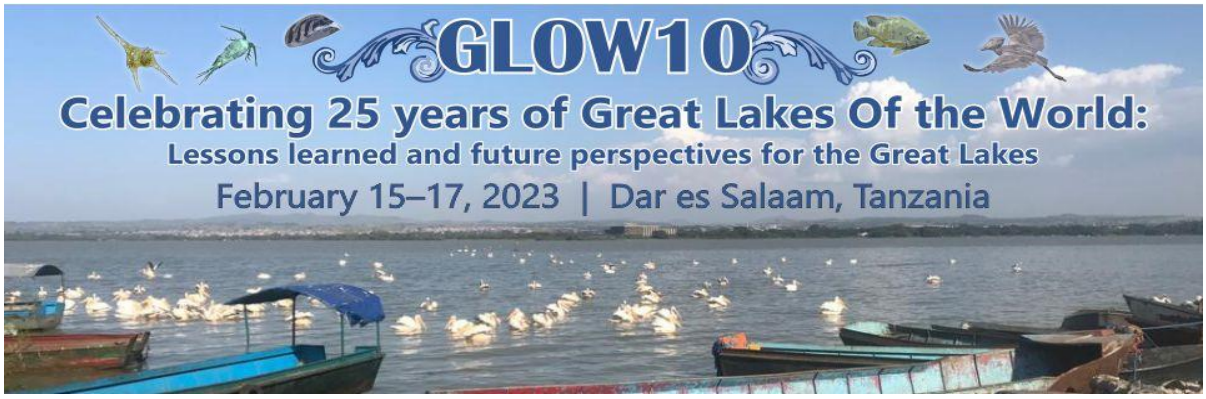

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AQUATIC ECOSYSTEM HEALTH & MANAGEMENT SOCIETY

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Welcome to GLOW10 in delightful Dar es Salaam, Tanzania!

GLOW10 is part of an ongoing series of symposia organized by the GLOW (Great Lakes of the World) Chapter of the Aquatic Ecosystem Health & Management Society (AEHMS). It is the silver jubilee event celebrating 25 years of GLOW. The first GLOW symposium was organized more than 1996 in Victoria Falls, Zimbabwe. Since then the AEHMS has launched a continuing series of GLOW symposia regularly in order to promote interaction and communication amongst various Great Lakes/Large Lakes researchers across the world. The purpose of GLOW is to establish a global platform where ecosystem-based studies of the structure, function and performance of Great Lake ecosystems are promoted, organized and synthesized. In addition, GLOW propagates ecosystem science-based management from an integrated, multi-trophic and multi-disciplinary perspective.

GLOW10 is the eighth of the series organized in the African continent. The AEHMS always co-organizes GLOW conferences with local hosts with regional knowledge to improve participation of African scientists. The AEHMS is proud to be partnering with the Lake Victoria Fisheries Organization (LVFO), the African Center for Aquatic Research and Education (ACARE) and the Tanzania Fisheries Research Institute (TAFIRI), to promote the health of the African Great Lakes. The AEHMS is delighted to collaborate with its partners in an international exchange of ideas and peer reviewed high quality publications.

We are indeed pleased to report that GLOW10 had overwhelming response. Selected presentations will form the basis of an interesting GLOW program in Dar es Salaam. Later it is planned to publish selected papers in special issues of the journal, *Aquatic Ecosystem Health and Management* (AEHM) published jointly with Michigan Statue University Press, USA and/or a book under the Ecovision World Monograph Series published by AEHMS and Michigan State University Press.

We greatly appreciate the assistance of Organizing, Scientific and Local Arrangements Committees towards the facilitation of this meeting. Sincere thanks to the AEHMS secretariat (Jennifer Lorimer, Lisa Elder) for their assistance in all aspects of the organization of GLOW10.

We are optimistic that the GLOW10 symposium in the beautiful surroundings of Dar es Salaam, will be a productive, scientific and interesting experience generating new ideas, energy and momentum for the continued success of the AEHMS-GLOW Chapter and its future activities.

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AQUATIC ECOSYSTEM
HEALTH & MANAGEMENT SOCIETY

The AEHMS at a Glance

The ***Aquatic Ecosystem Health & Management Society (AEHMS)*** was established in 1989 to promote ecosystem-based science for managing both marine and freshwater aquatic resources of the world. The Society has four broad objectives centering on health, management, the convening of conferences/symposia, and peer-reviewed publications through its international journal, monograph series, and website (www.aehms.org). The objectives of the Society are:

- To focus on the aquatic ecosystem structure, function, performance and management from an integrated multidisciplinary and multi-trophic and sustainable perspective.
- To enhance our knowledge about the ecology and integrity of the Great/Large Lakes of the world
- Advocate holistic approaches, novel concepts, techniques, tools, models and emerging technologies for remediation and restoration
- Elucidate food-web linkages from microbial loop to plankton, fish and fisheries
- To explore the impact of multiple stressors (climate change, invasive species, HABs etc.)
- To foster global interdisciplinary communication of ecosystem management science amongst researchers, managers, citizens, universities, governments, industry, and the public sector.
- To promote ecosystem-based science, practices, knowledge and publications in developing countries across the world

The Society is actively involved in primary and peer-reviewed publications. It publishes an international journal, ***Aquatic Ecosystem Health and Management (AEHM)*** on a quarterly basis (in collaboration with the publisher Michigan State University Press). From 2007 onwards the AEHM was selected by Thomson Scientific for coverage in the Science Citation Index Expanded (SciSearch®); Journal Citation Reports; Current Contents®/Agriculture, Biology, and Environmental Sciences; Zoological Record; Biological Abstracts; and BIOSIS Previews. It has published over **50** special issues on diverse topics from across the world. Table 1 provides a general overview of lake publications (also see www.aehms.org).

Table 1. Selected special issues of the Aquatic Ecosystem Health and Management devoted to Great Lakes.

Special issues	Volume	Year
Large Lakes of the World: Comparative Ecology	3(1)	2000
Great Lakes of the World: Food Web, Fisheries, and Management	5(3)	2002
Comparing Great Lakes of the World	6(3)	2003
Coastal Wetlands of the Laurentian Great Lakes: Health, Integrity and Management	7(2)	2004
Emerging Issues in Lake Superior Research	7(4)	2004
Great Lake Victoria Fisheries: Changes, Sustainability, and Building Blocks for Management	10(4)	2007
Changing Great Lakes of the World	11(1)	2008
State of Lake Huron: Ecosystem Change, Habitat, and Management, Part I	11(2)	2008
Checking the Pulse of Lake Ontario	11(4)	2008
The State of Lake Huron: Ecosystem Change, Habitat and Management, Part II	12(1)	2009
Changing Great Lakes of the World and Rift Valley Lakes: Sustainability, Integrity & Management	13(1)	2010
Assessing Large and Great Lakes of the World	13(2)	2010
Ecosystem Health and Recovery of the Bay of Quinte, Lake Ontario	14(1)	2011
Ecology of Lake Superior	14(4)	2011
Great Lakes of the World (GLOW VI): Linking Ecosystem-Based Science to Management	16(3)	2013
Protecting Great Lakes of the World: Managing Exploitation with Ecosystem-Based Science (GLOW VII)	17(1)	2014
State of Lake Vänern Ecosystem	17(4)	2014
Lake Ontario Ecosystem: Status and Future Directions	18(1)	2015

Application of ecosystem approach to fisheries and good governance in Lake Malawi and other Great Lakes	21(2)	2018
Restoring Great Lakes Areas of Concern: 32 Years of Remediation and Restoration	21(4)	2018
Ecology, fisheries and aquaculture in African aquatic ecosystems: GLOW 9, Part I	24(1)	2021
Ecology, fisheries and cage culture in African aquatic ecosystems: GLOW 9, Part II	25(4)	2022

In addition, the AEHMS also publishes a peer reviewed book series under the banner of the ***Ecovison World Monograph Series***. It has already published over 20 peer reviewed books on a large variety of subjects, including lakes, ecosystems and other topics of interest (see http://aehms.org/publications/ecovision/published-books/).

The Society welcomes individuals for membership belonging to a wide range of disciplines. AEHMS cordially invites you to join the Society to support global conservation and outreach. Membership includes 4 quarterly issues of the journal with on-line access as well as discounts on conference registration fees, purchases of books and back issues of our journal. A discounted membership is available for students, retired persons and members of developing countries. See http://aehms.org/membership/ for the application. Welcome aboard.

Mohiuddin Munawar, Ph.D
President and Chief editor
Aquatic Ecosystem Health & Management Society, Canada

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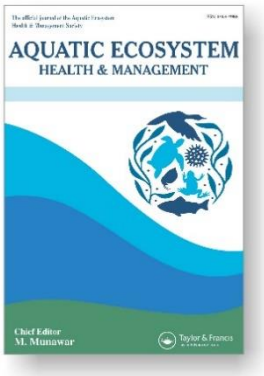

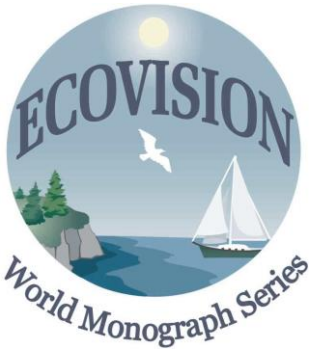

The Organizers at a Glance

Lake Victoria Fisheries Organization

The Lake Victoria Fisheries Organization (LVFO) was established by a Convention in 1994, and became a specialized institution of the East African Community (EAC) after the latter's re-establishment in 1999. The LVFO Secretariat is based in Jinja (Uganda), and signatories to the Convention comprise four Partner states: The Republics of Kenya, Uganda, Burundi and the United Republic of Tanzania. On the other hand, the EAC with its headquarters in Arusha (Tanzania), is guided by a Treaty (1999). In addition to the LVFO Member States, the Republics of Rwanda and South Sudan, and the Democratic Republic of Congo (DRC) are also signatories to the EAC Treaty.

The mandate of LVFO is to promote and coordinate the sustainable management and development of fisheries and aquaculture resources in the EAC region for the purpose of ensuring sustainability in food security and wealth creation. As one of its functions, the LVFO is charged with strengthening the EAC framework and capacity for fisheries and aquaculture research and resources monitoring, and dissemination and sharing of fisheries and aquaculture research results.

It is in this regard that LVFO has teamed up with TAFIRI, AEHMS and ACARE to co-organize this important conference in Dar es Salaam, Tanzania. It is our belief that researchers, students, managers, policy makers, the civil society and the private sector from the seven EAC Partner States and beyond, will utilize this auspicious occasion to attend and present their findings of research, actively participate in policy dialogues, showcase their work through exhibitions, discuss issues of strategic importance in fisheries and aquaculture, and most importantly, reflect on lessons learned and future perspectives for the Great Lakes.

African Center for Aquatic Research and Education

Recognizing that no one organization or institution can address the challenges that our global freshwater resources face, the African Center for Aquatic Research and Education (ACARE) partners with local, regional, and global experts to leverage the combined skills, assets, technologies and resources to strengthen freshwater science and networks in the African Great Lakes region.

To do this well, ACARE is creating a long-term collaborative process by which the scientific, academic, policy and management, and other interested communities interact to prioritize research and thus, harness the resources and knowledge to positively influence policy and management of these resources. The entire focus of ACARE is to ensure that the ecological structures of the African Great Lakes are preserved and enhanced for the benefit of the millions of people who depend on them.

ACARE serves as a support mechanism for local and regional partners, collaborating, coordinating, and harmonizing efforts and information to ensure the health of some of the largest, and most important freshwater resources in the world.

Tanzania Fisheries Research Institute

The Tanzania Fisheries Research Institute (TAFIRI) is an Institution under the Ministry of Livestock and Fisheries that was established by the Act of Parliament No. 6 of 1980 with the aim of promoting, conducting, and coordinating fisheries and aquaculture research in Tanzania. The Act was repealed by the Act of Parliament No. 11 of 2016.

TAFIRI headquartered at the Coelacanth House, located on Ugweno Street in Kunduchi, Dar es Salaam, Tanzania. The Institute has four Research Centres and one sub-station, which are located on all major water bodies — the three Great Lakes and the Indian Ocean. The Centres are in Kigoma, Kyela, Mwanza and Sota for Lakes Tanganyika, Nyasa and Victoria respectively, and at Kunduchi in Dar es Salaam for the Indian Ocean. TAFIRI's scope of research extends to all water bodies — natural and man-made —including satellite lakes, dams, wetlands, streams, rivers and brackish water. TAFIRI has a Vision of becoming "a strong centre of excellence in fisheries research and consultancy in the eastern and southern Africa", and a Mission "to promote, conduct and manage fisheries research and consultancy for sustainable development of fisheries in Tanzania".

TAFIRI's mandate includes the obligation to ensure that all fisheries and aquaculture and alied research conducted in the country is properly and timely communicated/disseminated to the scientific and policymakers' communities through research meetings, conferences, science-to-policy dialogues and various publication outlets. To fulfill this mandate, TAFIRI is, in collaboration with the Aquatic Ecosystem Health and Management Society (AEHMS), the African Center for Aquatic Research and Education (ACARE), and the Lake Victoria Fisheries Organization (LVFO), organizing the 10th Great Lakes of the World (GLOW 10) conference which will focus on the health of the Great Lakes of the world. The conference, which will take place from 15th to 17th February 2023 at the Julius Nyerere International Convention Centre (JNICC) in Dar es Salaam, Tanzania, is expected to bring together over 300 scientists, scholars and decision-makers to expound on the status and future of the world's Great Lakes. We believe the conference will offer a platform for communicating fundamental, innovative and applied research approaches, thus informing policy to guide sustainable resources use, conservation and management in the Great Lakes of Africa and the world.

On behalf of the Organizing and Program Committees at AEHMS, ACARE and LVFO, we are pleased to welcome you to Tanzania, Dar es Salaam in particular, to enjoy both the healthy scientific and policy discourses and the beautiful and unforgettable nature experiences — ranging from ancient lakes, nature reserves and parks, to white sand beaches and rich underwater worlds. As co-chairs of this conference, we are delighted and honored to extend a warm welcome to you all.

"Karibuni Tanzania"

GLOW10

Publication Plans

Selected manuscripts will be considered for publication subject to peer review in the ISI rated journal: Aquatic Ecosystem Health and Management (AEHM). AEHM is an ISI rated international primary journal published by Michigan State University Press.

Presenters are encouraged to submit manuscripts to the AEHM for consideration for publication subject to the AEHMS instructions to authors, and guidelines (http://aehms.org/publications/author-instructions/). Due to the large number of manuscripts expected the AEHMS has set page limit guidelines as follows: Keynote: 12; Oral & Poster: 10 printed pages including tables and figures (Text: Times New Roman 11 pt, Margins: 2.5 cm (1"), Paper: letter size 21.6x28 cm (8.5x11")). For more information please contact Dr. M. Munawar, Chief Editor (mohiuddin.munawar@dfo-mpo.gc.ca).

Presenters who are planning to publish in the special issues are requested to complete the publication questionnaire (https://conferences.aehms.org/glow10/publication/).

General Information

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All presentations and posters are the property of the presenter. Audio recordings, copying, videotaping or photography of the presentations is prohibited. Media should obtain the permission of the AEHMS for use of any conference material.

Disclaimer
Lake names may be given at the discretion of the contributors in their own presentations. The organizers are not responsible for the content of the presentations or abstracts.

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We request participants to silence mobile phones in the conference hall.

Badges
You should consider your personal name badge as your entry ticket. Please wear your badge at all times during the conference.

Coffee and tea breaks
Coffee/tea breaks are included with registration.

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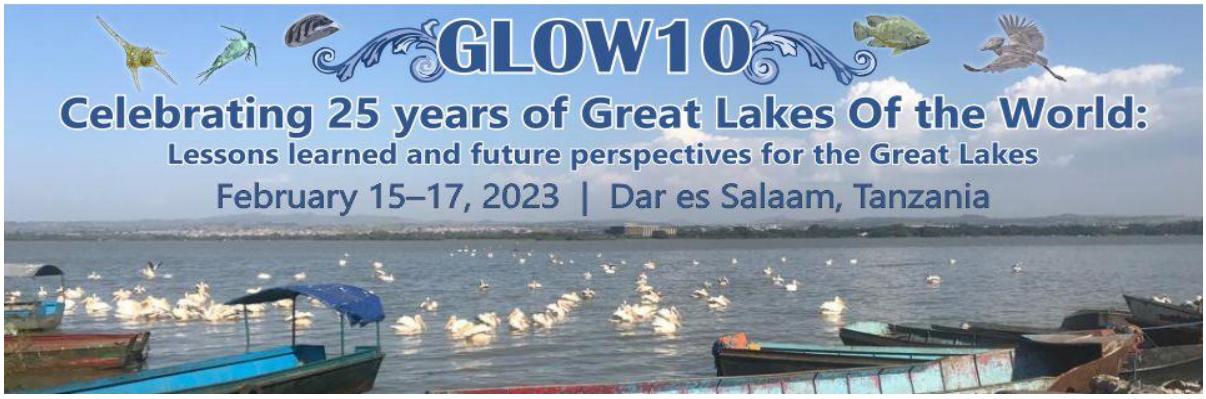
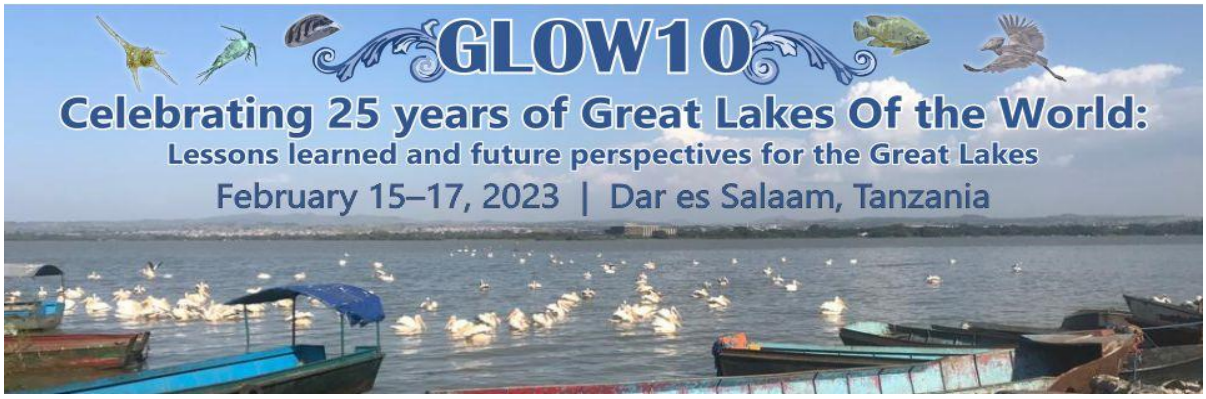
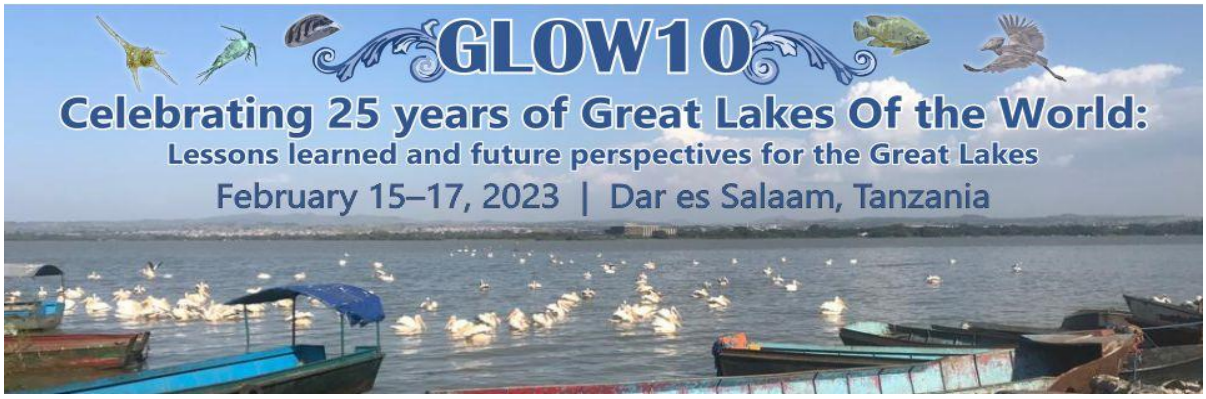


	Wednesday, February 15th	
8:30-9:00	**Registration**	
9:00-9:30	**Opening Ceremonies with: Dr. Ismael Kimrei** (TAFIRI), **Dr. Rashid Tamatamah** (Permanent Secretary of Fisheries, Ministry of Livestock and Fisheries), **Dr. Mohiuddin Munawar** (AEHMS)	
9:30-10:15	**Key:** Mohiuddin Munawar	Celebrating the Silver Jubilee of GLOW: Promoting the Ecosystem Approach and Water Quality Agreements in the Great Lakes of the World
10:15-10:45	**Break**	
10:45-11:30	**Key:** Martin Van der Knaap	The influence and effectiveness of the Great Lakes of the World (GLOW) Conferences and publications to manage the African Great Lakes
	Session 1. Adoption and implementation of ecosystem approach for healthy lakes and livelihoods	
11:30-11:45	Marie Claire Dusabe	Family-level bio-indication does not detect the impacts of dams on macroinvertebrate communities in a low-diversity tropical river
11:45-12:00	Jeppe Kolding	The potential of Silver cyprinid (*Rastrineobola argentea*) to improve food and nutrition security in East Africa
12:00-12:15	Deogratias Nahayo	Assessing land-use/land-cover effects on the hydrological regimes of the major influents of lake Kivu, Rwandan side
12:15-12:30	Deogratias Nahayo	Water quality assessment of major influent rivers of the Lake Kivu, Rwandan side
12:30-12:45	Stuart A. Ludsin	Needs for and challenges to successful implementation of ecosystem-based approaches in the world's Great Lakes
12:45-1:45	**Lunch**	
1:45-2:30	**Key:** Ted Lawrence	Lessons from the past, focusing on the future: A 100 year vision for the African Great Lakes
2:30-3:30	African Great Lakes Action Commitments Session	
3:30-4:00	**Break**	
4:00-5:30	African Great Lakes Action Commitments Session	
5:30-6:15	Special Remote Sensing Presentation	

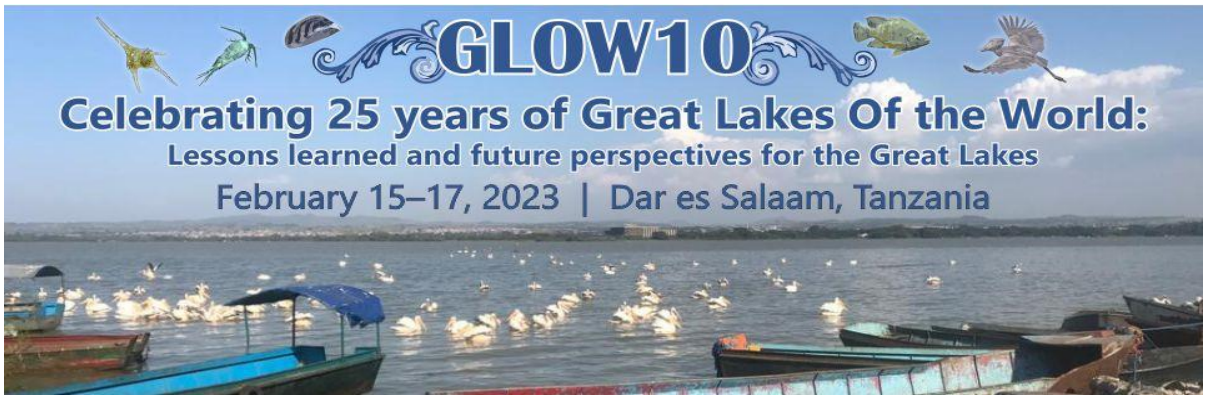
	Thursday, February 16th – PARALLEL PROGRAM (Main Hall)	
9:00-9:45	Key: Jouko Sarvala	Climate change and overfishing threaten the fisheries on Lake Tanganyika – or do they?
	Session 2. Status and trends of African Large and Great Lakes' health and resources	
9:45-10:00	Kenneth Irvine	Lessons from the past and directions for the future sustainable use of the African Great Lakes
10:00-10:15	Patrick Doran	Defining coastal resilience in the Laurentian Great Lakes: A systematic review and critical comparison
10:15-10:30	Pierre-Denis Plisnier	African Great Lakes limnological cycle driven by trade winds
10:30-10:45	Stuart A. Ludsin	Overview of the 2019 CSMI program designed to understand harmful algal bloom & hypoxia impacts on Lake Erie's webs
10:45-11:15	**Break**	
11:15-11:30	Elizabeth Wanderi	Ecological changes in the Lake Victoria Basin: trends, status and a search for mitigation
11:30-11:45	Mboni Elison	Spatial distribution and biomass of pelagic fish of Lake Tanganyika, Tanzania
11:45-12:00	Herbert Nakiyende	Solar lights as alternatives for increased and sustainable fisheries production in lakes Victoria and Albert, East Africa.
12:00-12:15	Mulugeta Wakjira	Fish diversity and Fisheries of Omo-Turkana Basin in the face of hydrological modifications
12:15-12:30	Huruma Mgana	Seasonal patterns in growth of three commercially important pelagic fish species of Lake Tanganyika, Kigoma, Tanzania
12:30-12:45	Janvière Tuyisenge	Assessing the implications of cage aquaculture on Lake Kivu
12:45-1:00	Benedicto Kashindye	Fish maws trade; its implication to Nile perch (Lates niloticus: linnaeus, 1758) fisheries management in Lake Victoria, Tanzania
1:00-2:00	**Lunch**	
	Session 3. Techniques	
2:00-2:15	Victor Langenberg	The Role of Life Scientists in the African Great Lakes' Biospheric crisis: 25 yrs of perceiving success and flaws, and the need for changing tactics
2:15-2:30	Lisa Peters	Using eDNA/eRNA analysis to assess change metrics in aquatic community health.
2:30-2:45	Steven Greb	Satellite Remote Sensing of African Great Lakes
2:45-3:00	Emma Tebbs	Towards a satellite-based monitoring system for the African Great Lakes: Pilot study in Winam Gulf, Lake Victoria, Kenya.
3:00-3:15	Lauren Timlick	Utility of fish embryo-larval exposures for Great Lakes contaminants research
3:15-3:45	**Break**	
	Session 4. Multiple stressors: climatic events, invasive species and eutrophication	
3:45-4:00	Nestory Gabagambi	Life history shifts in an exploited African fish following invasion by a castrating parasite
4:00-4:15	Claver Sibomana	Lake Tanganyika biodiversity conservation challenges and opportunities: the case of a highly populated country, Burundi
4:15-4:30	Diane Umutoni	Effect of Octylphenol (OP) water exposure to sexually mature female mosquitofish, Gambusia affinis life history
4:30-4:45	Oscar Wembo Ndeo	Impact of anthropic activities on the littoral zone of Lake Edward (RDC)
4:45-6:15	**Poster Session**	



	Thursday, February 16th – PARALLEL PROGRAM (Saadani Room)	
9:00-9:45	Key: Jouko Sarvala	Climate change and overfishing threaten the fisheries on Lake Tanganyika – or do they?
	Session 5. Fisheries management and emerging aquaculture in relation to value chains, food and nutrition security	
9:45-10:00	Christopher Aura	Unbundling Sustainable Community-Based Dam Aquaculture for Blue Growth
10:00-10:15	James Barasa	A metagenomics study uncovers bacteria microbial diversity in African catfish hatcheries of Western Kenya
10:15-10:30	Julie Bwoga	Fish Parasites and Diseases: Contextual Analysis of the Kenyan Aquaculture
10:30-10:45	Lwabanya Mabo	The Atyid shrimps' fishery of Lake Tanganyika: Implication for Bycatch Management and its Application in Functional Aquafeeds in Zambia
10:45-11:15	**Break**	
11:15-11:30	Lambert Niyoyitungiye	Assessment of Physico-Chemical and Trophic Characteristics of Lake Tanganyika Water, with Reference to Pollution Stage and Pisciculture Potential
11:30-11:45	Maxon Ngochera	Assessment of the status of Oreochromis species and Other Shallow-water Stocks in the Southwest and Southeast Arm of Lake Malawi
11:45-12:00	Jeppe Kolding	Monitoring and assessing Balanced Harvest approaches in data limited inland fisheries
12:00-12:15	Abebe Getahun	Socio-economic and management status of small-scale fisheries in Omo River Delta and Ethiopian side of Lake Turkana, southern Ethiopia
12:15-12:30	Elizabeth Wanderi	Value Chain Bottlenecks to Attaining Sustainability and Economic Empowerment Of Fisher Communities Of The African Great Lakes: A Case Of Lake Turkana
12:30-12:45	Hashim Muumin	The Lake Tanganyika sprat, sardine and perch value chain in Tanzania: Summary analysis and design report
12:45-1:00	Jonathan MacKay	Aquaculture Suitability Analyses - Examples from Lake Tanganyika, the Region, and the Globe
1:00-2:00	Lunch	
2:00-3:15	TNC Workshop on Aquaculture in and around Lake Tanganyika	
3:15-3:45	Break	
3:45-4:45	TNC Workshop on Aquaculture in and around Lake Tanganyika	
4:45-6:15	**Poster Session**	



Posters	
Simon Buhungu	Assessment of water quality of Lake Dogodogo in Burundi by zooplanktonic diversity indices
Gladys Chigamba	Costing Ecosystem Services for African Rivers, does it matter in management? A case of Linthipe River in Southern Africa.
Tallent Dadi	Availability of phosphorus in sediments of Lake Victoria
Catherine Fridolin	The Role of Shredders in the Dynamics of Particulate Organic Matter in Streams
Lloyd Haambiya	A Pilot Approach Towards Managing the Commons of Lake Tanganyika
Enock Mlaponi	Impact of New Technologies in the Fisheries of The Lake Victoria
Naftaly Mwirigi	Recommended nutrient daily intakes of micronutrients from Lake Victoria's small pelagic fish for dietary populations.
Prisca Mziray	Predictions on the effects of climate change on nutrient availability and primary production in the upper layers of Lake Tanganyika
Asante Nkhata	Community Participation in Ecosystem Based Fisheries Management in Restoring Lake Malawi Fish Biodiversity
Joseph Nyaundi	Using a Hazard Quotient to Evaluate Pesticide Residues Detected in cultured Nile tilapia, Oreochromis niloticus, (Linnaeus 1758) in River Kuja drainage Basin, Kenya
Ragnhild Overå	Small fish for small children: Challenges and potentials of increasing the dietary intake of small fish among primary school-age children in Northern Uganda
Margret Sinda	Analysis of the quality of fried and smoked Engraulicypris sardella and Copadichromis species using Chitofu 3-in-1 fish processing technology
Lauren Timlick	Fish mucus as a non-lethal sampling matrix to quantify contaminant exposure



	Friday, February 17th	
9:00-9:45	**Key:** James Njiru	
	Session 6. Generating cross-disciplinarity among African Great Lakes science for the application of systemic solutions	
9:45-10:00	James Last Keyombe	Opportunities and Challenges in the Lake Turkana Fishery; Building a Sustainable Fisheries Sector
10:00-10:15	John Malala	Harnessing the potential of a Conflict Prone Trans-Boundary Fisheries for Blue Economic Growth: The Case of Lake Turkana
10:15-10:30	Frank Masese	Challenges and opportunities for sustainable management of transboundary water resources in East Africa
10:30-10:45	Geoffrey Chavula	Lake Malawi/Niassa/Nyasa Basin: Status, Challenges, and Research Needs
10:45-11:15	**Break**	
11:15-12:00	**Key:** Stuart Ludsin	Understanding and anticipating fish community change in large, human-dominated lakes: lessons learned from North American Great Lakes
12:00-1:00	**Panel Discussion**	
1:00-2:00	**Lunch**	
2:00-2:15	**Concluding ceremony and publication plans**	
2:15	**Adjournment**	

GLOW10

Abstracts

Organized by Keynote → Oral → Poster, then alphabetically by presenter's surname

LAWRENCE, TED **KEYNOTE**

Lessons from the past, focusing on the future: A 100 year vision for the African Great Lakes

Lawrence, T.*

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*ted@agl-acare.org

The African Great Lakes (AGL) have been formally studied for over a hundred years. There are few surprises as to what is causing the many environmental issues that negatively affect these bodies of water that millions of people rely on for their livelihoods and that governments reap large benefits from. What is surprising, is the relative lack of resources directed towards addressing these problems, demonstrated, in part, by under-funded AGL research stations, inadequate consistent and continual monitoring of even basic parameters, barriers to accessing data and information relevant to these resources, and a dearth of in-field training opportunities. What happens next to make these lakes better is also not unknown. During at least the past 50 years there have been calls for increased collaboration, regionally and internationally; a need for enhanced education and training; more information exchange and to break down barriers (both figurative and literal) to relevant data and publications; the need for more monitoring to gather comprehensive information; and to increase the number women in science. While it is important to look back at what we have accomplished, it is critical to understand where we need to go. Herein, I present ideas for shifting from a reliance on international and top-down approaches to funding and research, to long-term comprehensive processes that give agency to the African scientific community.

LUDSIN, STUART A. **KEYNOTE**

Understanding and anticipating fish community change in large, human-dominated lakes: lessons learned from North American Great Lakes

Ludsin, S.*

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The world's Great Lakes have long been experiencing change from multiple human-driven stressors, yet understanding their individual and combined impacts has proven challenging. In turn, the ability of agencies to develop appropriate conservation and management strategies has remained limited in most ecosystems, with their decision-making being further complicated by potential tradeoffs that can arise from management actions (e.g., reducing nutrient inputs to improve water quality might reduce fishery production). Herein, I discuss efforts to clarify both past and anticipated impacts of human-driven stress (e.g., altered nutrient inputs, climate change, and invasive species) on North American Great Lakes ecosystems, including their valued fisheries and fish communities. I also discuss research approaches and interdisciplinary, interorganizational efforts that have facilitated the ability of agencies to understand past ecosystem changes, as well as anticipate future ones, including the potential for management actions to cause tradeoffs in valued ecosystem services. I conclude by discussing the value of holistic, ecosystem-based approaches to management, offering recommendations to help with their successful implementation. Ultimately, I seek to help fishery management agencies in the Great Lakes of the world (e.g., East Africa's Great Lakes) identify new ways to sustain and manage their fisheries in the face of continued human-driven environmental change.

MUNAWAR, MOHIUDDIN **KEYNOTE**

Celebrating the Silver Jubilee of GLOW: Promoting the Ecosystem Approach and Water Quality Agreements in the Great Lakes of the World

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The ecosystem approach is a holistic assessment tool for resolving environmental stressors that simultaneously relates events within an ecosystem to those in the surrounding biosphere. In the 1970s, Dr. Jack Vallentyne strongly advocated for such an approach to be applied in the North American (Laurentian) Great Lakes. Responding to widespread concerns about severe environmental degradation, Canada and the United States agreed to formally protect the Great Lakes in a mutually beneficial and friendly fashion by signing the Great Lakes Water Quality Agreement (GLWQA) in 1972. From the initial GLWQA and through its subsequent revisions, both countries made commitments to protect and restore the health of the Great Lakes. Several important concepts and multiple programs related to ecosystem based management emerged, including: formal adoption of the ecosystem approach, phosphorous abatement, lake wide research and monitoring surveys, and remediation of degraded habitats including the identification of beneficial use impairments (BUIs). Equally important, this immense and colossal effort generated an extensive Great Lakes science program including various models and technologies which could be successfully transferred to the Great Lakes of the World. An African Great Lakes Water Quality Agreement, that is mutually beneficial to all signatories, is recommended for remediation and restoration of African Great Lakes. To start with, a phosphorus abatement program based on the empirical modelling of Dr. Vollenweider linking P loads to primary production and algal standing crop, provides a ready-made tool for controlling eutrophication but it requires a commitment from all stakeholders. Likewise, developing BUIs for the restoration and remediation of polluted habitats requires sharing the workload of research and monitoring among different countries. The GLOW working group was established in 1996 and provides an ideal forum for bringing together researchers, managers and other stakeholders in a mutually respectful manner. We celebrate GLOW's Silver Jubilee by promoting the successes of cooperative agreements and advocating for the development and implementation of an African Great Lakes Water Quality Agreement.

NJIRU, JAMES **KEYNOTE**

The role of science in informing blue economy growth and development: the case of Kenya

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Currently in the world, Blue Economy concept is widely endorsed as a means of achieving economic growth and development. Several tangible and intangible benefits through the sustainable use of ocean resources are envisaged. The accrued economic benefits are expected to improved livelihoods, create jobs and growth of countries GPDs. Other benefits of ocean resources include climate mitigation, coastal protection and conservation, cultural values, and biodiversity among others.

To achieve the full potential of Blue Economy, research and information will be very key. In Kenya, Kenya Marine and Fisheries Research Institute (KMFRI) is the lead agency charged with providing scientific data and information for the sustainable growth of the Blue Economy in Kenya. To that end, KMFRI conducts research in "marine and freshwater fisheries, aquaculture, environmental and ecological studies, and marine research encompassing chemical and physical oceanography."

The research and information provided has been very key in policy direction in development of Blue Economy in Kenya.

Keywords: Blue Economy, data, information, benefits

SARVALA, JOUKO **KEYNOTE**

Climate change and overfishing threaten the fisheries on Lake Tanganyika – or do they?

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Pelagic fisheries on Lake Tanganyika provide a unique protein source for expanding human populations in the surrounding countries. The increasing fishing pressure has aroused concerns about the sustainability of the fisheries, particularly when climate change is thought to reduce the productivity of the Tanganyika ecosystem. Previous evaluations of Tanganyika fisheries potential assumed bottom-up regulation of the fish populations. Total fish production in Tanganyika is indeed predictable from primary production as in other lakes. Recent studies, however, indicated more complex recruitment dynamics in the small clupeid *Stolothrissa tanganicae*, the most important species in the fishery of northern Tanganyika. Being short-lived planktivore, its recruitment success is expected to closely track variations in food resources. Earlier studies documented pronounced seasonal variation of catch-per-unit-effort (CPUE), related to variable strength of usually four annual cohorts. Contrary to expectations, the catches were not related to zooplankton abundance. The strongest cohort was often born in the dry season when zooplankton was scarce. The intensive fishing may have reduced the planktivore populations below the level where food availability would limit their recruitment. In this situation the hypothesized decrease of plankton productivity caused by climate change would not directly translate into decreasing fish populations. In this presentation, I will use a larger database from 1993-2015 to examine whether this new view of the recruitment dynamics of *S. tanganicae* can be corroborated. Further, I propose a new mechanism that might account for the seasonal differences in *S. tanganicae* cohort strength. This mechanism is sensitive to climate change. I also show that in 1993-2015 in northern Tanganyika, no consistent trend was observed neither in zooplankton biomass, nor in the CPUE of *S. tanganicae* and *Limnothrissa miodon*. During the investigated period, spanning over two decades, the clupeid populations of northern Tanganyika were apparently not over-exploited and/or reduced by climate change.

Abstracts

Organized by Keynote → Oral → Poster, then alphabetically by presenter's surname

VAN DER KNAAP, MARTIN **KEYNOTE**

The influence and effectiveness of the Great Lakes of the World (GLOW) Conferences and publications to manage the African Great Lakes

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Since GLOW conferences were first convened 25 years ago, numerous papers with management and monitoring recommendations have been the result. But many questions emerge:

• Did these publications reach the right audiences of policy / decision makers?
• Have the fisheries been managed and aquaculture in floating cages regulated?
• Can introduction of alien species be controlled? Was there control of invasive weeds and water pollution?
• What was the impact of the discovery of fossil fuels near lakes?
• How did land use affect water quality in the lakes?
• Did the rivers draining into the lake have effects on the quality of the lake and aquatic life?
• Will the increasing temperature of the water column continue?
• What were the consequences of lake levels subjected to periods of drought and extreme rainfall?
• Do the waste products from (illegal) gold mining accumulate in fish and humans?
• What was the effect of civil strife on fishing behavior of the riparian communities?
• How about the effects of population growth and urbanization around the lakes?

There have been various approaches to managing the lakes, for instance the precautionary approach, the "People, Planet, Profit" (PPP) principle as well as the ecosystem approach (to fisheries) and eventually Blue Economy and Blue Transformation. Multi-million projects have been implemented to research, develop and manage fisheries, to control invasive weeds, to reduce sewage disposal, to stop sand and gravel mining, to clean up effluent rivers, to protect the natural vegetation and wildlife, to generate electricity, to regulate water flow downstream, etc.

At this landmark occasion of the silver jubilee of the GLOW this paper overviews the progress of research in the African Great, as evidenced by more than 110 research papers published in the AEHM and Ecovision books. This study discusses the impact and effectiveness of the different management initiatives during the 25 years of research.

AURA, CHRISTOPHER **ORAL**

Unbundling Sustainable Community-Based Dam Aquaculture for Blue Growth

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Dam restocking has emerged as one of the enhancement techniques to riparian social-ecological systems and lake management alternatives. Dams can thus promote community-aquaculture initiatives to increase fish production and availability in rural areas with proper management and husbandry. This paper highlights the development of the Framework for Community-based Dam Aquaculture (FCODA) which lays a solid foundation for blue growth and which are based on poverty alleviation and food security. In the implementation of FCODA, countries are encouraged to focus on environmental, economic, and social considerations that are critical for the Blue Economy's long-term development. The FCODA herein was developed using expert opinions and various literature sources such as national and international policy documents such as the African Agenda 2063, and the United Nations Sustainable Development Goals (SDGs. The framework's three KRAs are: (i) Enhanced economic benefits to the communities; (ii) infrastructural and human capacity development; and (iii) Enabling environment for sustainable dam aquaculture. During the framework's implementation, the resources required to operationalize a given business enterprise over a given period could be mobilized through ploughing back mechanisms, lobbying development partners and the government for additional funding, and other stakeholders. To ensure that the framework is implemented effectively, monitoring and evaluation should be done on a regular basis.

BARASA, JAMES **ORAL**

A metagenomics study uncovers bacteria microbial diversity in African catfish hatcheries of Western Kenya

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African catfish, *Clarias gariepinus* is second only to Nile tilapia, *Oreochromis niloticus* as a preferred farmed fin fish species in Kenya, for food and nutrition security. Poor survival of larvae is a challenge in Clarias culture, constraining availability of high quality seeds for stocking by farmers. Contamination of hatchery and nursery facilities with bacteria is one of the causes of poor survival of larvae. Farmers routinely use antibiotics to control these microbes, but antimicrobial resistance often makes antibiotics ineffective, especially at high temperature. In a metagenomics study through sequencing of 16 S rDNA region, bacteria microbial communities of 4 hatcheries of Western Kenya were characterized, from samples of fertilized eggs and internal organs of brood stock, as well as water samples from ponds. From 6 clone libraries, Operational Taxonomic Units (OTU) grouped into 6 phyla, 13 classes, 26 families and 50 genera. Proteobacteria was the most dominant phyla, comprising 88.67% of samples, while Actinobacteria and *Deinococcus thermus* were the least abundant, represented by only 0.47% of samples each. Gammaproteobacteria was the most abundant class level OTU, with 49.07% of samples, while 6 classes were least abundant, with 0.46% of samples each. *Stenotrophomonas* was the most abundant genera, represented in 14.2% of samples, while several genera had low abundance of 0.49% of samples. Clone libraries from water samples had higher richness of genera compared to tissue samples. Indices of diversity and richness in bacteria community structure were higher in clone libraries of water than tissue samples. Both Shannon-Weinner and Simpson indices of diversity and evenness were higher in water than tissue clone libraries, just like Chao I and SACE indices. High diversity of genera of bacteria could be characterized further, isolated, cultured and tested as potential probiotics to control microbes in hatcheries and nurseries.

BWOGA, JULIE **ORAL**

Fish Parasites and Diseases: Contextual Analysis of the Kenyan Aquaculture

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Successful fish health management begins with the prevention of disease rather than treatment. The rise in intensification and commercialization of aquaculture predisposes fish stocks to disease due to a rise in stress levels and consequent reduction in fish immunity. There exists a balance between, parasites, their fish hosts, and the environment. However, when this balance is broken parasites spread rapidly in culture facilities inducing severe epizootics. This study was conducted with the objective of highlighting stocking density and seasonality as drivers of monogenean and digenean trematode parasitism in *Oreochromis niloticus* in cages in Uhanya Beach, Lake Victoria, Kenya. The study adopted a systematic random sampling technique to sample an aggregate of 600 fish during the rainy and dry seasons. Parasites isolated from the sampled fish were the monogenean *Dactylogyrus* and the digenean; *Tylodelphys*, *Clinostomum*, and *Neascus*. *Dactylogyrus* sp. was predominantly abundant in the fish from all 10 cages. Mann-Whitney U-test revealed that the mean intensity of *Dactylogyrus* sp. infestation considerably augmented with a higher stocking density of fish ($p < 0.05$; df =298). On the contrary, *Clinostomum* sp., *Tylodelphys* sp., and *Neascus* sp. exhibited significantly reduced infestation with increased stocking densities ($p < 0.0001$). The relationship between the intensity of parasite infestation and fish condition factor was not also weak and significant in all the parasite species (*Dactylogyrus* sp.: r2 = 0.017; *Clinostomum* sp.: r2 = 0.001; *Tylodelphys* sp.: r2 = 0.008; & *Neascus* sp.: r2 = 0.026). The study recommends setting up a specialized fish diagnostic laboratory recognized by the World Animal Health Organization and the development of a health management strategy for farmed fish in Kenya.

CHAVULA, GEOFFREY **ORAL**

Lake Malawi/Niassa/Nyasa Basin: Status, Challenges, and Research Needs

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Lake Malawi/Niassa/Nyasa (LMNN) is one of the most important African Great Lakes. It has the largest number of fish species in the world, most of which are endemic. Current estimates put the number of fish species at 1000. In addition to its rich biodiversity, LMNN fish is the main source of animal protein for the riparian countries of Malawi, Mozambique and Tanzania, and provides 4% to Malawi's GDP. However, the lake is experiencing severe adverse impacts from anthropogenic stressors, including catchment degradation which is fuelling sedimentation. Of late, the lake has also been experiencing weed infestation, particularly water hyacinth. The lake's large number of fishers has resulted in the dramatic decline in the volume of fish stocks and the variety of fish species, especially the *Oreochromis* sp. (locally called Chambo in Malawi), while the fish species Ntchira (*Labeo mesops*) and Mbalule (*Copadichromis* sp.) have declined to levels nearing extinction. The main objective of this study was to assess the current status of Lake Malawi/Nyasa/Niassa with a view to identify existing research gaps in order to enhance the sustainable management of the lake. Specifically, the assessment focused on the state of the lake's limnology and fisheries biodiversity, climate change, and current challenges; and proposed measures for improving the management of the lake by the three riparian countries. It further outlines past research work, existing research gaps, and proposes the way forward to gain a better understanding of a healthier lake.

DORAN, PATRICK **ORAL**

Defining coastal resilience in the Laurentian Great Lakes: A systematic review and critical comparison

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There are many definitions of resilience, and a growing body of literature suggests that how resilience is defined may have significant consequences for planning and policy making outcomes. In the North American Laurentian Great Lakes Region, resilience is gaining increasing attention from planners and policy makers in response to more frequent disruptions to social-ecological systems and built environments from coastal hazards. There has not yet been extensive research into how resilience is being defined in practice and how these definitions can affect geographies of risk and resilience and contribute to varying ecological, social, cultural, political, and economic outcomes. In this paper, we analyzed how stakeholders engaged in natural resource management activities within the Laurentian Great Lakes coastal environment define resilience and discuss the implications for planning and policy making through a critical geography and critical space lens. We systematically reviewed gray literature published by these stakeholders to document definitions of resilience. We then applied a 5Ws + H of resilience framework—resilience for whom, what, where, when, why, and how—to develop descriptive statistics and qualitatively analyze the definitions, considering the potential implications for ongoing regional planning and policy making efforts. Our analysis revealed a large degree of variation in the definitions, although we note two distinct gaps. We discuss how these gaps could affect ongoing regional planning and policy making efforts, and we lay out four research needs to inform planning and policy making going forward. Finally, we discuss the relevance of our approach to the African Great Lakes region.

DUSABE, MARIE CLAIRE **ORAL**

Family-level bio-indication does not detect the impacts of dams on macroinvertebrate communities in a low-diversity tropical river

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The Ruzizi River, the outlet of Lake Kivu in the Albertine Rift, flows into Lake Tanganyika and is important for hydropower generation and irrigation. The impacts of two dams in the Ruzizi River on macroinvertebrate community composition and diversity were surveyed every three months from December 2015 to October 2017. Macroinvertebrate samples were collected at sites upstream and downstream and additionally at two sites further downstream of the dams, in both comparatively pristine and highly disturbed areas. Several indices (Shannon-Wiener index, Simpson index, Pielou's evenness, Rare Family Prevalence, and Average Score Per Taxa) were used to determine the alpha diversity and evenness of macroinvertebrates at the family level. Our results showed little to no immediate effect of the dams on macroinvertebrate diversity. Macroinvertebrate composition differed slightly below the dams compared to upstream. Communities near Dam II had slightly higher diversity compared to Dam I, probably because the vicinity to Lake Kivu has an immediate effect on diversity upstream of the first dam and likely because Dam II is 30 years younger than Dam I. This study suggests the importance of using species-level indices to better understand the ecological impacts of dams on macroinvertebrate diversity of tropical rivers with low species diversity.

ELISON, MBONI **ORAL**

Spatial distribution and biomass of pelagic fish of Lake Tanganyika, Tanzania

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Pelagic fishery of Lake Tanganyika is dominated by three commercial important pelagic species, including *Stolothrissa tanganicae*, *Limnothrissa miodon*, and *Lates stappersi*. Millions of people who live around the Lake depend on the fishery. However, there is limited information on stock status of pelagic fish. The objective of the study was to provide information on the current standing stock of pelagic fish in Lake Tanganyika Tanzanian water. Hydro acoustic survey was conducted from 23rd February to 19th March 2022 on the Tanzanian side of the lake which was divided into three major basin i.e. Northern, Central and Southern region. The acoustic data was collected alongside limnological and biological parameters from pre-defined transects. Echo sounder system, SIMRAD EK 80 WTB with 120 kHz as a central frequency operating in FM mode was used to collect acoustic measurements. The results showed total biomass of pelagic fish in Lake Tanganyika Tanzanian side to be 144,690 tons, with highest biomass coming from Central basins (60,796 tons), followed by southern basin 52,928 tons and the least from Northern basins contains (30,966 tons). The biomass declined by of 8% compared from biomass estimates of last survey conducted in 1998. GAM analysis revealed statistically significant correlation between the fish density and physicochemical variables. Fish density was associated with both low and high fluorescence values, with densities dropping at 0.1 mg/m-3. Temperature showed a linear positive relationship with densities of fish. High densities of fish occurred where there were high temperatures, with highest densities at 27° C. The decline in biomass may be associated by the increase in fishing effort and adjustments to environmental factors. There is a need to have regular surveys in Lake Tanganyika in different seasons as a basis for determining fishing policy.

Keywords: Pelagic fishes, biomass, *S. tanganicae*, *L. miodon*, and *L. stappersi*

GABAGAMBI, NESTORY **ORAL**

Life history shifts in an exploited African fish following invasion by a castrating parasite

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Evolutionary theory predicts that infection by a parasite that reduces future host survival or fecundity should select for increased investment in current reproduction. In this study, we use the cestode Ligula intestinalis and its intermediate fish host *Engraulicypris sardella* in Wissman Bay, Lake Nyasa (Tanzania), as a model system. Using data about infection of *E. sardella* fish hosts by L. intestinalis collected for a period of 10 years, we explored whether parasite infection affects the fecundity of the fish host *E. sardella*, and whether host reproductive investment has increased at the expense of somatic growth. We found that L. intestinalis had a strong negative effect on the fecundity of its intermediate fish host. For the noninfected fish, we observed an increase in relative gonadal weight at maturity over the study period, while size at maturity decreased. These findings suggest that the life history of *E. sardella* has been shifting toward earlier reproduction. Further studies are warranted to assess whether these changes reflect plastic or evolutionary responses. We also discuss the interaction between parasite and fishery-mediated selection as a possible explanation for the decline of *E. sardella* stock in the lake.

Keywords: African Great Lakes, environmental change, Lake Malawi sardine, Lake Nyasa, life history evolution, parasite invasion, Usipa

GETAHUN, ABEBE **ORAL**

Socio-economic and management status of small-scale fisheries in Omo River Delta and Ethiopian side of Lake Turkana, southern Ethiopia

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Ethiopia's inland fisheries offer an alternative livelihood for the riparian communities. One of these inland fisheries, the Omo-Turkana fisheries, have not been properly studied and managed. The main purpose of this study, therefore, was to assess socio-economic aspects and related problems of fisheries in the Lower Omo River and Ethiopian side of Lake Turkana for better management and sustainable use of the resources. Various instruments including structured questionnaires, focus group discussions, key informant interviews, personal observations, and secondary sources were used to gather data. The fisheries support a considerable number of the local communities, who have much less other livelihood options apart from pastoralism. However, development of fisheries in these localities is marred by lack of appropriate scientific studies, lack of material and technical support to the fishers cooperatives, lack of government commitment to capacitate the institutions that work on fisheries management and development, and the continued conflicts between Ethiopian and Kenyan fishers in an apparent competition over a fertile fishing ground. For comprehensive insight, we developed a fisheries value chain and discussed major issues arising out of it. To sustain the fisheries contributions to community livelihoods, it is recommended that due attention be given to conflict resolution between the Ethiopian Daasanach and the Kenyan Turkana fishers. Additionally, the co-management arrangement by the two countries is urgently needed to regulate illegal fishing in the lake as well as the Omo River Delta. Moreover, there need to be appropriate scientific studies and collection of relevant data on the biological, chemical and physical as well as socio-economic aspects of the lake and associated rivers. This calls on having a well-equipped research station located closer to the lake and Omo River, as this has been the major bottleneck for the lack of organized, concerted and focused research undertakings in the area.

GREB, STEVEN **ORAL**

Satellite Remote Sensing of African Great Lakes

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Recent advances in satellite remote sensing now provide greater opportunity to monitor essential surface water quality conditions from space. This new, transformative approach to water quality monitoring can elucidate inland and coastal conditions in the African Great Lakes. Technological improvements in satellite remote sensing of water bodies, and the maturity of available applications have stimulated use of, and confidence in satellite-derived data. Temporally, these tools can be used in conjunction with traditional sampling methods to monitor lake conditions, in some cases, in near real time, to quantifying long term trends. Here, we showcase some of the freely available emerging satellite-derived water quality and associated products currently being produced today and focused on the parameters of temperature, turbidity, chlorophyll-a and lake stage height. Recommendations, such as coordinating in situ sampling with satellite overpass times for parameter validation would help insure greater confidence in these data. This effort was conducted in collaboration with GEO AquaWatch, the global water quality initiative.

IRVINE, KENNETH **ORAL**

Lessons from the past and directions for the future sustainable use of the African Great Lakes

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The African Great Lakes are a treasure house of biodiversity and vitally important for sustaining food security and livelihoods of millions of people. The earliest colonial era investigations of lakes, while documenting taxa distributions and the high number of endemics often occurring as species flocks, also recognised over-exploitation of species. By the 1960s, research on ecological processes within the lakes gathered pace, with connections made with natural resource management and the sustainability of the resource. By the 1990s extensive surveys, often lake-wide, and fisheries statistics had been done on a number of lakes. While these were often based on individual donor supported projects it was evident that the vast water bodies were not immune from human pressures. Other projects were and continue to be funded to research more fundamental bio-physical, ecological and social processes. Across the lakes there is now an extensive body of information, as well as policy instruments, that can be used for sustainable management. Yet, coherence in sharing information and scientific collaborations remain a challenge despite the widespread desire across scientific and policy communities to do so. Into the future a more concerted effort is needed to consolidate existing knowledge, recognising the gaps and setting up mechanisms to share and use knowledge and create coherent and harmonised data collection and monitoring. This requires focus and common purpose, securing longer-term funding and to build capacity and resilience of local institutions and international partnerships as a core activity for sustainable management. This is the mission of The African Centre for Aquatic Research and Education (ACARE). The largely unconsolidated mix of past activities provides a firm foundation for the direction of the future of the African Great Lakes, that are resilient to the reality of increasing pressures, including a changing climate, and managed for benefit of people and nature.

KASHINDYE, BENEDICTO **ORAL**

Fish maws trade; its implication to Nile perch (Lates niloticus: linnaeus, 1758) fisheries management in Lake Victoria, Tanzania

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Fish maws (Swim bladder) extracted from Nile perch is a highly sought product in Lake Victoria due to its high commercial value in the international market. Although the Nile perch fishery is governed by the slot size regulation of >50 cm total length (TL), there has been challenges in determining the size of fresh and dry fish swim bladder that correspond to the Nile perch slot size regulation. Therefore, this study investigated the size of swim bladder relative to the current slot size regulation for Nile perch fisheries, and also assessed the influences of market forces on sizes and weights of fish maws traded at domestic, regional and international markets. This study uses data collected from fish factories (in 2018 and 2021) and from hydroacoustic surveys conducted in 2014. We found a strong positive relationship between swim bladder and Nile perch sizes. This study reports the slot size of ≥12cm TL and ≥13g for fresh maws, ≥9cm TL and ≥5g for dried maws, as compromise size for Nile perch of approximately >50 cm TL. Therefore, Nile perch maws trade should be regulated and adhere to the slot size regulation by rounding to slot size of ≥12 cm TL and ≥13 g for fresh maws, ≥9 cm TL and ≥5 g for dried maws to ensure that the fisheries and the trade in fish maws are both sustainable

KEYOMBE, JAMES LAST **ORAL**

Opportunities and Challenges in the Lake Turkana Fishery; Building a Sustainable Fisheries Sector

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Turkana County's fisheries sector, which is entirely dependent on Lake Turkana, is vital to the county's economy. The Fisheries Sector in the County supports 1,500 households directly and 1,100 indirectly. Despite its economic and social importance, the sector faces numerous challenges such as high post-harvest fish losses, over-exploitation of some lake areas and weak links between research, management, and other sector players. Furthermore, since the start of devolution in 2013, the sector has been operating without an overall policy and legal framework. The primary goal of the study was to identify important challenges in the management of the fisheries sector in Turkana County that would lead the successful and coordinated growth of the fisheries industry. To capture their perspectives on the problems and potential in the usage of Lake Turkana's fisheries resources, semi-structured questionnaires and Key Informants interviews were used to collect primary data from the sector's fisheries actors. A total of 60 people were interviewed, and their responses were recorded in the Kobo Collect toolbox for later analysis. Secondary data was also gathered from numerous national policy declarations, guidelines, and legislation that have been used to manage Lake Turkana's fishery resources. The findings indicate that a policy directing the exploitation and development of fisheries is required in order to fully realize the potential of fisheries and aquaculture in the County. The development of the policy will lay a solid foundation for the creation of a legal framework to strengthen the sector in Turkana County, which is a necessary step toward achieving sustainable development and management of fisheries in accordance with national, regional, and international frameworks. By leveraging the role of the County Directorate of Fisheries and Beach Management Units in the sectors' monitoring, management, and development, the policy will also promote effective coordination of stakeholders at all levels.

KOLDING, JEPPE **ORAL**

Monitoring and assessing Balanced Harvest approaches in data limited inland fisheries

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Balanced harvest (BH) has been suggested as a "management strategy and collective fishing processes that impose moderate fishing mortality on each utilisable (and societally acceptable) ecological group in proportion to its production, to increase long-term total yields while minimizing fishing impact on the natural ecosystem structure". BH also aims to create an operational strategy to achieve the goals of international conventions and policies, such as the United Nations Convention on the Law of the Seas, the Convention on Biological Diversity, the Ecosystem Approach to Fisheries, and the FAO Code of Conduct for Responsible Fisheries. In addition, the objectives address the 2030 Sustainable Development Goals (SDGs), where meeting food and nutrition security in sustainable ways are a core theme, and to alleviate observed adverse effect of conventional selective fisheries. While the theory and rationale have been widely discussed, it remains to develop methods and indicators for practical implementation, particularly under data limited situations, such as most inland fisheries. This talk will focus on some simple multispecies indicators and reference points that can be used to monitor, evaluate, and assess the status of a fishery in relation to a balanced harvest approach.

KOLDING, JEPPE **ORAL**

The potential of Silver cyprinid (*Rastrineobola argentea*) to improve food and nutrition security in East Africa

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In Sub-Saharan Africa the prevalence of food insecurity is still high. Silver cyprinid (*Rastrineobola argentea*) from Lake Victoria can be sustainably harvested in large amounts with an estimated potential sustainable catch of about 2 million tonnes yearly, which is four times the amount of the current catch. In the present study, whole sun-dried Silver cyprinid was purchased from five market stalls at eight different markets in Kenya and analysed for nutritional value (vitamins, minerals as well as the amino acid and fatty acid profile) and potential hazards (including chemical contaminants, microbial hygienic condition). It was shown that sun-dried Silver cyprinid are a nutrient-rich animal sourced food with the potential of providing a significant daily source of vitamin B12, calcium, zinc and iron. Heavy metal concentrations appeared to be low, but other food safety aspects like microbial counts call for improvements along the value chain. In this study, it was shown that sun-dried Silver cyprinid could contribute to improve malnutrition and food security by providing an affordable, nutrient dense animal sourced food to a large number of people. Improvements along the value chains are needed in order to reduce waste and increase the safety of this food commodity.

LANGENBERG, VICTOR **ORAL**

The Role of Life Scientists in the African Great Lakes' Biospheric crisis: 25 yrs of perceiving success and flaws, and the need for changing tactics

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We are challenged by an emergency that encompasses most of East African Great Lakes Systems (EAGLS), with worrying consequences for riparian communities and the natural environment on which they depend. As the climate and ecological crises seem to accelerate, scientists seem more motivated to improve on the way to engage with governments and society about their ongoing and future effects.

Life scientists — including geohydrologists, pedologists, ecologists, plant and animal scientists, but also medical scientists and public health experts — seem no exception. An increasing number of scientific articles, surveys, and reports have enabled more detailed insights in the scale and rate of physical, biological, and social impacts, and its consequences for water, food and health.

Still, these advances seem insufficient to ensure a conscientious management of the basin's floral and faunal resources. Scientists remain having difficulties to inspire stakeholders to initiate the transformative change required to avoid further lake system degradation, including production and biodiversity loss. On the other hand EAGLS' stakeholders must continue to appreciate the fact that current environmental policies and practices are still inadequate and cannot see us attain a sustainable future.

We elaborate here on how our current academic practises across the EAGLS are weakening our own scientific recommendations and call attention to the need to change the tactics academics use to effectively engage with EAGLS' governments and societies as a whole and influence the sustainable management of future eventualities.

Our aim is to use the GLOW10 as an opportunity to contextualise 25 yrs of EAGLS' research and experiences to shed light on how science can better support riparian institutions, resource users, governments and other stakeholders while integrating the most critical points for socioenvironmental sustainability of the African Great Lakes region.

LUDSIN, STUART A. **ORAL**

Needs for and challenges to successful implementation of ecosystem-based approaches in the world's Great Lakes

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We convened a workshop to learn how to enhance the successful implementation of ecosystem-based approaches (EbAs) in large ecosystems such as the world's Great Lakes. Workshop participants consisted of researchers with global expertise in the natural sciences, social sciences, conservation and management, and policy-making. Herein, we offer insights gleaned from our workshop activities, which included a writing exercise designed to identify the most important needs for and challenges to effective EbA implementation. This exercise's responses fell into six categories that spanned the initial phases of EbA development (e.g., setting clear goals; getting stakeholder buy-in) to the final ones (e.g., adapting to change; maintaining program support). While setting clear, measurable, achievable goals was identified as most critical to successful EbA implementation (mentioned in 28.3% of the 46 "needs" responses), it also offered the fewest barriers (only mentioned in 2.6% of the 42 "barrier" responses). By contrast, accounting for limitations in governance structure and navigating administrative constraints posed the biggest barrier (26.2% of responses), with inability to sustain support for EbA efforts (21.4% of responses) and getting stakeholder buy-in (19% of responses) being next most mentioned. These latter three barriers were also identified as critical to EbA success (mentioned in 13.0% to 23.9% of the "needs" responses), thus helping to understand why effective EbA implementation has remained elusive globally. The need for good science (and overcoming associated hurdles) was also deemed important (in 13.0% of "need" responses and 16.7% of "barrier" ones), with effective communication being essential (4.3% to 11.9% of responses). Using these and other workshop insights, we offer recommendations to facilitate effective EbA implementation in the world's Great Lakes so that the biodiversity and societal services they support can sustained or bolstered during the Anthropocene.

LUDSIN, STUART A. ORAL

Overview of the 2019 CSMI program designed to understand harmful algal bloom & hypoxia impacts on Lake Erie's webs

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Harmful algal blooms dominated by cyanobacteria (cyanoHABs) have become commonplace in freshwater lakes worldwide, owing primarily to human-induced environmental change, yet the impacts of these blooms on aquatic flora and fauna remain speculative in most ecosystems. To better understand how cyanoHABs have been influencing the food webs of Lake Erie (USA-Canada), we sampled its western basin before, during, and after the 2019 cyanoHAB season. Herein, we describe our research program, which combined multi-ship synoptic sampling, real-time HAB forecasts, and time-varying, natural gradients in lake conditions to test hypotheses regarding the influence of cyanoHABs on western Lake Erie's food web. Afterwards, we summarize how the lake's phytoplankton, zooplankton, and fish communities varied inside and outside of cyanoHABs. Finally, we discuss the relevance of our findings to East Africa's Great Lakes with the goal of helping agencies in this region better understand and anticipate the potential impact of cyanoHABs on their uniquely diverse and valued aquatic food webs.

MABO, LWABANYA **ORAL**

The Atyid shrimps' fishery of Lake Tanganyika: Implication for Bycatch Management and its Application in Functional Aquafeeds in Zambia

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Even though management of bycatches/discards has been contentious in global fisheries, the problem is less pronounced in artisanal fisheries. This is because most of what is landed in the latter has a consumptive value, thus, fisheries managers have not paid attention to the issue. On Lake Tanganyika, however, the case is different as the endemic atyid shrimps caught as incidental catch in the landings of small pelagics (*L. miodon* and *S. tanganicae*) are commonly discarded and are not a delicacy for people. Even if caught in large quantities, atyid shrimps remain of no economic value and end up being discarded. These freshwater shrimps are mainly from the genera *Atyella*, *Caridella*, and *Limnocaridina* in the family Atyidae, with an average body length (BL) and carapace length (CL) of 3.87mm and 1.02mm, respectively. Thus far, there is data paucity on the current production of shrimps as bycatch and their economic value/use has not been evaluated. It's here proposed that atyid shrimps be utilized for economic purposes as an alternative protein source for functional aquafeed on Lake Tanganyika. Preliminary proximate and mineral composition revealed atyid shrimps to have comparative crude protein (>55% CP) content to fishmeal. Being a preferred prey and highly ranked on dietary index for most piscivores on Lake Tanganyika, atyid shrimps meets the criteria for an alternative protein source. This research study intends to evaluate the possibility of utilizing atyid shrimps in aquafeeds, quantify annual shrimp production and assess socio-ecological trends that may be associated with shrimps as an alternative protein source. The success of the study will help reduce the cost aquafeed in Zambia that currently stands at more than 60% of the total production cost. Conversely, the study will present a chance to understand how valuable bycatches and discards can be managed in artisanal fisheries.

MACKAY, JONATHAN **ORAL**

Aquaculture Suitability Analyses - Examples from Lake Tanganyika, the Region, and the Globe

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In this talk, The Nature Conservancy (TNC) will provide an overview of aquaculture suitability analyses with specific examples from a local and global context. Aquaculture suitability models utilized by TNC are based on multi-criteria decision analysis where complex datasets are scored and combined with the outcome being proposed suitable aquaculture sites. The data input represents the best available data from various sources, including remotely-sensed satellite sensors, ground-truthed, and regional datasets. During this talk, we will introduce a Lake Tanganyika-focused site suitability project. The project focuses on identifying potential locations for cage aquaculture using a site suitability analysis that evaluates ideal environmental conditions for native tilapia (Oreochromis tanganicae) growth while accounting for other lake uses. TNC will also provide examples from the region and globe that highlight the importance of site suitability in the development of aquaculture projects.

MALALA, JOHN **ORAL**

Harnessing the potential of a Conflict Prone Trans-Boundary Fisheries for Blue Economic Growth: The Case of Lake Turkana

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Lake Turkana, a transboundary resource shared between Kenya and Ethiopia is a dependable source of livelihood for over 300,000 people in an area characterized by drought, famine, resource use conflict as it occupies mainly an arid and semi-arid area. It has a great potential to support the livelihoods and economic well-being of the mainly pastoral communities who derive alternative livelihoods from it. The richest fishery is found in the northern half dominated by the Omo River wetlands. Despite being semi-saline, it supports diverse fish species many of which are exploited at subsistence level by the indigenous communities living in the riparian countries. Fish production has stagnated over the years yet the potential is high. Currently production is over 14,000 metric tons valued at over 1.2 billion Kenya shillings (USD 11 million), significant quantities of which are exported in the Great Lakes Region of Africa. The Fish production potential has been estimated at over 30000 metric tonnes valued at 3.5 billion Kenya Shillings (USD 40 million). Insecurity, resource use conflict, inadequate production, processing and market infrastructure, weak market linkage and access, poor beach infrastructure, amongst some of the factors identified as inhabiting the realization of the full potential of the fishery. We present several management measures specific to this waterbody and developed from field surveys and best practices aimed at reducing resource use conflicts, enhance shared resource use, boost livelihoods, generate wealth and improve living standards hence boost the blue economic growth in this unique region. quantities are also exported to markets in the great Lakes region while production in the northern part goes mainly to markets in Ethiopia.

MASESE, FRANK **ORAL**

Challenges and opportunities for sustainable management of transboundary water resources in East Africa

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Transboundary waters include more than 263 watersheds and 300 aquifers that cross the political boundaries of two or more countries. International river basins cover over 45 percent of the earth's land surface and affect roughly 40% of the world's population. They also represent nearly 80% of global river flows. Transboundary basins and aquifers connect populations in different countries, making them interdependent not only hydrologically but also economically and socially. In East Africa, many inland aquatic ecosystems are transboundary between two or more countries, which presents opportunities for water cooperation for shared prosperity. However, several emerging and persistent challenges make transboundary water resources management more of a bane than a boon. The conflict between water uses for hydropower and agriculture, land use change and land degradation, reduced river flows and degraded water quality, poor condition of hydraulic infrastructure, and the legacy of pollution all have implications for health, economy, and stability in the region. These challenges are further complicated by climate change, which alters rainfall regimes, resulting in droughts, and flooding. The existing legal and institutional frameworks for regional cooperation on governance and shared water resources provide excellent opportunities for sustainable integrated water resources management in East Africa but require improvement. There are also opportunities to reconcile differences between countries in water-use objectives, management capacity and political approach for effective management of transboundary water resources. There is a need for novel and innovative approaches to help find sustainable long-term solutions for the reasonable and equitable use of shared water resources. For river basins, these approaches include water accounting and sharing arrangements for people and the environment, including assessment of environmental flows, payment for ecosystem services, biomonitoring, and involvement of community participation in management through citizen science. Transboundary water management that is effective can benefit people who depend on it.

MGANA, HURUMA **ORAL**

Seasonal patterns in growth of three commercially important pelagic fish species of Lake Tanganyika, Kigoma, Tanzania

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The pelagic fish catches in Lake Tanganyika are dwindling and the sizes of *Lates stappersii*, *Limnothrissa miodon*, and *Stolothrissa tanganicae* appear to be declining. The causes of the declining catches and changing fish sizes are elusive, although a link to lake warming/climate change that is affecting growth rates of these species have been suggested. This study investigated growth based on otoliths microstructure of *Lates stappersii*, *S. tanganicae*, and *L. miodon*, the most important pelagic fish species of Lake Tanganyika in order to understand the influence of seasonal dynamics of environmental factors on growth rates of, and possible long-term effects to, the three fish species. Otoliths were collected from fishes using standard protocol followed with biometric characteristics measurements using standard techniques. The otoliths were photographed using the NIS-Element program, and the growth rings were counted using the ImageJ program. The growth data was divided into two seasons—dry (cold) and wet (warm)—and then fitted with a linear function. Seasonal differences were then examined using the F-test. The regression of the growth slopes was then compared using the analysis of covariance (ANCOVA) between seasons and between species. The results indicate that all the species exhibited preferential growth increments during the cool (dry) period of the year and that seasonality in environmental variables seem to be the driving force of this patterns. This suggests that if lake temperatures continue to rise, some pelagic species may grow more slowly overall, which could eventually lead to smaller individuals predominating the catches. There are two probable routes that warming affects fish growth in Lake Tanganyika: stability of the thermocline that locks nutrients in deep water, this affecting food availability; and physiological effects from increased water temperatures.

MUUMIN, HASHIM **ORAL**

The Lake Tanganyika sprat, sardine and perch value chain in Tanzania: Summary analysis and design report

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The Lake Tanganyika sprat, sardine and perch fisheries value chains report presents the outputs of analysis and design work completed early 2022. The FISH4ACP study methodology used the FAO's Sustainable Food Value Chain (SFVC) and Agrinatura's Value Chain Analysis for Development (VCA4D) methodologies. It has four main components as follows:

The functional analysis revealed that there are two market channels in the Value Chain (VC). The domestic channel is 64% of the total fish catch while export channel is 36%. The fisheries are artisanal with 85% of the catch sold to processors. The processed fish are smoked perch or dried sprat and sardine for preservation and sold to Wholesalers, exporters and retailers. Processors sell 66% to wholesalers and 34% to exporters.

An assessment of the economic performance of the VC revealed low profitability for processors and high to fishers where the number of actual full-time remunerative jobs is 10% of total Full-Time Equivalent (FTE) jobs. Return on sales for processing are very low (4%) compared to the fishers, wholesalers and retailers selling fresh or frozen fish (i.e. 21%, 18% and 20% respectively).

In assessing the environmental sustainability of the VC, found that the VC is dependence on fossil fuel especially firewood for fish smoking. There is a lack of adequate monitoring and enforcement of laws and regulations related to illegal fishing, water pollution and air pollution as well as regular formal stock assessments, which limits information on the stock status.

The analysis proposed upgrading strategy, which consists of four key elements, aiming to improve the (economic, social, and environmental) sustainability performances of the VC. Those are; (1) VC actors adopting improved processing and cold chain techniques, (2) VC actors adopting improved business models to supply high-value markets, (3) Increased participation by women and (4) Increased compliance with fisheries legislation.

NAHAYO, DEOGRATIAS **ORAL**

Water quality assessment of major influent rivers of the Lake Kivu, Rwandan side

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Lake Kivu and its surroundings are of great economic importance to the population of Rwanda and the Democratic Republic of Congo (DRC). However, all the benefits and the multiple activities in the lake and its surroundings have increasingly been put under threat by anthropogenic activities. This study aimed at assessing the water quality of the major influent rivers of Lake Kivu on the Rwandan side. To achieve this, the following methodology was used. The samples were taken from seventeen rivers in four seasons for 2018 and 2021. Fifteen parameters including pH, Electrical conductivity, Turbidity, TDS, Nitrates, Nitrites, Ammonia, Phosphate, Chloride, Copper, Manganese, Total iron, Total Hardness, and Zinc were tested to calculate water quality index (WQI) for assessing their effects on the water quality of the Lake. The water quality results showed that some rivers present increasing trends of water pollution in comparison with recommended values for natural water sources. For instance, it was found with high-temperature values in Nyabahanga, Mugonero, and Musogoro rivers while Mwaga and Muregeya rivers present high Nitrite levels compared with the recommended values by the standards. It was also found that the Sebeya river presents the highest turbidity and ammonia. These results were confirmed by computing the averaged Water Quality Index (WQI) of 284.37 which is ranked as very poor water (200-300). The high pollution was due to turbidity, ammonia, and nitrate content in most of the rivers and moderately from nitrites and phosphate. The reason behind this should be caused by land use/land cover change due to human activities like a decrease in forested areas to cropland, industrial water uses and its effluent discharged into the Lake. Therefore, catchment restoration measures are needed to safeguard the Lake from its surrounding pollution.

NAHAYO, DEOGRATIAS **ORAL**

Assessing land-use/land-cover effects on the hydrological regimes of the major influents of lake Kivu, Rwandan side

Nahayo, D.,[1]* Ntwali, J.,[2] Ujeneza, E.,[2] Dusabimana, J.,[2] Nsanziyera, A.,[2] Habimana, J.,[2] Muvundja, F.,[3] Mudakikwa, E.[4]

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Floods are natural hazards that most countries cannot estimate the magnitude of disasters they are causing. Information about losses from them is crucial to develop policies for risk reduction. This research aimed at assessing the land-use/land-cover (LULC) effects on the hydrological regimes of the major influent rivers of the lake Kivu. This research aimed at assessing the LULC effects on the hydrological regimes of the major influent rivers of lake Kivu on Rwandan side. To achieve this, the following methodology was used. The exploratory field survey was done around the lake. The LULC tagged image file format (TIFF) of 2000, 2010, and 2020 were analyzed in quantum geographical information system (QGIS) to detect LULC change during each decade, and to weigh the soil conservation service-curve number (SCS-CN) of each subbasin. Six rain-gauge stations data were chosen to develop rainfall intensity-duration-frequency (IDF) curves for estimating the design storms. The hypothetical 10-year-return-period storms were chosen as the only inputs of the meteorological model. The HEC-HMS model was used to evaluate the effects of LULC variations on the rainfall-runoff response at the end of each decade (2000, 2010, and 2020). The LULC change detection showed that, in 20 years, forested areas, grassland, cropland, water body, and built-up areas were highly changed. The decrease in forest cover (61.4%, 57.3%, and 38.2%) and increase in grassland/cropland (4.4%, 7.9%, and 11.0%); and 31.8%, 32.0%, and 47.8% respectively) have significantly affected the increase in runoff volume in all 17 watersheds [e.g.: 243.08m3/s (46.27mm), 252.62m3/s (47.44mm) and 299.78m3/s (53.07mm) in Musogoro watershed]. Afforestation and riverbank protections can contribute to the reduction of runoff volumes for flood management, and the water pollution from effluents discharged into the lake.

NAKIYENDE, HERBERT **ORAL**

Solar lights as alternatives for increased and sustainable fisheries production in lakes Victoria and Albert, East Africa.

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Light fishing, the technique of catching fish by light attraction, is commonly used globally to target small pelagic species (SPS). In Uganda, the technique emerged on Lake Victoria in the 1970s to target *Rastrineobola argentea* and later spread to lakes Kyoga, Nabugabo, and Albert to target other SPS such as *Engraulicypris bredoi* and *Brycinus nurse*. Initially, light fishing was by use of the polluting and dangerous pressurized kerosene lanterns as source of light. Following a demonstration of solar light fishing technology on Lake Victoria by the National Fisheries Resources Research Institute, fishers of *R. argentea* quickly switched to solar-electric lanterns because they have lower daily operation costs, catch more fish, and are safer. But the Nile perch fishers have successfully lobbied against their use, claiming that solar lights exasperate the problem of declining Nile perch stocks by having a much higher bycatch mostly of juvenile Nile perch. Our study presents recent scientific data from fishing experiments with solar and kerosene lanterns, showing that solar-electric lights are safer, better for the environment, and can contribute to more productive and sustainable fishing. The SPS light fishery has greatly increased annual yields in lakes Albert (from <60,000 tonnes (t) dominated by large-bodied species in the 2000 to > 330,000 t dominated by SPS in 2020) and Victoria (from <100,000 t by 2005 to > 300,000 t dominated by mukene (50%) in 2021)). The light fishery also currently employs ~60% of the lakeside fishing communities, the majority women and youths engaged in fishing, processing, and marketing. We conclude that the benefits of environmentally safe solar for increased fish production, employment, and improved livelihoods are threatened by fishing conflicts. The solar light technology, when operated at the right fishing grounds (depths) using appropriate intensities and net panels, can well co-exist in the multi-species fishery.

NGOCHERA, MAXON **ORAL**

Assessment of the status of *Oreochromis* species and Other Shallow-water Stocks in the Southwest and Southeast Arm of Lake Malawi

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There is overwhelming evidence that the shallow water stocks of Lake Malawi have been noticeably overexploited predominantly through fishing. Recently, there have been initiatives to restore some critical areas such as enhanced monitoring, control and surveillance, revamping of local fisheries management authorities and establishments of community managed fish protected areas or sanctuaries. Yet, information evaluating the impacts of such interventions on the fish stocks is limited amidst increased fishing pressure, environmental degradation and climate change. We instituted a study to determine the current status of Chambo (*Oreochromis* spp.) and other shallow water fish stocks of the southwest arm (SWA) and southeast arm (SEA) of Lake Malawi. The status of fish stocks collected using the RV Ndunduma in the two arms was assessed using stock abundance and biodiversity indicators. A total biomass of 10,722 tons was estimated in both regions with the SEA contributing 57%. The biomass for Chambo was estimated at Chambo was 3,964 tons of which 54% was registered in the SEA. Overall, Chambo (Oreochromis spp.) was among the top ten fish that contributed a significant amount by weight to the total sampled catch. Fish diversity between the SEA and SWA was comparable at 3.64 while the effect number of species (ENS) was 38. The study also agrees with previous observations that indicated an overall decline of fish stocks in the shallow areas as compared to the open and deep water. This is worrisome considering the efforts by Government and its partners to ensure the restoration and sustainability of fish stocks in such critical areas. It is therefore strongly believed that regulating mesh sizes, limiting fishing effort and protecting critical breeding habitats are critical in reversing the observed trends.

NIYOYITUNGIYE, LAMBERT **ORAL**

Assessment of Physico-Chemical and Trophic Characteristics of Lake Tanganyika Water, with Reference to Pollution Stage and Pisciculture Potential

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The water of Lake Tanganyika is subject to changes in physicochemical characteristics resulting in the deterioration of water quality to a great pace. The present investigation was carried out on Lake Tanganyika at 4 sampling sites and aimed to assess the water quality with reference to: (i) its suitability for fish culture purposes, (ii) determining the trophic and pollution status of the sampled stations, (iii) establishing an inventory and taxonomic characterization of fish species diversity and (iv) highlighting the effect of pollutants on the abundance and spatial distribution of fish species. The physico-chemical and biological parameters of water samples were compared to desirable and acceptable international standards for fish culture and the results of comparative analysis indicated that the Lake has a high fish potential as the most important of the water quality parameters were suitable for fish culture. The investigation revealed the occurrence of 75 species belonging to 7 different orders and 12 families in all sampling sites and among the different species recorded, those belonging to the order Perciformes and the family Cichlidae were most dominant. The values of transparency, chlorophyll a and total phosphorus were indicative of eutrophication phenomenon. Besides, Kajaga and Nyamugari stations were found heavily polluted while Rumonge and Mvugo Stations were moderately polluted and for this purpose, three categories of fish species have been distinguished, depending on their adaptation level to pollution: polluosensitive species, polluotolerant species and polluoresistant species.

PETERS, LISA **ORAL**

Using eDNA/eRNA analysis to assess change metrics in aquatic community health

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Increasing pressures on environmental resources have necessitated the advancement of minimally invasive tools for environmental assessment and monitoring programs. The development of environmental DNA (eDNA), RNA (eRNA), and sediment paleoDNA as monitoring tools have greatly contributed to this objective. At the International Institute for Sustainable Development's Experimental Lakes Area (IISD-ELA) several studies have been conducted that contribute to our understanding of the utility, and constraints, of these methods for aquatic monitoring programs in North American lacustrine environments. Environmental and biological factors that can affect eDNA detection such as lake retention time, stratification, and species distribution within a lake have been investigated. Other studies at IISD-ELA have isolated eDNA from sediment cores to reconstruct the plankton community of an impacted lake and to guide restoration efforts to recolonize an extirpated keystone species. Findings from these research projects have applications to the development of fish and fish habitat monitoring programs in Great Lakes environments. Case studies will be presented with the intent of facilitating collaborative discourse.

PLISNIER, PIERRE-DENIS **ORAL**

African Great Lakes limnological cycle driven by trade winds

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Several African Great Lakes (AGL) show a similar limnological sequence during an annual cycle. Seasonal winds (trade/monsoonal) pile up epilimnion water over several months at the extremities of lakes which are stratified (permanently or occasionally). This tilting of epilimnion waters corresponds to an accumulation of potential energy. At inter-monsoon or transition periods, trade winds change in direction or speed. This induces a relaxation of the tilted epilimnion and internal waves. Those could be influenced by the Coriolis force (Kelvin waves) and induce stronger mixing along the coasts resulting in planktonic blooms, fish kills, and various events which may be considered as proxies of lake mixing. The magnitude of those events is expected to be particularly intense in lakes with a strong vertical gradient of nutrient and dissolved oxygen concentration. The frequency of those mixing events presents two peaks during the year corresponding to inter-monsoons when relaxation of trade winds and tilted waters are expected. The redistribution of this potential energy has a strong impact on the lake's ecology. A long-term monitoring of a few variables at each lake, particularly at the northern and southern ends, would allow a better understanding of the way the AGL behave, and hence possibly predict the frequency and magnitude of events such as planktonic blooms and fish kills. A common approach amongst African Great Lakes would boost the knowledge of those ecosystems and possibly open ways of forecasting changes in various fields including fisheries.

SIBOMANA, CLAVER **ORAL**

Lake Tanganyika biodiversity conservation challenges and opportunities: the case of a highly populated country, Burundi

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Despite its importance, Lake Tanganyika ecosystem is threatened by changes induced by human activities which have detrimental consequences for its water resource and biodiversity. The main threats are fish stock over-exploitation, deforestation, sedimentation, climate change and pollution caused by domestic and industrial sewage, and nutrients' deposition mainly from agricultural land. These human-induced threats are more severe in the lake shore next to the most populated areas of the lake basin where land use has rapidly changed. Among the riparian countries, Burundi has the highest population density in the Lake Tanganyika basin and the country has the greatest portion of the watershed compared to its surface area. Along the lake shore, the Burundian side has the highest concentration of human settlements with cities and towns, and a minimal protected area with one national park and one nature reserve. Thus, the anthropogenic pressure, which is concentrated in the northern part of the lake, is highest in the Burundian part where increasing human population density coupled with poverty has more severely impacted the Lake Tanganyika ecosystem health. In the last decades, the country has gone through political unrest and instability. This situation has resulted in uncontrolled use of natural resources in and around protected areas and other important ecosystems such as Lake Tanganyika, as well as diminished focus on conservation programs for government policy implementation. However, Burundi has recently made significant progress toward biodiversity conservation goals, with the expansion of protected areas and the establishment of legal mechanisms for biodiversity conservation. Despite the challenges, the country's engagement with regional and international mechanisms provides opportunities for the improvement of its legal mechanisms and implementation of biodiversity conservation policy in the framework of the lake-wide initiatives for Lake Tanganyika biodiversity and water resource sustainable management.

TEBBS, EMMA **ORAL**

Towards a satellite-based monitoring system for the African Great Lakes: Pilot study in Winam Gulf, Lake Victoria, Kenya

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The African Great Lakes support rich fisheries and sustain over 50 million people, but they are under threat from a range of pressures including eutrophication, climate change and invasive species. A lack of long-term observations limits our understanding of how these lakes are changing and how to mitigate threats. Current ground-based monitoring is limited in its spatial and temporal coverage. There is a critical need for a satellite-based monitoring system to underpin science and decision-making. However, current global satellite products have been developed using data primarily from North American and European waterbodies and are not reliable for African lakes. There is a need for satellite products and algorithms that are tailored to local conditions, but this requires 'ground-truth' observations for training and validation. We demonstrate how satellite data can improve the monitoring and management of the African Great Lakes, with a focus on two use cases identified as priorities by local stakeholders: harmful algal blooms and invasive floating plants. Fieldwork conducted in June 2022 to collect 'ground-truth' data in Winam/Nyanza/Kavirondo Gulf, Lake Victoria, was combined with satellite data. At 26 stations, water quality parameters and hyperspectral spectral reflectance measurements were collected. These data were used to evaluate the performance of various satellite sensors and to determine the best algorithms for retrieving chlorophyll-a in the Winam Gulf. As a result, maps depicting the spatial and temporal patterns of harmful algal blooms and the invasive floating plant, water hyacinth, in the Gulf have been created. Hence, delivering a satellite-based monitoring system for the African Great Lakes requires the following steps: (1) developing the capacity of local institutions to collect ground-truth data; (2) co-creating satellite products with local partners; (3) producing open source and user-friendly software tools for visualizing and analyzing data; and (4) providing training to local researchers and managers.

TIMLICK, LAUREN **ORAL**

Utility of fish embryo-larval exposures for Great Lakes contaminants research

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When assessing overall contamination of a localized area or the effects of specific contaminants, it is important to consider interacting physical, chemical, and biological effects. Biological effects can be lethal, but there are also quantifiable sublethal effects. Fish are often the trophic level within a freshwater ecosystem that are of highest concern to local populations as they may represent livelihood, nourishment, or cultural significance. The stages of fish development from egg to fry are often the most sensitive to contaminant exposure and are also more simple to house and monitor than exposures with adult fish. In this presentation, we will address how to design an efficient embryo-larval study with minimal equipment, considerations during the experiment's execution, and how to incorporate ethical animal use throughout. We will also discuss potential endpoints that can be assessed using this methodology and share some examples of data generated at the International Institute for Sustainable Development- Experimental Lakes Area (IISD-ELA) in Canada and how these data apply to Great Lakes research.

TUYISENGE, JANVIÈRE **ORAL**

Assessing the implications of cage aquaculture on Lake Kivu

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With human population growth and increasing food demand in the African Great Lakes (AGL) region, capture fisheries are overexploited. Cage aquaculture in AGL provides an alternative for fish production to address food and nutrition security. The contribution of cage fish farming to organic matter and nutrient increase is reported in marine and freshwater bodies where cage aquaculture operates. Such disturbances may induce changes in aquatic greenhouse gas fluxes. However, there is a limited information on environmental impacts of cage aquaculture in the AGL. In the deep (485 m) Lake Kivu, there is an expansion of cage farms in the under-studied shallow nearshore zones (< 40 m). Therefore, there is need to evaluate local effects of these operating cages on these lake's zones. A study is undertaken to assess the environmental implications of cage aquaculture for the nearshore zones of Lake Kivu, focusing on local effects of cage aquaculture on sediment and water quality in Lake Kivu bays and fluxes in greenhouse gas emissions in relation to cage fish farming. In the study sites, data of vertical profiles of the physical chemical characteristics are measured. Nutrient and organic matter are analysed and greenhouse gas concentration and fluxes quantified. Spatial and temporal variations of the measured variables in response to cage aquaculture are determined. Results contribute knowledge on the shallow zones of Lake Kivu, determine the role of cage fish farming in nutrient and organic matter increase in the lakes, and evaluate the role of cage fish farming in CH4, CO2 and N2O emissions. The study provides environmental aspects of the lake in response to cage aquaculture to inform planning and decision-making based on the scientific findings to achieve sustainable cage aquaculture.

UMUTONI, DIANE **ORAL**

Effect of Octylphenol (OP) water exposure to sexually mature female mosquitofish, *Gambusia affinis* life history

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The energy allocation to growth and reproduction, in relation to OP water exposure with different concentrations, was investigated in laboratory experiments with the sexually mature female mosquitofish, *Gambusia affinis*. 4-tert-octylphenol (OP) is an environmental pollutant that has been shown to influence reproduction parameters as well as sexual development and growth. The effects of OP on life history in mature female fish are unknown. Thus, my study investigated the energy allocation between reproduction and somatic growth in sexually mature female mosquitofish exposed to octylphenol (OP) in water for 28 days with 0 (control), 50 and 100 µg/l concentrations. Exposed females devoted less energy in reproduction (reduction in reproduction allocation and embryo fat content as concentration increases) and increased body energy storage (increase in somatic lean weight). Additionally, a high number of well-developed fish with undeveloped or regressed ovaries revealed, and the Chi-square test shown a significant association between this condition and OP concentrations. But still, the mechanism of OP reducing the ovarian development in sexually mature exposed fish is unclear. In conclusion, this study showed that OP increased the energy in body building which may result in obese individuals and the reduction in energy devoted to reproduction, and the elevated number of undeveloped ovary may affect the population with low number of offspring. This study results enforce the point that any stage of life cycle can be affected significantly by EDCs. In a continuous exposure, these results may rise a prediction of the species extinction and the protection of unexposed aquatic environment is needed as well as reducing the use of EDCs and reduce the release of wastewater into aquatic environment.

Keywords: Energy allocation, OP concentrations,

WAKJIRA, MULUGETA **ORAL**

Fish diversity and Fisheries of Omo-Turkana Basin in the face of hydrological modifications

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The Omo-Turkana Basin spans a large part of southwestern Ethiopian highlands and northern Kenya, and consists of the Omo River and a northern portion of Lake Turkana. It is undergoing a period of rapid environmental and social changes, principally in response to the development of hydropower dams and sugarcane plantation on Omo River, consequently transforming the river's regime and its input to Lake Turkana. Nevertheless, the basin lacks full scientific documentation on its fish diversity and fisheries. The main purpose of this study was to assess fish diversity, socio-economic aspects, and related problems of the basin fisheries for better management and sustainable use of the resources. Our present survey supplemented with verified historical data provides an annotated list of 69 native species, for the basin within the Ethiopian limit, out of the 79 total for the Turkana Basin. Despite their considerable socio-economic benefits, the basin fisheries face a number of challenges. Detailed analysis of the problems and viable recommendations have been made to sustain the fisheries contributions.

WANDERI, ELIZABETH **ORAL**

Value Chain Bottlenecks To Attaining Sustainability And Economic Empowerment Of Fisher Communities Of The African Great Lakes: A Case Of Lake Turkana

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Lake Turkana is the largest permanent desert lake in the world and the largest lake in Kenya, rich in endemic fish species. It is a vital source of food, water for drinking and watering livestock, papyrus, and transport, and home to the indigenous community, the El Molos. Despite hosting 79 fish species, food security, hunger, and malnutrition are still significant challenges facing the community depending on these resources. The lack of opportunities to market fish catches from Lake Turkana is attributed to value chain bottlenecks and socio-economic factors attributed to the remoteness of the lake, lack of electricity, poor roads, post-harvest losses, cultural barriers, and illiteracy among the fisherfolk. The post-harvest losses have resulted in losses of catches as most fish fail to meet hygienic standards. Consequently, most fishermen rely on traditional sun-drying methods to preserve fish which is not sustainable as most fish are predisposed to pests and parasite infestation. Also, sun-drying fish on beaches reduce the quality of the fish due to the accumulation of sand particles. Post-harvest losses have also been due to a lack of electricity, forcing the fishers and sellers to use sun-drying or frying, yet most buyers prefer fresh fish, which also fetch higher prices than sun-dried fish. The lack of markets for fish also prevents the fishing community from maximizing benefits through the sale of fish, nutrition security and sustainable fisheries. This paper presents value chain bottlenecks that hinder the marketability of Lake Turkana fish which has consequently consigned the fisher community to unrelenting poverty. We also discuss existing opportunities for eliminating the bottlenecks to make the fisheries more sustainable and the fisher communities more economically empowered. The study findings are based on anecdotal evidence, personal experiences, conversations with the fisherfolk, value chain actors, and a literature review.

WANDERI, ELIZABETH **ORAL**

Ecological changes in the Lake Victoria Basin: trends, status and a search for mitigation

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Lake Victoria Basin (LVB) plays a central role as an economic growth zone supporting the livelihoods of over 35 million people in the basin with a population density of about 300 per km². The basin is richly endowed with natural resources and related ecosystem services thereof which forms the backbone of its economy. Sustainability of these resources depends largely on maintenance of the basin's environmental integrity. However, in the last few decades, unsustainable exploitation of these natural resources has led to various environmental challenges. These include catchment and riparian deforestation, insufficient sustainable sources of energy for industrial and domestic use, degradation of wetland ecosystems, changes in water quality and quantity, uncontrolled water abstractions, water hyacinth infestation, increasing prevalence of diseases and pests, declining fisheries resources and loss of biodiversity among others. These are further catalyzed by increasing conflicts over resource access and use and inadequacies in policy, laws and institutional structures. It is imperative that comprehensive management strategies are set to mitigate these diverse challenges for posterity. Priority should be given to a coordinated IWRM supported with harmonized regional laws and regulations, enhancing participatory approaches through co-management and citizen science, improved collation and dissemination of research findings, mainstreaming climate change in conservation and agricultural activities, sustainable environmental monitoring and novel approaches of sustaining conservation efforts such as payment for ecosystem services. This paper outlines the challenges facing the natural resources and suggests some strategies which should either be introduced or enhanced to mitigate the continuous degradation of environmental integrity in the Lake Victoria Basin.

WEMBO NDEO, OSCAR **ORAL**

Impact of anthropic activities on the littoral zone of Lake Edward (RDC)

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The littoral zone of the African Rift Lake Edward was studied in terms of its macrobenthic communities on the Congolese side where recent assessments are lacking. The littoral is usually very sensitive to environmental changes and anthropogenic stressors and there is anecdotical evidence that Lake Edward might face a "creeping" biodiversity crisis. Using the standard methodology, shoreline and off-shore parts of the lake were investigated using sieves and dredges. The physico-chemical parameters were measured using a multi-parameter probe. The physico-chemical parameters considered in this survey were within the limit ranges of aquatic life, particularly for the survival and reproduction of aquatic species. Nevertheless, strong variations of some physico- chemical factors over time were observed, as well as the low presence of EPT families in the insect group collected. Mollusk communities were characterized by high dominance of species of the genus *Melanoides*, and a very high percentage of dead shells. This might hint at changes in the water quality and in the overall benthic communities of the littoral zone of Lake Edward Lake. Conservation assessments are broadly needed for the lakes' invertebrate species, particularly in regions where the littoral zone is facing intense pressure from increasing deforestation and pollution, with additional stresses of a changing climate and rising lake levels.

BUHUNGU, SIMON **POSTER**

Assessment of water quality of Lake Dogodogo in Burundi by zooplanktonic diversity indices

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A study on zooplankton diversity and water quality of Lake Dogodogo in Burundi was carried out from April to July 2021 in six sampling stations among which four stations were selected in the littoral zone whereas the two remaining stations were taken from the pelagic zone. The main objective was to assess the water quality of this lake using zooplankton diversity indices for a better management of this fishery resource essential for the surrounding populations. As results, 30 species of zooplankton were recorded in Lake Dogodogo, including 19 species of rotifers, 9 species of copepods and 2 species of cladocerans. The number of species varied from one station to another and from the littoral zone to pelagic zone. The study showed that the pelagic zone is characterized by high zooplankton abundance than littoral zone. The study highlighted species that are essentially pelagic such as *Anuraeopsis fissa*, *Brachionus angularis*, *Brachionus calyciflorus*, *Brachionus falcatus* and *Keratella tropica* and those species are indicators of a high trophic level. The diversity indices used to assess the water quality of Lake Dogodogo showed that the waters are moderately polluted with a low-level contamination of agricultural origin. Therefore, it is necessary to protect this important resource for fish production purposes, which is essential in protein supply for human life.

CHIGAMBA, GLADYS **POSTER**

Costing Ecosystem Services for African Rivers, does it matter in management? A case of Linthipe River in Southern Africa.

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Valuation of environmental goods and services has an important role to play in the protection and conservation of riverine resources. However, literature shows a dearth of information regarding factors that influence people's willingness to pay (WTP) for riverine resources. This research study was undertaken to estimate the value of aquatic resources and key factors that affect the willingness of people to pay for the conservation of the aquatic resources in the lower section of the Linthipe River, one of the main tributaries of Lake Malawi/Nyasa/Niassa, in Malawi. Data was collected through household interviews, focus group discussions, key informant interviews, and contingent valuation (CV) surveys. The study noted that communities were willing to offer annual household contribution of $3.51 per household (generating aggregate annual value of $116,312.38) for the conservation of aquatic resources in the river. This study established that the people's WTP is a function of education level, household usage of the goods and services, community support in the management of the resources, household income, and distance of the household from the river ecosystem. The study further discovered that the pay-out level of the users along Lithinpe River was driven by household usage of resources from the river, period of stay in the area, and level of household income. In conclusion, it is evident that Linthipe river ecosystem is important to the communities considering the higher value they are willing to offer for its conservation. We therefore recommend that the Government and development partners should popularize the important role played by rivers and streams to surrounding communities and beyond to appeal for more support from users. The authorities must further empower the communities along the rivers and streams to sustainably manage the aquatic resources for the continued appreciation of aquatic resources by future generations.

DADI, TALLENT **POSTER**

Availability of phosphorus in sediments of Lake Victoria

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Eutrophication is major global problem; most of the eutrophication is now due to legacy phosphorus stored in the lake sediments. We determined the spatial distribution of P and forms in which P is stored in the sediments of Lake Victoria. We employed P-fractionation to gain insights into the availability of P stored in the sediments. Biogenic silica was analyzed to gain insights into the changes of diatoms abundance over time. Depth profiles for physical parameters in the water column were also evaluated. Decreasing oxygen concentration was observed at the deepest part of the lake from 45 meters onward. Some of the sediments had organic matter content of more than 20%. More than 40% of the P in the sediment is stored in easily available forms. The N:P ratios decreased by more than half from the bottom sediment to the upper sediment indicating the accumulation of P in the lake overtime. Decreasing biogenic silica in the upper sediment layers is an indication of the dominance of cyanobacteria. The high proportion of easily available P is a considerable source of P that can sustain algal blooms especially in the shallow areas of the lake which are prone to re-suspension. The high organic matter content can increase the oxygen consumption leading to anoxia and subsequent release of P bound to iron minerals. Sediments are lake records which can provide many insights into what happened in the past.

FRIDOLIN, CATHERINE **POSTER**

The Role of Shredders in the Dynamics of Particulate Organic Matter in Streams

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The information on the functional feeding groups in the river streams is quite significant for understanding the breakdown of organic matter, energy flow along the river gradients, the trophic relationships and finally the management strategies to minimize activities that could lead into the impairment of the ecosystem functions. This paper discusses the influence that the shredders communities impose on the dynamics of both the course and fine particulate organic matter. The samples of the shredders and the particulate organic matter were collected from the three zones of the Morogoro River, the upper, the middle and the lower zones. The samples were collected in five replicates for each zone. After collection the shredders sample were well preserved using the 70% ethanol and labeled. The samples of particulate organic matter were also preserved and labeled. Both samples were then taken to the laboratory for analysis. In the laboratory the quantities of both coarse and fine particulate organic matter were determined in terms of ash free drymass. The fine particulate organic matter quantity was higher in lower zone than the upper and middle zones. The shredders were identified using a microscope with the help of an identification key. A total of 159 shredders individuals were identified from 5 taxas, Chironomidae, Potamonantidae, Tipulidae, Capniidae and Limnephilidae. The chironomidae showed high dominance over the other since this taxon has a gut that can digest lignin. The results showed that the shredders abundance, composition and diversity were high in the upper zone than in the middle and lower zones. However, there was no significant difference in the CPOM in three zones since $p>0.265$ ($p=0.265$). The FPOM quantities on the other hand showed a significance difference between the upper, middle and lower zone of the river since $p<0.05$ ($p=0.008$).

HAAMBIYA, LLOYD **POSTER**

A Pilot Approach Towards Managing the Commons of Lake Tanganyika

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Arguably, fisheries of Lake Tanganyika operate under an open access regime - where everyone is free to fish. The fishery contributes to the welfare of the riparian communities in terms of employment, wealth generation, social and cultural amenities, as well as food security. However, the absence of an effective Monitoring, Control and Surveillance system on the lake, constrained by inadequate manpower, lack of capacity and capacity development programmes, erratic financing, insufficient field equipment and infrastructure, and interference by local politics, has led to unregulated entry of fishers, use of destructive and illegal fishing gear, unprescribed and illegal fishing methods, low levels of compliance in acquiring fishing permits which has ultimately increased fishing pressure - resulting in decreasing fish biodiversity and production. To address this rampant tragedy of the commons on the fishery, Frankfurt Zoological Society (FZS) partnered with The Nature Conservancy (TNC) to pilot a community-led fisheries co-management approach in five fishing communities, in the Nsumbu Ecosystem of Lake Tanganyika in Zambia. Under the support of the FZS-TNC project, governance structures were constituted, communities supported to establish fisheries management zones and fish nursery grounds, and committee members oriented in relevant fish stock and fishing effort monitoring basics. While results of the initiatives may be moderate, they provide valuable lessons for successful management of the Lake.

MLAPONI, ENOCK **POSTER**

Impact of New Technologies in the Fisheries of The Lake Victoria

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The decline of fish stock in Lake Victoria especially the two major commercial fish species *Lates niloticus* and *Oreochromis niloticus* has resulted due to increasing use of the fishing efforts, illegal gears, eutrophication of the lake and climate changes hereby referred to as environmental changes. However, little is known about the impact of the new technology in fisheries and fisheries activities, this including the growing sector of the fish farming in the lake through cage culture, Long line fishery of the Nile perch, Light fishing of Dagaa. Vertical joining of the gillnets (UKUTA), Use of Monofilaments gillnets, Ghost fishing, and increasing solid wastes.

Keywords: Fishing gears, Aquaculture, Fishing technology, Ghost Fishing

MWIRIGI, NAFTALY **POSTER**

Recommended nutrient daily intakes of micronutrients from Lake Victoria's small pelagic fish for dietary populations.

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People gain nutrients from varied diets, although fish—which are a rich source of bioavailable micronutrients that are essential to human health and often overlooked. A lack of understanding of the nutrient composition of most fish and how nutrient yields vary among fisheries has hindered the policy shifts that are needed to effectively harness the potential of fisheries for food and nutrition security. We find that species from tropical thermal regimes contain higher concentrations of calcium, iron and zinc; small pelagic species contain higher concentrations of calcium, iron and omega-3 fatty acids. Here we use nutrient data of fresh and sun-dried haplochromines sp. and *Rastrineobola argentea* (Silver cyprinid) to identify nutrition abundance of micronutrients for low- and middle-income communities. We find that a 100 g portion of fish cost between 10 and 30% of the cheapest daily diet, with small pelagic fish (Omena and Haps) being the cheapest nutritious fish in the Lake Victoria riparian countries. In sub-Saharan Africa, where nutrient deficiencies are rising, <20% of small pelagic catch would meet recommended dietary fish intakes for all children (6 months to 4 years old and pregnant women) living near to water bodies. Nutrition-sensitive policies that ensure sustainability and promote consumption of small-scale fisheries could help address nutrient deficiencies in vulnerable populations.

MZIRAY, PRISCA **POSTER**

Predictions on the effects of climate change on nutrient availability and primary production in the upper layers of Lake Tanganyika

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Sensitivity of lakes to changes in climate have been widely demonstrated. In most cases, climate warming is predicted to stimulate blooms of phytoplankton and thus generally enhance eutrophication symptoms. However, for Lake Tanganyika in Africa, studies suggest that warming cause a decline in primary production and the productivity of higher trophic levels ultimately affecting fisheries. We applied a coupled one-dimensional hydrodynamic-ecological model (GOTM-FABM-ERGOM) in order to quantify the effect of future climate change (increase in air temperature and decreases in wind speed) on the thermal structure, nutrients availability, primary and secondary production in the upper mixed layer of Lake Tanganyika. Scenarios for increase in air temperature (+0.6° C, +2° C and +5° C) and a decrease in wind speed (0, -10 and -30%) were manipulated for the period 2018-2050 to generate three potential future scenarios: the near future, medium and extreme, respectively, relative to baseline (2013-2017). Our results show that climate changes will induce a cascade of changes in the lake. These include a decrease in the thickness of the thermocline, a decrease in vertical mixing and therefore reduced vertical nutrient fluxes, leading to a decrease in primary and secondary production. Simulations of climate change indicated a decrease in chlorophyll a and primary production (gross primary production) of about 19% and 15%, respectively, in the extreme scenario relative to baseline. A decrease in vertical mixing may also contribute to a shallowing of the oxic layer depth. Future climate change favor flagellates and cyanobacteria owing to its higher optimum temperature for growth while diatoms will be disadvantaged. Thus, continuous change in climate will likely have effects on the lake's planktonic community structure, productivity and fish production, which is currently estimated to provide up to 40% of the animal protein to the surrounding populations in the lake region.

Community Participation in Ecosystem Based Fisheries Management in Restoring Lake Malawi Fish Biodiversity

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Lake Malawi with over 700 endemic fish species boasts about having the greatest fish biodiversity than other freshwater lake in the world. The lake offers services that are socio-economically important to many fishing communities, traders, researchers, tourists etc. However, overpopulation, unsustainable fishing practices and habitat destruction have significantly reduced fish stocks particularly the economically important species like Chambo. Restoring Fisheries for Sustainable livelihoods in Lake Malawi (REFRESH) Project is making new efforts by increasing resiliency to climate change and improving biodiversity conservation through effective and sustainable fisheries management. Through the adoption of the Ecosystem Based Fisheries Management (EBFM) system, the project is engaging communities in finding solutions to the current fisheries management challenges. Establishment and management of breeding areas (sanctuaries) is one of the key areas that the communities are implementing following successful development of fisheries management plans and their subsequent by-laws. Communities are also conserving immediate terrestrial ecosystem, especially vegetation along Lake Malawi and tributaries. The community engagement in the fisheries resource management has brought many success stories that include increased sense of ownership, active participation and establishment of conservation enterprises that shifts focus of the communities away from the fisheries resource exploitation.

NYAUNDI, JOSEPH **POSTER**

Using a Hazard Quotient to Evaluate Pesticide Residues Detected in cultured Nile tilapia, *Oreochromis niloticus*, (Linnaeus 1758) in River Kuja drainage Basin, Kenya

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Concentrations of organochlorine pesticide residues were determined in cultured Nile tilapia (*Oreochromis niloticus*) fish in sampled areas along River Kuja wetlands, Kenya, between August 2016- March 2017 with objective to evaluate residue concentrations in wild and pond cultured fish within a densely populated agricultural areas of South West Kenya. Biota matrices were analysed for selected Dichlorodiphenyltrichloroethane and metabolites (DDTs), Hexachlorocyclohexane isomers (HCHs), and Cyclodienes pesticide concentrations by gas chromatography equipped with electron capture detector (GC-ECD). Organochlorine pesticides (OCPs) observed were below detection limit (BDL) to detectable levels. Higher percentages of DDTs and HCHs were BDL and exhibited consistency, with significant ($p<0.05$) differences in mean contamination levels in fish within the target wetlands, average muscle tissue pesticides concentrates ranged between 0.229-2.541 μgKg^{-1} for Nile tilapia. Most dominant isomer in target species was lindane (γ-HCH) (3.417±SE0.983 μgKg^{-1}) and Methoxychlor. Mean Endosulfan sulfate was 2.499±SE0.071 μgKg^{-1} d.w. and most frequently detected, and Methoxychlor (2.235±SE1.459 μgKg^{-1}), respectively. Concentration for DDT and its metabolites was 0.27–3.71 for p, p'-DDE, BDL–1.098 for p, p'-DDD, 0.105–3.518 μgKg^{-1} for p, p'-DDT with significant differences in mean values and ranges whose levels were below the WHO maximum acceptable thresholds (μgKg^{-1}) in target fish. Ecological risk assessment of pesticides residues in water using the Hazard Quotient indicated the likelihood of cause adverse effects on *O. niloticus* fish ($RQ \geq 1$) and potential human health implications. Interventions and monitoring need up-scaling in minimizing public health risks posed by consumption and exposure.

Keywords: Organochlorine pesticides (OCPs), River Kuja Basin, Gas chromatography, ecological risk

Small fish for small children: Challenges and potentials of increasing the dietary intake of small fish among primary school-age children in Northern Uganda

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Small indigenous fish species (SIS) are ubiquitous in African waters and rich in protein, fatty acids, and micronutrients. They have the potential to address the triple burden of malnutrition: undernutrition, micronutrient deficiencies and obesity. However, the full utilization of these ecologically resilient and productive small fish resources for human consumption is hampered by various factors, such as strict regulations on harvesting and marketing. Furthermore, the role of small fish in contributing to food security and nutrition (FSN) is not well understood and is missing in policies that address malnutrition.

School meals provide an entry point for addressing hunger and malnutrition. This project aims to examine the role of small fish in the diets of primary school-age children in low-income households in northern Uganda. Further, the project will assess challenges and potentials of improving the nutrition of school meals by inclusion of small fish as a strategy to reduce child malnutrition.

To assess environmental, economic, political, and socio-cultural factors that affect the availability, accessibility, and consumption of small fish among children in low-income households, the study will collect quantitative data using a household survey questionnaire. This will be complimented by collection of qualitative data through interviews, observations, and focus group discussions to examine school feeding practices and menus in selected schools, and the potential role of parents, school management and district administrations in facilitating and increasing the inclusion of small fish in school feeding. Study communities will be selected based on their proximity to Lake Albert (and other water bodies) and fish markets in Gulu, Nwoya, and Pakwach Districts with data collection commencing in the second quarter of 2023.

SINDA, MARGRET **POSTER**

Analysis of the quality of fried and smoked Engraulicypris sardella and Copadichromis species using Chitofu 3-in-1 fish processing technology

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One of the factors that affect fish consumption is the quality of fish products. The present study was conducted to assessed the quality of *Engraulicypris sardella* and *Copadichromis* species fried and smoked using Chitofu 3 in 1 fish processing technology in and its efficiency in comparison to traditional smoking kiln and open fire. The processed fish samples were analyzed for the changes in nutritional attributes, microbiology quality and shelf life. The results for nutrient content analysis indicate that there was loss in moisture content and a significant increase in crude protein, crude fat and minerals after processing *Engraulicypris sardella* and *Copadichromis* species in both Chitofu 3 in 1, traditional smoking kiln and open fire. Moisture content, crude protein and crude fat for both fried and smoked *Engraulicypris sardella* and *Copadichromis* species did not differ significantly between Chitofu 3 in 1 and traditional processing units (traditional smoking kiln and open fire), $p>0.05$. Significant differences were observed in TVB-N contents between samples that were processed in Chitofu 3 in 1 and traditional processing units $p<0.05$. On the other hand, there was a significant increase in total viable counts and total coliforms with increase in duration of storage but within the acceptable range of less than 105cfu/g. None of the processed fish samples were analyzed positive for *E. coli* and Salmonella. On the basis of the efficiency of the technology, processing time, oil consumption and the quantity of firewood used to process 2kg of fish differed significantly between Chitofu 3 in 1 and traditional processing units $p<0.05$. Chitofu 3 in 1 is efficient, retains the nutritional attributes and extends the shelf life of fish.

TIMLICK, LAUREN **POSTER**

Fish mucus as a non-lethal sampling matrix to quantify contaminant exposure

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Non-lethal sampling methods are an important developing area in fisheries research, particularly in regions with limited fish populations or with other ongoing external pressures. An effective non-lethal sampling method supplies information that is comparable to that from standard lethal methods, while imposing minimal stress and handling on a fish. Epidermal mucus acts as a barrier between the fish and its immediate surroundings and is easily sampled by swabbing or scraping the flank of a sedated fish. This mucus contains proteins and genetic material that can provide information on stress or immune response. In this presentation, we will summarize the methods of mucus collection, potential research endpoints, and how these endpoints compare to those studied in traditional lethal sampling tissues (e.g., liver). We will also discuss studies underway at the International Institute for Sustainable Development Experimental Lakes Area (IISD-ELA) that use mucus sampling to inform Great Lakes research.

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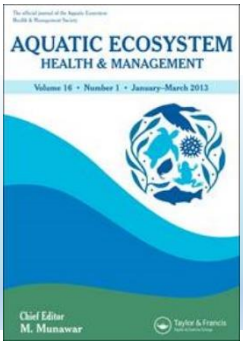

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