Environmental Science and Policy 171 (2025) 104089

Contents lists available at ScienceDirect

Environmental Science and Policy

journal homepage: www.elsevier.com/locate/envsci

Opportunities to better integrate inland fish and fisheries in multilateral environmental agreements

Abigail J. Lynch [a,*], Devin Bartley [b], T. Douglas Beard, Jr. [a], Gabriel Borba [c], Steven J. Cooke [d], Ian G. Cowx [e], Vittoria Elliott [f], Holly Embke [g], Edith Gondwe [h], Zeb Hogan [i], Jonathan G. Low [c], Jamie C. Madden [d], Sui Phang [j], Emma D. Rice [c], Nicholas Sievert [k], Gretchen L. Stokes [l], Leonard Akwany [m], Edward H. Allison [n], Robert Arlinghaus [o,p], Robert Arthur [q], Vidyadhar Atkore [r], Mahatub Khan Badhon [c,s], Claudio Baigun [t], Jill L. Brooks [u], Leandro Castello [c], Somvilay Chanthalounnavong [v], Seila Chea [w,x], Soksan Chhorn [x], Michael S. Cooperman [y], Kim Crisafi [z], James Dalton [aa], Caitlin A. Doughty [ab], Jason Earl [ac], Wasseem Emam [ad,ae,af], Rebecca Flitcroft [ag], Daria Gundermann [o], Henry H. Hansen [ah], Ian Harrison [ai], Kathy Hughes [ai,aj], Külli Kangur [ak], Ted Lawrence [al,am], Roman Lyach [an], Bonnie J.E. Myers [a], Muruganandam Muthiah [ao], Nguyen Thi Kim Quyen [ap], Vivian M. Nguyen [d], Elizabeth A. Nyboer [c], Julian D. Olden [aq], Craig Paukert [ar], Morgan L. Piczak [d], Yasmín Quintana [as], Vu Dang Ha Quyen [at], Shehu Latunji Akintola [au], Roshani Shrestha [h], Sokmoly Uon [av], Sophorn Uy [x], Cassie M. VanWynen [a]

[a] US Geological Survey, National Climate Adaptation Science Center, 12201 Sunrise Valley Drive, MS-300, Reston, VA 20192, USA
[b] 2718 Concord Avenue, Davis, CA 95618, USA
[c] Virginia Polytechnic Institute and State University, Department of Fish and Wildlife Conservation, Cheatham Hall, 310 W Campus Dr, Blacksburg, VA 24060, USA
[d] Carleton University, Department of Biology, 1125 Colonel By Drive, Ottawa, ON K1S 5B6, Canada
[e] University of Hull, International Fisheries Institute, Hull HU6 7RX UK
[f] National Museum of Natural History, Smithsonian Institution, PO Box 37012, Washington D.C. 20013-7012, USA
[g] US Geological Survey, Midwest Climate Adaptation Science Center, 1954 Buford Ave, St Paul, MN 55108, USA
[h] Department of Fisheries and Wildlife, Michigan State University, 480 Wilson Rd #13, East Lansing, MI 48824, USA
[i] Department of Biology and Global Water Center, University of Nevada, Reno, NV 89557, USA
[j] The Nature Conservancy, London, UK
[k] Missouri Department of Conservation, 3500 E Gans Rd, Columbia, MO 65201, USA
[l] School of Forest, Fisheries, and Geomatics Sciences, University of Florida, 2181 McCarty Hall A, Gainesville, FL 32605, USA
[m] Conservation International, Nairobi PO Box 1963-00502, Kenya
[n] WorldFish, Jalan Batu Maung, Batu Maung, Bayan Lepas, Penang 11960, Malaysia
[o] Leibniz Institute of Freshwater Ecology and Inland Fisheries, Müggelseedamm 310, Berlin 12587, Germany
[p] Division of Integrative Fisheries Management, Faculty of Life Sciences and Integrative Research Institute on Transformations of Human-Environment Systems (IRI THESys), Humboldt-Universität zu Berlin, Unter den Linden 6, 10099 Berlin, Germany
[q] Woodhill Solutions, Longtown, Herefordshire, UK
[r] Salim Ali Centre for Ornithology and Natural History, Anaikatty Post, Coimbatore, Tamil Nadu state Pincode-641108, India
[s] Department of Zoology, University of Dhaka, Dhaka 1000, Bangladesh
[t] Universidad Nacional de San Martin, Escuela de Hábitat y Sustentabilidad, San Martin 1650, Argentina
[u] Lotic Environmental Ltd., 101 Kootenay St N, Cranbrook, BC V1C 3T5, Canada
[v] National University of Laos, Faculty of Forest Science, Vientiane 2JQJ+XFQ, Laos
[w] Institute of Technology of Cambodia, Department of Water and Environment, Russian Federation Boulevard, Phnom Penh, Cambodia
[x] Royal University of Agriculture, Faculty of Fisheries and Aquaculture, Dongkor District, Phnom Penh P.O.Box 2696, Cambodia
[y] PlusFish Philanthropy, PO Box 230, Manchester, VT 05254, USA
[z] Department of Interior, Technical Assistance Program, 1849C St NW, Washington DC 20240, USA
[aa] International Union for Conservation of Nature, 28 rue Mauverney, Gland CH-1196, Switzerland
[ab] The Nature Conservancy, 74 Wall Street, Seattle, WA 98121, USA

* Corresponding author.
E-mail address: ajlynch@usgs.gov (A.J. Lynch).

https://doi.org/10.1016/j.envsci.2025.104089
Received 8 August 2024; Received in revised form 23 April 2025; Accepted 25 April 2025
Available online 18 July 2025

[ac] South Australian Research and Development Institute (SARDI), Aquatic and Livestock Sciences, 2 Hamra Avenue, West Beach South Australia, Australia
[ad] Ethical Seafood Research, 20-23 Woodside Place, Glasgow G3 7QL, UK
[ae] Institute of Aquaculture, University of Stirling, UK
[af] Complutense University of Madrid, Spain
[ag] US Department of Agriculture Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97330, USA
[ah] Karlstad University, Universitetsgatan 2, Karlstad 651 88, Sweden
[ai] Freshwater Conservation Committee, IUCN Species Survival Commission, 6180 E. Camden Road, Flagstaff, AZ 86004, USA
[aj] World Wildlife Fund - Living Planet Centre, Rufford House, Brewery Rd, Woking GU21 4LL, UK
[ak] Estonian University of Life Sciences, Centre for Limnology, Rannu 61117, Estonia
[al] African Center for Aquatic Research and Education, 2200 Commonwealth Blvd. Ste. 100, Ann Arbor, MI 48105, USA
[am] International Institute for Sustainable Development, 111 Lombard Avenue, Suite 325, Winnipeg, Manitoba R3B 0T4 Canada
[an] Scio Research, Pobřežní 34, Prague 186 00, Czechia
[ao] ICAR-Indian Institute of Soil and Water Conservation (ICAR-IISWC), 218-Kaulagarh Road, Dehradun 248 195, India
[ap] Department of Fisheries Management and Economics, College of Aquaculture and Fisheries, Cantho University, Campus 2, 3/2 Street, Xuan Khanh, Ninh Kieu, Cantho City, Viet Nam
[aq] School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195, USA
[ar] US Geological Survey, Missouri Cooperative Fish and Wildlife Research Unit, 302 ABNR Building, The School of Natural Resources, University of Missouri, Columbia, MO 65211 USA
[as] Conservation Research Department, John G. Shedd Aquarium, 1200 South DuSable Lake Shore Drive, Chicago, IL 60605, USA
[at] Nha Trang University, 2 Đ. Nguyễn Đình Chiểu, Vĩnh Thọ, Nha Trang, Khánh Hòa 650000, Viet Nam
[au] Fisheries Department, Lagos State University, Badagry Expresway, Lagos State, Nigeria
[av] Asian Institute of Technology, P.O. Box 4, 58 Moo 9, Km. 42, Paholyothin Highway, Klong Luang, Pathum Thani 12120, Thailand

ARTICLE INFO

Keywords:
Freshwater
Wetland
Governance
Aquatic
Conservation
Fish

ABSTRACT

Inland fish and fisheries are globally important to environmental function and human services, yet their persistent lack of recognition in global agreements, especially multilateral environmental agreements (MEAs), may hinder progress towards biodiversity conservation and human well-being. The connection between inland fish, fisheries, and their ecosystems means that addressing the needs of fish directly offers opportunities to meet multiple global commitments and provide indicators of progress towards many global goals. In this perspective, we highlight opportunities to better integrate inland fish and fisheries into MEAs, specifically the Convention on Biological Diversity (CBD), Convention on Wetlands (commonly known as the Ramsar Convention), Convention on Conservation of Migratory Species (CMS), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and World Heritage Convention (WHC). Greater attention on inland fish and fisheries through MEAs could help ensure more holistic planning, investment, and conservation of these important fish and fisheries, their biodiversity, the essential resources they provision, and the environments they inhabit.

1. Introduction

Inland[1] fish and inland capture fisheries[2] occur in rivers, lakes, reservoirs, and wetland habitats across the world, from ice-covered polar regions to tropical river-floodplains, and they support essential ecosystem services and functions, including food security, nutrition, livelihoods, and recreational benefits (Orru et al., 2014; Parkkila et al., 2004). Inland fish provide an important source of protein and micronutrients for billions of people, contributing to global food security, health, and nutrition (Arthur, 2024; Arthur et al., 2015; Funge-Smith et al., 2019; Youn et al., 2014). Additionally, inland fisheries support livelihoods and economic provisioning for approximately 60 million people (World Bank, 2012), with 40 % of global inland capture fisheries originating from low-income food-deficit countries (FAO, 2018). Inland fisheries serve as vital livelihood "safety nets" (Funge-Smith et al., 2019) by contributing to a diverse set of livelihood strategies for fishers and fish workers throughout food systems and other uses (Arthur et al., 2022; Bavinck et al., 2023). Inland fisheries also provide recreational opportunities for more than 220 million recreational fishers (Arlinghaus et al., 2019) and the ornamental fish trade (90 % of which is freshwater) fuels a hobby industry worth between US$15 and 30 billion each year (Evers et al., 2019).

A persistent lack of recognition of the value and significance of inland fish and fisheries has historically hindered their inclusion in global policy arenas due to unsubstantiated assertions including: (1) they are predominantly domestic issues (i.e., not of transboundary concern), (2) there are suitable alternatives for fish production (e.g., aquaculture), (3) impacts can be easily mitigated (e.g., via stocking, or the preservation or restoration of migratory fish by installing fish passages), or (4) inland fisheries will, in any case, decline in relevance and importance in the face of increasing populations (Ainsworth and Cowx, 2018; Silva et al., 2018; Friend et al., 2009). These arguments do not consider the value of inland fisheries beyond production (e.g., recreation and leisure, Arlinghaus et al., 2019; livelihoods and food systems, Arthur et al., 2011) and they fail to consider the environmental and social costs for alternative food systems, lack of nutritional substitutability between wild fish and farmed fish, operation expenses for aquaculture facilities, unintended consequences of disease or invasive species, or changes in cultural practices (Arthur, 2024; Ainsworth and Cowx, 2018). Opportunities to correct these erroneous assertions are limited because those in international fora and conventions often have no specialized knowledge of inland fish and fisheries. Critically, there are also social justice implications as the fishers and those most affected by the decisions are often excluded from these processes (Arthur and Friend, 2022).

Multilateral environmental agreements (MEAs), global conventions and protocols between multiple countries with a focus on a range of environmental topics, provide an underutilized opportunity to address these multi-sectoral power dynamics, governance fragmentation, and resource and capacity constraints for inland fish and fisheries (Claudet et al., 2024; Coates et al., 2023). MEAs are legal instruments that aim to promote international cooperation and actions to address global environmental challenges such as sustainable development, improving

[1] "Freshwater" and "inland" are often used synonymously. However, "inland" is a broader term that also includes landlocked saline waters. "Inland" is the preferred terminology of the Food and Agriculture Organization of the United Nations. Here, we use "inland" as possible but use "freshwater" when a source specifies this term. The nuances between these terms can contribute to challenges for cross-MEA integration.

[2] "Fisheries" often includes "aquaculture" and sometimes organisms other than fish but our focus, here, is on wild capture fish-based fisheries.

biodiversity status, and reducing species extinction rates (Delreux, 2018; Steiner et al., 2003). These international agreements can inform national environmental and biodiversity planning as well as international development aid. More directly linking sustainable inland fisheries and fishing cultures of Indigenous Peoples and local communities (IPLCs) to environmental and development goals through 'wise use' or customary sustainable use narratives may serve as an entry point for enhancing conservation and fisheries outcomes as rights of IPLCs are often recognized in MEAs (e.g., Arthur and Friend, 2011).

Our perspective seeks to highlight opportunities to better integrate inland fish and fisheries into MEAs and recognize synergies among them for meeting conservation, sustainability, and development goals. Here, we focus on the following global conventions, often collectively considered MEAs, presented in order of anticipated potential: the Convention on Biological Diversity (CBD), Convention on Wetlands (commonly known as the Ramsar Convention), Convention on Migratory Species (CMS), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and, World Heritage Convention (WHC). Delivery on their mandates may collectively benefit inland fish and fisheries by enhancing their relevance and visibility on a global scale, while contributing to other targets within their respective mandates (Table 1). The International Union for Conservation of Nature (IUCN) played a fundamental role in developing many of these MEAs and, consequently, these MEAs have a strong biodiversity conservation component, but all also acknowledge the importance of sustainable use. For each MEA, we: (1) introduce the convention; (2) identify specific mechanisms available for elevating inland fish and fisheries and current limitations; and (3) provide a case study of real-world application (Fig. 1; Appendix 1). We identify possible ways for inland fisheries professionals, as well as Parties to these MEAs, to increase the impact of these mechanisms for inland fish conservation as well as sustainable inland fisheries management.

2. Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD), or Biodiversity Convention, is a multilateral treaty involving the governments of the United Nations (UN) Member States (196 Parties) that provides a framework for sustainable use and protection of natural resources. CBD, originally enacted in 1993, has three main goals: "the conservation of biological diversity; the sustainable use of its components; and the fair and equitable sharing of benefits arising from genetic resources" (CBD, 1993).

The Kunming-Montreal Global Biodiversity Framework (GBF) was adopted by Parties to CBD in 2022, expanding on the 2011–2020 Strategic Plan and the Aichi Targets. The 2050 vision of the GBF is a world living in harmony with nature where biodiversity is valued, conserved, and restored, and ecosystem services sustain a healthy world and provide benefits for all people (GBF 2050 Vision and 2030 Mission). More practically, the GBF also outlines implementation objectives through 23 action-oriented global targets to be achieved by 2030. These are grouped in three main themes: (i) reducing threats to biodiversity (Targets 1–8); (ii) meeting people's needs through sustainable use and benefit-sharing (Targets 9–13); and (iii) tools and solutions for implementation and mainstreaming biodiversity (Targets 14–23) (GBF 2030 Targets).

While the GBF does not explicitly address inland fisheries, fisheries are mentioned in Target 10 and are relevant to many other targets. Specifically for Target 5, the proposed monitoring framework does include a complementary indicator explicitly for inland fisheries: "*Sustainable watershed and inland fisheries index*" (IUCN Fisheries Expert Group, 2023). The inclusion of the indicator was a major win for inland fisheries; however, it is still insufficient for recognizing the full range of inland fisheries value chains and the more widespread values of inland fish for achieving other targets (Lynch et al., 2016).

2.1. CBD opportunities for inland fish and fisheries

Programmatic management of GBF could prioritize an inland focus (analogous to existing marine, coastal, and island work areas) to provide a mechanism to help CBD improve inclusivity of inland fish and fisheries. With such programmatic support, there is an opportunity to inform National Biodiversity Strategies and Action Plans (NBSAPs), as well as to define component and complementary indicators that are more locally usable. Countries could explicitly include targets and indicators for inland fish and fisheries in their policy actions and identify them as priorities within NBSAPs. One such effort is the inclusion of inland species by India's Biodiversity Management Committees formed at the local level to identify, compile, and prepare People's Biodiversity Registers for monitoring local biodiversity made possible by the Biological Diversity Act of 2002 of India under the guidance of CBD (http://nbaindia.org/blog/580/57/UnderstandingPeople.html).

Countries could also potentially call for greater attention to biodiversity mainstreaming as part of proposed work for inland fisheries, in the Food and Agriculture Organization of the UN (FAO) Committee on Fisheries (COFI) and its Blue Transformation Roadmap 2022–2030 decision-making process to direct the agency's program of work. This could increase the focus on inland fisheries within efforts to harmonize international commitments during the next round of UN goal development, while simplifying the implementation and monitoring by Member States. There may also be opportunities to use assessments of sociocultural, economic, and environmental measures of inland fish and fisheries to better monitor multiple GBF targets at national and global scales, as well as monitor broader components of freshwater ecosystems, such as health and water quality. For example, the complementary indicator for inland fisheries developed by FAO and the U.S. Geological Survey (USGS) could help assess inland fish biodiversity and production, as well as the health of freshwater ecosystems, addressing goals and targets across multiple MEAs.

Greater recognition of inland fish and fisheries could be achieved through additional indicator development and greater national implementation of inland ecosystem-focused actions contributing towards achieving targets. For example, while GBF Targets 2 and 3 for restoration and protection of aquatic systems, respectively, do not explicitly mention inland fisheries, they present opportunities to protect and restore inland aquatic ecosystems. Proxies for aquatic restoration, including fish populations, could provide valuable insights for assessing improvements, making them a useful indicator for Target 2. Likewise, inland community fisheries reserves have been identified as potential Other Effective Area-based Conservation Measures (OECMs; FAO, 2024a; Moberg et al., 2024) that can contribute towards achieving GBF Target 3. Likewise, actions addressing other targets offer opportunities to deliver on inland fishery needs.

3. Convention on Wetlands (Ramsar Convention)

The Convention on Wetlands (Ramsar Convention), first ratified in 1971, is a global treaty aimed at promoting the conservation and sustainable utilization of inland and coastal wetlands, whether natural or human made. Wetlands designated under the Convention are known as Ramsar Sites. Fishing is generally allowed if it is conducted in an ecologically sustainable manner that does not impact the wetlands but, Ramsar Sites may be "no-take" zones where fishing and other extractive practices are prohibited.

As outlined in its strategic plan for 2016–2024 (Ramsar Strategic Plan 2016–2024: Resolution XII.2), the Convention on Wetlands focuses on three main pillars: (i) wise use of all wetlands; (ii) designation and management of Wetlands of International Importance (also known as Ramsar Sites); and (iii) international cooperation. Through these pillars, the Convention on Wetlands aims to fulfill its mission of conserving wetlands, promoting their sustainable utilization, and ensuring their recognition and value for present and future generations

Table 1
Key multilateral environmental agreements with substantial opportunities for integrating inland fish and fisheries.

Multilateral Environmental Agreements	Agreement description	Potential areas of interaction for inland fish and fisheries	Key actors	Key instruments	Potential action
Convention on Biological Diversity (**CBD**, enacted in 1993)	CBD is designed to (1) conserve biodiversity, (2) sustainably use biodiversity, and (3) share benefits, fairly and equitably, from genetic resources.	Kunming-Montreal Global Biodiversity Framework (GBF) Target 4, 5, 9, and 10 and possibly 2, 3, and 12: Complementary indicator: Sustainable watershed and inland fisheries index; many other tools and solutions are also applicable.	National Governments of CBD Parties (196); the Ad Hoc Technical Expert Group on Indicators (AHTEG); CBD secretariat; Indigenous Peoples and local communities; private sector.	GBF: 23 Targets to be achieved by 2030.	Strengthen the inclusion of inland fisheries in the indicators across targets. Look for areas of synergy where the inland fisheries threat index can also be adopted to monitor progress against other targets. Recommend replacement of impractical indicators. Look for efficiencies to apply indicators (i.e., streamline and reduce). Identify overlap across GBF targets and among other MEAs: Convention on Wetlands, CITES.
Convention on Wetlands (also known as the **Ramsar** Convention), ratified in 1971)	The Convention on Wetlands promotes the conservation of wetlands worldwide through sustainable practices, designation of key sites, and international collaboration on shared wetland ecosystems and species.	Two of the nine Convention on Wetlands criteria (7 and 8) are specifically about fish–focusing on indigenous subspecies, species, and families and their ecology (criterion 7); and the importance of the site for food, spawning, migration etc for the fish species present (criterion 8)	The Convention comprises the contracting parties (172 countries), Convention on Wetlands secretariat, scientific and technical review panel (STRP), and a Standing Committee which was formed by representatives from the member countries. The Convention works closely with a group of International Organization Partners (IOPs), which are: Birdlife International, the International Union for Conservation of Nature (IUCN), Wetlands International, the World Wildlife Fund (WWF), the International Water Management Institute (IWMI) and the Wildfowl & Wetlands Trust (WWT).	The Convention on Wetlands's "wise use" of wetlands handbooks: Wise use of wetlands: Concepts and approaches for the wise use of wetlands; Convention on Wetlands. (2021); Global Wetland Outlook: Special Edition 2021.	Of the 2051 inland Ramsar Sites, 454 include criterion 7 (22 %) and 588 include criterion 8 (29 %), the two fish specific Ramsar site criteria. This is possibly a result of the Convention on Wetlands's original bird focus. Collaboration with relevant bird groups should occur to learn from their experiences and enhance action plans for the inclusion of inland fisheries. Further, engaging the Convention on Wetlands through key international partners and bodies will be essential for the integration of inland fisheries. It will be useful to overlay maps of fish biodiversity and identify wetlands of fish importance for the creation of an easily digestible communication tool.
Convention on Migratory Species (**CMS**, ratified in 1979)	CMS is the only MEA specially designed to protect migratory species. CMS focuses mainly on species which cross national boundaries on a regular and predictable basis.	Only four non-sturgeon freshwater fish species are currently listed under CMS (European eel, Mekong giant catfish, and two Amazon catfish). A review of the status of migratory freshwater fish was produced in 2011; there was a request at the Conference Of Parties (COP) 14 (held in 2024) for an updated review of the status of migratory freshwater fish.	CMS parties (133 + signed countries), CMS Secretariat, CMS Scientific Council, NGOs	CMS Cop15 will be the next opportunity to make significant progress on foregrounding freshwater fish in CMS. CMS and CITES have tried to coordinate in the past but these efforts have not to date resulted in much. The Secretariats of the Convention on Wetlands, CBD, CITES, and CMS all indicated at CMS COP14 that they wanted to work more closely together.	Create a comprehensive list of freshwater fish species that would qualify for listing under CMS, emphasizing those that exhibit transboundary movements. Present also a map of main transboundary waterbodies overlaid with countries party to CMS. Review all CMS documents where language for "inland/freshwater" fish could be added.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (**CITES**, entered into force 1975)	CITES is an international agreement among governments established in 1963 to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species.	~27 freshwater fish taxa are currently listed under CITES (including sturgeon, European eel, Mekong giant catfish)	CITES Member Parties (184 signed countries), CITES Secretariat	Member Parties can continuously propose additions to taxa listings in CITES appendices by gaining two-thirds majority support from member countries, demonstrating significant conservation concern for the species of interest (e.g., listing the species nationally as endangered or threatened), and	Create a comprehensive list of inland fish species that would qualify for listing under CITES. Compare potential CITES species of concern listings to other MEA potential listings (e.g., CMS) to generate multi-agreement priorities. For CITES documents available for review, note where language for "inland/

(*continued on next page*)

Table 1 (*continued*)

Multilateral Environmental Agreements	Agreement description	Potential areas of interaction for inland fish and fisheries	Key actors	Key instruments	Potential action
				demonstrating the species of concern contributes to international trade.	freshwater" fish could be added.
Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention, **WHC**, ratified in 1975)	WHC was adopted by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1972 as an instrument to protect cultural and natural heritage.	Any inland fish and fisheries present in World Heritage Sites.	WHC Member parties (196 signed countries), UNESCO, International Union for Conservation of Nature (IUCN), World Heritage Committee	Member parties can identify, nominate, and protect cultural and natural sites within their borders that can conserve inland fishes and preserve traditional inland fisheries practices and associated cultural heritage.	Expand the representation of freshwater ecosystems on the World Heritage List. Prioritize inland fish and fisheries within existing World Heritage Sites through increased capacity for monitoring and enforcement of sustainable practices.

Fig. 1. Examples of the role of inland fish and fisheries in featured multilateral environmental agreements shown by major watersheds (Level 3 hydroBASINS; Lehner and Grill, 2013). Photo credits (clockwise from top left): N. Guerrera, I. Cowx, O. August, T. Agbaje, K. Winemiller.

(Ramsar Convention Secretariat, 2016). As of 2025, the Convention on Wetlands has over 170 contracting Parties (countries). The Conference of Contracting Parties (COP) is the main decision-making body, meeting every three years to review progress, share knowledge, and make decisions on new and existing sites.

As indicated, wetlands designated under the convention are recognized for their international importance, particularly regarding waterfowl habitat. The bird focus makes it challenging to effectively integrate

fish conservation and management into local Convention on Wetlands management plans. Considering that the Convention on Wetlands permits the sustainable use of resources within designated sites, including fisheries, additional inland sites could meet the criteria for designation based on their importance for fish. However, the lack of relevant information about fish populations and their ecological significance in many countries likely hinders such designation.

3.1. Convention on Wetlands opportunities for inland fish and fisheries

Only two of the nine criteria outlined for the designation of Ramsar Sites (i.e., Criteria 7 and 8) directly pertain to fish. These two criteria focus on the significance of wetlands for indigenous fish species and their ecological importance for fish populations, respectively. Several other criteria (e.g., Criteria 2, 3, 4, and 9) are relevant for fish conservation goals because of their inclusion of multiple types of organisms including fish. Of the 2051 Ramsar Sites that are classified as inland waters, several include the two fish-based criteria (i.e., Criteria 7 and 8) as part of their justification. Of these, 454 sites (22 %) include Criterion 7 and 588 (29 %) include Criterion 8, but these are rarely of primary importance. Nevertheless, these data do indicate that fishes are considered as part of the justification of several sites, and highlight that conservation of fishes and proper management of fisheries are integral to Ramar's philosophy of "wise use" of wetlands. This is defined as "the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development" (Ramsar, 1996).

Further integrating the inclusion of inland fish and fisheries in Ramsar Sites may benefit from collaboration with agencies and non-governmental organizations (NGOs) associated with bird conservation, that can offer valuable insights and lessons learned, facilitating the incorporation of fish conservation efforts. A more strategic approach may involve prioritizing the protection of pristine or human-modified environments that represent key habitats for fish of various life stages, harbor significant fish biodiversity, and support inland fisheries. Collaborating with local communities and fisheries departments to safeguard these habitats could help sustain fish resources.

4. Convention on the Conservation of Migratory Species of Wild Animals (CMS)

The Convention on the Conservation of Migratory Species of Wild Animals (CMS) is the only MEA focused specifically on the protection and management of migratory animals, providing "a global platform for the conservation and sustainable use of migratory animals and their habitats" (CMS, 1979). First adopted in 1979, over 130 countries are now CMS Parties; voluntary membership is concentrated in Europe, Africa, and South America with gaps in North America and Asia (Hensz and Soberón, 2018). Migratory species, for the purposes of CMS are defined as *animals that make cyclical and predictable movements across international boundaries*, can be listed on CMS Appendix I and/or CMS Appendix II (Hensz and Soberón, 2018). *Appendix I* is reserved for endangered animals at risk of extinction. CMS Parties agree to strictly protect such species including actions to reduce take, protect critical habitats, and remove migration barriers. CMS Parties are encouraged to develop "concerted actions" to protect Appendix I listed species. *Appendix II* is designated for migratory species of unfavorable conservation status that would benefit from international cooperation for their management. CMS Parties are encouraged to develop cooperative actions for the management and conservation of Appendix II species.

CMS (and listing on the CMS Appendices) often serves as the framework for the development of additional CMS instruments including: 1) binding or non-binding Agreements, 2) Memoranda of Understandings (MoUs), and 3) Special Species Initiatives, targeting specific taxonomic groups and regions (CMS, 2024a). For example, the Agreement on the Conservation of Albatrosses and Petrels, the MoU on the Conservation of Migratory Sharks, the African Carnivores Initiative, and Concerted Action for the Ganges River Dolphin are instruments that have been created under the CMS framework (CMS, 2024a) to prioritize and focus conservation actions aligned with specific taxonomic groups.

CMS connections to inland fish (generally classified as "freshwater" in CMS lexicon) have historically been limited to sturgeons (*Acipenseridae*), European eel *Anguilla anguilla*, the Mekong giant catfish *Pangasianodon gigas*, and most recently two species of Amazon catfishes *Brachyplatystoma vaillantii* and *B. rousseauxii* (CMS, 2024b). However, inland fish remain underrepresented on the CMS appendices and examples where action that has been taken to improve management or protection of inland fishes through CMS are rare (e.g., European Union (EU) eel regulations are independent of CMS). Therefore, the scope of these appendices to strengthen the concept of the conservation value of migratory species in general has been very limited.

4.1. CMS opportunities for inland fish

As many inland fish species are now likely to meet the criteria to be included in CMS Appendices, listing inland fish is increasingly viewed as a mechanism that could be used for strategic conservation and management measures. For instance, at the February 2024 CMS Conference of the Parties, the need to protect migratory inland fish was highlighted, aiming to mitigate threats like habitat degradation and overexploitation (UNEP-WCMC, 2024). The Parties tasked the CMS Scientific Council to develop a review of inland fish species for potential listing on the CMS Appendices (Sayer et al., 2024). CMS Parties, NGOs, and the CMS Secretariat were encouraged to work together to compile and share data, reduce threats, and improve conservation of inland fish. Additionally, CMS working groups were urged to integrate inland fisheries concerns into their agendas, highlighting the importance of addressing issues like illegal fishing and habitat conservation.

Building from the Living Planet Index for migratory freshwater fishes (Deinet et al., 2024), the FAO Aquatic Sciences and Fisheries Information System (FAO, 2024b), and similar databases for other taxa, a comprehensive database of inland fish species meeting CMS listing criteria could help identify additional inland fish species for listing on the CMS Appendices, particularly those impacted by fishing or migration interference. Inclusion in CMS Appendices I and II highlights the urgency of safeguarding these species and could promote action for protection. Likewise, the establishment of communication campaigns around "flagship" CMS-listed inland fish species, such as the large migratory golden mahseer *Tor putitora* and Alwan snowtrout *Schizothorax richardsonii* in the Indian Himalayas and Hilsa *Tenualosa ilisha and* Jullien's golden carp *Probarbus jullieni* in Southeast Asia, could also boost momentum for management. The Swimways concept (Worthington et al., 2022) can be used to upscale these efforts such has been done in the Mekong River (Cowx et al., 2025).

5. Convention on International Trade of Endangered Species of Wild Flora and Fauna (CITES)

The Convention on International Trade of Endangered Species of Wild Flora and Fauna (CITES) is an international agreement among governments established to ensure international trade in specimens of wild animals and plants does not threaten the survival of the species (World Wildlife Trade Report, 2022). CITES came into force in 1975 to address the growing threat of unsustainable exploitation of wild species driven by international demand and increasing market accessibility. International wildlife trade is worth billions annually (Mozer and Prost, 2023) and the convention covers live specimens and derived products (e.g., food, souvenirs, medicine). Currently, 184 countries are Parties to CITES and they benefit from the government-to-government certification process (e.g., pre-convention, bred in captivity, scientific exchange) and intelligence sharing on wildlife trade. Of the MEAs considered here, CITES is the only one with potential for binding provisions, including the

potential for trade implications and monetary consequences for non-compliance.

CITES has contributed to curbing international trade driving exploitation of species, including marine fishes (Vincent et al., 2022, 2014). Of the 259 fish species listed in the three CITES appendices (https://cites.org/eng/disc/species.php), only 39 are inland fish (CITES Secretariat, 2024). Overall, inland fish are among one of the major groups with the highest number of species likely to be threatened by international trade and not currently listed in CITES (i.e., cichlids and carps; Challender et al., 2023).

Despite CITES past successes with addressing international trade threats to species, including inland fishes, several considerations are worth noting. First, the Convention's deliberate scope of international trade limits the ability to directly impact exploitation driven by local and subnational market demand. Most inland fish are traded locally (Welcomme et al., 2010). Second, the requirements for species listing onto the convention's appendices necessitates a certain level of data and science, which can exceed the capacity of many low- and middle-income countries, making it difficult to achieve for many data-limited species (Smith et al., 2011). Moreover, the bureaucracy needed for agreement among Parties introduces an additional layer of politics. Other criticisms consider the actual effectiveness of CITES in dealing with illegal trade (Bennett, 2011; Challender et al., 2015) and potential for illegal activity if legal exports are too cumbersome. Indeed, coordination between CITES and other MEAs and international organizations, including FAO and World Trade Organization, to coherently address the entire value chain beyond international trade remains a challenge.

5.1. CITES opportunities for inland fish and fisheries

CITES is potentially relevant for any inland fishes involved in international trade of fish products. Inland fish may be traded for ornamental purposes (pets), medicinal use, and/or food (wild-capture or aquaculture) reasons. CITES has improved monitoring and control of caviar trade in support of conservation of 25 sturgeon and two paddlefish species (Raymakers, 2006, 2002). As with these listed species, CITES is most relevant for trade control of charismatic, internationally traded fishes with high economic value, which have the necessary monitoring and science to justify its listing (e.g., Russian sturgeon *Acipenser gueldenstaedtii* and Asian arowana *Scleropages formosus*). Another group of species that are often uncontroversial CITES listings are culturally-important species of low economic value where there is little or no interest in opposing listing on the appendices (e.g. cui-ui *Chasmistes cujus*). For species of high interest in international trade, securing the necessary two-thirds support by Member States to apply CITES may prove difficult (Cooney et al., 2021). Even still, listing is just the first step and may have only a tenuous link to conservation outcomes (Cooney et al., 2021).

CITES's past successes addressing unsustainable trade of endangered species, including inland fish species, makes it a promising opportunity, but limitations, like data availability and bureaucracy, may need to be considered. The call for burden-of-proof poses substantial challenges in establishing sound evidence-based and effective management even for well-studied, charismatic species (e.g., *Arapaima* spp. in Brazil; Castello and Stewart, 2010). Even when trade is blocked by negative non-detriment findings, illegal trade may still continue in practice (Friedman et al., 2020). Another issue is the accuracy of reporting by countries due to lack of standardized terminology (Musing et al., 2023). Promisingly, increasing data availability through large-scale syntheses (e.g., Ainsworth et al., 2023; Embke et al., 2022; Fluet-Chouinard et al., 2018) presents opportunities to overcome these barriers and expand the potential for inland fisheries incorporation into CITES.

6. World Heritage Convention (WHC)

The Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention, WHC) represents an instrument to protect cultural and natural heritage. For inland fisheries, an important aspect is the ability to recognize the relationships and interdependencies between environmental, social, and cultural aspects that are associated with fisheries within landscapes or watersheds. The WHC protection of cultural and natural heritage can maintain and restore environments and secure and support the livelihoods and wellbeing of those dependent upon these environments and landscapes. The WHC has a high potential to galvanize more action for inland fish because, based on data from 2023, (1) World Heritage Sites already protect 40 % of assessed freshwater fish species and 23 % of threatened freshwater fish species (UNESCO, 2023), (2) the "World Heritage brand" elevates local issues of concern to international conservation priorities, and (3) it is the only active UN oversight mechanism for protected areas with global coverage.

The WHC has a unique monitoring mechanism under which countries have to regularly demonstrate (including through scientific information) that fishing (and other activities) does not jeopardize a site's World Heritage values. Countries may be requested to undertake specific action, and the WHC also provides the platform for international collaboration. Management plans for World Heritage Sites provide a mechanism for including fisheries management measures, preserving traditional fishing practices, or even advancing an ecosystem approach (Appendix 2). This can be through introducing fisheries co-management measures (e.g., in Lake Malawi National Park), or recreational fishing quotas (e.g., in Everglades National Park). World Heritage Sites where the importance of fishing (including traditional or recreational) is recognized as a value and not only considered as a threat or management issue can help ensure those fishing activities are conserved (e.g., East Rennell, Saloum Delta, Pimachiowin Aki). Other conventions such as the Convention for the Safeguarding of the Intangible Cultural Heritage can also provide a more formal recognition of traditional cultural and management practices (e.g., collective fishing tradition of Sanké mon in Mali or recipe for Tomyum Kung in Thailand).

Where they are recognized and supported, traditional knowledge and practices can provide an important basis for supporting positive relationships and responsible management. The WHC has been identified as an instrument that can provide opportunities for such engagement and a number of the World Heritage Sites including the Okavango Delta (Botswana), the Pantanal (Brazil), the Rift Valley lakes (Kenya), and Lake Malawi (Malawi) are locations with important inland fisheries (Coates et al., 2023). Because of its high visibility and "brand," the WHC also provides the platform for mobilizing action and resources to address specific issues, akin to the decade-long restoration of Angkor Wat or restoration of Timbuktu's mausoleums. Similar initiatives could be set up such as expeditions to map inland fish species in World Heritage Sites, support to replace fishing gear with a more sustainable alternative (as was done in Gulf of California for vaquita *Phocoena sinus* and in Lake Malawi where mosquito nets were used to fish), or even certify and promote local, sustainable fisheries from World Heritage Sites.

6.1. WHC opportunities for inland fish and fisheries

One fifth of all species are found in World Heritage Sites, creating an opportunity for conservation and sustainable management (UNESCO, 2023). The World Heritage List already recognizes iconic inland ecosystems such as lakes (Lake Ohrid, Lake Baikal, Lakes of Ounianga), wetlands (Sundarbans, The Ahwar of Southern Iraq, Donana National Park), freshwater dune lakes (K'gari, previously Fraser Island), complete watersheds or river catchments (Kakadu National Park, Lorentz National Park, Puerto Princesa Subterranean River National Park), or inland fish (Central Amazon Conservation Complex). Traditional knowledge and practices can provide an important basis for supporting positive relationships and responsible management.

The biggest challenge for better integrating inland fish and fisheries in the WHC is that freshwater ecosystems are currently

underrepresented on the World Heritage List. Inland ecosystems can be further elevated as priorities for future World Heritage Sites, where inland fish and fisheries can be recognized both in terms of sustainable use, biodiversity, and cultural importance. Concurrently, more support could increase capacity for monitoring inland fish ecosystems, as well as training World Heritage site managers, identifying standards and guidelines for fishing activities inside World Heritage Sites (currently absent even for marine fisheries), and highlighting case studies to better communicate how and why traditional fishing practices, including by Indigenous Peoples, are sustainable.

7. Synergies across MEAs

It is important to note that there are numerous other MEAs (e.g., UN Convention to Combat Desertification's goal of land degradation neutrality, UN Framework Convention on Climate Change and associated Paris Agreement, UNEP's Minamata Convention on mercury) that could potentially be relevant for inland fisheries (see Coates et al., 2023) but with less direct applicability than these five conventions. Formal and informal coordination among MEAs could potentially amplify inland fish and fisheries issues in multiple fora. Parties have already called for greater attention to inland fisheries as part of the COFI program of work (FAO, 2017). As COFI provides global recommendations and policy advice to governments, regional fishery bodies, and actors from the international community, civil society, and private sector, better representation of inland fisheries at COFI could facilitate harmonization of recommendations made across MEAs.

Joint work plans, such as the Joint Work Plan between the Convention on Wetlands and CBD, can provide a formal mechanism and spell out collective responsibility for integrating inland fish and fisheries across multipe MEAs. Through that relationship, the Convention on Wetlands is recognized as the lead for implementation of wetland activities under CBD. Aligned with it, the Convention on Wetlands completed a detailed comparison of the synergies between each of the targets of the GBF and the 2016–2024 Ramsar Strategic Goals and an analysis of how the goals and targets for Ramsar's Strategic Plan relate to the UN Sustainable Development Goals (SDGs) and targets (Ramsar, 2022, Annex 2 and 3, respectively).

As limited resources are available to dedicate to any one MEA, identifying these overlaps between targets can simplify tracking and reporting. If Parties can use a handful of measures that work across multiple global instruments, they can make progress towards multiple targets at once (e.g., fisheries, ecosystem health, water quality, target species status, sustainable use, biodiversity conservation). For instance, the Convention on Wetlands recognizes the importance of the complementary inland fisheries GBF indicator for its Targets 9 and 10 (Simpson et al., 2024). GBF Target 10 needs a bounded site, which the Convention on Wetlands provides. Investments could be linked between ecosystem restoration (GBF Target 2) and protection (GBF Target 3) with actions on species in Ramsar Sites. These GBF targets and the Convention on Wetlands could also be linked with CMS through actions to conserve migratory species. These collaborative approaches hold promise for promoting the conservation and sustainable management of fish populations within Ramsar Sites and broader aquatic ecosystems.

There is also potential to capitalize on synergies between the (albeit limited) species lists of CITES and CMS. Both MEAs operate at the species-level, wherein Member Parties could propose additional species to be protected under the MEAs (Appendix 3). Coordination between CITES and CMS for inland fishes may be especially beneficial for species that are endangered, traded internationally, and migratory, leading to multiple layers of protection. For example, European eel is listed on both CITES and CMS (Appendix 3) but EU eel regulations currently go beyond the requirements of both conventions to strengthen policy.

Beyond formal mechanisms, opportunities exist across common objectives. For example, the Joint Work Plan of CBD and the Convention on Wetlands for 2024–2030 underscores several areas of shared interest and collaboration, including "develop and implement NBSAPs and National Wetland Policies in a consistent and mutually supportive way, and integrate them into relevant national plans" and ensuring "wetland targets, policies and actions are incorporated into updated NBSAPs aligned with the … GBF." In the 'Submission to the Ad Hoc Technical Expert Group on Indicators (AHTEG) by the Convention on Wetlands,' the Convention on Wetlands supports the use of GBF Target 5 complementary indicator for inland fisheries. Likewise, the 'wise use' pillar of the Convention on Wetlands relates to fisheries (not just fish) and may serve to elevate the needs of Indigenous Peoples and local community fishers (e.g., Arthur and Friend, 2011). There are also examples of ongoing collaborations between WHC, CBD, and the Convention on Wetlands (e.g., Lake Malawi National Park, Malawi; Rice-fish-duck ecosystem in Congjiang County, Guizhou Province, China) that support inland fish, fisheries, and freshwater environments at these cultural and natural heritage sites. There are also potential opportunities with other international designations such as expanding FAO "Globally Important Agricultural Heritage Systems" to recognize "Inland Fisheries Heritage Systems."

8. Opportunities for actions to protect and conserve inland fish and fisheries

While scientific processes tend to be linear, governance is often nonlinear so it can be difficult to find avenues to plug science into to those processes (e.g., Chakalall et al., 1998). Integrating inland fisheries requires aligning work programs, enforcement of regulations and policies, and investment to meet the needs and demands of inland fisheries and fish conservation. Below, we discuss opportunities to coordinate across MEAs to streamline and improve efficiency of funding, capacity, and strategic, holistic management for inland fish and fisheries.

Existing global and regional resolutions and mechanisms could be better utilized to amplify inland fish and fisheries messaging through the aims of MEAs. For example, groups like IUCN, environmental NGOs, and the EU often have comprehensive agendas that are designed to bolster MEA commitments. The IUCN 2020 World Conservation Congress adopted Resolution WCC-2020-Res-018 *Valuing and protecting inland fisheries,* which calls for better inclusion of inland fisheries in the SDGs and GBF, using an ecosystem approach to managing inland fisheries, improved assessment and monitoring of inland fisheries and implementation of the 10 Steps to Responsible Fisheries that emerged from the 2015 Global Conference on Inland Fisheries (Taylor and Bartley, 2016). Resolution 018 also called for IUCN to strengthen its focus on sustainable inland fisheries as part of its programs on species, water, and ecosystem management. A high priority for the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is engagement with MEAs. MEAs could use IPBES calls for input to request topics related to a global assessment of inland fish and fisheries to both increase visibility and encourage inclusion of inland fish and fisheries at the global-scale.

Fisheries programs could be more inclusive and aligned with inland issues. For example, the focus of SDG 14 (Life Below Water) is specifically marine but almost all targets could translate to inland waters (Elliott et al., 2022). While it may not be possible to amend the Sustainable Development Goals (SDGs) at this point, there are other avenues where the purview of marine programs could be expanded. Another IUCN Resolution, for example, Resolution 107 *Reducing the impact of fisheries on marine biodiversity*, calls for a new IUCN Intercommissional Task Force on Fisheries and Conservation to be formed. This Task Force will be led by IUCN's Commission on Ecosystem Management, with the engagement of the Fisheries Expert Group. While Resolution 107 has a marine focus, its call for an Intercommissional Task Force on Fisheries and Conservation provides an important opportunity to link with a recommendation from Resolution 018 that the Fisheries Expert Group "address equally both inland and marine fisheries." By including inland fisheries considerations as part of the Task Force's objectives, it could also address the other objectives of Resolution 018 to

strengthen the focus on sustainable inland fisheries within IUCN's work and global policy.

Habitat restoration initiatives have the potential for transformative impact on both inland fisheries and inland fish conservation. Indeed, the UN Decade for Ecosystem Restoration - while technically not a MEA - shares some elements including awareness raising, coordinating global efforts, and enabling community-level activities. Similarly, the Freshwater Challenge, a multi-stakeholder partnership launched in 2023 to integrate freshwater restoration in national action programs, relevant policies and planning frameworks, has elevated challenges related to inland fisheries even further. It is the largest river and wetland restoration initiative in history. As of 2025, supported by 50 countries and the EU, the Freshwater Challenge aims to leverage the support needed to restore 300,000 km of rivers and 350 million hectares of wetlands by 2030. These targets correspond to the total extent of degraded rivers which meet (and exceed) the extent of restoration in GBF Target 2 (i.e., 30 ×30; GEO BON and FWBON, 2022). By restoring and conserving freshwater ecosystems, the Freshwater Challenge addresses MEA targets focused on sustainable use and benefit-sharing, including those related to inland fisheries and the ecosystems that support those fisheries (Lynch et al., 2020). In particular, it addresses GBF Target 10 which includes sustainable fisheries and Target 11 that addresses aquatic ecosystem functions. The Freshwater Challenge has been closely tied to the UNFCCC and the role of freshwater in addressing the climate crisis (https://www.freshwaterchallenge.org/news) as well as relevant to the EU Nature Restoration Law, the Convention on Wetlands, and the SDGs.

Aligned objectives between inland fisheries and other interests could help amplify broader public messaging and support. Groups traditionally focused on conservation or use of freshwater biodiversity are realizing the value of working together to increase stakeholder involvement and political support (Phang et al., 2019). Similarly, groups focused on marine or freshwater fisheries are realizing the connectedness of ecosystems and the common issues associated with sustainable use of aquatic resources (Cooke et al., 2014). Perhaps most influential but perhaps most difficult to undertake, making allies of water infrastructure developers (e.g., dams, dikes, weirs, irrigation channels), agriculture, industry, and urban expansion and water providers could greatly reduce problems their activities currently pose to inland fisheries (e.g., Gregory et al., 2018). In addition, there is a need to clarify potential impacts on inland fisheries when international organizations provide financial support for development of water infrastructure, agriculture, and flood control. For example, small dams development has proliferated at a global scale (Couto and Olden, 2018) without requiring environmental impact studies and ignoring their potential to severely fragment watersheds (Couto et al., 2021). Therefore, while it is essential to strengthen relations with organizations involved in the conservation of natural resources, it is equally important to strengthen links with development sectors.

Multi-stakeholder and rightsholder action coalitions provide a real opportunity to enlarge political support for conservation and management (Taylor and Bartley, 2016). Transboundary organizations have the power to integrate management of resources, governance, water use, and conservation throughout river basins that extend across national boundaries. They are critical for promoting spaces that facilitate dialogue, action, and social participation. Particularly, in those basins where inland fisheries are dominated by migratory species, transboundary management needs to be well-developed for effective local, regional and basin scale actions (Valbo-Jørgensen et al., 2008). But, many of these basin organizations do not recognize inland fisheries as a valuable contributor to informal economies and livelihoods (Cooke et al., 2021), or inland fisheries have been subsumed within efforts to address biodiversity needs, such as proposed for the Amazon basin (OTCA, 2021). Other differences based on cultural, social, economic, and even military aspects as well as the history of fisheries management are often not taken into account for cross-border management plans, as has been seen in African fisheries where merging transboundary and community-based management can result in oversimplification of the heterogeneity of fisheries, users, and institutions (Abbott et al., 2007).

Leverage existing sustainable use and contributions to environmental stewardship framing, including as a driver of restoration initiatives, to link fisheries management and fish conservation to MEAs (Shephard et al., 2022). Inland fishers can and do manage inland fisheries through their communities (Daedlow et al., 2011), drawing on knowledge of both the environment and its dynamics, and the needs and aspirations of local communities to generate livelihoods and conservation benefits (e.g., limiting catches, catch and release, and eco-friendly approaches; Jones et al., 2024; Mustafa, 2020). Wise or sustainable use is a common feature of many of the MEA targets and offers opportunities to link local knowledge and practices to conservation objectives. At the same time, where sustainable fisheries are affected by external change (which is often the case; Cowx et al., 2010), being able to demonstrate wise use and contributions to MEA targets could strengthen local efforts to manage fisheries and aquatic environments sustainably. Indeed, enabling those involved in fishing and dependent upon well managed fisheries to be involved in decision making has provided opportunities to identify new, and possibly unanticipated, interventions based on local knowledge and to support the creative capabilities of local communities (Arthur and Friend, 2022). Greater recognition of the importance of inland fish and fisheries and how they could help Parties to MEAs meet their legally mandated obligations may serve as an additional incentive to take action.

9. Conclusion

Conserving inland fish biodiversity and supporting sustainable fisheries have the same fundamental needs, functional aquatic systems and healthy watersheds (e.g., adequate water quality and quantity, hydrological regimes, nutrients, and sediments) Targeted investment of resources and capacity to support aquatic ecosystems can help meet both human development and conservation needs (Phang et al., 2019). Local actions, while essential to these targeted investments, are often limited in scope and frequently face obstacles in addressing complex issues comprehensively (Jansujwicz et al., 2021). Therefore, conserving inland fish and fisheries also requires higher order coordination among global policies and initiatives to identify opportunities for synergies between biodiversity conservation and development goals – such as how targeted assistance can address common environmental challenges (Biermann et al., 2009; Ulph and Maddison, 1997).

If they perform as intended, the MEAs discussed here provide a potential mechanism to elevate inland fish biodiversity conservation and the fisheries built upon this biodiversity sustainability, also increasing efficiencies among global instruments. While there are many competing goals and objectives in the MEA space, inland fisheries can provide an important entry point for demonstrating how multiple goals can be met in practice. Evidence of wise use from existing sustainable fisheries and the stewardship and care demonstrated within inland fisheries indicate the vast potential that they offer for meeting multiple goals. From this perspective, they can represent a valuable entry point for efforts to work towards multiple global commitments and can provide evidence and indicators of progress towards varied MEA goals (Elliott et al., 2022; Lynch et al., 2020).

At minimum, MEAs can highlight opportunities for funding, whether national or international, to be channeled effectively. Additionally, many MEAs now make provision for shared or devolved governance to 'environmental stewards' – who are often the resource users and/or Indigenous Peoples – these provisions can explicitly support resource management efforts of fishers and the needs of inland fisheries management. While underfunding of agencies and consequent ineffective management is unlikely to be solved via prominence in MEAs, the legitimacy and representation from MEAs can bring greater attention to inland fisheries management needs (i.e., water, pollution, and

catchment management which are covered by some of the MEAs), and their potential to attain national and international goals.

Because of emphasis on local stewardship among MEAs, they can provide opportunities for more inclusive approaches that address outcomes for both environments and communities. Recognition across MEAs of rights of fishers, benefits of wise use, and social benefits of inland resources, can also provide critical entry points for communities to contribute their knowledge and perspectives to local, national, and international policy and dialogues and to monitoring changes in their fisheries and aquatic environments (Arthur and Friend, 2022). This may include co-management and other power-sharing arrangements, including different legal frameworks that allow for ecosystem-based approaches compared with conventional top-down methods (e.g., Koning et al., 2020; Loury and Ainsley, 2020). This approach can challenge exclusion and marginalization, conferring agency on previously unrecognized groups to determine the issues, priorities, and solutions needed for inclusive and equitable governance.

Securing a sustainable future for inland fish and fisheries is most likely when conservation action through MEAs recovers fish species and is less likely when conservation action limits access to inland fisheries, even when species recover. Having sustainable use of inland fish and fisheries featured in conservation agendas emphasizes how these interests can benefit from being well aligned (Phang et al., 2019). Better coordination across the global scale guidance provided by MEAs may enhance the efficiency and effectiveness of national-level implementation through mechanisms like NBSAPs. Offering approaches that improve the ease of implementation while enhancing recognition of how inland fish and fisheries could help MEA Parties meet and monitor national progress towards their global commitments may be the most effective way to secure a sustainable future for inland fish and fisheries, while meeting other international goals.

Funding

This article did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. Authors would like to acknowledge funders for support to participate in this exercise, including an international InFish network (infish.org) workshop in March 2024 held at the 9th World Fisheries Congress in Seattle, USA. These funders include: DST-SERB/EEQ/2021/000603 (VA), CGIAR Trust Fund through the Resilient Aquatic Food Systems Initiative (EHA), Great Lakes Fishery Commission (MKB), U.S. Geological Survey (TDB, HSE, AJL, BJEM, CPP), BNP-Paribas (LC, GB), and the Estonian Research Council (KK; grant PRG 1266).

CRediT authorship contribution statement

Baigun Claudio: Writing – review & editing, Writing – original draft. **Doughty Caitlin:** Writing – review & editing, Writing – original draft. **Crisafi Kimberly:** Writing – review & editing, Writing – original draft. **Dalton James:** Writing – review & editing, Writing – original draft. **Chhorn Soksan:** Writing – review & editing, Writing – original draft. **Cooperman Michael S.:** Writing – review & editing, Writing – original draft. **Chanthalounnavong Somvilay:** Writing – review & editing, Writing – original draft. **Chea Seila:** Writing – review & editing, Writing – original draft. **Brooks Jill:** Writing – review & editing, Writing – original draft. **Castello Leandro:** Writing – review & editing, Writing – original draft. **VanWynen Cassie M.:** Writing – review & editing, Writing – original draft. **Uon Sokmoly:** Writing – review & editing, Writing – original draft. **Atkore Vidyadhar:** Writing – review & editing, Writing – original draft. **Uy Sophorn:** Writing – review & editing, Writing – original draft. **Badhon Mahatub Khan:** Writing – review & editing, Writing – original draft. **Arlinghaus Robert:** Writing – review & editing, Writing – original draft. **Shrestha Roshani:** Writing – review & editing, Writing – original draft. **Arthur Robert:** Writing – review & editing, Writing – original draft. **Akwany Leonard:** Writing – review & editing, Writing – original draft. **Allison Edward H.:** Writing – review & editing, Writing – original draft. **Sievert Nicholas:** Writing – review & editing, Writing – original draft, Conceptualization. **Stokes Gretchen L.:** Writing – review & editing, Writing – original draft, Conceptualization. **Phang Sui C.:** Writing – review & editing, Writing – original draft, Conceptualization. **Rice Emma D.:** Writing – review & editing, Writing – original draft, Conceptualization. **Nguyen Kim Quyen:** Writing – review & editing, Writing – original draft. **Nguyen Vivian:** Writing – review & editing, Writing – original draft. **Muruganandam Muthiah:** Writing – review & editing, Writing – original draft. **Madden Jamie C.:** Writing – review & editing, Writing – original draft, Conceptualization. **Hogan Zeb:** Writing – review & editing, Writing – original draft, Conceptualization. **Low Jonathan G.:** Writing – review & editing, Writing – original draft, Conceptualization. **Akintola Shehu Latunji:** Writing – review & editing, Writing – original draft. **Embke Holly S.:** Writing – review & editing, Writing – original draft, Conceptualization. **Gondwe Edith:** Writing – review & editing, Writing – original draft, Conceptualization. **Quintana Yasmín:** Writing – review & editing, Writing – original draft. **Cowx Ian G.:** Writing – review & editing, Writing – original draft, Conceptualization. **Quyen Vu Dang Ha:** Writing – review & editing, Writing – original draft. **Elliott Vittoria:** Writing – review & editing, Writing – original draft, Conceptualization. **Paukert Craig P.:** Writing – review & editing, Writing – original draft. **Borba Gabriel:** Writing – review & editing, Writing – original draft, Conceptualization. **Piczak Morgan L.:** Writing – review & editing, Writing – original draft. **Cooke Steven J.:** Writing – review & editing, Writing – original draft, Conceptualization. **Nyboer Elizabeth A.:** Writing – review & editing, Writing – original draft. **Olden Julian D.:** Writing – review & editing, Writing – original draft. **Beard, Jr. T. Douglas:** Writing – review & editing, Conceptualization. **Earl Jason:** Writing – review & editing, Writing – original draft. **Emam Wasseem E.:** Writing – review & editing, Writing – original draft. **Lynch Abigail J. J.:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Conceptualization. **Bartley Devin:** Writing – review & editing, Writing – original draft, Conceptualization. **Lawrence Ted:** Writing – review & editing, Writing – original draft. **Myers Bonnie J. E.:** Writing – review & editing, Writing – original draft. **Hughes Kathy:** Writing – review & editing, Writing – original draft. **Kangur Külli:** Writing – review & editing, Writing – original draft. **Hansen Henry:** Writing – review & editing, Writing – original draft. **Harrison Ian:** Writing – review & editing, Writing – original draft. **Flitcroft Rebecca:** Writing – review & editing, Writing – original draft. **Gundermann Daria:** Writing – review & editing, Writing – original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We thank Sarah Weiskopf (USGS NCASC), multiple anonymous reviewers, and Editor Klenk for feedback on earlier drafts. We thank Robbert Casier from IUCN for support on the World Heritage sections. All authors are members of the international InFish network (infish.org). Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2025.104089.

Data availability

No data was used for the research described in the article.

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