



Designing Equitable Ocean Technology

Matt Ziegler • October 22, 2025 • One Ocean Week



OCEAN NEXUS



PAUL G. ALLEN SCHOOL
OF COMPUTER SCIENCE & ENGINEERING





Designing Equitable Ocean Technology

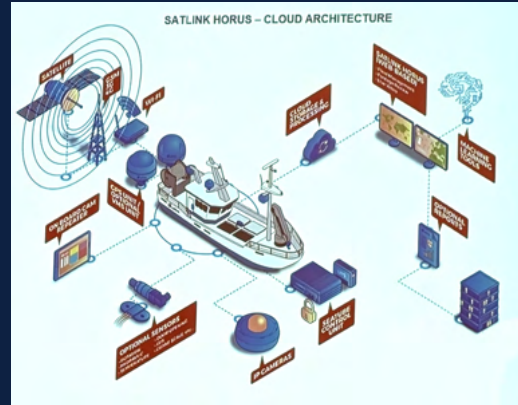
This talk:

1. Definitions & Considerations
2. Technology Examples
3. Discussion

Emerging Ocean Technologies



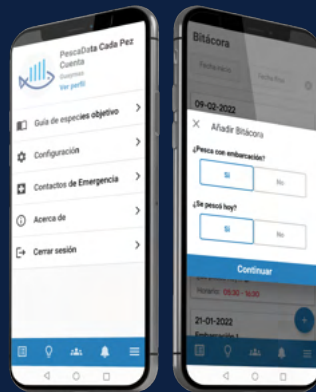
Ocean observation systems



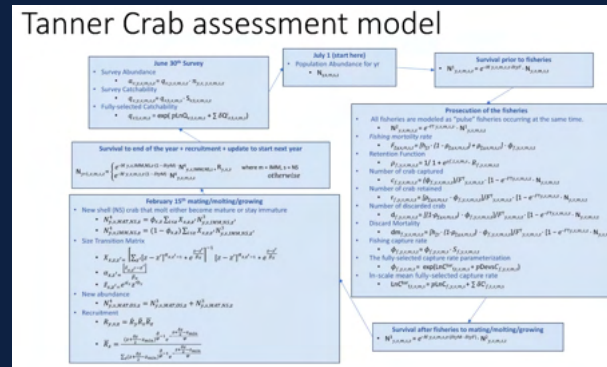
Vessel monitoring systems



Onboard video surveillance



Mobile apps for fishers



Fisheries modeling



Traceability tools

Image credits: (1) Global Fishing Watch, (2) Satlink, (3) Juan Carlos Ovalle Macías et. al., WFC Presentation 2024 (4) CoBi PescaData, (5) Madison Heller-Shipley et. al., WFC Presentation 2024 (6) Hyperledger Foundation

Example: Algorithmic conservation planning

Rank Priorities

Budget

Loggerhead turtle habitat

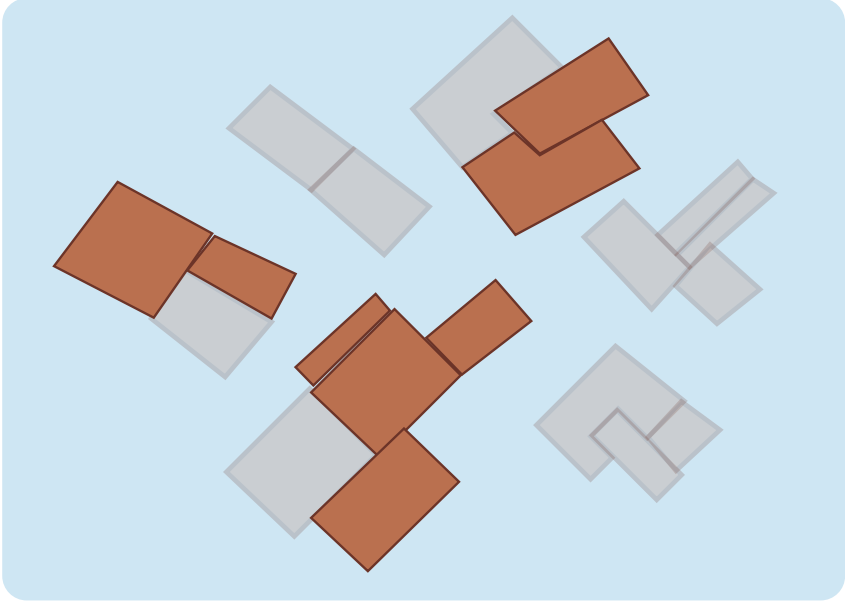
Manatee habitat

Connectivity

Cultural value

Calculate

Optimal selection of candidate protected areas



Goal: achieve the greatest conservation impact for your budget.

Features + PAs + Cost

Grid Setup

Gap Analysis

Q Search by feature name...

Albertine Rift Montane For...

Highlight on map

■ Current: 11% ▨ Target: 30%

Target not met

Banded Mongoose

Highlight on map

■ Current: 5% ▨ Target: 30%

Target not met

Black Rino

Highlight on map

■ Current: 10% ▨ Target: 30%

Target not met

Central Zambesian Miomb...

Highlight on map

■ Current: 0% ▨ Target: 30%

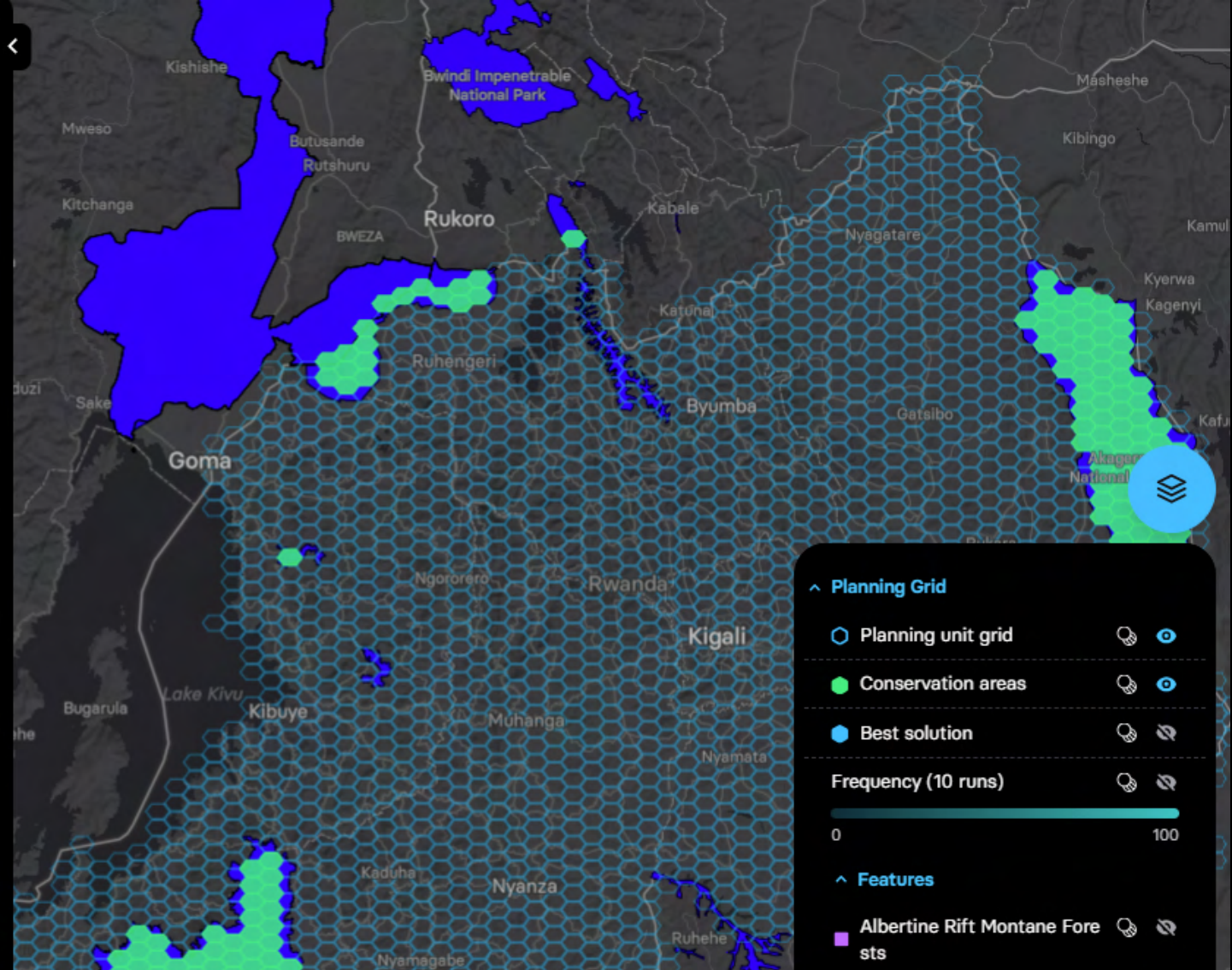
Target not met

Chimpanzee

■ Current: 46%

Elephant

■ Current: 66%

Algorithmic Conservation Planning:
Marxan

Planning Grid

○ Planning unit grid

● Conservation areas

● Best solution

Frequency (10 runs)

0 100

Features

■ Albertine Rift Montane Forests

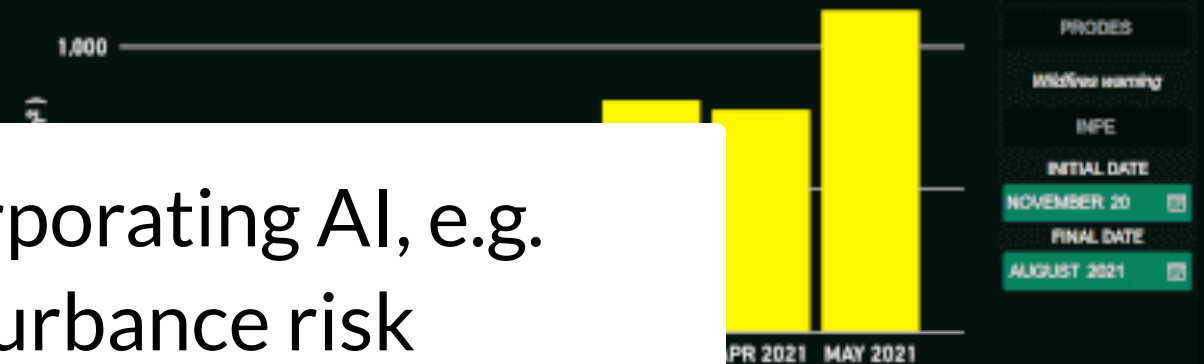
Banded Mongoose

Black Rino

Central Zambesian Miombo Woodlands

Kibingo

© Mapbox © OpenStreetMap Improve this map



Increasingly incorporating AI, e.g.
modeling disturbance risk

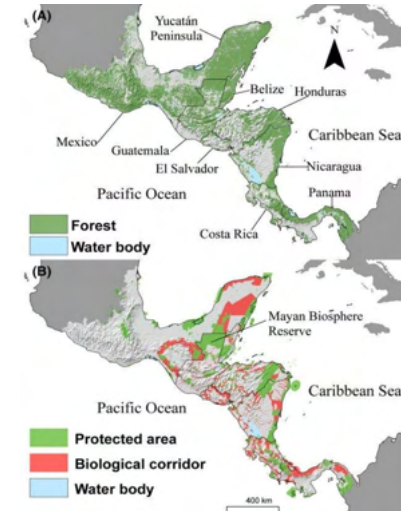
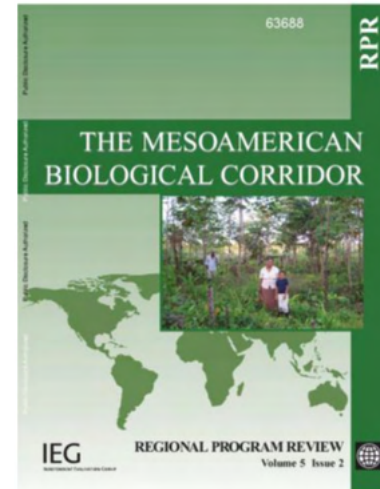
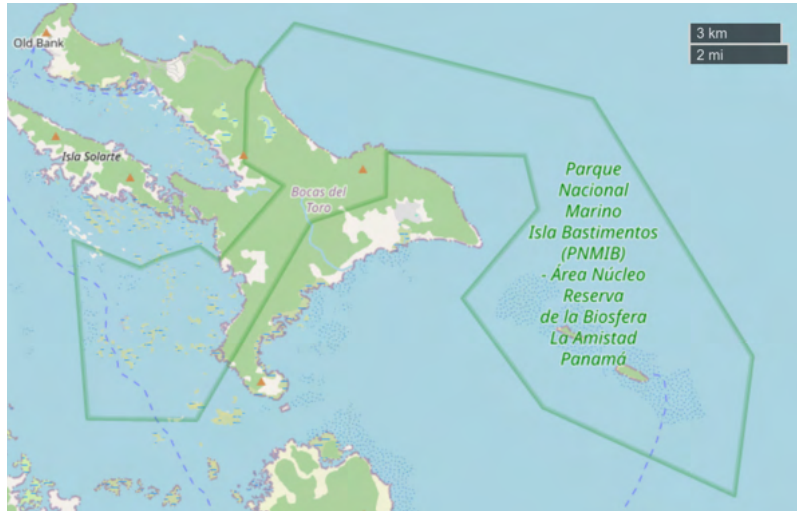
An aerial photograph of a tropical coastline. The top half shows a sandy beach with various green plants, including palm trees and shrubs. The bottom half shows the ocean with white, foamy waves crashing onto the shore. A semi-transparent white rectangle is centered over the image, containing the text.

Case Study

Isla Bastimentos National Marine Park

Photo By Dronepicr - Own work, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=48472009>





Isla Bastimentos National Marine Park

- Created by decree in 1988 from Panama City
- Support from World Bank, FAO, IUCN
- Stated goals: protect a range of habitats, particularly for turtles
- Secondary goal: “Tourism for Development” agenda
- **Local people apparently not consulted in park's design**

Park Impacts

- Local people excluded from subsistence use
- Unclear whether conservation goals accomplished
- One third of Isla Bastimentos bought by American resort company
- Harmful tourism impacts
 - Indigenous and Afro-Antillean people largely forced off land
 - Most tourism businesses owned by White Americans
 - Environmental harm: coastal development, mangrove removal, freshwater depletion, coral damage from snorkeling, wildlife disturbance

What if local people had more decision-making power?

Features + PAs + Cost

Grid Setup

Gap Analysis

Albertine Rift Montane For...

Highlight on map ☒

■ Current: 11% ▨ Target: 30%

Target not met

Banded Mongoose

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Central Zambesian Miomb...

Highlight on map ☒

■ Current: 0% ▨ Target: 30%

Target not met

Chimpanzee

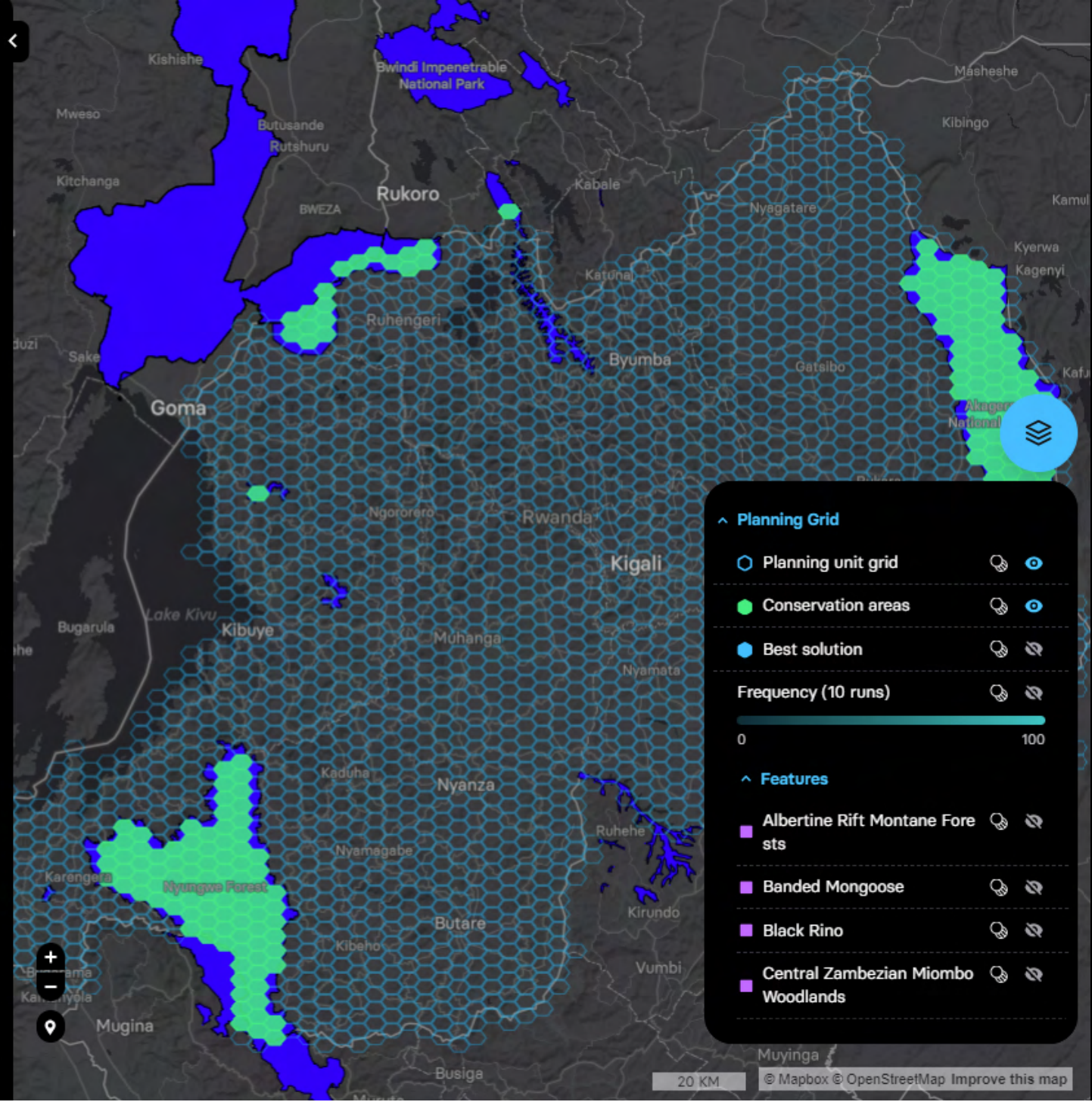
Highlight on map ☒

■ Current: 46% ▨ Target: 30%

Elephant

Highlight on map ☒

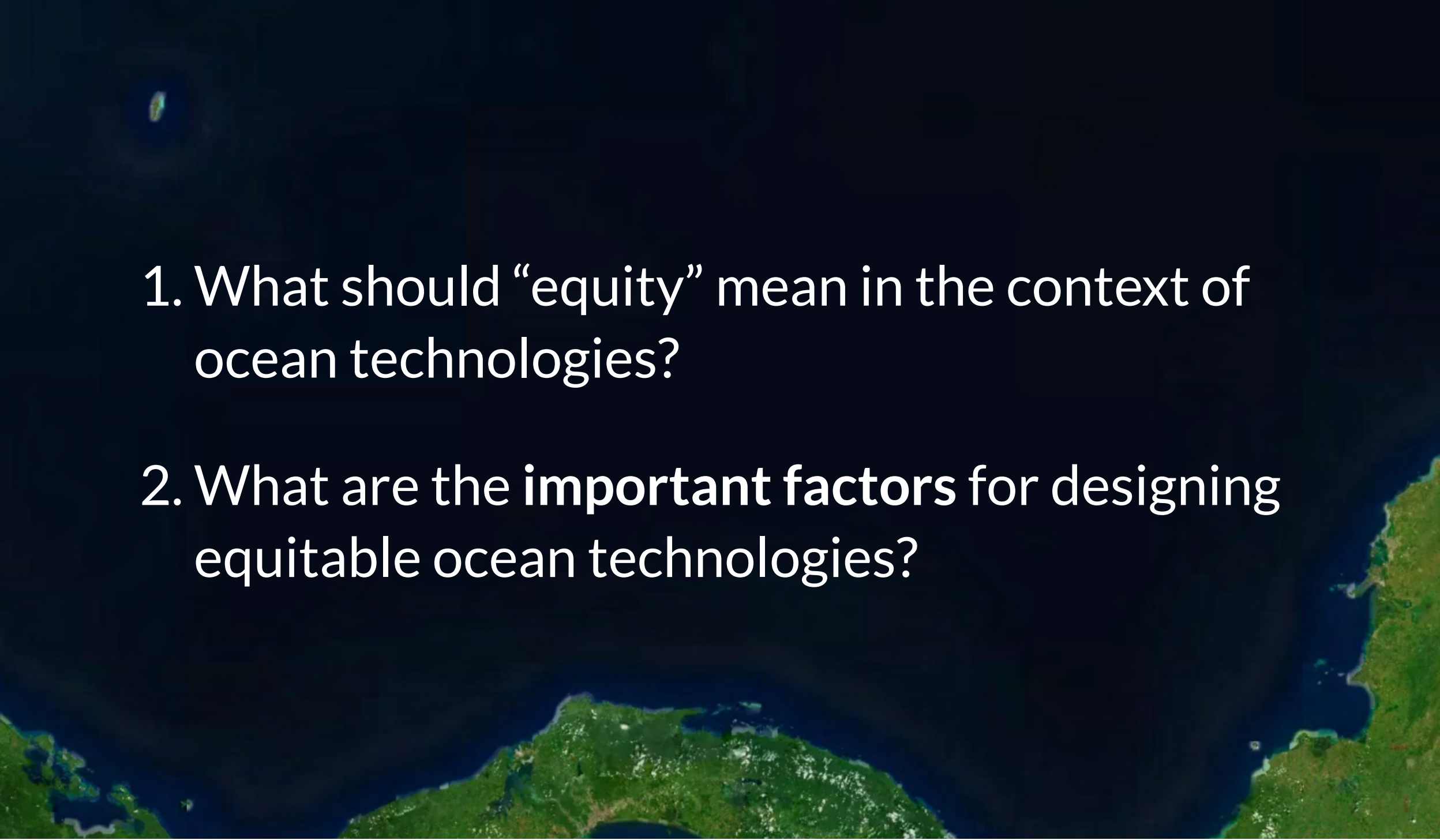
■ Current: 66% ▨ Target: 30%

Run
scenario

Algorithmic Conservation Planning

Benefits vs. Equity Concerns?

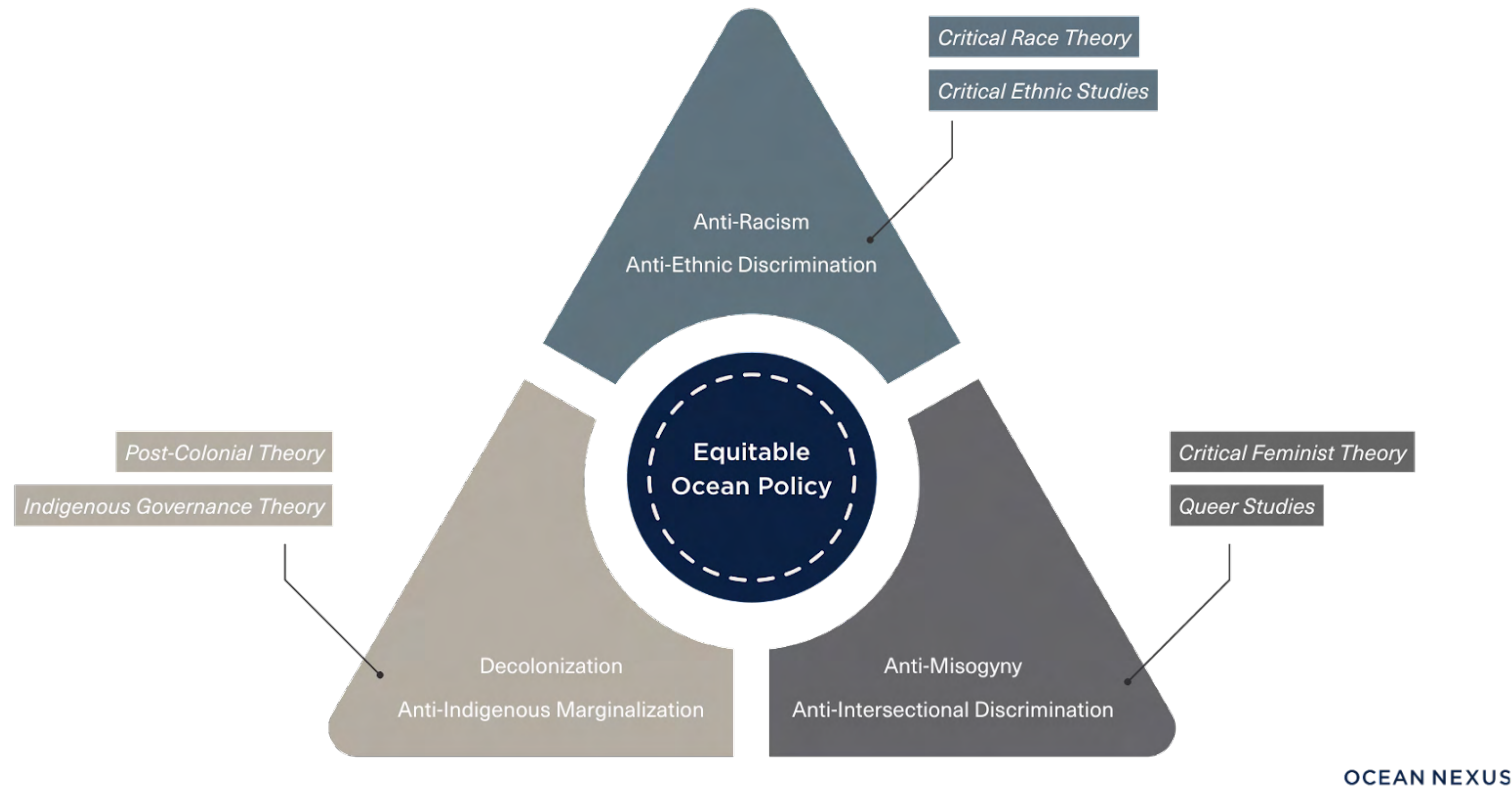
- **Benefits:** analysis, coordination, organization
- **Risks:** consolidating decision-making power
- Technical fixes can help, but don't solve everything
- **Danger:** undermining the slow and fragile progress towards inclusive environmental governance

A satellite image of the Earth's surface, showing a vast expanse of dark blue ocean. In the lower portion of the image, there are green landmasses, likely parts of Southeast Asia or the Pacific Islands, with visible coastlines and some white clouds. The text is overlaid on the ocean area.

1. What should “equity” mean in the context of ocean technologies?

2. What are the **important factors** for designing equitable ocean technologies?

Ocean Equity as Anti-Inequity

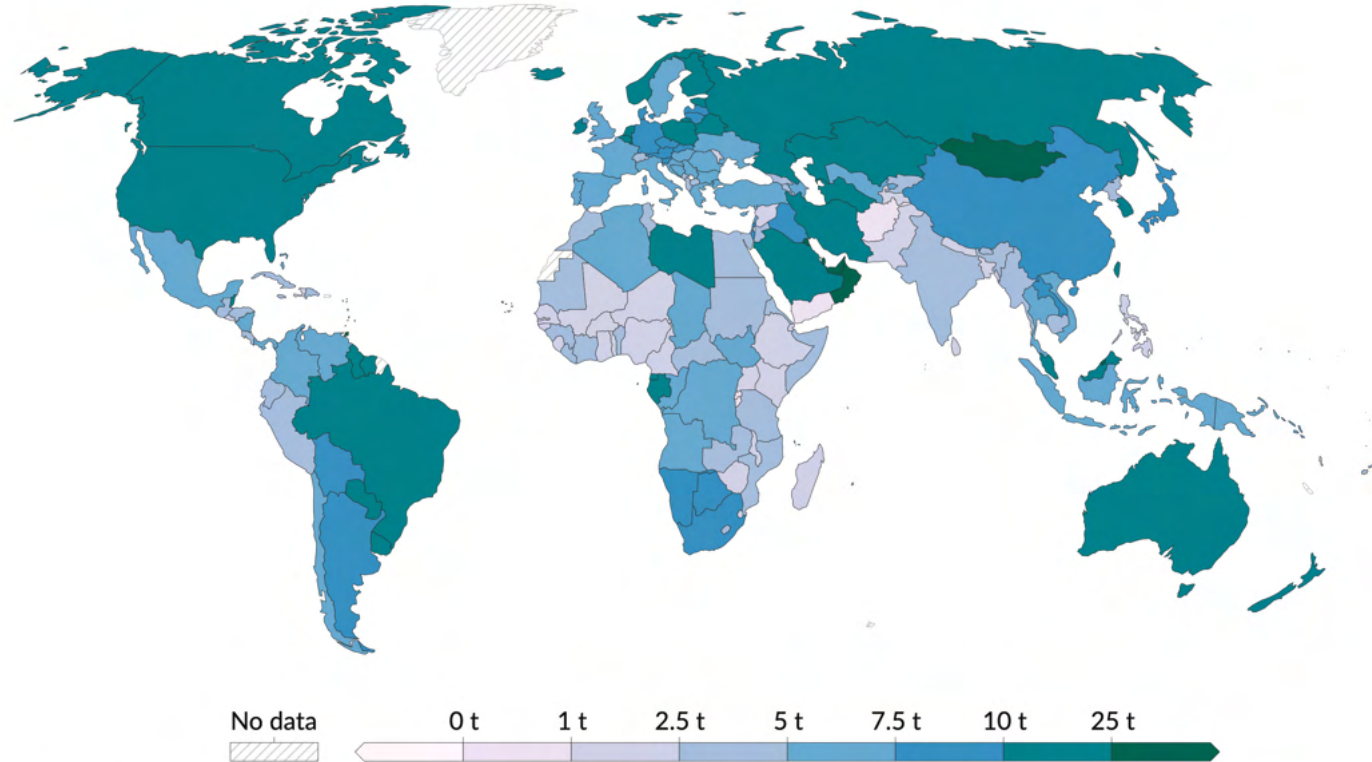


Ocean Governance Inequities

Per capita greenhouse gas emissions, 2021

Our World
in Data

Greenhouse gas emissions include carbon dioxide, methane and nitrous oxide from all sources, including agriculture and land use change. They are measured in carbon dioxide-equivalents over a 100-year timescale.



Data source: Calculated by Our World in Data based on emissions data from Jones et al. (2023).

Note: Land use change emissions can be negative.

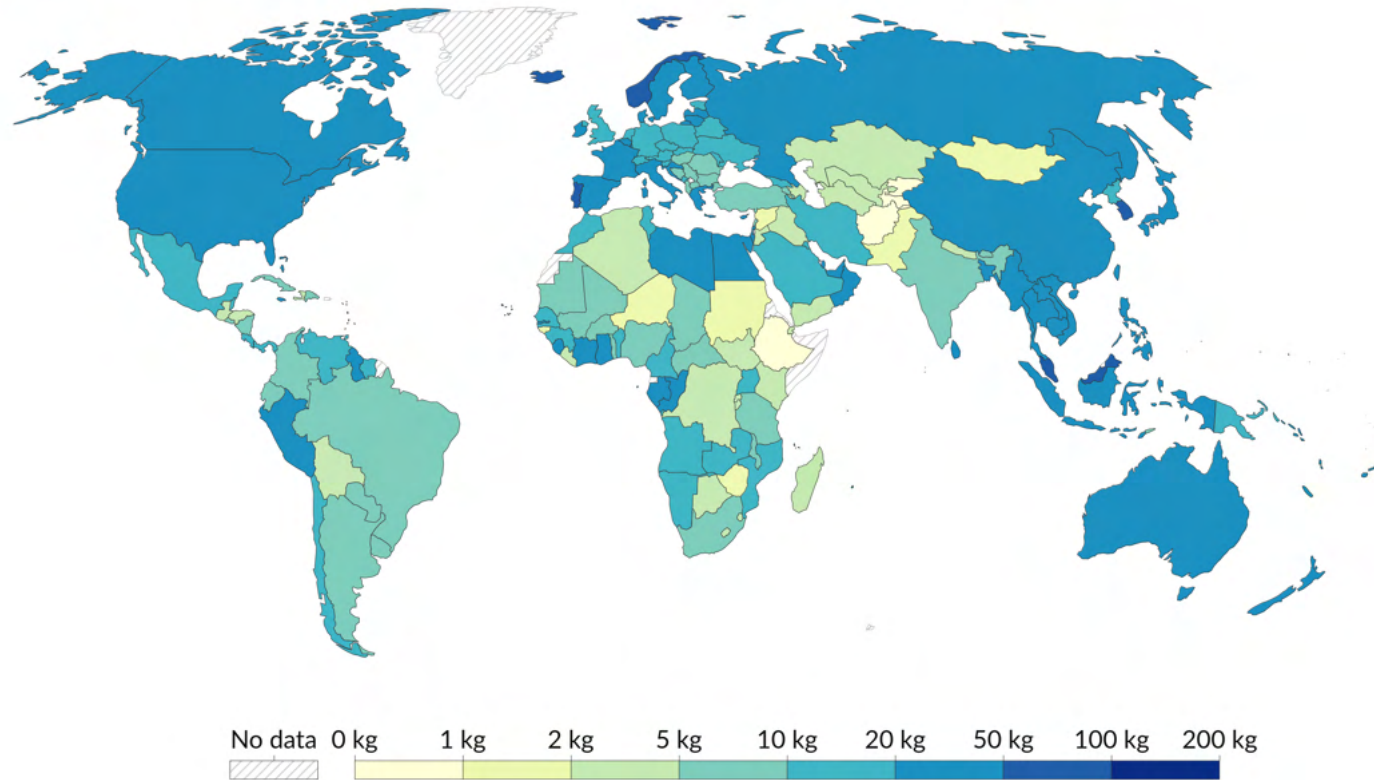
OurWorldInData.org/co2-and-greenhouse-gas-emissions | CC BY

Ocean Governance Inequities

Fish and seafood consumption per capita, 2021

Our World
in Data

Data is inclusive of all fish species and major seafood commodities, including crustaceans, cephalopods and other mollusc species.



Data source: Food and Agriculture Organization of the United Nations (2023)

OurWorldInData.org/fish-and-overfishing | CC BY

Note: Data is based on per capita food supply at the consumer level, but does not account for food waste at the consumer level.

Gendered Fisheries Labor

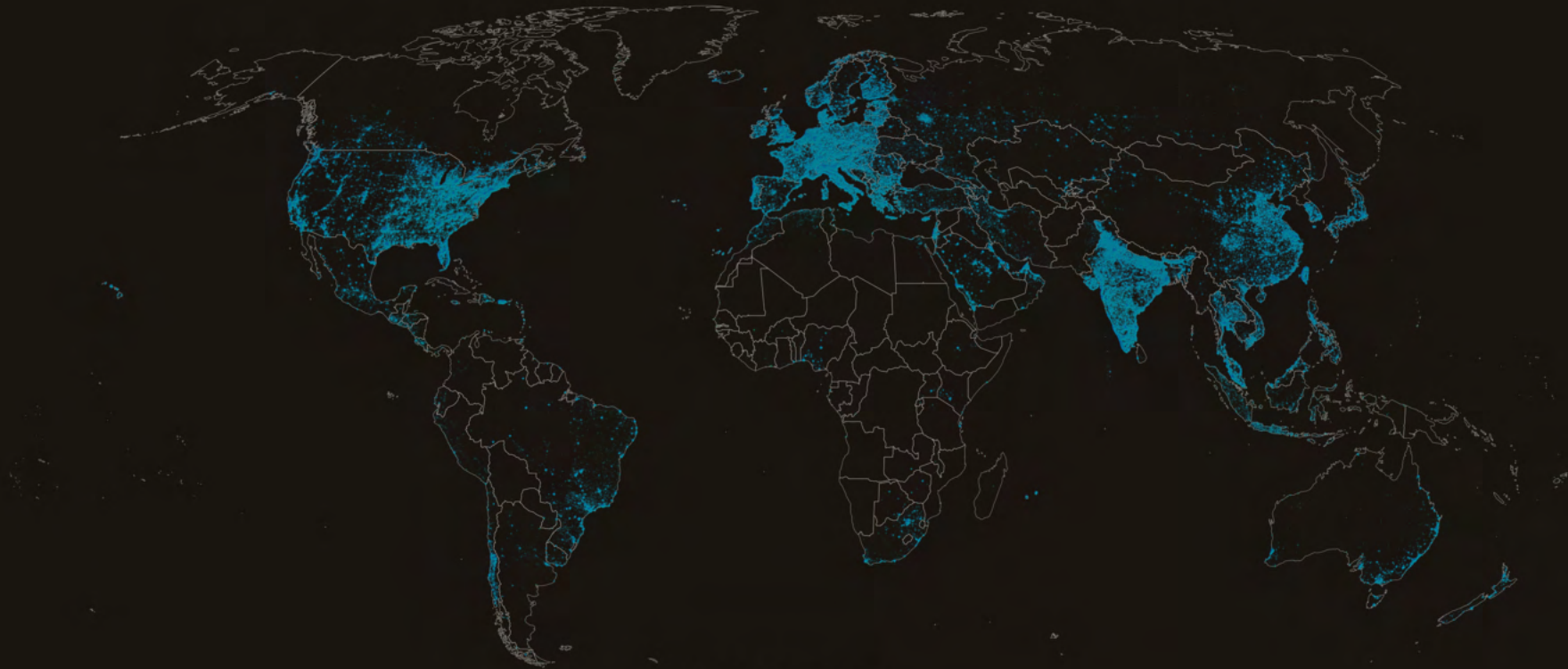


Photo credits: Asian Development Bank; Peninsula Daily News; Alaskan Seafood Marketing Institute; RARE

Technology Inequities

Average Mobile Download Speed of Over 100 Mbps

Ookla® Open Datasets | Mobile Network Performance Maps | Q3 2023



Zoom level 16 web mercator tiles.

AI Model Biases

why are black women so

why are black women so **angry**

why are black women so **loud**

why are black women so **mean**

why are black women so **attractive**

why are black women so **lazy**

why are black women so **annoying**

why are black women so **confident**

why are black women so **sassy**

why are black women so **insecure**

**ALGORITHMS
OF
OPPRESSION**

HOW SEARCH ENGINES
REINFORCE RACISM

SAFIYA UMOJA NOBLE

✗ The photo you want to upload does not meet our criteria because:

- Subject eyes are closed

Please refer to the technical requirements. You have 9 attempts left.

Check the photo [requirements](#).

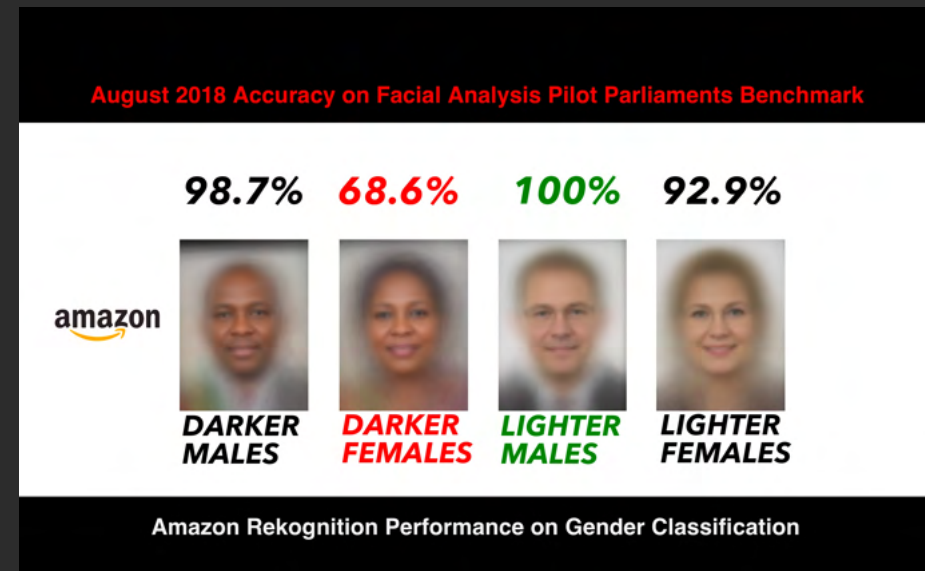
Read more about [common photo problems and how to resolve them](#).

After your tenth attempt you will need to start again and re-enter the CAPTCHA security check.

Reference number: 20161206-81

Filename: Untitled.jpg

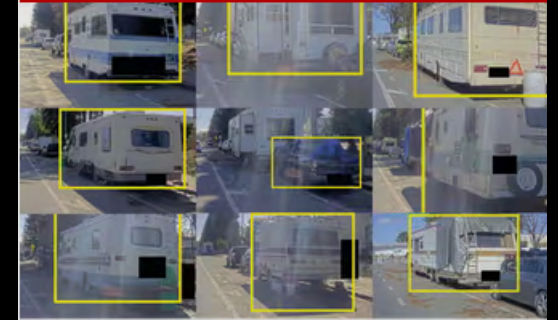
If you wish to [contact us](#) about the photo, you must provide us with the reference number



Disproportionate Surveillance of Marginalized Groups



Credit: Amnesty International / Spencer Platt / Getty Images; The Guardian / Betsy Reed



Revealed

A California city is training AI to spot homeless encampments

San Jose invited tech companies to mount cameras on a vehicle in what appears to be first-of-its-kind experiment

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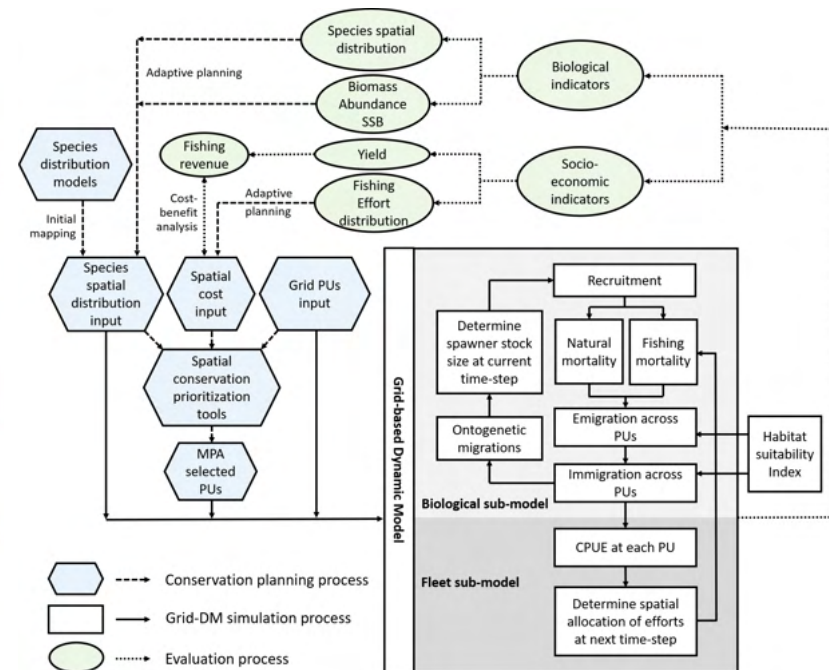
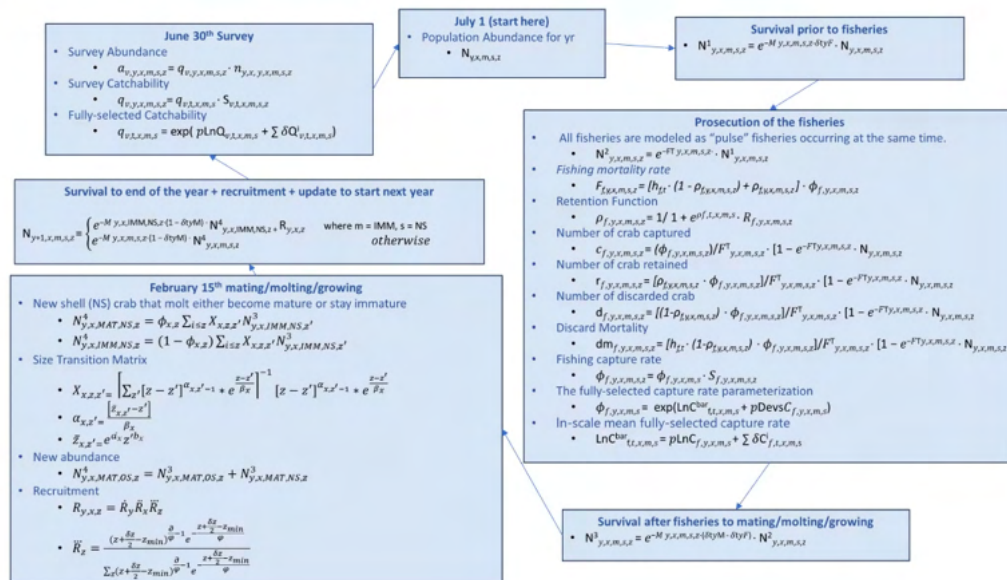
1. Who has **decision-making power**?
2. Who is **excluded**?
3. Who benefits from **model biases**?
4. Who takes on **burdens and risks**?
5. Who benefits from **hype**?

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Example: Fisheries Modeling

Tanner Crab assessment model



- Madison Heller-Shipley et. al. Streamlining MSE: Assessing Shortcut Methods for Expedited Science Integration. World Fisheries Congress Presentation 2024
- Yunzhou Li et. al. Evaluating fisheries conservation strategies in the socio-ecological system: A grid-based dynamic model to link spatial conservation prioritization tools with tactical fisheries management. PLOS One 2020.

Example: Fisheries Modeling

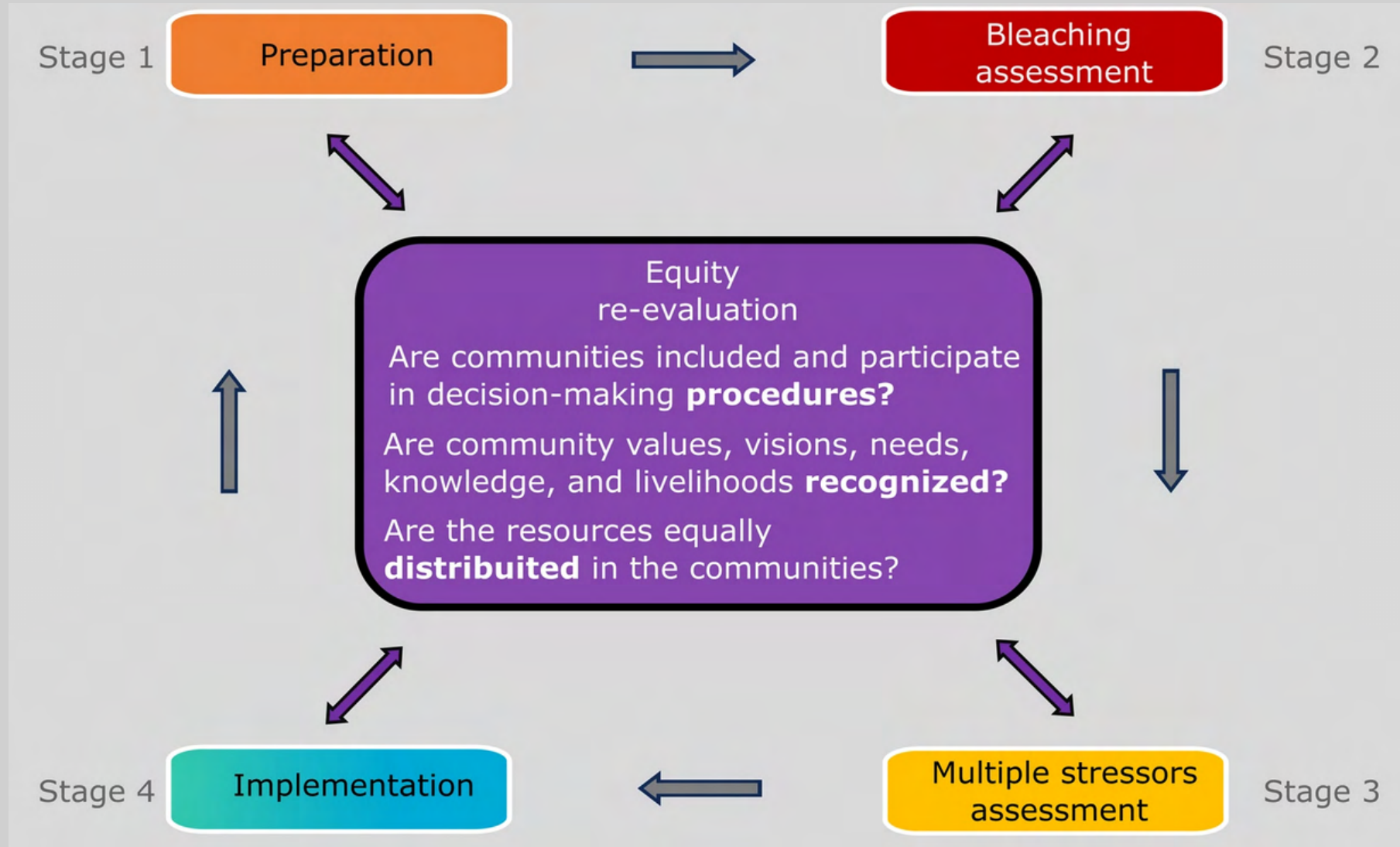
- Complexity squeezes out less-powerful stakeholders
 - What is modeled and why?



Angela Abolhassani, Jessica Vandenberg 2024. Management Procedures and the Science Management Interface in International Tuna Management. Presentation at World Fisheries Congress 2024. (citing Lave 2012.)

- "Participatory" modeling methods often fall short in practice
 - More powerful actors still control the process
- Partial technology mitigations?
 - Simpler models • better user interfaces • more interactivity

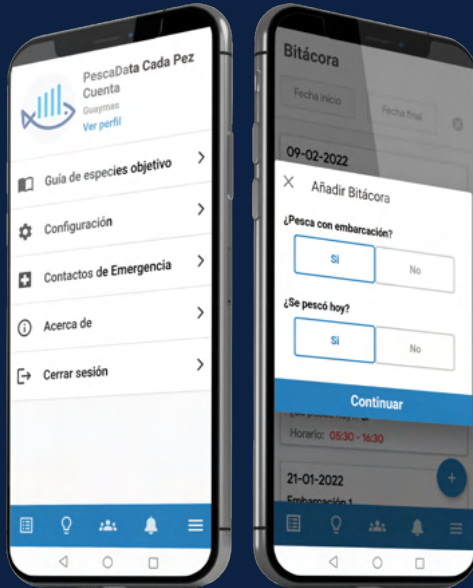
Core problem: Who has Decision-Making Power?



Designing Equitable Ocean Technology

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Example: Mobile Apps for Fishers



— **PescaData:** data management for small fishing cooperatives

— **Access barriers:**

- Mixed formal education levels
- Literacy barriers
- Generational differences
- Gender differences
- Bad connectivity at sea

Claudia Delgado Ramírez et. al., forthcoming



— **What to do?**

- Center the most-marginalized users in design process
- Use diverse communication channels
- Training

Example: Exclusion in online spaces

- Gendered Facebook and Whatsapp groups for fishers
Claudia Delgado Ramírez et. al., Forthcoming
- From interviewing environmental organizations: social stigmas are a main barrier for online community engagement
Matt Ziegler et. al., Forthcoming
- Sometimes addressable with moderation, sometimes not

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GPTs

Discover and create custom versions of ChatGPT that combine instructions, extra knowledge, and any combination of skills.

environmental policy

All



Environmental policy

We provide you with intelligent text generation capabilities to help you create high-...
By Zoe Jenkins 1



Environmental Policy Advisor

I'm an AI advisor for environmental policy, analyzing data to suggest sustainable so...
By moidhin ramshid 0



EcoGPT

Assists with environmental research and policy-making.
By Giorgi Chipashvili 1



EcoJustice Envoy

Champion environmental stewardship with EcoJustice Envoy, where environmental ...
By metutors.com 0



EcoSimulator

Simulates environmental changes for science and policy insights.
By zezhou lin 10+



Eco Educator Expert

Specialist in environmental education, aiding in policy and community engagement.
By HIDEITO FUJITA 2



Excel Trainer Analyst

Excel analyst and trainer for environmental economics and policy.
By GABRIEL A OROZCO R 3



Eco Advisor

Expert in environmental science and sustainability, aiding in policy and practice.
By Ashley Estrella 0



Climate Researcher

Analyzes and models climate systems to inform policy and predict environmental i...
By cureai.co.uk 1



United Nations

Agreement on Marine Biodiversity of Areas beyond National Jurisdiction BBNJ Agreement

BBNJ Agreement / High Seas treaty

- Adopted 2023
- Enters into force Jan 17 2026

Four themes / "package deal"

1. Marine genetic resources
2. Area-based management tools
3. Environmental impact assessments
4. Capacity building and technology transfer

20 Years of Open/Closed Negotiations

Consensus process



Ziegler, Lothian, O'Neill, Anderson, Ota. 2025.
AI Language Models Could Both Help and Harm Equity in Marine Policymaking.
Nature/npj Ocean Sustainability.
[doi:10/qb4p](https://doi.org/10.1038/s41566-025-0144-4)

1. Built BBNJ ChatBot
2. Tested with officials in BBNJ negotiations

Opportunities:

- Capacity building
- Interpreting complex policy instruments
- Consultative processes

Risks

- Technical capacity gap
- Displacing capacity building
- Biases favor developed countries

Experimental BBNJ Question-Answering Bot

Experimentall Using ChatGPT 3.5, this bot attempts to answer questions from documents in the BBNJ 5th session. When you ask a question, this program first tries to find the most relevant passages from the selected documents (visible under "source passages"), and then sends them to ChatGPT 3.5 to try to answer your question. You can also record feedback on its answers using this page.

Question

Can emergency measures be taken?

Documents

Select documents to use in the search

☒ BBNJ final draft agreement

☒ Prior 5th-session draft agreements

☒ Small group work outcomes

☒ Delegates' submitted proposals

☒ President's statement on suspension

☒ Party statements

☒ Earth Negotiations Bulletin Reports: initial 5th session

☒ Earth Negotiations Bulletin Reports: resumed 5th session

ChatGPT Temperature / Randomness

0.3

Submit

Answer

Yes, emergency measures can be taken according to the final draft of the agreement. The Conference of the Parties (COP) has the authority to adopt measures on an emergency basis in areas beyond national jurisdiction when a natural phenomenon or human-caused disaster has caused, or is likely to cause, serious or irreversible harm to marine biological diversity. These measures are intended to ensure that the harm is not exacerbated. The measures must be based on the best available science and scientific information, as well as relevant traditional knowledge of indigenous peoples and local communities. They are temporary and must be reconsidered for decision at the next meeting of the COP following their adoption. The measures will expire either upon being replaced by area-based management tools established in accordance with the provisions of the agreement or at a date to be decided by the COP, which shall not be later than two years after their adoption. Procedures

Source passages used for the answer

This text was provided to GPT to analyze for its response. We can currently only put about 2500 words here, so a pre-processing step searches for the most relevant chunks in the BBNJ documents.

From document "SUMMARY OF THE RESUMED FIFTH SESSION OF THE INTERGOVERNMENTAL CONFERENCE ON AN INTERNATIONAL LEGALLY BINDING INSTRUMENT UNDER THE UN CONVENTION ON THE LAW OF THE SEA ON THE CONSERVATION AND SUSTAINABLE USE OF MARINE BIODIVERSITY OF AREAS BEYOND NATIONAL JURISDICTION: 20 FEBRUARY – 4 MARCH 2023":

Marine Genetic Resources, Including the Fair and Equitable:

Emergency measures (article 20 ante): The rationale behind this proposal was highly welcomed. However, a regional group expressed concerns about the suitability of solving an emergency through the creation of ABMTs.

Final Agreement: In the final agreement, parties agree, inter alia, that the COP shall take decisions to adopt measures in ABNJ, to be applied on an emergency basis, if necessary, when a natural phenomenon or human-caused disaster has caused, or is likely to cause, serious

Record feedback on this answer

Use via API

Built with Gradio

Who benefits from model biases?

Example: Generative AI in Policymaking

Q: Does the USA violate human rights?

ChatGPT: The question of whether the United States violates human rights is complex and subjective. The U.S. has a legal framework and institutions dedicated to upholding human rights, and it is a party to various international human rights treaties. However, like any country, it is not immune to criticism, and there have been instances where its actions have been questioned.

Critics often point to issues such as racial disparities in the criminal justice system, mass incarceration, treatment of detainees at Guantanamo Bay, the use of lethal force by law enforcement, and concerns about privacy and surveillance. Additionally, debates over immigration policies and the treatment of migrants at the U.S. southern border have raised human rights concerns.

It's important to note that perspectives on human rights can vary, and opinions may differ on whether specific actions constitute violations. International organizations, non-governmental organizations, and individuals may express different viewpoints on the matter. Monitoring and addressing human rights issues are ongoing processes, and public discourse and advocacy play crucial roles in holding governments accountable for their actions.

Q: Does India violate human rights?

ChatGPT: India, like many countries, has faced criticism and accusations of human rights violations, particularly in areas such as:

- 1. Kashmir:** The region of Kashmir has been a longstanding source of tension between India and Pakistan, with allegations of human rights abuses by Indian security forces in the Indian-administered part of Kashmir.
- 2. Armed Conflicts:** Instances of alleged human rights abuses have been reported in areas affected by armed conflict, such as in states like Jammu and Kashmir, Chhattisgarh, and Manipur, where security forces have been accused of extrajudicial killings, torture, and arbitrary detention.
- 3. Freedom of Expression and Press Freedom:** Concerns have been raised about the state of freedom of expression and press freedom in India, with instances of censorship, attacks on journalists, and harassment of activists.
- 4. Discrimination and Violence Against Minorities:** There have been reports of discrimination and violence against religious and ethnic minorities, including Muslims, Christians, Dalits (formerly known as "untouchables"), and indigenous communities.
- 5. Women's Rights:** Despite legal protections, women in India still face challenges related to gender-based violence, discrimination, and access

Q:Have access and benefit sharing been prioritized in the BBNJ treaty?

BBNJ Chatbot: Yes, access and benefit-sharing have been prioritized in the BBNJ treaty. The final draft of the agreement establishes an access and benefit-sharing mechanism, which is composed of members elected by the Conference of the Parties. The mechanism aims to provide guidelines for benefit-sharing, ensure transparency, and facilitate a fair and equitable sharing of both monetary and non-monetary benefits. The agreement also includes provisions for monitoring and transparency, with the access and benefit-sharing committee preparing reports based on information received through the clearing-house mechanism and making it available to Parties for consideration. The Conference of the Parties can determine appropriate guidelines for the implementation of access and benefit-sharing, taking into account national capabilities and circumstances.

Q: From the perspective of developing countries, have access and benefit sharing been prioritized in the BBNJ treaty?

BBNJ Chatbot: Yes, access and benefit sharing have been prioritized in the BBNJ treaty, particularly for developing countries. The treaty includes provisions for fair and equitable sharing of benefits arising from marine genetic resources of areas beyond national jurisdiction, and capacity building and transfer of marine technology to developing states parties, particularly the least developed countries and landlocked developing countries. The treaty also establishes a financial mechanism aimed at ensuring efficient access to funding through simplified approval procedures and enhanced readiness of support for developing states parties, taking into account their specific needs and special circumstances. The GEF has also set aside funding to support national ratification and implementation of the treaty, particularly for developing countries.

LLM Challenges with UN Documents

- Developed States produce more text
- LLMs struggle with nuances of diplomatic language: “repertoires of decorum”
- Many disagreements not publicly documented

Computer Vision Applications



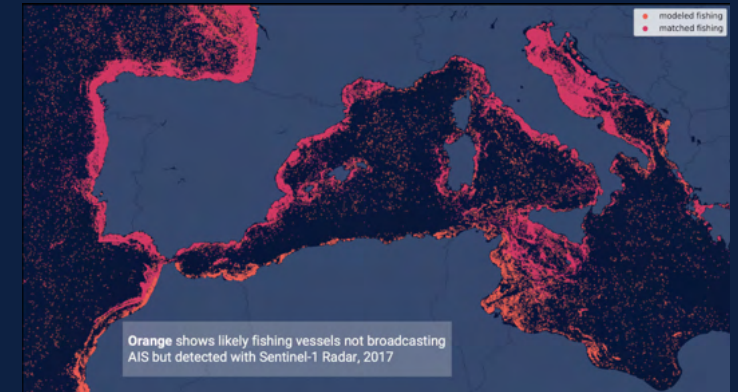
Counting/identifying fish in a net

Credit: NOAA, Katherine Wilson et. al., WFC Presentation 2024



Fishing boat onboard monitoring

Credit: Satlink, Manuel Menchaca. WFC Presentation 2024



Predicting fishing boats from satellite images

Credit: Global Fishing Watch, Press Photo 2022.

- These AI models will have errors and biases; unevenly distributed
- Governance of foundation models?
- **Future work:** Lots more research needed on fairness and accountability

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5. Who benefits from **hype**?

Who takes on burdens and risks?

Example: Fishing Boat Surveillance



- Monitoring systems including AIS, VMS, camera systems
- Need to balance fishers' privacy and security with enforcement needs
- Partial technical mitigations: blurring faces with AI

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Who benefits from technology hype?

Example: Blockchain Traceability

Case Study:  **HYPERLEDGER**
BLOCKCHAIN TECHNOLOGIES FOR BUSINESS

How Walmart brought unprecedented transparency to the food supply chain with Hyperledger Fabric

Walmart  Global Tech 

Blockchain in the food supply chain - What does the future look like?

 Archana Sristy
Sr. Director - U.S. Omni Tech
Nov. 30, 2021 | 6 min read



JUNE 6, 2017

Walmart and IBM looking at "blockchain" to radically improve traceability

 Madelyn Kearns published in SeaWeb Seafood Summit

ZDNET



Home / Finance / Blockchain

Walmart implements IBM's blockchain for food traceability

The aim is to track food from farm to store in near real time using blockchain's distributed ledger system.

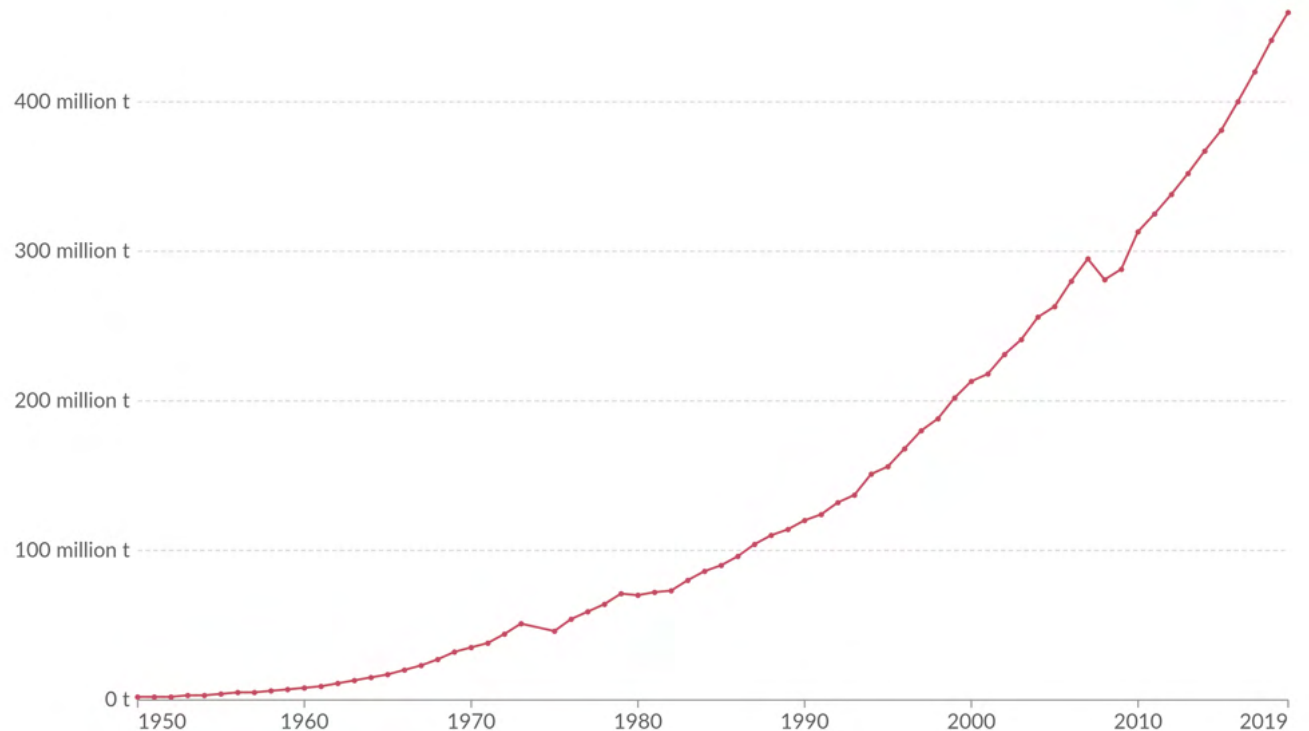
Who benefits from technology hype?



The Coca-Cola Company Partners with The Ocean Cleanup to Tackle Plastic Pollution in Vietnam

Global plastics production

Annual production of polymer resin and fibers.



Data source: Geyer et al. (2017); OECD (2022)

OurWorldInData.org/plastic-pollution | CC BY

Former Google CEO says climate goals are not meetable, so we might as well drop climate conservation — unshackle AI companies so AI can solve global warming

News

By [Jowi Morales](#) published October 7, 2024

"We're not going to hit the climate goals anyway..." says former Google chief Eric Schmidt.



When you purchase through links on our site, we may earn an affiliate commission. [Here's how it works.](#)



(Image credit: Special Competitive Studies Project/YouTube)

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