



SIL

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Aerial image of the experimental stream array at the Sierra Nevada Aquatic Research Laboratory (SNARL) in Mono County, California, USA. Courtesy: Paul Page (2025)

LETTER FROM

the President

Dear SIL Members,

I would like to share some reflections on persistent inequalities in science and discuss how we can collectively foster a more inclusive and equitable scientific system.

The Universal Declaration of Human Rights, Article 27.1, states: “Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts, and to share in scientific advancement and its benefits”. This declaration affirms our collective right to science and underscores the responsibility of science to support other basic human rights, including access to food, health, security, clean air, and clean water. Despite the universal potential to contribute to science, a significant imbalance persists: 83% of top researchers in ecology and evolution (h-index over 30) are based in just 12 high-income countries (the USA, Australia, and European countries), and only 14% are female (Hughes *et al.* 2023). Similarly, a 2025 Nature portfolio report showed that women comprise a smaller proportion of corresponding authors, which varies over the range of 10-30% depending on the journal subject matter, and decreases as the journals become more selective (Nature 642, 7, 2025). These data reflect deep-rooted inequalities in the scientific system and highlight historically marginalized groups: women, researchers from low- and middle-income economies, and, in particular, non-Caucasian men and women.

While science is an extraordinary human achievement, it shares the imperfections of all social systems (Graves *et al.* 2022)—imperfections that we must identify, confront, and address to create a more inclusive and diverse research culture. A paradigm shift is required. The right to science strengthens the call for science to be more beneficial to society and for scientists to embrace greater social responsibilities (Graves *et al.* 2022). **Achieving environmental goals is impossible without inclusivity.** For instance, how can we halt biodiversity loss in inland waters if most of the world’s biodiversity is concentrated in developing economies, and scientists from these regions are underrepresented? How can we recognize global lake responses to climate change if data from the Global South are lacking? How can we achieve net-zero emissions if African data are excluded from the models? (Mutiso 2022) The answer is clear: we will fall short unless the entire research ecosystem—including scientists, publishers, universities, governments, and non-governmental organizations—takes concrete actions to transform this systemic problem.

“While science is an extraordinary human achievement, it shares the imperfections of all social systems (Graves *et al.* 2022)—imperfections that we must identify, confront, and address to create a more inclusive and diverse research culture.”

Multiple factors contribute to systemic barriers in science, including inequality in capacity building (such as resource allocation and access to information), disparities in funding and access to funds, gender and ethnic bias in the publication process, and language barriers. These obstacles are difficult to overcome and often



require either external support or systemic changes. For example, non-native English speakers spend 51% more time writing papers in English and face 2.6 times more rejections due to English writing than native English speakers (Amano *et al.* 2023). The combined effects of language and economic barriers, along with gender or ethnic bias, further widen the productivity gap: non-native English women from low-income economies experience up to a 70% reduction in productivity compared to native English-speaking men from high-income countries (Amano *et al.* 2025).

Beyond these barriers, the publishing enterprise has shifted from a traditional subscription model to an open-access (gold access) or hybrid model. The original idea behind Open Access (OA) was to benefit researchers in the developing world; however, it has not truly aided North-South/South-North communication or collaboration as intended (Nobes and Harris 2019). The high article processing charges (APC) of gold and hybrid OA—often several thousand dollars—impose a significant barrier for researchers, particularly those in the Global South, who may find these fees surpass their annual research funds or may be forced to divert already limited resources to cover publication costs. Waivers for OA fees exist, but only a small fraction of gold OA articles are covered, and these are generally targeted at researchers in low-income economies, leaving out researchers from middle- and low-income economies (Hughes *et al.* 2023, Nobes and Harris 2019). To be fair, the OA increases access to information; however, this publishing model simultaneously exacerbates inequalities in the scientific community, making publishing less diverse and inclusive. Despite this, the OA model has tripled the revenue of major publishers between 2019 and 2023 (Dewidar *et al.* 2022). So, the question remains: who is really winning—science or the publishers?

Counteracting disparities and increasing diversity in science demand a new agenda: **a cultural shift in which everyone must participate.** One essential step is to foster stronger collaboration between researchers from the global North and South. Researchers in emerging economies also require greater support for capacity building and heightened awareness of the e-resources available to them.

Editorial policies play a significant role in this regard. Increasing the diversity of editorial boards—by recruiting editors with a range of gender identities, ethnicities, and geographical backgrounds—and establishing mentoring programs for editors from underrepresented groups are crucial (Dewidar *et al.* 2022). Implementing double-blind or even triple-blind peer reviews would help reduce bias in the publication process (Hughes *et*

al. 2023). Additionally, lowering the costs of Open Access by transitioning to models like diamond OA is important to broaden participation (Haustein *et al.* 2024).

Representation matters. Underrepresented groups should be promoted as speakers, committee members, and leaders at academic events and in scientific organizations (Dewidar *et al.* 2022). Candidate evaluations in universities and scientific societies should not rely solely on metrics such as the h-index or the impact factor. Instead, a holistic approach—like that advocated by the [Declaration on Research Assessment \(DORA\)](#)—should be embraced, considering the quality and significance of research, mentorship, peer review, and outreach activities. Reference letters and applications for promotions or awards should include targeted information to minimize evaluation biases.

SIL has taken tangible steps to advance diversity and inclusion in the scientific system. In 2021, the Associate Editor Mentoring Program for Early-Career Researchers was launched to train the next generation of editors. This year, the Equity, Diversity, and Inclusion (EDI) Task Force was established, with representatives from nearly every continent. The EDI Task Force crafted the EDI Mission Statement and Core Principles and developed recommendations to foster a welcoming and safe environment at SIL congresses. It also contributed to setting the criteria for the Kilham and Baldi Awards and the Naumann-Thienemann Medal—criteria that were shared and agreed upon by new committee members. As chair of these award committees, I promoted gender balance and the inclusion of researchers from diverse geographic backgrounds to ensure a broad representation. We have made significant progress, but we must remain self-critical and strive to do even better.

As members of the research ecosystem, we must confront reality and actively promote cultural change toward a more diverse and inclusive scientific system. Continuing the current model only perpetuates inequality and undermines our shared ability to achieve the environmental goals required by both humanity and nature. Every action we take matters and can make a difference in the future.

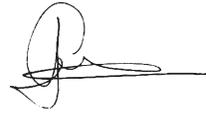
I extend my heartfelt thanks to all the committee members for their collaboration and dedication throughout the award evaluation process. My warmest congratulations go to the awardees: Sylvia Bonilla (Kilham Award), Claudia Bonecker (Baldi

Award), and Warwick Vincent, David Hamilton, and Judit Padisák, recipients of the Naumann-Thienemann Medal.

Wishing you all a Happy New Year, dear members!

Together, let us continue striving for a more diverse and inclusive limnological community.

With my best wishes,



**María de los Ángeles
González Sagrario**

SIL President

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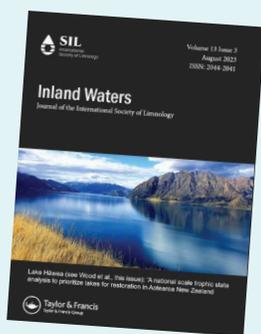
Message from the Editor

This issue opens with a thoughtful letter from our president addressing persistent inequalities in science and outlining SIL's tangible steps to foster a more inclusive global community. Building on this momentum, we hear from our Communications, ECR, and EDI committees, who provide a recap of the 2025 activities and updates on their plans for 2026. A major highlight of this issue is the announcement of the Naumann–Thienemann Medal winners—Warwick Vincent, Judit Padišák and David Hamilton—recognized for their outstanding contributions to limnology; as well as “FOREL goes to the Arctic,” a feature on the sailing vessel using novel technology to study land-sea interactions. Midway through the issue, we traverse the globe with investigations into the drivers of eutrophication in Mexican karst lakes and the role of internal nitrogen loading in the lakes of Estonia. Expanding on climate-related challenges, we discovered how snow droughts and shifting hydrological regimes are reshaping mountain stream ecosystems in the Limnology Around (A More Extreme) World section. After this, we meet PRISMAq, the Pan-American Research Initiative for the Study of Macroinvertebrates, and the Rivers of South America book, a comprehensive new reference for limnologists in the Global South. Closing this issue, we can read an inspiring report from the “Women in Limnology” workshop in Argentina—a model for fostering support in times of crisis. Finally, we pause at the end to remember U. Theodore (Ted) Hammer and celebrate his life and his lasting legacy in lake studies.

Let this issue inspire action to address the pressing challenges in modern limnology.

Juan David González-Trujillo
Editor SILNews

Call for Papers – Inland Waters



We invite researchers to submit their work to *Inland Waters*, the Society's peer-reviewed journal and a leading forum for original research in limnology. *Inland Waters* publishes studies that advance the understanding of inland aquatic ecosystems and their management, spanning all aspects of physical, chemical, and biological limnology as well as applied and regional perspectives. In addition to original research articles, *Inland Waters* welcomes synthesis papers, contributions based on plenary lectures, and themed issues that focus on particular ecosystems, regions, or water bodies. The publication is open to both SIL members and non-members.

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Marble quarry, Vila Viçosa Portugal.
Photo by Estefania Guerra Montealegre

Contribution deadline for the July 2026 issue:
May 2026
Send to: SILnews editor at SILnews@limnology.org

Building Bridges Between Limnology and Oceanography: FOREL goes to the Arctic

Warwick F. Vincent

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As limnologists, we are well aware that François-Alphonse Forel founded the science of limnology in the 19th century and defined it as “the oceanography of lakes” (Fig. 1). This definition was subsequently broadened by Einar Naumann and August Thienemann with the creation of SIL in 1922 to extend to all inland waters, while retaining the integrative approach that Forel sought to achieve across disciplines, from geology and geophysics to chemistry and biology, including land–air–water interactions.

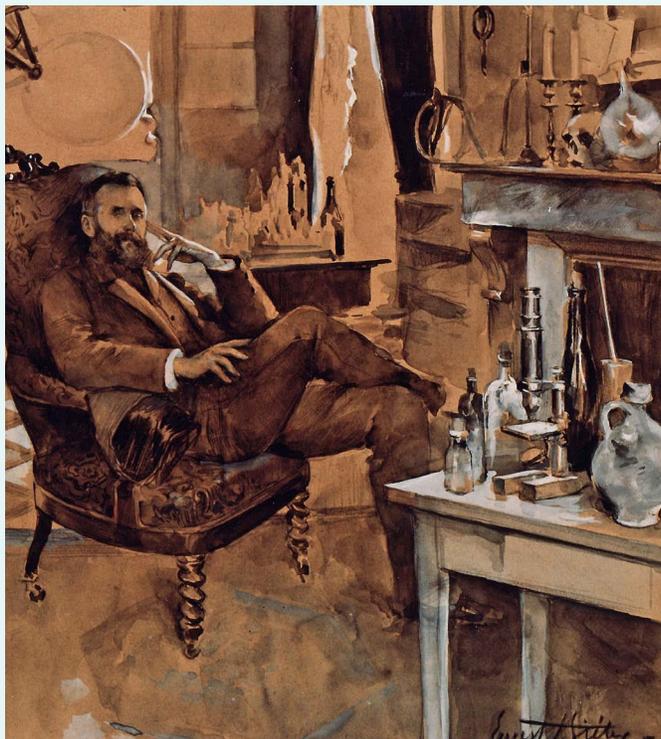


Fig. 1 Portrait of François-Alphonse Forel in his study and laboratory at Lake Geneva (Image courtesy of the Forel family).

It is less well known, however, that Forel’s founding concept of limnology also included the human dimensions of a lake ecosystem. In his seminal monograph on the limnology of Lake Geneva, “Le Léman – Monographie Limnologique,” Forel listed *Homo sapiens* among the species of the lake, devoting more than 200 pages to describing the human ecology of Lake Geneva (le Léman). These topics included prehistoric communities and their relationships with the lake, the ancient and modern history of human settlements, and demographic changes in the basin.



Fig. 2 The FOREL research platform working in the Arctic along the western coast of Greenland (photo credit: Valentin Proutl).

Forel described and analyzed the ecosystem services provided to Lake Geneva residents, ranging from the aesthetic and other cultural pleasures of being on and next to the lake to the more practical matters of safe drinking water, boat transport, and commercial fishing. Forel also drew attention to the environmental and health impacts of human activities on the lake, such as pollution by wastewater discharges, the release of contaminants by steamships, and defective engineering control of water levels.

Many aspects of Forel’s inclusive approach, including human dimensions, are incorporated into the research and outreach program of the new FOREL science platform, named in honor of the Swiss founder of limnology. The FOREL is a 28-m high-tech sailing vessel designed and operated for research across the land-air-water continuum in the coastal polar and subpolar regions (Fig. 2). It has just completed its second year of activities focused on Greenland, with the intention of extending future work to the Canadian Arctic and Antarctica.

In his studies of the limnology of Lake Geneva, Forel developed and applied a variety of innovative technologies and approaches, including a formalized protocol for Secchi disk measurements, automated high-resolution recorders of lake level to observe and model seiches, reversing thermometers to track deep water mixing, in situ moorings to measure photochemically active radiation, and novel dredging systems to sample the benthic animals of the lake. He would be delighted to see the array of novel features and sensing

instruments that make FOREL well suited to the advanced study of coastal land-water ecosystems.

The FOREL has a shallow draft, with a dagger board that can be retracted to work in shallow inshore waters, and a reinforced bow that permits the aluminum vessel to move safely through ice floes and even ride up onto sandy beaches (thanks to its two keels, the ship remains stable when beached). The twin polymer-blade sails allow the vessel to move quietly across the Arctic seas and during long transits without disturbing marine mammals and other wildlife and with a minimal carbon footprint.



Fig. 3 Deployment of the glacier meltwater sampling drone by the EMPA-EPFL team on the deck of the FOREL (photo credit: Julien Girardot).



Fig. 4 Young Greenlanders interviewing a researcher onboard the FOREL during the GreenFjord campaign (Photo credit: Julian Girardot).

FOREL's many projects based on new technologies include sampling of freshwater runoff from coastal glaciers using drones, where it is too dangerous for the vessel or crew to sample (Fig. 3), and the study of land-sea interactions via the atmosphere using a miniaturized air-sampler held aloft by a balloon tethered to the sailboat. These technological developments allow the collection of samples from areas that are otherwise inaccessible while minimizing disturbance to the surrounding ecosystem.

An important complement to the FOREL research program (as it is to all our work as SIL limnologists!) is education, outreach, and knowledge exchange, both during and after the research campaigns. These interactions with the public center on environmental change issues and include youth-oriented activities at the home port of Lorient (France), podcasts, YouTube videos, and schoolchild-focused activities on the vessel during visits to the Arctic Inuit communities (Fig. 4), which have proven to be popular among children, parents, and teachers alike.

The FOREL educational program has benefited from the engagement of many scientists working onboard the platform, who have teamed up with artists, local residents, and others to co-produce novel outreach materials. A notable example is the production of mini-comics that illustrate the different research themes onboard the vessel (Fig. 5). This series is produced in the Greenlandic language, Kalaallisut, as well as in French and English, to ensure full access by local communities.

Greenland and its vast melting ice cap are on the frontline of climate change, with global as well as local impacts on human society. The Greenland Inuit have lived in the land-water coastal environment for millennia and have a vital interest in how the region is changing in response to amplified Arctic climate warming, as well as other aspects of environmental change, such as shipping impacts and microplastic pollution. The friendliness and human scale of FOREL have made it a welcoming platform for connecting with local communities and sharing information across cultures in both directions. In particular, the Inuit perspective that we are all part of the land-water ecosystem is an inspiring concept that is consistent with F-A Forel's original vision of limnology, as humanity now confronts the enormous challenges of planetary change.



Fig. 5 Panel from the 'The Forel Notebook' mini-comics published in English, French, and Greenlandic (Image credit: Forel Heritage Association).

Further information about the FOREL research platform is available at www.forel-heritage.org/en



News from our SIL Officers & Committees



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FROM THE COMMUNICATIONS COMMITTEE

The year 2025 was a year of change for the SIL Communication Team. Building on three years of work dedicated to reconstructing SIL's 100 years of history and the successful rebranding with a new logo and website, the team is now embracing new challenges in an ever-evolving communication landscape.

This year also marks the leadership transition. Juan David González-Trujillo has stepped down to begin a new adventure as Editor of SILNews, and we are delighted to welcome Gülce Yalcin as the new ECR/Student Representative for SIL Communication.

Throughout the year, SIL has remained active and visible online through several successful campaigns, including the Volunteer Campaign, Wetzels videos, and our society journal *Inland Waters*.

Our communication channels have also evolved. After many active years on Twitter/X, SIL made the bold decision to deactivate its account, as the platform no longer aligned with SIL's values—despite having over 3,000 followers. Instead, we strengthened our presence on LinkedIn and launched a new BlueSky account created by Benjamin Misteli (newly elected ECR/Student Representative for SIL Global Outreach and previously a volunteer in the SIL Communication Team).

You can now follow SIL and stay up to date by

 <https://limnology.org/>

 https://www.instagram.com/sil_limnology/

 <https://bsky.app/profile/sil-limnology.bsky.social>

 <https://www.linkedin.com/in/sil-international-society-of-limnology>

Last but not least, are you creative and enjoy creating social media posts? You like to work on wordpress websites? Come join the communication committee contract: cecilia.barouillet@gmail.com

FROM THE ECR COMMITTEE

The SIL Early Career Researcher (ECR) Committee is working with the Global Outreach Committee on several initiatives for next year's Montreal conference. First, we contributed to an Education and Policy session focused on collaborative projects led by ECRs across organizations. This session is being coordinated jointly by the EFYR and ASLO. In parallel, we are working with ASLO and other partner organizations AQUACOSM, GLEON, and SCAS on a global questionnaire aimed at compiling information on the needs, experiences, and priorities of aquatic-science ECRs. The goal is to build a clearer picture of the global ECR landscape and use this knowledge to guide future initiatives.

We are also preparing a network-of-networks effort that will be launched through a series of town-hall events during the ASLO-SIL Aquatic Confluence. This meeting will bring together ECR committees from organizations, including ASLO, EFFYR, AQUACOSM, GLEON, and SCAS, with the aim of identifying shared needs and exploring avenues for deeper collaboration. Potential joint activities include creating a cross-organizational job board, shared communication platforms, systems to promote ECR participation in major events, and co-authored publications summarizing ECR priorities, among others. More broadly, the SIL ECR Committee aims to learn from the strengths of existing ECR groups in aquatic sciences and adapt effective strategies for the SIL community.

Finally, we are coordinating with ASLO to develop mixers for students and early career researchers to foster community building and informal connections across organizations. Additional details regarding these events will be shared as the planning progresses.

FROM THE EDI TASK FORCE

In 2025, we focused on advancing equity, diversity, and inclusion through several key initiatives. We started the year by establishing the EDI Mission Statement and Core Principles, as well as providing recommendations for the election criteria for selected SIL awards. We later focused on two main initiatives: the ASLO-SIL joint meeting and the development of an EDI survey.

Regarding the ASLO-SIL Joint Meeting, we developed a set of recommendations designed to foster a welcoming and safe environment for all participants. These recommendations focus on diversity, accessibility, engagement, networking, and participant safety. In addition, we are organizing a policy and education session entitled "Uncharted Waters: Navigating Equity, Diversity, Inclusion, and Knowledge in Aquatic Sciences." We look forward to meeting you there!

As for the EDI Survey, we developed a survey to better understand the experiences and perspectives of SIL members and non-members regarding EDI. The goal is to support evidence-based actions that promote a more diverse and equitable community within the SIL. The survey will be conducted in early 2026 in collaboration with the Developing Economies Committee. Stay tuned!

Join us! We were pleased to welcome new members and now have representatives from almost all five continents (with Oceania still to come).. If you are interested in volunteering or learning more about our work, please do not hesitate to contact us.

Happy 2026!

EDI and ECR Taskforce



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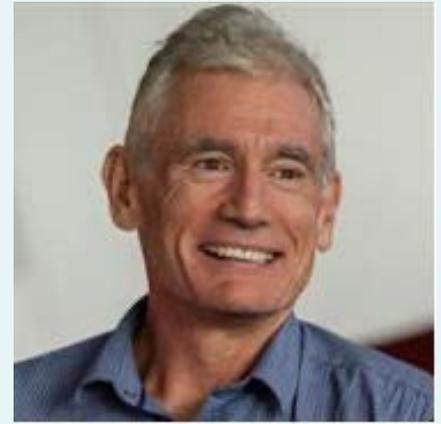
Winners of the Naumann-Thienemann Medal



WARWICK VINCENT



JUDIT PADISÁK



DAVID HAMILTON

The International Society of Limnology (SIL) is pleased to announce that Warwick Vincent, Judit Padisák, and David Hamilton have been selected as recipients of the prestigious Naumann–Thienemann Medal, one of the highest honors in limnology. The award recognizes outstanding and lasting contributions to the study of inland waters and aquatic ecosystems worldwide. The three scientists will receive their medals during SIL’s 38th Congress, held jointly with the Association for the Sciences of Limnology and Oceanography (ASLO) in Montreal, Canada, in May 2026. They will also be invited to share their accomplishments and experiences in a special awards session, where they will be honored alongside other medalists and lifetime achievement awardees.

New job announcement platform!

Content

- Equity, Diversity & Inclusion
- Wetzel Videos
- Workshops and seminars
- Past Congress Presentations
- Jobs
- Looking for a job
- Job Announcements
- Application request form

Job announcement form | Looking for a job form

Job Title *

Application Opening * Deadline for application *

yyyy-mm-dd yyyy-mm-dd

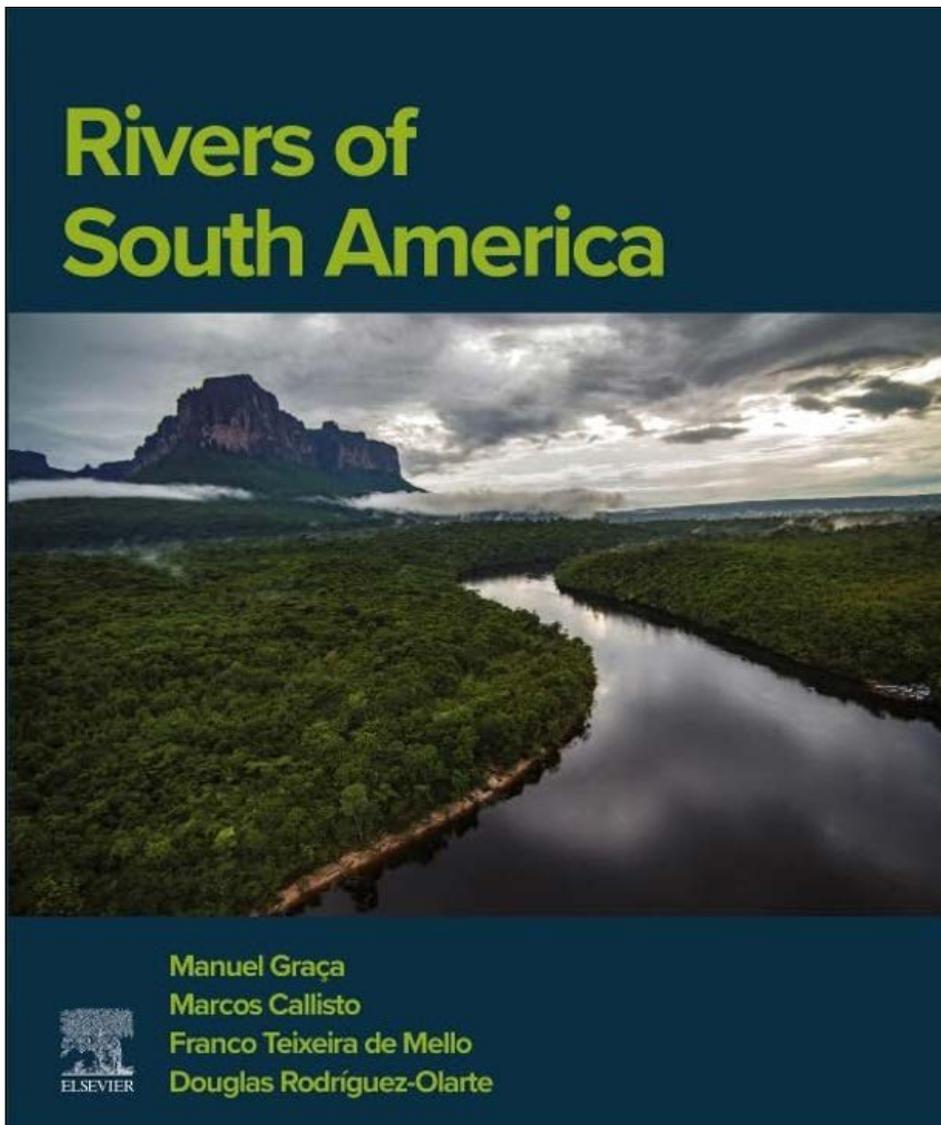
Geographical Location *

Job description (indicate the salary if possible) *

Are you hiring? You can share and post your job announcements directly onto the SIL website using the [job announcement form](#).

Are you looking for a job? You can create a profile and share your CV using the [looking for a job form](#).

Book Announcement



Editors: Franco Teixeira de Mello¹, Marcos Callisto², Douglas Rodríguez-Olarte³, Manuel Graça⁴

Elsevier, 1st Ed., 2024, 800 pages

ISBN: 978-0128234297

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What are the main rivers in South America that shape the lives of its people? What do we know about the biodiversity of South American rivers? What are the main threats to flowing water? What are the knowledge gaps and conservation priorities? *Rivers of South America* is the first book to comprehensively address the biodiversity, hydrology, management, and conservation of South American rivers, as well as their main environmental challenges and the history of Indigenous peoples connected to these systems. South America is home to six of the ten largest rivers in the world and unique, understudied ecosystems. However, pollution from mining and wastewater, dam construction, agricultural expansion, and deforestation has degraded these habitats before their biodiversity and ecological functions are fully understood.

The book originated from a meeting of the IBEPECOR project in 2018, with the goal of providing an updated overview of these systems. *Rivers of South America* has contributions from 140 authors and 45 international reviewers. It describes 89 rivers across 23 chapters, encompassing entire basins, such as those of the São Francisco and Magdalena rivers, as well as groups of smaller rivers draining continental versants, as in basins draining into the Pacific. Very large basins, such as the Amazon and Paraná, encompass heterogeneous biogeography, climate, and orography; these rivers are treated in more than one chapter.

All chapters are enriched with maps, climographs, flag species, and landscape images. When available, long-term discharge data were provided, along with chemical and physical information on river water at selected locations. An introductory chapter

provides general information on the continent's history and demography, biogeography, climate, hydrography, biomes, and land use. The concluding chapter summarizes the threats to South American rivers and conservation priorities.

'Rivers of South America' enables comparisons among different river systems and highlights knowledge imbalances across many basins, identifying key information gaps in the literature. Combining scientific rigor with accessible language, the book stands as an essential reference for researchers, environmental managers, and anyone interested in the conservation of these ecosystems. The content provides key tools for protecting and sustainably managing South American rivers, contributing to the development of effective strategies for their preservation.



LIMNOLOGY AROUND THE WORLD: MEXICO

Tracing Environmental Change Through Time: Human Impacts on the Montebello Karst Lakes

Javier Alcocer¹, Mariana Vargas-Sánchez² and Margarita Caballero³

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<https://doi.org/10.5281/zenodo.18420605>

Human impact has become the leading cause of environmental change in lakes, especially in the neotropical aquatic ecosystems of southern Mexico, owing to the rapid human population growth during the 20th century. Historical data for the study area are extremely limited before 2010, and the few existing records are inadequate for reconstructing the baseline conditions of water quality or biodiversity in these tropical freshwater ecosystems. However, the neotropical ecosystems in southern Mexico represent a hotspot for tropical endemic species that could vanish, possibly even before they are described. The Montebello Lake district in southern Mexico is one of those regions with particular importance owing to its tourism appeal and numerous lakes. This lake district, part of the Río Grande de Comitán Basin, is located on the Central Plateau of Chiapas in southeastern Mexico and belongs to the upper Grijalva–Usumacinta River system (Fig. 1).

The Montebello Lake district mainly consists of Mesozoic carbonate rocks, primarily Cretaceous limestones and dolomites, which are highly karstified and interbedded with marls. Sandstones, shales, and volcaniclastics are also present in areas with complex geological structures in the basin. Karst-driven processes have shaped waterscapes characterized by sinkholes, dolines, and extensive underground drainage networks. In the depressions formed by these processes, 139 water bodies comprise the “Lagunas de Montebello” lake system (Alcocer *et al.* 2023).

The hydrology of the system is shaped by detailed interactions between the surface water and groundwater. The soils—mainly Rendzinas and Leptosols—are thin and rich in organic matter, while Luvisols and Vertisols are common in the valleys, supporting

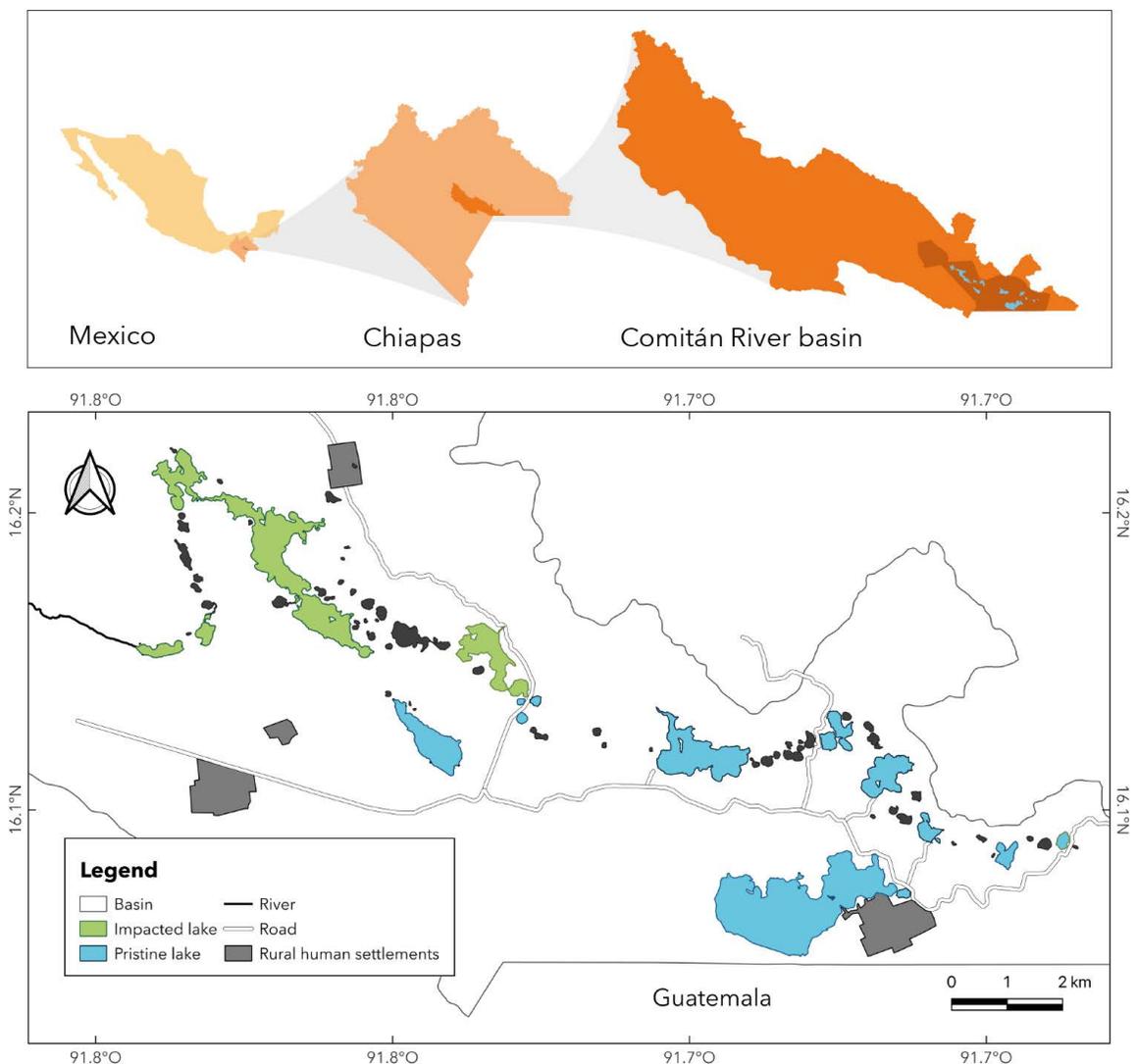


Fig. 1 Geographic setting of the Montebello Lake district within the Grande de Comitán River basin, Chiapas, Mexico (top). Spatial distribution of lakes within the Lagunas de Montebello National Park (bottom). Lakes situated in the lowland plains (green) exhibit anthropogenic impacts and eutrophic conditions, while those in the upland mountain region (blue) retain relatively pristine, oligotrophic characteristics.

agriculture. The humid subtropical to temperate climate, characterized by annual rainfall ranging from 1,200 to 1,800 mm and noticeable seasonality, promotes aquifer recharge that sustains the lakes (Salguero-Olvera, 2018).

Morphologically, lakes are highly diverse, ranging from small shallow bodies to large deep bodies, with water volumes varying by several orders of magnitude (Alcocer *et al.* 2016). Lakes can be divided into two groups based on their location (Figs. 1 and 2). The first group includes lakes on the plateau in the northwestern region, which are mainly fed by groundwater but also receive surface water from the Río Grande de Comitán River. Artificial channels and overflow connect them during the rainy season. The second group consists of lakes at higher altitudes in the southeastern mountains, which are fed almost exclusively by groundwater (Durán Calderón *et al.* 2014). This distinction is essential for understanding the patterns of anthropogenic impact (Alcocer *et al.* 2018). Most human development and activities are focused on the plateau, whereas the mountainous zone remains largely forested and relatively undisturbed by human activity.

The sedimentary record from one of these lakes provides detailed insights into environmental changes during the Late Holocene. Paleolimnological studies have shown a gradual shift toward drier conditions starting approximately 3,400 years ago, linked to shifts in global climate patterns, including changes in the Intertropical Convergence Zone (ITCZ) and variations in the frequency and severity of decadal events such as the El Niño-Southern Oscillation (ENSO) (Franco-Gaviria *et al.* 2020). In Mexico, a period of increased drought intensity was identified during the Classic period of Mesoamerican history (100–900 CE) (Rodríguez-Ramírez *et al.* 2015). This drought period is also evident in the Montebello lakes record, which experienced its most severe droughts between 500 and 900 CE (Franco-Gaviria *et al.* 2020). These harsh conditions caused the earliest Maya inhabitants (Tojolabales and Tseltales) to abandon the area between 900 and 1200 CE. The subsequent absence of humans and increased moisture allowed the cleared forests to recover, leading to the resurgence of montane cloud forests, including tropical and temperate species (Arqueología Mexicana, 2022). Contrary to being a static environment, Montebello displays resilience and the ability to recover despite the climatic challenges.

The main causes of these disturbances have shifted over the past few centuries. When people reoccupied the region between 1200 and 1521 CE, they made significant changes to its landscape. This may have included building or expanding canals connecting lakes on the northwestern plain, which altered hydrological connections and water flow (Ceough, 1944; Alcocer *et al.* 2023). Recently, the region has faced new disturbances caused by human activities such as deforestation, agricultural expansion, and urban development.

The most sudden and widespread change occurred during the 20th century, driven by national socioeconomic and political forces. Programs such as the Agrarian Reform (1940s) and, notably, the National Forest Clearance Program (PRONADE, 1972–1983) promoted deforestation for agricultural expansion (March Mifsud and Flamenco Sandoval 1996). Between 1960 and 2000, the area experienced growth in human settlements and the expansion of intensive farming practices. Land-cover analyses show a drastic

shift from mostly forest to a mosaic where cropland and grazing land made up 55% and urban areas 10% by 2025 (Rivera-Herrera *et al.* 2025). This process was further accelerated by the arrival of Guatemalan migrants from Maya groups (Chuj, Cakchikel, and K'anjobal) in the late 1980s and the creation of communities such as Tziscaco in 1983, which added new layers of social complexity and increased pressure on natural resources (CONANP, 2007).

Sediment cores also showed increasing erosion reaching the plateau lakes, caused by deforestation and land use changes (Caballero *et al.* 2019, 2022). This process has been ongoing since the 1950s and is linked to key trophic shifts, with lakes that were oligotrophic rapidly changing to mesotrophic and eutrophic conditions. These shifts occurred during the 1950s in lakes directly affected by sediment transport and agricultural runoff from the Río Grande de Comitán, and later in the 2000s in less connected plateau lakes (Caballero *et al.* 2025). The start of the system's current degradation can be traced back decades, but major shifts in some lakes occurred in the 2000s, as reported by local residents.

Today, the effects of these increasing pressures are evident, caused by various competing stressors such as fertilizer-rich agricultural runoff, urban expansion, and discharges of untreated wastewater, which degrade the water quality (Rodríguez-Izquierdo *et al.* 2023; Mazari-Hiriart *et al.* 2024). Eutrophication, characterized by high nutrient levels, reduced water clarity, phytoplankton blooms, and hypoxic conditions, leading to fish kills, has become the most serious and dangerous threat. Recently, a striking discovery revealed the hidden danger: although local communities reported sudden changes in water color and sulfur smells starting in 2003, retrospective satellite analysis showed that signs of eutrophication, indicated by color change, were already present in 1990 (Rivera-Herrera *et al.* 2025), and paleolimnology confirmed that deterioration has been ongoing since the 1950s.

This 13-year gap between the initial instrumental detection and visible changes shows how degradation can develop quietly before accelerating suddenly. Currently, degradation levels vary but follow a clear impact gradient based on the initial functional divide: lakes on the northwestern plateau, with more human influence, are the most advanced in eutrophication, while lakes in the southeastern mountain range, with less human activity and more forested basins, remain oligotrophic. This trend is concerning and suggests that eutrophication is likely to continue progressing, thereby threatening these relatively pristine lake waters. Paleolimnological data from one of these apparently untouched oligotrophic lakes revealed that it has begun to exhibit signs of eutrophication, and that deforestation and erosion have impacted this ecosystem, leading to a shift in diatom flora from benthic to planktonic dominance (Caballero *et al.* 2025). Furthermore, rising temperatures have also impacted these lakes, favoring smaller planktonic species at the expense of the original, diverse, and sometimes endemic taxa that were previously present in these lakes.

The long history of the “Lagunas de Montebello” demonstrates its resilience to major natural and climatic disturbances. However, the rapid and combined human impacts over the past century pose a fundamentally different threat against which the system lacks natural defenses. This underscores the urgent need for an



Fig. 2 Lakes in upland forested areas, away from significant human activity (e.g., Lake Tziscaco), have largely remained pristine, blue, and oligotrophic. In contrast, lakes in the lowland plains are surrounded by agricultural fields and urban settlements (e.g., Lake Balanttic), receive inputs of human waste, and show impacted, green, eutrophic conditions.

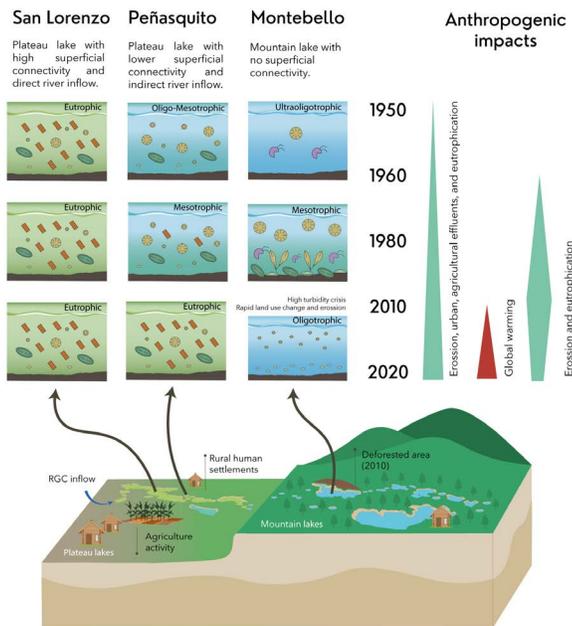


Fig. 3 Schematic representation of plain lakes and mountain lakes, highlighting the different anthropogenic impacts they have experienced over time.

integrated watershed management plan to address both the social and environmental causes of the problem. The sediment record of Montebello offers an important lesson: nature can recover if given a chance to do so. However, this chance now depends on translating scientific insights into coordinated management that views the watershed as a single, interconnected system rather than as separate parts.

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LIMNOLOGY AROUND THE WORLD: ESTONIA

The Importance of Internal Nitrogen Loading from the Water Column in Driving Eutrophication in Lake

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Eutrophication is a widespread environmental problem in lakes worldwide. In the European Union, nutrient pollution affects 38% of surface water bodies (European Environment Agency 2018). The consequences of eutrophication include harmful algal blooms, depletion of dissolved oxygen, changes in aquatic communities, threats to drinking water supplies, and degradation of recreational opportunities (Chislock *et al.* 2013). Climate change is predicted to intensify the harmful effects of eutrophication (Paerl *et al.* 2016a). Research and management efforts to understand and control eutrophication in lakes often minimize or exclude N and focus mainly

on P (e.g., Schindler *et al.* 2016), which has long been considered the limiting nutrient in inland waters (Correll 1999). However, combined P and N enrichment usually results in higher phytoplankton biomass, including bloom-forming cyanobacteria, than P or N enrichment alone (Levine *et al.* 1997; Frost *et al.* 2023), indicating that the concentrations and cycling of both N and P are important for controlling eutrophication (Paerl *et al.* 2016b).

The role of N has not been regarded as important because N fixation by some cyanobacteria is considered sufficient to support productivity in eutrophic lakes (Beversdorf *et al.* 2013). However, N fixation likely does not fully support biomass production in many aquatic ecosystems due to the high energetic costs of N fixation and simultaneous N removal via denitrification (Scott and McCarthy 2010; Scott *et al.* 2019). Increased N loads, that is, N pollution, are associated with shifts to toxin-producing, non-N-fixing cyanobacterial blooms in many lakes (Paerl *et al.* 2016b; Steffen *et al.* 2017). Toxin production by many cyanobacteria, especially non-N-fixing taxa, also increases when N is in excess (Glibert and Burford 2017).

The preferred N source for most primary producers (Glibert *et al.* 2016), including cyanobacteria (Monchamp *et al.* 2014), is the most reduced form, ammonium (NH₄⁺), because its uptake and assimilation are energetically more efficient than those of other bioavailable N forms. Non-N-fixing cyanobacteria are superior competitors for NH₄⁺ compared to eukaryotic taxa (Blomqvist *et al.* 1994). Owing to its high biological demand, NH₄⁺ rarely accumulates in water, and because its concentrations are often low or undetectable, the importance of NH₄⁺ has previously been overlooked (e.g., Dove and Chapra, 2015). Nevertheless, NH₄⁺ regeneration from organic matter remineralization, zooplankton excretion, algal exudation, and other pathways is particularly rapid during summer cyanobacterial blooms (McCarthy *et al.* 2013; Hoffman *et al.* 2022). Therefore, commonly used snapshot NH₄⁺ concentration measurements do not accurately reflect its availability, and turnover rates (i.e., uptake and regeneration)



Fig. 1 Vörtsjärv Lake in summer and winter. Photos: Margot Sepp.



Fig. 2 Lake Peipsi in summer and winter. Photos: Margot Sepp.

should be measured to determine the actual availability of NH₄⁺ for primary producers (McCarthy *et al.* 2013). Measuring NH₄⁺ uptake and regeneration rates can substantially improve our understanding of N dynamics and availability in eutrophic lakes. Several recent studies have shown that internal N loading from NH₄⁺ regeneration in the water column can exceed external N loads by several times and fuel continued phytoplankton biomass and cyanobacterial toxin production, such as in Lake Taihu in China (Paerl *et al.* 2011; Hampel *et al.* 2018), Lake Champlain (McCarthy *et al.* 2013), and Lake Erie (Hampel *et al.* 2019; Hoffman *et al.* 2022) in North America. However, our understanding of N dynamics and the importance of rapidly regenerated N (internal N loading) in driving eutrophication in lakes is still limited. For example, very few studies have addressed NH₄⁺ turnover and N cycling in general during winter in northern temperate regions, where lakes are often ice-covered. These studies have shown that microbes remain active despite cold and dark conditions (Gardner *et al.* 2004; Cavaliere and Baulch 2021). More research measuring N cycle processes across seasons and lake types and determining the main drivers of these processes is urgently needed to provide essential information for developing strategies for eutrophication control and climate change adaptation.

In a recent study, we measured ca. monthly NH₄⁺ uptake and regeneration rates in the two largest lakes in Estonia: shallow, eutrophic, cyanobacteria-dominated Lakes Võrtsjärv (Fig. 1) and Peipsi (Fig. 2), over multiple years (2019–2022), encompassing warm seasons, ice-covered winters, and the exceptionally warm, ice-free winter of 2019/2020 (Sepp *et al.* 2025). Our objectives were to quantify NH₄⁺ uptake and regeneration across seasons, explore relationships between NH₄⁺ turnover rates and in-lake variables (physicochemical parameters, nutrient concentrations, phytoplankton biomass, among others), and evaluate the importance of internal N loading from the water column in supporting the NH₄⁺ demand of phytoplankton, including potentially toxic cyanobacteria.

We observed clear and consistent seasonal patterns in NH₄⁺ turnover across both lakes. Uptake and regeneration rates were highest during summer months, coinciding with elevated water temperatures, increased phytoplankton biomass, enhanced microbial respiration, and higher pH, which are characteristic conditions of intense primary production and cyanobacterial dominance. These conditions stimulated rapid NH₄⁺ regeneration, leading to an extremely high turnover relative to ambient concentrations. In contrast, winter turnover rates were much lower; however, they were never zero. Both uptake and regeneration continued even at water temperatures of approximately 1 °C and under very low light availability, underscoring active microbial functioning throughout the year. The similarity of turnover rates during ice-covered and ice-free winters, despite 2019/2020 being the warmest winter in six decades, indicates that winter N cycling in these high-latitude lakes is constrained primarily by light rather than by the physical presence of ice. This finding demonstrates the importance of winter sampling: without it, the persistence of N cycling during cold, low-light conditions would remain underestimated.

Seasonally changing in-lake variables explained the majority of the variation (almost 60%) in NH₄⁺ turnover rates. Temperature and chlorophyll *a* emerged as strong predictors of the turnover processes, reflecting the fundamental link between biological activity and NH₄⁺ turnover. Microbial respiration rates, dissolved oxygen concentrations, and pH also played important roles, particularly in explaining the variation in light-dependent uptake. The negative correlations between turnover rates and concentrations of dissolved inorganic N (NH₄⁺, nitrates, and nitrites) showed that internal regeneration becomes increasingly important under N-depleted conditions, precisely when cyanobacterial blooms peak and exert strong N demand.

One of the most striking outcomes of our study was the magnitude of internal N loading. NH₄⁺ regeneration in the water column supported the majority of potential NH₄⁺ uptake during the warm season (from May to October), on average 65% in Võrtsjärv and 76% in Peipsi, and often more than half in individual months. These values were similar to those reported for other eutrophic lakes, such as Lake Champlain (McCarthy *et al.* 2013), Lake Erie (Hoffman *et al.* 2022), and Lake Taihu (Hampel *et al.* 2018). The scale of internal

N loading was particularly pronounced in Võrtsjärv in 2020, for which we had complete annual records. That year, the estimated internal N loading from NH₄⁺ regeneration in the water column was approximately 18 times greater than the external N load entering the lake from the three main inflows. Even when compared to historically higher external loads, our estimated internal loading would still exceed the external loading by 5–8 times. Because water column regeneration occurs in addition to NH₄⁺ fluxes from sediments and other internal and external N sources, these results demonstrate that rapid NH₄⁺ regeneration is an important driver of productivity in eutrophic lakes.

This strong internal nutrient loading has major implications for understanding, predicting, and managing the eutrophication process. Many current monitoring and modelling frameworks heavily emphasize external nutrient inputs and rely on concentration data, while dynamic internal processes, such as rapid remineralization, may be overlooked or simplified. Our findings showed that such approaches risk severely underestimating true N availability, especially during summer, when phytoplankton demand is highest and NH₄⁺ turnover is most rapid. Ignoring internal N loading could lead to inaccurate predictions of bloom development, nutrient limitation status, and the potential for toxin production by non-N-fixing cyanobacteria that rely on regenerated NH₄⁺.

Our results also highlight the need to consider climate-driven changes, particularly in winter. As ice cover duration shortens and winter temperatures rise across northern temperate regions, the period of active microbial N cycling may lengthen, potentially increasing the supply of regenerated NH₄⁺ ahead of the summer stratification and bloom season. Altered winter conditions may also affect mixing, light penetration, and the timing of spring phytoplankton growth, all of which interact with nutrient cycling. Simultaneously, climate change is expected to intensify warm-season eutrophication by increasing water temperatures, stimulating respiration and NH₄⁺ turnover, and enhancing cyanobacterial competitiveness. More intense rainfall events and changing hydrology may further modify the external nutrient loads. Given these combined pressures, understanding internal N dynamics has become increasingly important for predicting how lakes will respond to ongoing environmental changes.

Overall, our findings show that NH₄⁺ regeneration in the water column plays a central role in sustaining primary production in eutrophic lakes and that internal N loading can far exceed external loads. This underscores the need for management strategies that target both N and P while recognizing that internal processes can maintain eutrophic conditions even after external loading has been reduced. Incorporating direct measurements of N cycling processes, especially NH₄⁺ turnover, into monitoring programs and ecosystem models is essential for developing effective eutrophication control and climate adaptation strategies that support lake ecosystem health in a rapidly changing, more extreme world.

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Lake Fúquene, Colombia. Photo by JD González-Trujillo



LIMNOLOGY AROUND (A MORE EXTREME) WORLD: USA

Climate Change, Snow Droughts, and Shifting Stream Ecosystems in the Mountains

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Climate change is transforming the seasonal rhythms of rivers and lakes in mountain ranges across the globe. Snowpacks are thinning, snowmelt is occurring earlier, and streams that once flowed cold and fast well into summer now regularly enter prolonged low-flow periods. Snow droughts, or years with unusually low snowpacks and accelerated melting, are emerging as a central expression of climate warming. In the western United States, snow droughts have become longer and more intense over the last four decades, and the region has been identified as a global hotspot for changing snow dynamics (Huning and AghaKouchak 2020; Siirila-Woodburn *et al.* 2021). These hydrologic changes are a challenge for water managers and are reshaping freshwater ecosystems (Power *et al.* 2024). However, these ecological changes are difficult to predict.

In my research group at the University of California, Berkeley, we have been examining how snow droughts alter the rates and timing of key ecological processes and what this means for the linkages between aquatic and terrestrial environments. We are approaching these questions via a combination of long-term observations and large-scale field experiments in California's Sierra Nevada (e.g., Leathers *et al.* 2024; Cowell *et al.* 2025; Evangelista *et al.* 2025; Leathers *et al.* 2025), with the goal of combining attention to mechanisms with ecological realism.

Global analyses provide a sense of the scale of current and impending hydrologic shifts. Using a standardized Snow Water Equivalent Index derived from NASA's Modern-Era Retrospective Analysis for Research and Applications (MERRA-2), Huning and AghaKouchak (2020) showed that in the western United States, snow droughts between 1980 and 2018 became more prevalent, more intense, and approximately 28% longer. At the same time, observational work has documented significant declines in mountain snowpack across the region. Mote *et al.* (2018) reported that April snowpack had decreased at more than 90% of long-term monitoring sites in the western U.S. (33% of which significantly), with losses in the order of 15-30% in average end-of-winter snow water equivalent relative to the past mid-century conditions. In California's Sierra Nevada, high-resolution modelling suggests that the midpoint of annual runoff could occur roughly 25 days earlier under a mitigated emissions scenario and approximately 50 days earlier under a business-as-usual scenario by the end of the century (Reich *et al.* 2018).

Earlier snowmelt, reduced snow-water storage, and warmer air temperatures combine to produce longer and hotter summers with extended periods of low-to-no flow. However, quantifying and predicting ecological responses to these hydrological shifts remains difficult for three major reasons. First, there is a challenge in accurately capturing the cross-scale interactions between regional climate and local hydrology. Even when climate change is the main driver of long-term shifts in hydrology (e.g., in driving shifts from perennial to intermittent flow regimes; Carlson *et al.* 2024), ecological responses are filtered through local-scale variation, from groundwater inputs and channel geomorphology to riparian shading. As a result, communities may show strong spatial variation in how they respond to the same climate stress. Second, due to the difficulty to capture,

via experiments or monitoring, the wide range of processes that are relevant to food-web dynamics and occur at different timescales. Stream organisms can respond to climate change via a wide range of mechanisms, such as physiological, behavioral (including changes in feeding preferences), and phenological; however, most past studies have typically focused on changes in population or community structure. As Kharouba and Wolkovich (2020) argue, there are persistent disconnects between theory and data in the study of phenological mismatches. Last but not least, stream ecosystems do not occur in a vacuum, but rather they are connected to the terrestrial environment via fluxes of organisms and nutrients (Baxter *et al.* 2005). While we know that emerging stream insects transfer critical nutrients (e.g., long-chain polyunsaturated fatty acids) to riparian predators such as spiders, birds, and bats; it remains largely unstudied how drought could alter the strength, timing, and quality of these cross-ecosystem linkages.

Given these complexities, my group has used experimental approaches to probe the potential mechanisms by which climate-induced changes in snowmelt and low flows affect stream communities and food webs. In an experiment at the Sierra Nevada Aquatic Research Laboratory (see the experimental setting in the front page), we manipulated the timing and duration of low-flow periods under otherwise realistic environmental conditions (Leathers *et al.* 2024). We implemented three flow regimes: a "current" hydrograph mimicking present-day snowmelt timing, and two "future" regimes in which the onset of summer low flow was advanced by three and six weeks, respectively (Fig. 1). These offsets were selected based on projections of Sierra Nevada runoff timing under different greenhouse gas scenarios (Reich *et al.* 2018). We then monitored epilithic biofilm metabolism (gross primary production and ecosystem respiration), benthic

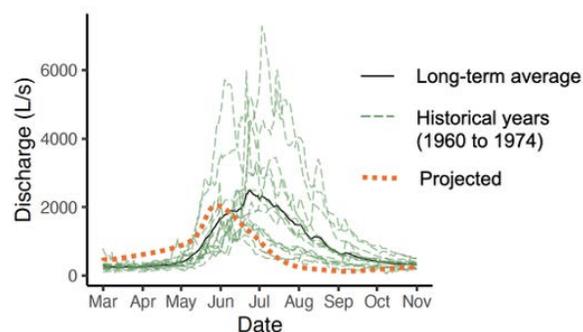


Fig. 1 (Above) Network of artificial stream channels at the Sierra Nevada Aquatic Research Lab (Mammoth Lakes, California), used to mimic the behavior of headwater streams under present-day conditions and future climate change scenarios. Credit: Albert Ruhí. (Below) Historical and future flow regimes of Convict Creek, an illustrative example of a Sierra Nevada headwater stream vulnerable to ongoing and future climate change. The green dashed lines indicate seasonal trends in the mean daily discharge from March to November each year from 1960 to 1974, as measured by a nearby USGS gaging station. The black line represents the daily mean discharge, and the orange dotted line illustrates the projected peak runoff and low-flow conditions advancing up to 6 weeks, in agreement with the downscaled climate change projections from Reich *et al.* 2018. Credit: Kyle Leathers.

invertebrate dynamics, and emergent insects at a high temporal resolution across the spring-summer growing season. Earlier and extended low flows intensified mid-season ecosystem respiration. This result suggests that ecosystem processes may show strong intra-seasonal sensitivity to flow timing. Invertebrate communities also showed fine-scale phenological shifts rather than simple changes in their standing biomass. In the low-flow treatments, many benthic insect taxa advanced or delayed their peak abundances relative to the control hydrograph, and the emergent insect assemblages exhibited changes in species composition and emergence timing. Most of the taxa that contributed to community dissimilarity between treatments were those that changed phenology rather than those that were lost altogether (Leathers *et al.* 2024). In other words, the community re-timed itself in response to earlier and more prolonged low-flow periods. Notably, this ecological shift had important consequences for cross-ecosystem linkages: emergent flux pulses of the dominant insect group (midges, Chironomidae) almost doubled in magnitude, benefitting birds that nested nearby (mostly Brewer's Blackbirds) via an unexpected flux of midges early in the season.

In a second experiment in this outdoor channel system, we examined to what extent insect emergence may respond not just to future low flows arising from snow droughts- but from the interaction between these novel physical conditions and novel biological conditions induced by non-native fish (Evangelista *et al.* 2025). Thus, in addition to manipulating low flow timing (current vs. earlier onset), in half of the channel sections we added non-native brown trout (*Salmo trutta*), a widespread invader in cold-water streams globally. We found that low flows and non-native fish presence had largely additive effects, with non-native trout increasing the seasonally aggregated abundance of emerging insects by up to approximately 12%, mainly by increasing the emergence of Chironomidae and small-bodied mayflies and caddisflies (Evangelista *et al.* 2025). These patterns suggest that invasive predators and climate-driven flow changes can jointly, but additively, reshape the magnitude, timing, and size structure of cross-ecosystem fluxes.

Notably, some observed ecological changes may not be evident from the standpoint of numerical abundance or community composition alone. In this vein, by combining stable isotope analysis with gut content data, we measured changes in the isotopic niche space of three abundant predatory taxa (a Perlidae stonefly, a *Rhyacophila* caddisfly, and turbellarian flatworms; Fig. 2). We found that low flows led to reductions in niche areas, consistent with the idea that environmental stress can narrow diet breadth as predators lose access to certain prey or become more specialized (Cowell *et al.* 2025). This work points toward a key mechanism by which snow droughts may erode food-web stability: by changing foraging choices. Indeed, if extended low flows reduce prey diversity or accessibility, predators may rely on a narrower set of resources, which theory and empirical work suggest increases the vulnerability of food webs to further perturbations (Rooney *et al.* 2006).



Fig. 2 Large stonefly nymph (*Doroneuria*) that specializes in cold-water Sierra Nevada streams. Credit: David Herbst.

Taken together, these experiments provide a mechanistic picture of how snow droughts may alter mountain stream food webs. Earlier, extended low flows shift biofilm metabolism toward higher respiration during critical windows, constrain the foraging choices of predators, and alter the phenology and dynamics of benthic insects that ultimately emerge and connect the stream ecosystem with riparian and terrestrial environments. Importantly, many of these changes occur at fine temporal scales (e.g., over days to weeks) and would likely be overlooked if measurements were taken opportunistically or if they were averaged over time (e.g., seasonally aggregated).

In addition to highlighting the importance of high-frequency sampling, our results suggest the need for further investigation into how the multiple dimensions of global change converge in mountain streams. Climate-induced shifts in snowpack and flow regimes can interact with water abstraction, land-use change, and biological change (e.g., via invasions and extinctions), thereby shaping ecological outcomes (Palmer *et al.* 2008; Siirila-Woodburn *et al.* 2021). Extending experiments and long-term observations to systems with stronger human modification, such as large regulated rivers and urban catchments, would allow us to better understand the role that environmental flow management could play in driving river ecosystem restoration outcomes in the future (Palmer & Ruhi 2019, Tonkin *et al.* 2019).

Looking ahead, I see several key questions and opportunities for limnologists interested in climate impacts on freshwater ecosystems under an increasingly extreme water cycle: (1) Will climate “whiplash” (i.e., intensifying extremes) erode the capacity of stream populations to migrate, acclimate, or locally adapt to changing conditions? (2) To what extent will phenological shifts at lower trophic levels (algal production, stream insect growth, and emergence) propagate to riparian predators (e.g., insectivorous birds), and when can we expect climate-induced trophic mismatches or even ‘novel matches’? (3) Is drought changing the nutritional value of cross-ecosystem linkages, for example, by altering the synthesis and transfer of unique fatty acids (e.g., LC-PUFA) from algae to aquatic and riparian consumers? (4) Finally, how can ecological insights from experiments and long-term observations be incorporated into environmental flow and river ecosystem restoration practices that explicitly account for low-to-no snow futures?

Addressing these questions will require continued integration across disciplines and scales, from global hydrologic modelling to fine-scale experiments, such as those described here, and from individual physiology and behavior to food-web structure and whole-ecosystem functioning. As the cryosphere recedes, the seasonal pulse of snowmelt that has long-structured mountain rivers is being rewritten. For regions such as California and many other snow-dependent regions worldwide, sound science will be essential to safeguard freshwater and the integrity of the ecosystems that depend on it.

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*Hacha river, Florencia, Caquetá, Colombia.
Photo by Estefanía Guerra Montealegre*

Limnological Groups Around the World



PRISMAq - Pan-American Research Initiative for the Study of Macroinvertebrates in Aquatic Habitats

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Small, dynamic freshwater habitats, such as wetland ponds, springs, and headwater streams, are among the most abundant and ecologically important ecosystems on Earth. They support a remarkable diversity of aquatic life but remain largely overlooked in large-scale biodiversity studies that tend to focus on large rivers and lakes. To fill this gap, we must better understand the factors that shape biodiversity in these small water bodies across the Americas.



Fig. 1 Coordinators of the PRISMAq initiative. From left to right, Juan Pablo Bonelli (undergraduate student), Dr. Luis B. Epele (researcher) and Dr. Emilio A. Williams-Subiza

The PRISMAq project was launched in December 2024 as a collaborative initiative seeking to gather an international community of macroinvertebrate scientists aiming to (1) compile a comprehensive macroinvertebrate dataset from studies across North and South America, (2) identify large-scale patterns and drivers of freshwater macroinvertebrate diversity, and (3) develop models to predict how assemblages might shift under future climate scenarios.

Coordination Team (Fig. 1), Juan Pablo Bonelli (undergraduate student), Dr. Emilio A. Williams-Subiza (postdoc), and Dr. Luis B. Epele (researcher) began by contacting more than 100 potential contributors. Datasets of aquatic macroinvertebrates were requested, along with associated coordinates, key hydrological characteristics, and water chemistry data

(if available). Within 5 months, this effort yielded a robust dataset with over 4,500 freshwater bodies gathered from 49 contributors across 14 countries (Fig. 2).

The first article, a data paper detailing the compilation methods and openly releasing the majority of the collected information (some contributors were not allowed to openly publish their data), has already been submitted and is currently under review. The next phase involves preparing a second manuscript to rigorously test the second major objective of the project. Importantly, all contributors retain the right to use their data for independent local or regional-scale investigations.

Looking ahead, PRISMAq is considering a second round of invitations to further expand this dataset. Together, we aim to enhance the visibility of small waterbody biodiversity and contribute to more inclusive freshwater conservation strategies throughout the Americas.

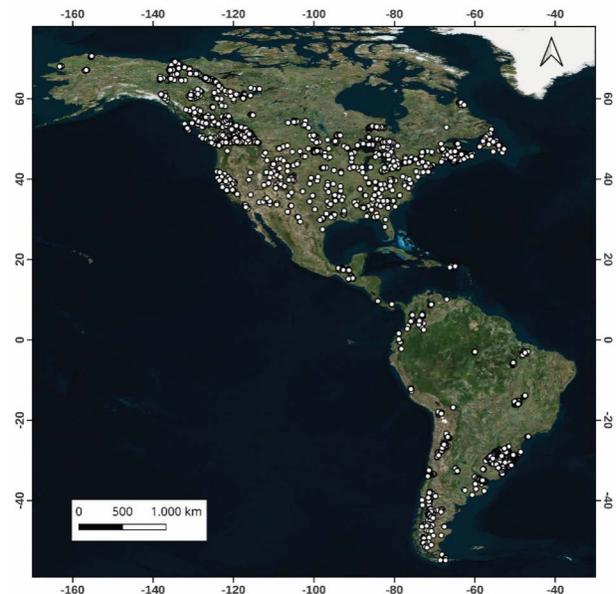


Fig. 2 Geographic distribution of the sites compiled in the PRISMAq dataset.

Find more about PRISMAq: <https://prismaq.org>



Reports from the SIL community

Trankilandia River, San José de Guaviare, Colombia. Photo by JD González-Trujillo

WOMEN IN LIMNOLOGY: HOW TO SUPPORT OURSELVES IN TIMES OF CRISIS. DRAWING ON THE WORKSHOP FORMAT AND EXPERIENCE TO FOSTER REPLICATION AND BROADER IMPACT

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In August 2025, a workshop entitled ‘Women in Limnology: How to Accompany Ourselves in Times of Crisis’ was held at the Argentinean Limnology Conference. The aim of this report is twofold: first, to share experiences and outcomes emerging from the workshop; to foster open discussions about issues that matter to women in limnology; and second, to encourage the limnological community to create similar spaces for dialogue. It was the first workshop of its kind in the 20-year history of this conference. So, by sharing our workshop format, experience, and results, we aim to inspire colleagues to replicate this approach at as many limnology conferences and meetings as possible in the future.

How did we arrive at the idea of holding this workshop?

We are a group of three limnologists who advocate for the empowerment of women in science (Fig. 1). Together, we are part of a team of 17 women scientists who recently published a guide on empowering women in science (de Tezanos Pinto *et al.* 2025). In line with our commitment to continually promote women’s empowerment in the field, we created this workshop as a safe space for discussion at the conference.

Why hold this workshop at a conference?

Conferences are an important avenue for career development; they help raise your profile, allow you to share research results, network, and foster collaborations (Oester *et al.* 2017). They also bring together the diversity of limnologists, including the wide range of leadership roles that women hold.

Why discuss the crisis aspect?

In the workshop title, we chose to include the dimension of crisis because Argentina is currently facing significant cuts to scientific funding, along with growing social hostility toward science, encouraged by presidential discourse. This has a particularly negative impact on women scientists, adding an additional layer to the systemic barriers that women and mothers in science already face, and highlighting the need for creativity and mutual support. Thus, we envisioned the workshop as a safe space where different voices could be heard and hoped to bring together a diverse group of women attending the conference.

What was the format of the workshop?

The workshop lasted for two hours, was scheduled within the conference timetable, and was announced in the program. We scheduled it for mid-week to allow time for continued conversations and networking during the

remaining days of the conference. Between 30 and 40 women, along with three men, participated in the workshop. The women remained attentive and engaged throughout the entire activity. The men stayed for the testimonials but then spontaneously left the room before the group discussion. Notably, the number of attendees was similar to that of regular conference sessions, highlighting the strong interest in the topic. The audience was diverse, bringing together women from different regions of Argentina and abroad at various stages of their scientific careers—from undergraduate students to senior researchers.

The format was entirely new for this type of setting in the country. Instead of traditional, one-way presentations, we chose to share the testimonies of four limnologists addressing the topics of maternity, empowerment, retirement, and gender in limnology. Each testimony lasted 10 min, followed by a 5-minute question-and-answer segment. The women sharing their testimonies stood close to the audience to create proximity (Fig. 1). Second, each speaker sat at one of the four tables. Participants then chose one of the four topics they wished to discuss further in a small group setting (Fig. 1). Before starting the group activities, we provided guidelines, including (i) the time frame (20-minutes), and (ii) the intention that every woman in the group could have the chance to speak while avoiding monopolizing the conversation. Third, after the discussion time ended, feedback from each working group was shared (5 minutes per group) with all participants. We encouraged someone other than the speaker who gave the testimony to present these summaries, to foster leadership and visibility opportunities. Finally, we summarized the main messages and concluded with a photograph of all the participants.

Approximately 5–8 women participated in each discussion group. All the testimonies drew interest from the audience. We anticipated the possibility that one or more tables might remain without participants and had planned that, if needed, participants could be redistributed among the topics that did attract interest, but this was not necessary.

We observed an interesting pattern in the way the participants chose their groups. The distribution was not random; it reflected both personal interests and career stages of the participants. Younger women, mostly undergraduate or early career researchers, were drawn to the ‘Empowerment and Gender Survey’ tables. Mid-career women, many of whom balance motherhood and professional responsibilities, chose the ‘Motherhood table.’ Women approaching retirement gathered at the ‘Retirement’ table. This pattern shows how the participants gravitated toward the topics that resonated most with their current life and career stages.



Fig. 1. Workshop organizers, testimonials, working groups, and participants. The group photo captures the joy, inspiration, and collective energy that emerged from working together on this project.

Below, we summarize the testimonies and main feedback from each group.

Retirement

The discussion in this table started with Dr. María Laura Miserendino sharing her experience of transitioning into retirement. She explained that she felt ready to retire and pass on the legacy of the laboratory she had led. She described how she prepared for this transition, including deciding when to stop accepting new PhD students. She emphasized that she is retiring with a sense of fulfillment, knowing that she leaves behind a strong, well-prepared group with clear continuity. She also highlighted the importance of having a family and engaging in activities outside work.

After Dr. Miserendino's words, several challenges related to retirement were discussed, including i) the legal requirements and paperwork needed to begin the process, ii) financial considerations (the percentage of salary received and the timing of payments), iii) health insurance issues (loss of social security coverage), and iv) uncertainty about possible changes to the retirement age under the new government. Most women in the retirement group held leadership positions (e.g., heads of laboratories, institutes, or museums). They shared difficulties such as i) men questioning their authority and undermining their leadership, ii) the challenge of passing their laboratories on to the next generation, iii) deciding whether they wished to stop working entirely, and iv) planning what to do after retirement.

Gender in Limnology

The discussion in this table started with Dr. Laura Sanchez, Dr. Lilen Yema, and Dr. Verónica Lozano presenting results from a survey on gender issues among Argentinean limnologists. They gathered more than 160 responses, most of which were from women (75%). They found that in teaching environments, all gender-related barriers were selected exclusively by women. The open-ended comments also revealed tensions related to gender inequalities, sexual diversity, and caregiving responsibilities—all factors shaping professional trajectories.

After the presentation of the results, several participants expressed that they initially thought the survey was intended only for women, as they associated the word "gender" with "women," and discussed whether this may have reduced male participation in the survey. They also debated whether "gender" was being equated with "gender-based violence." Job insecurity was another topic, particularly how scholarship-based positions offer no contributions or social security, complicating future retirements. Participants also noted gender differences in team formation, with women often assigned secretarial tasks, organizational roles, or data entry.

Motherhood of children with disabilities and adoption.

The discussion in this table started with Dr. Natalia Ossana expressing that motherhood already represents a major shift in the professional trajectory of many women. When this is combined with less visible realities—such as caring for children with disabilities or chronic conditions, undergoing fertility treatments, or navigating adoption processes—work performance, professional participation, and career advancement become even more complex. These forms of motherhood require immense physical and emotional effort, including miscarriages, medical examinations, ongoing therapies, daily health monitoring, and extensive bureaucratic procedures. This leads to exhaustion, which becomes even heavier within the scientific environment, where constant evaluation is the norm. Her testimony sought to spark reflection and increase visibility around caregiving roles and the challenges faced in non-traditional forms of motherhood.

Participants addressed many facets of motherhood, including daily caregiving challenges, solo motherhood, fertility treatments (medical procedures and emotional strain), miscarriages, and adoption processes (paperwork, bonding, and legal procedures). Moreover, many forms of non-traditional motherhood—fertility treatments, caregiving for children with disabilities, and adoption—lack appropriate work-leave policies. Financial difficulties were also highlighted, especially the struggle to afford schooling on precarious salaries or through loans. Many women noted that these motherhood experiences are often lived in silence, without formal acknowledgement at work, and remain outside traditional understandings of motherhood, leaving them invisible and unrecognized. Participants emphasized the need for institutions to recognize these experiences and include them in their care policies. Explicit references to maternity-related challenges in evaluation and promotion reports could help committees better assess and value women's achievements despite the barriers they experience.

Empowerment of women in science: a guide to good practices.

The discussion in this table started with Dr. Valeria Casa presenting the recently published Guide of Good Practices for the Empowerment of Women in Science (de Tezanos Pinto *et al.* 2025) to the limnology community. She explained that the publication emerged from an intensive and highly collaborative workshop held in 2023, which brought together 17 women from diverse disciplines, backgrounds, and institutions—including the authors of this study—to collectively develop tools for promoting empowerment and equity in science. During her testimony, Dr. Casa highlighted several of the guide's more than 60 recommendations at the individual, collective and systemic levels. For example, in the context of conferences, she emphasized (i) the importance of attending conferences, (ii) asking questions during sessions (as these are often dominated by men), and (iii) when moderating a session, giving the first question to a woman or a young participant to encourage more diverse engagement in the discussion.

Many participants also expressed feeling isolated when facing systemic challenges. For some, this isolation was intensified by being foreign (e.g., from Brazil or Uruguay). A general sense of exhaustion was evident, tied to the ongoing feminist struggle and the realization that progress is never secure but must be continually defended. Additionally, pressures of completing studies, seeking stable employment, managing low salaries amid a national economic crisis, and conducting research with limited funding and resources are prevalent. Many participants expressed this fatigue with anguish, and some even cried. A brief debate arose around the term "empowerment." Some participants felt uncomfortable with the word, perceiving it as an additional burden—another responsibility in their already demanding personal and professional lives. For them, the term can evoke guilt or frustration, as it implies an individual responsibility to

“stay strong” despite structural barriers beyond women’s control. From our perspective, however, empowerment is not an individual task but a collective process built through shared experiences, mutual support, and solidarity among women. For us, empowerment means creating power together—a collective strength that enables us to question and transform systemic conditions that continue to limit our possibilities and voices.

Final remarks

The working format allowed us to cover four important aspects of women in limnology within a short time frame. Participants emphasized how important and healing it was to speak openly about these experiences with colleagues and to feel heard and understood. The discussion also underscores the crucial role of building networks of women—spaces of support, trust, and empowerment that can transform individual struggles into collective strength. We invited participants to leave their email addresses so that we could stay in touch after the meeting, share inspiring articles, and send photographs from the event. Although relationships take time to grow and the workshop lasted only two hours, we believe that continued email communication will help us remain connected and build familiarity ahead of future Argentinean limnology conferences. In fact, members of the retirement group are already collaborating on a research paper on the challenges women face during the transition to retirement.

Our experience serves as a catalyst for similar encounters at limnological meetings, whether courses, workshops, laboratory gatherings or conferences. The format we describe can be easily replicated and adapted to different time availabilities and interests (e.g., work–life balance, ethics, violence, leadership challenges, mental health, sexism, etc.). Other formats that encourage conversation and amplify diverse voices, such as lunch or dinner discussions or activities using cartoons or other visual materials (Pérez *et al.* 2024), can also be used. A longer version of the workshop could be held before the start of a conference to allow deeper conversations and stronger bonds among participants. Regardless of the chosen format, discussing gender remains essential in our field. Even “passive participants,” who may not speak during these encounters, are nonetheless exposed to the content, which can help shape their attitudes toward gender equity (Jackson *et al.* 2014).

The workshop title explicitly invited women to participate because we wanted a safe space for them to speak. Nevertheless, we also want to involve men in these conversations. Indeed, the topics addressed in the workshop concerned both women and men. First, gender does not refer only to women. In addition, many men are or will be parents and may experience the “parenthood effect,” which reduces scientific output and slows career progression for researchers with children (although fathers face fewer barriers than mothers) (Pérez *et al.* 2024). Men may be caregivers of children with disabilities and may eventually retire. Additionally, they must understand the systemic barriers faced by women and support actions that promote equity.

Acknowledgements

We would like to thank the organizers of the XI Argentine Limnology Conference for providing us with this space and supporting a format that is uncommon within the context of the conference. The event was held at the Universidad Nacional del Nordeste (Corrientes, Argentina). We are deeply grateful to all the women who shared their testimonies and thoughts, enriching the workshop with their experiences and knowledge.

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Other Conferences

XII International Shallow Lakes Conference

OCTOBER 4 TO 9, 2026 • BUENOS AIRES

We are pleased to announce the XII International Shallow Lakes Conference, the world's leading event for shallow lake ecology. The conference will take place in Buenos Aires from October 4 to 9, 2026. This meeting is a fantastic opportunity for shallow lakers of the world to share, learn, showcase and debate the knowledge that builds our science. We are preparing an exciting program that invites you to be part of this gathering, which will focus on the ecology of these wonderful water bodies, their structure and function, the essential services they provide, and the biodiversity and natural beauty they harbor.

The motto of the XII International Shallow Lakes Conference is **“Inside, beside, and beyond.”** This guiding theme expresses our vision and approach to research on shallow lakes.

“Inside” refers to our perspective on the ecosystem itself, its biodiversity, the interactions between living organisms, and the forces that regulate the system's state, whether in equilibrium or not.

“Beside” represents the watershed perspective -- the need to understand each water body as a product of geology, geomorphology, climate, and human activities -- and it also encompasses the recognition and appreciation of the ecosystem services that shallow lakes provide to the entire biosphere and society.

“Beyond” leads us away from the field of limnology, because our discipline has given rise to ideas, concepts, and paradigms that have transcended the boundaries of water and have inspired general ecology and other sciences, such as economics and sociology.

This conference will be an excellent opportunity to revisit what we have learned and gain new inspiration for the future.

The [official website](#) is regularly updated with information about the schedule, program, activities, etc. You can also access information through our newsletters (please send an email to shallowlakes2026@agro.uba.ar). We will soon provide more information on registration, abstract submission, and requirements for oral presentations and posters.

Join us and enjoy this extraordinary event.

We look forward to welcoming you!

María Boveri

School of Agronomy (and Environmental Sciences), Universidad de Buenos Aires,
on behalf of the Organizing Committee XII International Shallow Lakes Conference

Obituary



U. Theodore (Ted) Hammer
1924 – 2025



An original and lifetime member of the salt lake research group of SIL (later becoming the International Society for Salt Lake Research), Ted attended the group's first Salt Lake Research meeting held in Adelaide, Australia, in 1979 and hosted its second meeting in Saskatchewan, Canada, in 1982.

Growing up on a cattle ranch in the Canadian prairies, Ted received his education through high school in a tiny, one-room country school. He chose to leave ranching behind to pursue a career in education, teaching in rural schools while completing his B.Ed. degree, he took correspondence and summer school courses and graduated in 1950. For the next decade, Ted taught science in high school but was increasingly drawn to the idea of a university research career.

While teaching high school, Ted began taking summer school courses at the Yellow Bay Biological Station on Flathead Lake in Montana, USA. He then won a NSF scholarship that enabled him to move to Missoula in 1958 to complete a M.Sc. in Biology from the University of Montana. In the spring of 1959, Ted and his wife, Marie, moved to Saskatoon, Canada to begin his Ph.D. with Dr. Donald Rawson who was one of the leaders in Canadian limnology. Ted's research on blue-green algae and the influence of phosphorus on algal growth in Saskatchewan lakes culminated in his Ph.D.

at the University of Saskatchewan in 1963. Shortly thereafter, he became a professor in the Biology Department, and Saskatoon became the family home for 63 years.

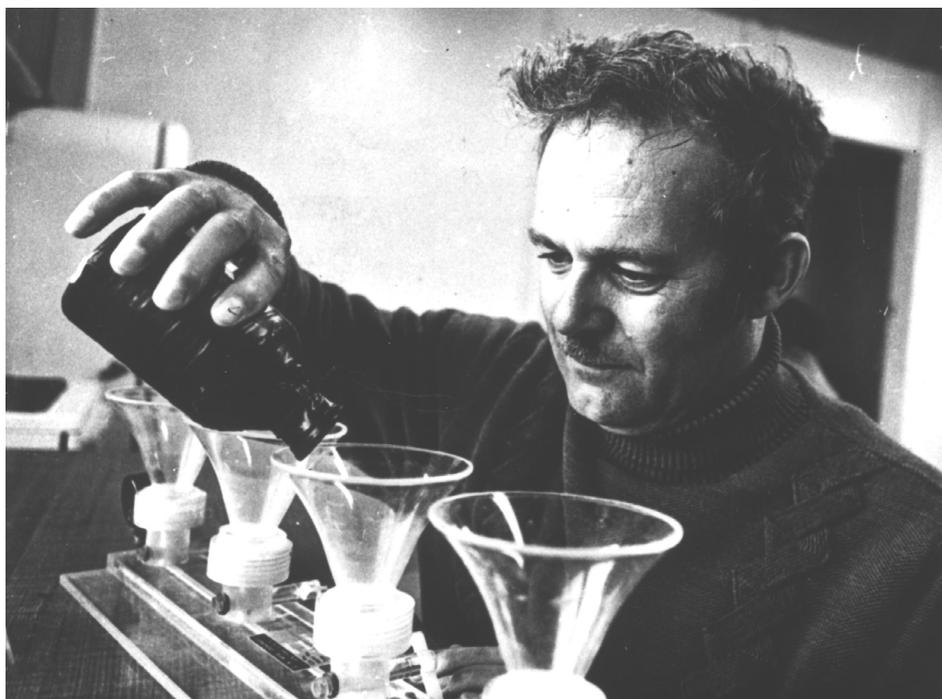
Wide-ranging investigations into blue-green algae and pollution in prairie lakes were the central theme of Dr. Hammer's research. In the 1960s, his work in the Qu'Appelle River Basin was the first demonstration that the excessive phosphorous concentrations and associated toxic blue-green algae blooms were caused by runoff from fertilized farm fields and feedlots. This contributed to industry awareness of the problem and changes locally and internationally. In the 1970s, acid rain caused by emissions from the Alberta oil industry began to affect lakes in the region. This led Dr. Hammer to conduct a major study on the sources, mechanisms, and ecological effects of acid rain in Canadian prairie

lakes. His work drew widespread interest and led to successful remedial action. His research interests took a different slant in 1969-70 when he enjoyed a sabbatical year at Monash University in Melbourne, Australia, where he worked on saline lakes. Ted's new focus continued after his return to Canada where he and his team investigated saline lakes in the Canadian prairies from biological, chemical, and geological perspectives. This work contributed to Dr. Hammer's book, *Saline Lake Ecosystems of the World* (1986), which was one of his 90 publications.

Professor Hammer served as the Head of the Department of Biology at the University of Saskatchewan (1973-76) and was an active member of many societies and committees. A limited selection includes: Director of the Rawson Academy of Aquatic Sciences (1986-92), Chairman of the Saskatchewan Water Studies Institute (1967-73), Co-Chairman of the International Biological Program Committee on Conservation of Terrestrial Ecosystems (IBP-CT) 1968-73), President of the Canadian Society of Fishery and Wildlife Biologists, Saskatchewan Branch (1963-64), member of the International Biological Program Committee on Freshwater (IBF-PF), the National Research Council (1968-73), and was a member of the Saskatchewan Environmental Advisory Council (1977-81).

Dr. Hammer was fascinated by the natural world and loved research, but also cared deeply about his students and was an outstanding educator. His kind and supportive leadership made him a role model and appreciated mentor for his students. In 1990, Ted established the [Hammer Scholarship in Limnology](#) which is now awarded annually to a qualified student studying limnology at the University of Saskatchewan. Ted retired from the university in 1991 but continued in an Emeritus capacity until 1998 to serve on graduate student committees and assist with their research.

Ted passed away at 101 years of age. He is survived by his wife of 71 years, Marie, and their two children Debra and Philip.



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