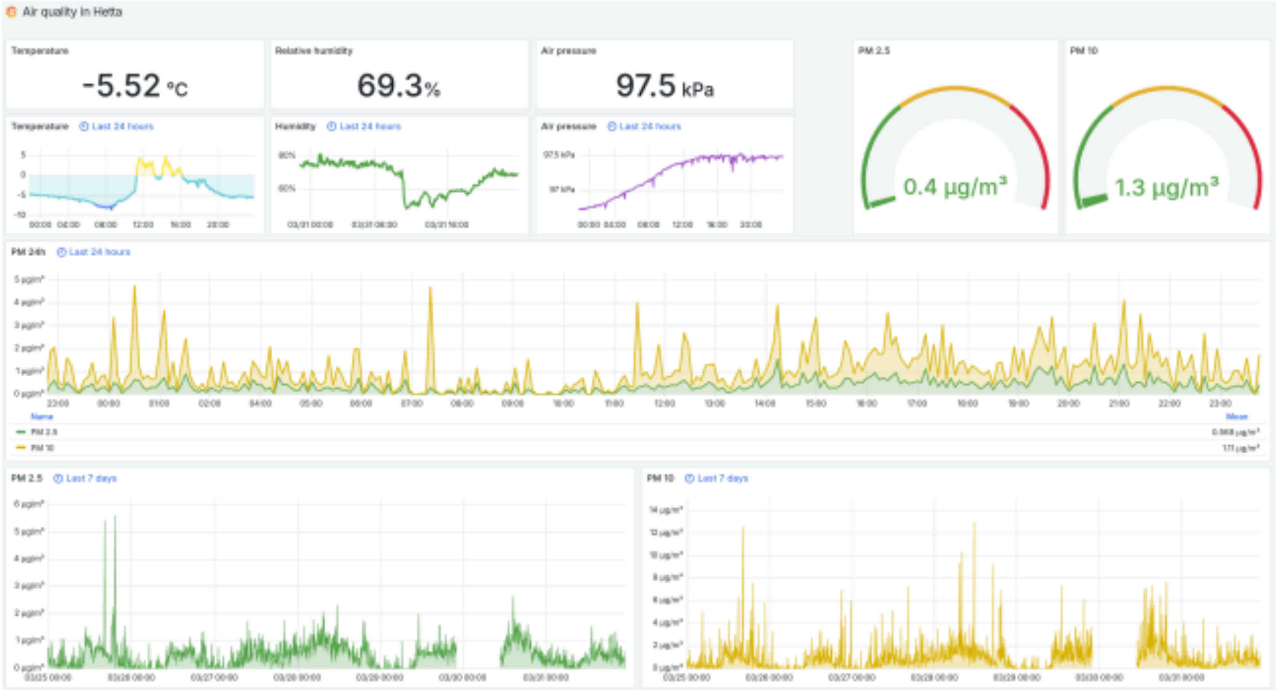

Fig. 3: Screenshot of self-hosted data based on collecting data from a citizen science air pollution measuring station, utilising the open source software Influxdb and Grafana to collect and visualise data © Gerald Zojer, 2024.

all over the world to pool their resources, ideas, and knowledge in order to co-develop, share, repair, or modify equipment and software for advancing citizen science based environmental monitoring. While citizen science projects often may not reach the quality of professional measuring equipment and cannot compensate for the lack of governmentally provided environmental monitoring, they can increase the resolution and supplement conventional data collection. Open source development and digitalisation can hence contribute to democratising environmental monitoring by increasing the quantity of measuring stations and by having the necessary tools accessible to the interested public.

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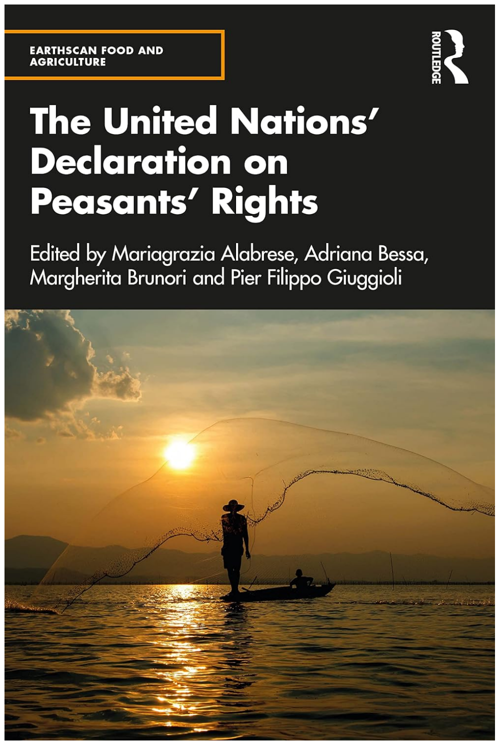
BOOK REVIEW

Alabrese, Bessa, Bruno and Guiggioli's '*The United Nations' Declaration on Peasants' Rights*'



In December 2018 the United Nations General Assembly adopted a landmark declaration that would be the first one to recognise the rights of people who live in close connection to land, but who are not necessarily indigenous: peasants and other people working in rural areas. Contrary to its older sister, the 2007 UN Declaration on the Rights of Indigenous Peoples (UNDRIP), the newly adopted declaration with the rather bumpy title UN Declaration on the Rights of Peasants and Other People Working in Rural Areas (UNDROP) did not find as much support and has, in the end, been signed by 121 countries, with 8 voting against and 54 abstaining. Not surprisingly, it was particularly developed nations that not only did not support the declaration by abstaining, but some also voted against it: Australia, Guatemala, Hungary, Israel, New Zealand, Sweden, United Kingdom and the United States. Of the European Union, Portugal was the only country that voted in favour of the declaration while the remaining abstained (apart from those having voted against it).

In an explanation of its vote, Sweden expressed concerns over the new rights that are enshrined in the UNDROP: the right to seeds and the right to food sovereignty, "for which the link to human rights still needs to be clarified" (Sweden, 2018). Moreover, Sweden considers the existing human rights system sufficient for the protection of those the declaration aims to protect. Indeed, the UNDROP contains several provisions that aim to create a new discourse on the rights of peasants. However, as we have argued elsewhere, many of these rights can be found in other legally and non-legally binding documents, such as by the International Labor Organization (ILO), or challenge the status quo of contemporary intellectual property law — such as the right to seeds (see *Sellheim Environmental*, 2022).

Despite this, the UNDROP appears to gain traction, also in international conservation initiatives. For instance, during the 18th Conference of the Parties (CoP18) of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2019, reference to the UNDROP was made in order to justify the establishment of a Rural Communities Committee (RCC), whose purpose it should have been to represent the interests of rural communities in the decision-making processes. The United States argued, however, that reference to UNDROP is not justifiable given the lack of signatures. In the end, the proposal was dismissed (also at CoP19 in 2022, when an amended proposal was tabled) (Sellheim, 2020). Despite these challenges in implementation, academic discourse surrounding the UNDROP continues to flourish, shedding light on its significance and implications within international legal frameworks.

The book *The United Nations' Declaration on Peasants' Rights*, edited by Mariagrazia Alabrese, Adriana Bessa, Margherita Brunori and Pier Filippo Giuggioli, is the first and a much-needed volume that provides an in-depth analysis of the drafting process of the UNDROP and of the different elements it contains. In addition, a plethora of different pieces of background and other information are provided that allow the reader to gain a professional understanding of the declaration and understand its significance in international human rights law. In 18 chapters, subdivided into four parts — Rights holders; Natural resources access and control; Food and agriculture governance; and The declaration on the ground —, in addition to an Introduction and a Conclusion, the reader gains profound insight into what constitutes the UNDROP.

The first issue that attracts attention is the utilisation of the term 'peasant' in the title of the declaration. In contemporary parlance, the term can carry negative connotations implying poverty, lack of education, or backwardness. As Marc Edelman shows in his chapter 'Defining peasants in the

UNDROP' (pages 19—31), it was especially representatives from the United Kingdom who, behind closed doors, made fun of the term and merely considered it through this lens. What they left out and what in the end led to its inclusion was self-identification, self-ascription and political identity, especially deriving from the term in Spanish, *campesino*, or French, *paysan*. Therefore, while the term appears to be somewhat strange or outdated in a UN declaration, it is nevertheless timely — especially when taking into account the fact that this is a term used by many peasants themselves.

The second issue that again underlines the importance of this book is the relationship between peasants (or 'traditional local communities') and indigenous peoples, tackled in the chapter by Adriana Bessa and Jérémie Gilbert (pages 32—46). While at first glance one might assume that the UNDROP might undermine the rights of indigenous peoples, a closer look reveals that this is not the case, but rather that UNDROP provides even more rights that also indigenous peoples might benefit from. After all, many indigenous peoples also fall under the rubric of 'peasants' and the UNDRIP is specifically referred to in the declaration's preamble. That said, Bessa and Gilbert rightly highlight the fact that contrary to the UNDRIP, the UNDROP does not hold any reference to self-determination, which constitutes a key element of indigenous peoples' rights. While self-determination was part of the negotiations of the declaration and was included in the draft, for political reasons it was in the end removed.

A similar element that cannot be found in the UNDROP is the right to free, prior and informed consent (FPIC), which also constitutes a cornerstone of indigenous rights. While the declaration requires states to conduct social and environmental impact assessments, consultations in good faith, and ensure benefit-sharing, this does not stand on the same footing as the right to FPIC. While that may be so, however, other bodies, such as the African Commission on Human and Peoples' Rights or the Inter-American Court of Human Rights have established that participation and consultation must include FPIC in matters that affect indigenous peoples' lives and livelihoods.

While it is not possible to review every single insightful , informative and thought-proviking chapter of this outstanding book, some chapters warrant further scrutiny. For instance, Chapter 5 'Shedding light on the human rights of small-scale fishers: complementarities and contrasts between the UNDROP and the Small-Scale Fisheries Guidelines' (pages 62—88) by Alisa Morgera and Julia Nakamura. At the centre of attention stand the similarities and differences between the UNDROP and the *Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication* by the UN's Food and Agriculture Organization (FAO) (SSF Guidelines; FAO, 2015). First, it is noteworthy that small-scale fishers, even in lieu of a formal definition, have been included into the text of the UNDROP. Second, although both documents differ in their scope, they are nevertheless supportive of one another. While the UNDROP establishes rights of small-scale fishers and therefore creates state obligations, the SSF Guidelines take a 'human rights-based approach' and identify good practices in the management of fisheries and fish-stock conservation, especially with regard to food security and environmental sustainability, "emphasising the role of small-scale fishers [...] as benefit holders of the social development, security, and safety, which is the

State's responsibility to deliver" (page 68).

While one might be easily inclined to argue that based on the definition of 'peasant' in the declaration which makes 'attachment to the land' crucial to identify the rights holders (Article 1.1), the rights of small-scale fishers only include inland waters, the UN Convention on the Law of the Sea (UNCLOS) extends the sovereign rights of a State into the sea — thereby extending its sovereign lands into marine areas. Therefore, this provides the legal avenue for small-scale fishers to hold rights also in marine areas. In addition, however, Article 17.1 clearly states that the 'right to land' includes "the right to have access to, sustainably use and manage land and the water bodies, coastal seas, fisheries, pastures and forests therein […]."

The 'Right to land' is tackled further by Lorenzo Cotula in Chapter 6 (pages 91—105), the only chapter that can be access free-of-charge online (here). The chapter emphasises the evolving role of agrarian movements in advocating for peasants' rights to land, from grassroots aspirations to international negotiations. The UNDROP emerges as a pivotal instrument, explicitly articulating land rights within a human rights framework and laying the groundwork for agrarian reform. It recognises the cultural significance of land to peasants while also addressing issues of production and control over resources. However, challenges persist in translating the right to land into tangible policy changes, given entrenched power dynamics and vested interests. Furthermore, the authors underscore the need for both legal and political strategies to ensure the implementation of land rights, highlighting the agency of activists in reshaping discourse and catalysing collective action. Ultimately, the struggle for realising the right to land remains a critical milestone in connecting land issues with human rights, demanding continued efforts towards effective implementation.

Here, the authors delve into the multifaceted nature of the right to land, highlighting its intersections with various aspects of rural life, including livelihoods, cultural identity, and production. By emphasising the agency of peasants in shaping their own vision of rural development, the chapter underscores the transformative potential of the right to land beyond merely securing access to basic necessities. It critically examines the structural barriers to realising this right, such as entrenched patterns of land ownership and the influence of transnational businesses. The chapter furthermore raises important questions about the role of legal strategies and international human rights bodies in advancing land rights, while acknowledging the inherent political challenges involved.

The importance of the UNDROP as a normative human rights instruments is underlined by Smita Narula's chapter entitled 'Peasants' rights and food systems governance' (Chapter 10, pages 151—164). Here, the author emphasises that the UNDROP provides new avenues within human rights contexts on several levels. For instance, while not challenging food systems governance that is rooted in productivity and economics as such, the UNDROP links food production with the needs of peasants and thereby establishes rights to food sovereignty linked to peasants' rights to land and the environment. To this end, the right to seeds, which is enshrined in Article 19, for example aims to "change the way agriculture and food systems are present organised" (page 159). Against this backdrop it is therefore not surprising that many industrialised nations have not endorsed the declaration.

Furthermore, the UNDROP establishes the right to a healthy environment as a human right. While landmark instruments like the International Covenant on Civil and Political Rights (ICCPR) or the International Covenant on Economic, Social and Cultural Rights (ICESCR) have established fundamental human rights, these have ultimately not been linked to the environment "[d]espite their obvious interdependence" (page 159). It seems, however, that the manuscript of the book was completed before 28 July 2022 since on that very day the UN General Assembly adopted a resolution that established the right to a clean, healthy and sustainable environment as a human right (United Nations, 2022). The chapter would have benefitted from slightly more depth on this issue, especially since already in October 2021, the Human Rights Council adopted a resolution on the very same issue (United Nations, 2021). A compelling inquiry would have delved into the extent to which the negotiations leading to the adoption of the UNDROP and those culminating in the 2022 resolution mutually informed or built upon each other.

Chapter 16, written by Adriana Bessa and Miguel Ángel Martín López, as the final example to be dealt with in this review, places its focus on 'The rights of small-scale fisherwomen in the EU: the potential impact of the UNDROP' (pages 227—236). Based on the *El Palmar* case in Spain, the chapter considers *inter alia* customary, gendered approaches to fisheries management and implementation. In the case, women challenged that they could not become active fishers based on the fishing community's century-old perception of women not being fishers — a challenge that was in the end supported by the Spanish Supreme Court.

Based on this example, the authors demonstrate what an important role the UNDROP could play in tackling discrimination. As the authors assert, in Spain, women "represent 5.4% of extractive fishing, 62.9% of all shellfish collectors, and the majority of workers in the fish processing industry […]" (page 227). The FAO estimates that while approximately 47% of the workforce in the fisheries sectors are women, the vast majority of these conduct post-harvest work (FAO, 2017, p. 7).

While the fisheries industry in the European Union (EU) is regulated by a large number of laws, regulations and policies, it is the EU's Common Fisheries Policy (CFP), that first arose in 1970 from a common agricultural policy, which now constitutes the legislative framework. While in 2013 the CFP was revised fundamentally and also included special rights of small-scale fishers, it was by and large silent on gender issues. In 2012, the European Parliament (EP) adopted a resolution that called for more recognition of women in the small scale fisheries sector, especially in light of rights to equal pay, unemployment benefits or pension, to name a few (European Parliament, 2012, para. 42). Unfortunately, however, the EP's calls were not included in the reformed CFP. Thus, the authors argue, the adoption of the UNDROP could provide momentum to include also gender issues in a potential new reform of the CFP. What falls of the table, however, is the fact that the vast majority of the EU Member States have not signed the UNDROP (except Portugal, as noted above). This perspective on the UNDROP cannot veil the fact that the declaration is not widely recognised as an influential instrument in the EU.

Whether or not a reform of the CFP will include gender issues remains to be seen, but if it does, it may not be rooted in the UNDROP, but rather in other developments. For instance, at CoP19 of CITES in 2022, a resolution on gender was adopted, recommending that "that Parties explore ways to further enhance the representation and participation of people of all genders, particularly women and girls, in conservation" (CITES, 2022, para. 4). This resolution, however, makes no reference to the UNDROP, but rather to UN General Assembly Resolution on 'Women and development' (United Nations, 2016) which *inter alia* calls on Member States "to accelerate their efforts and provide adequate resources to increase the voice and full and equal participation of women in all decision-making bodies at the highest levels of government and in the governance structures of international organizations" (ibid., para. 7) or "to ensure the full and equal participation of women in all levels of decision-making on environmental issues" (ibid., para. 11). Whether or not, therefore, the UNDROP will gain any traction in this regard cannot yet be ascertained, even though it is very much hoped for.

The United Nations' Declaration on Peasants' Rights is a volume that is long overdue, constituting a reference work and authoritative volume on a declaration that has not (yet) fully found its way into international human rights and environmental discourses. The book demonstrates how intricately interlinked human and environmental rights are, enshrined in the declaration itself, and how progressively and comprehensively it approaches the rights of peasants. The authors are experts in their fields and show, on the one hand, where the declaration is normatively located and, on the other hand, what potential it holds to achieve change on the ground — in the interest of those who have not yet had a voice in international law. The book shows how grassroots initiatives and 'human rights from below', to paraphrase Jim Ife (Ife, 2009) can influence decision-making on the highest level.

The book should therefore be read, analysed and criticised by human and indigenous rights scholars, experts and practitioners and serve as a basis for further inquiry. It is therefore highly recommended — also in order to shift the focus on those that have too long gone unheard.

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NEWS

Introducing the CITES Resolutions Depository

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is one of the oldest multilateral agreements for the conservation of biodiversity — in this case through the regulation of international trade. At the time of its conclusion in 1973, the international trade in endangered species was one of the major causes for their decline, which led to the adoption of the Convention.

In this sense, it is both a conservation and a trade agreement (Reeve, 2002) that requires its nowadays 184 Parties (including the European Union) to either restrict international trade (Appendix I), regulate this trade (Appendix II) or monitor it (Appendix III) with respect to the now more than 40,900 species (about 6,610 animal species and 34,310 plant species) that are included. Whether the Convention as succeeded in protecting wildlife, however, is a matter of debate (e.g. Wyatt, 2016).

In order to further ease the interpretation of the treaty and to bolster its effectiveness in light of the ever-growing number of species included in the Appendices, and in light of the ever-growing disparities between the CITES Parties, the main decision-making body of the Convention, the Conference of the Parties (CoP), has adopted 301 Resolutions over the courts of its now 19 CoPs, which have in one way or the other shaped the course of its functioning. While Resolutions themselves are legally not binding, they nevertheless are a compromise between all CITES Parties to tackle or address a certain issue.

Currently, 100 Resolutions remain valid, either in their original form or in revised versions, while the remainder have been repealed. However, for a comprehensive understanding of the Convention's evolution, access to Resolutions that are no longer valid is essential. While the CITES Secretariat offers access to all current resolutions, those that have been invalidated are no longer accessible, a measure intended to prevent confusion but posing challenges for research purposes.

Recognising this need, Sellheim Environmental has developed the CITES Resolutions Depository, the first comprehensive database containing all Resolutions adopted during various CoPs, available for download. This depository provides researchers and stakeholders with access to historical Resolutions, facilitating in-depth analysis and understanding of the Convention's trajectory. The Depository can be accessed through this link.

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Introducing our new Fellow, Gerald Zojer

We are happy to announce the joining of a new fellow: Gerald Zojer. After having a career as mechanical engineer and in the project management of an international oil and

gas exploration company, Gerald studied International Development at the University of Vienna, where he graduated with a master's degree (*Magister atrium*) in 2014. Currently he is a doctoral candidate at the Faculty of Social Sciences at the University of Lapland in Rovaniemi, Finland.

Due to his background in engineering, Gerald has been driven throughout his academic career by his interest in the interrelations between technological and societal developments. Following constructivist approaches of sciences and technology studies he has a particular interest in how technological progress affects socioeconomic developments. He has worked in the fields of energy politics, environmental politics, and political ecology. Recently he has mainly focused on the interplay between digitalisation and power politics. In the last few years he has worked as researcher at the Arctic Centre (University of Lapland) and as Assistant professor at UiT the Arctic University of Norway where he was teaching Societal Cybersecurity. Gerald is also entrepreneur and founder of *KaamosCreations*, which offers services to promote digitalisation for privacy oriented individuals and small organisations with a focus on utilising ethically sound software.

IN THE MEDIA

How AI can help protect species

Patricia Preis, *Tagesschau*, 25 March 2024

How can humans better understand animal and plant species? Artificial intelligence can be used to observe species more comprehensively.

Whether in the oceans, rivers, lakes or on land, biodiversity - the diversity of life - is declining everywhere due to species extinction. And it is serious: alongside climate change, species extinction is the second global crisis. In Europe alone, a fifth of all animal and plant species are threatened with extinction in the coming decades. This is the result of a study by scientists from the National Museum of Natural History Luxembourg and the University of Trier.

A game changer? More overview and insight with AI

Artificial intelligence can help us to better understand the interrelationships that lead to the extinction of species. What does coexistence in an ecosystem look like? And which species don't get along? These are questions that AI can provide an overview of. In fact, a study on the impact of AI applications shows that a large proportion of sustainability goals (79%) have a positive influence. AI has a particularly high potential to realise these goals (93%), especially in the case of sustainability goals directly related to climate and the environment, such as life on land and life in water. What does realisation with AI look like?

AI as a bird expert

To understand the complexity of our ecosystems, we need to take stock. Who lives within an ecosystem and who interacts with each other? Felix Günther takes a closer look at the forest ecosystem. He is an ecologist in the BirdNet team, an app and research platform of the Cornell Lab of Ornithology and Chemnitz University. Their research deals with the question of how computers can learn to recognise birds based on sounds. The AI-supported Birdnet app now recognises 6,000 bird species.

In the forest, sound makes the music

Every bird has a unique melody through which it communicates with other forest dwellers. There are certain calls to drive away its attacker and also calls to warn other birds of attackers. These calls are also known as mobbing calls. The great tit, for example, uses this call when it asks other birds for help to drive away the enemy, such as the owl. According to Günther in an interview with SWR, these calls not only allow ornithologists to detect different living conditions of the birds, but also to recognise which enemies are in the forest.

Big questions need big solutions

"We can better understand the ecosystem, at least everything that vocalises," says Günther. Audio recorders can be used to collect a lot of data about life in the forest. Quite a lot more than researchers and with significantly less effort. For example, there are areas that are hardly accessible, such as flood plains or nature reserves. In addition, the mere presence of researchers can drive away certain species, which means they cannot be recorded. An audio recorder, on the other hand, does not disturb the forest dwellers and provides the AI with several hundred hours of material per year, which it can then analyse. The archive of data is growing. Also thanks to amateur ornithologists and walkers who use the Birdnet app and feed the AI with their material. More data means a better overview and a better understanding of the ecosystem in its diversity and entirety.

AI dives down and becomes a trout expert

Similar to the forest, data is also collected in rivers. One reason for diving with video cameras was the trout. It is on the list of endangered species in all its forms (brown trout, lake trout and sea trout). Matthias Vahl, Head of Maritime Graphics at the Fraunhofer Institute, documents the spawning path of the sea trout in detail in order to determine its population. "What AI actually does is enable us to ask questions that we couldn't ask before," says Vahl. Previously, the almost 1.4 million videos, recorded over six months and totalling 5,600 hours, were painstakingly analysed by scientists. This time-consuming work has now been taken over by the AI. As a result, questions such as the condition and influence of dams and hydropower plants on the spawning path of sea trout can be answered more quickly and effectively. Supplemented by other data such as water temperature or salinity, life in the river can be mapped more comprehensively.

New orca species discovered? Researchers find clues

Morgenpost, 26 March 2024

Killer whales cavort off the US west coast. They are well studied - so researchers are certain that they have discovered a new species.

Orcas (also known as killer whales) are among the most fascinating marine mammals. The black and white predators capture the imagination and amaze researchers and laymen alike with their sophisticated hunting techniques and social behaviour.

But not all orcas are the same: biology distinguishes between ten different ecotypes, which differ in colouring, behaviour, body structure and other characteristics. Five of these ecotypes live in the northern hemisphere, while the others favour the southern hemisphere.

Of the northern ecotypes, the populations in the north-east Pacific, between Alaska and California, are particularly well studied. Researchers distinguish here between resident, transient and offshore populations - until now. This is because a team of marine biologists from the University of British Columbia (UBC) has evidence that there is a fourth, previously unknown oceanic orca population in the region.

Killer whale OCX043 encountered with three other whales 175km west of Bandon, Oregon, September 9, 2021 (Encounter 9). This whale was sighted previously 300 km offshore of Monterey Bay, California on January 23, 2020. Photo credit: Robert L. Pitman, Oregon State University.

Killer whales rarely encountered on the high seas

49 animals are thought to belong to this population, the team writes in its study. This could either be a subgroup of transient killer whales or an oceanic ecotype that lives in the waters off the US states of California and Oregon.

"The open ocean is the largest habitat on our planet, and observations of killer whales at sea are rare," said study author Josh McInnes in a UBC press release. The team is slowly beginning to understand how the animals move in the open ocean and how they differ from populations in coastal areas.

According to the press release, the unknown orcas have been sighted before. However, the study contains enough evidence - collected from nine encounters with 49 animals between 1997 and 2021 - to support the claim that this is a previously undescribed ecotype.

Orcas: bite marks provide crucial clue

The animals therefore do not match any known killer whales - and also appear to hunt their own prey. "In one of our first encounters with the group, we observed them attacking a pod of nine adult female sperm whales," said McInnes.

One of the female sperm whales eventually fell victim to the orcas. In other cases, the group had hunted dwarf sperm whales, elephant seals or leatherback turtles. This is unusual behaviour for the animals.

The decisive factor for their hypothesis, however, were bite marks from cigar sharks, which almost all of the observed killer whales had. The shark species lives in the open ocean - which means that the orcas prefer to spend their time there.

The physique of the killer whales also differs in parts from that of the other ecotypes. For example, the shape of their fins is different, as are the saddle patches, a grey-coloured area behind the dorsal fin. In part, they resemble those of orcas from tropical regions, according to the press release.

Ministry: authorisation for wolf shooting still valid

— *NDR*, 29 March 2024

For the first time, a wolf is to be shot in Lower Saxony following a new fast-track procedure because of a cattle kill. Wolf conservationists are taking legal action against this. So far without success.

According to the Ministry of the Environment, the permit for the controversial shooting of a wolf in the Hanover region is still valid. A spokesperson for the ministry said on Friday that the Oldenburg Administrative Court had on Thursday provisionally rejected an urgent application by the Gesellschaft zum Schutz der Wölfe e.V. (Society for the Protection of Wolves) to suspend the special permit to shoot a wolf in the Hanover region.

Fast-track procedure used for the first time

The applicant has lodged an appeal against this with the Lüneburg Higher Administrative Court. No decision has yet been made on this. "The authorisation to shoot cattle can therefore still be implemented," said the spokesperson. Last weekend, a cow was killed in the Hanover region. As a result, the responsible environment ministry permitted the shooting of a wolf for the first time under a new fast-track procedure. This was met with criticism from environmentalists and wolf conservationists.

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