

SEFS 12
Symposium for
European Freshwater Sciences



25–30 JULY 2021

#SEFS12

SEFS12 – July 2021

Key Take-home-messages



Note from the SEFS12 Chair

SEFS12 featured 350 oral presentations and 118 posters from researchers in 37 countries that were presented in six parallel sessions over three and a half days. While a key function of a conference such as SEFS is communication of scientific findings and networking among researchers the organisers of the meeting questioned whether SEFS should be more than this given the urgency of addressing declines in water quality and associated biodiversity losses as well as climate change pressures. Thus, the overarching theme of SEFS12 was 'communication', and indeed the need for greater and more effective communication to the wider community (policy, practice and the general public) was reflected in the take-home-messages of the speakers in the opening and closing ceremonies. This short report includes these messages and those from the various sessions in the conference.

Opening Ceremony

Messages from stakeholders

- Citizens enjoy and appreciate the importance of clean rivers and lakes.
- Farmers and landowners are aware of the pressures on freshwaters and want to know how to reduce their contribution to the pressures.
- Research findings need to be translated into clear, practical guidance.
- Citizens want to be involved in water quality protection and collection of data. The All-Ireland Pollinator initiative was cited as a good example of the co-ordination and level of engagement needed to effect change.

Messages from Lord Mayor of Dublin Alison Gilliland

- It is only through informing and engaging citizens through a bottom-up approach that we will get the change needed to protect the environment.
- The potential of citizen science needs to be recognised and the supports and tools put in place for it to make a valuable contribution not only in raising awareness but in contributing data that may not be so easily collected by scientists.

Closing Ceremony

Message from Laura Burke, Director General, Irish Environmental Protection Agency

- A huge amount of work remains to be done to protect freshwater ecosystems but there is evidence that a range of measures and restoration approaches are showing good promise.
- The big challenge is bridging the gap between research and policy and practice*.
- Researchers need to listen to others and understand the issues from their perspectives, talk to those involved in developing policy and implementing solutions, and engage with them through the lifecycle of your research.
- Ask policy makers and implementers what are the gaps in understanding, knowledge and evidence.
- Explain research findings in a simple and understandable way without the use of highly technical jargon.
- Involve as wide a range of expertise as possible in all stages of research.

*She drew attention to a publication on '*Knowledge management for policy impact...*' that highlights the 8 skill sets required to address challenges in knowledge transfer (<https://www.nature.com/articles/s41599-018-0143-3>)

Plenary speakers

Florian Leese

- Need to improve barcode reference libraries, we can only apply the methods in current context if we can link OTUs to taxa.
- Standardisation of methods is required via formal national and international standardisation bodies.
- There should be open and transparent analysis and data pipelines (options exist through EU funding, we have to play there).

Lisette de Senerpont Domis

- The Anthropocene has created a perfect storm of interacting multiple stressors compromising aquatic ecosystem functioning and services provisioning.
- Climate-pollutant interactions call for intensified efforts to achieve ecocentric water quality management.
- We need a water transition to move away from the current paradigm of water as a resource to water as a source of life, and it is up to us scientists to provide the ecological arguments for this shift.

R. Iestyn Woolway

- Lakes are responding dramatically to climate change with less ice cover, longer stratification seasons and shifting mixing regimes, as well as warmer surface temperatures and more intense lake heatwaves
- Future projections suggest dramatic changes under the worst-case scenarios, but less severe under the low-end emissions.

Andrea Reid

- Land-based learning benefits all learners.
- The best way to learn about a river is on and from the river.
- Researchers and teachers should engage with the land as a source of knowledge in and of itself.

Special Sessions

SS01:

Role of freshwater ecosystems in the carbon cycle and the climate system

- Freshwater carbon cycle research tackles old paradigms: stream metabolism is more important than previously thought and rolling sediments are key to better understand stream C processing.
- Bottom water oxygen conditions are of major importance for sediment greenhouse gas release.
- Small floodplain pools are a significant greenhouse gas source to the atmosphere.
- Marginal vegetation has paramount importance as a carbon sink in inland Mediterranean saline shallow lakes.
- Healthy wetlands are climate allies
- Thorough multi-year reservoir carbon footprint case studies are needed to refine large scale models

SS02:

Freshwater Food Webs in the Anthropocene

- Temporal snapshots of a food web may be insufficient to capture their true complexity as seasonal changes in resource availability and ontogenetic changes in consumer trophic ecology are continuously modifying the trophic environment.
- The session highlighted a need combine direct diet analyses with biomarkers such as stable isotope and fatty acids to develop thorough models of how nutrients and energy are moving through food webs.

SS03:

Importance of small water bodies in the landscape

- Ponds provide a suite of vital ecosystem services but are often omitted from legislative programmes designed to protect freshwater ecosystems.
- It would be very valuable to develop a proper set of standard sampling methods for ponds.
- Carbon budgets need to be developed for pond creation and management scenarios.
- Conservation of small water bodies needs to take a whole landscape approach, taking account of connectivity among small and large water bodies.
- There is an urgent need to translate the growing body of evidence on the importance of small water bodies into policy to ensure their effective protection and management.

SS04:
Citizen science and public participation in freshwaters: engaging citizens to research and management of freshwater ecosystems

- Volunteers from a range of age groups and societal profiles are engaging in a variety of citizen science projects, mostly based on rivers and macroinvertebrates but also algae and some lake projects.
- People are integral components of ecosystems and, through citizen science initiatives, can also be integral to their protection.
- Good training and tailored training resources are essential.
- There is potential to increase data collection using apps.
- Scientific language needs to be adapted for effective engagement of volunteers.
- Local and national coordinators are needed to ensure the sustainability of citizen science projects.
- Communication between volunteers and scientists in citizen science projects is a key element.

SS05:
Multidisciplinary perspectives on invasive alien species (IAS) in freshwater ecosystems

- There is an ever closer relationship between the invasion process by alien species and climate change scenarios. The experimental method best shows all possible consequences on native of invasive flora and fauna.
- The importance of also considering airborne aquatic microorganisms as alien species is growing due to their increasing spread globally with significant consequences on ecosystems and human welfare and health.
- In a period of several environmental changes recognised as issues of global concern, ecological connectivity in aquatic ecosystems should always be considered in clarifying the arrival, establishment and spread of IAS, and in developing effective management strategies.

SS06:
European Freshwater Ostracoda

- Integrative taxonomy using both morphological and molecular data will aid taxonomy and phylogeny studies of certain taxa, including the 'hunt' for cryptic species.
- Taxonomic harmonisation is needed to ensure databases are reliable.
- According to climate change modelling in South America ostracods could experience loss of diversity in the southern cone of the continent.

SS09:
Aquatic fungi: bringing a key freshwater microbial group into the spotlight

- Fungi are greatly neglected components of freshwater food webs with far reaching consequences for ecosystem functioning.
- New molecular tools illuminate the multiple facets of fungal biodiversity and their interactions with other organisms.
- Environmental change, including urbanisation, alters fungal ecological niches and community composition which affects global C- and nutrient cycles.

SS10:
Management of climatic extreme events in lakes and reservoirs for the protection of ecosystem services

- Storms are extreme weather events and as climate warms, are projected to become more frequent and intense. Their effects on lakes are only beginning to be quantified, however.
- Extreme flows only resulted in increases in inflow DOC concentration in summer in a temperate humic lake; in other months they diluted concentration.
- R-package 'algaeClassify' is an open access tool which assigns phytoplankton genus/species information to multiple functional trait groups.

**SS11:
Freshwater invertebrate
biodiversity - threats,
assessments, knowledge
needs and conservation
challenges**

- Reliable appropriate data are lacking across regions, habitats, waterbodies and taxonomic groups.
- Such data will enable strategies/information to aid future management and protection of invertebrate biodiversity.
- Both taxonomy and genetic work are needed as complimentary approaches to improve data and knowledge.

**SS14 (2C/3C):
Securing and managing
drying river networks**

- Drying leads to decline in taxonomic and functional diversity of diverse organisms, influencing the equilibrium of trophic food chains.
- The effect on species richness and community composition is context-dependent: depended on temporal dynamic of drying events and interaction with other factors (land-use, geology, microhabitats etc.).
- To improve the monitoring of dynamic ecosystems, both the terrestrial and aquatic communities must be included, and all stages from flowing to ponded to drying considered.
- Metrics/indices for within-region temporary stream types are required and should include dry and pool phases, together with terrestrial biota, and physico-chemical indicators.
- Flow cessation has high impact on river fish biota, therefore, there is a need to account for future impacts of altered flow regimes driven by climate change for a proper management of fish population

**SS16:
The science and
management of multiple
stressors in aquatic
ecosystems**

- Stressor timing, sequence and adaptation of organisms need more recognition in multiple stressor studies (how does previous exposure alter future response?)
- Changes in stressor interactions along the stressor gradient / magnitude need consideration and will help with predictive power.
- Mesocosms are useful for studying interactions and mechanisms in global-change research between different levels of anthropogenic stress.

**SS18:
Functional indicators of
freshwater ecosystem
health**

- Functional indicators are rarely considered in freshwater bioassessment but their inclusion is needed to allow an integrative evaluation of ecosystem ecological integrity.
- Ecosystem metabolism and organic-matter decomposition, as well as to a lesser extent trait-based approaches, show great potential to be used as bioassessment tools of stream and river functional integrity, and can be most useful to monitor restoration practices.
- Large scale and seasonal assessment may contribute to determine natural variation and establish reference conditions, with impacts for the development of bioassessment tools.

SS19:
**Aquatic metacommunity
ecology in depth:
ecosystems, scales and
applications**

- The observational scale used has fundamental implications for metacommunity dynamics, not only from a spatial perspective but also from a temporal perspective.
- Body size needs to be included into metacommunity studies beyond its relationship with dispersal.
- Consideration of network structure across the whole sampling design can more accurately capture dispersal drivers in fish communities across a whole river catchment.
- When considering community composition and size structure together, there is a stronger signal of anthropogenic stressor (i.e. we are able to better discriminate between different levels of anthropogenic stress).

SS21:
**Chemistry, biology and
ecology of protected
oligotrophic lakes in Europe**

- Mapping of dystrophic waterbodies requires the inclusion of pools and ponds < 1 ha in size, located in peat soil catchments containing characteristic dystrophic macrophytes
- Water chemistry is an important monitoring tool of soft water lakes and may highlight the early impacts of eutrophication from surrounding land-uses.
- Increasing biological monitoring of oligotrophic lakes to include algae and macroinvertebrates is necessary if their structure and function are to be characterised, such a holistic approach would strengthen their assigned conservation status under the EU Habitats Directive.

SS22:
**Genetic approaches to
assess and monitor
freshwater biodiversity and
ecosystem functions**

- Genomic methods are no longer in their infancy.
- DNA-based bioassessments provide data going well beyond species inventories, providing valuable information about the ecology of studied species and freshwater ecosystem functioning.
- Environmental DNA metabarcoding provides a deep insight into the spatio-temporal dynamics of observed diversity.
- The results obtained with DNA-based approaches are generally comparable with traditional morphology-based methods and can be readily applied to complement traditional approaches for long-term biomonitoring.
- It only remains for water managers to integrate them in their monitoring programmes.

General comments received

- There is a general increase in heterotrophy in lakes, often overtaking primary productivity.
- This increase is often accompanied by increases in DOC with factors such as temperature, water level and nutrients also important – i.e. multiple stressors associated with climate and land-use change.
- The language and knowledge barrier between the molecular scientists and traditional ecologist and taxonomists, particularly those engaged in WFD monitoring needs to be addresses. The same point would apply remote sensing tools.

Regular Sessions

RS01:

Advances in freshwater monitoring (high frequency monitoring, new techniques & big data)

- While there are new advances in monitoring, such as remote sensing and eDNA, there are also new and emerging challenges for freshwater quality, for example from pharmaceuticals.
- Standardisation of methodologies remains a challenge for many new monitoring approaches and needs collaboration and communication to resolve.

RS02 (9c):

Advances in freshwater monitoring (high frequency monitoring, new techniques & big data)

- Natural water retention measures could offer sustainable farm-scale solutions to both diffuse (storm event) and point source (farmyard) pollution transfers.
- There is evidence that edges, between polluted streams and upstream refugia, are acting as good buffers - with more ecological invertebrate similarities (including adaptation to pressures) between edges and refugia.
- Cattle access to streams has local scale impacts with some effects immediately downstream.

RS8C:

Agriculture/forestry operations and water quality

- Pesticide impacts in rivers require further evaluation in terms of impact thresholds and sampling/assessment regimes and protocols.
- Organic pollution from farmyard point sources in catchments can be dominant pressures for ecological responses in connected headwater streams.
- Modelled water balance responses to reforestation in Iberian catchments indicate increased groundwater flow contribution, benefitting this function, and also fibre and C sequestration functions.

RS10 1F:

Freshwater restoration: challenges, innovation and achievements

- New technologies like social media posts can be used to gauge people perceptions to cultural ecosystem services. Privacy remains an issue but can be mitigated by anonymising the data being analysed.
- Challenges are universal when it comes to convincing landowners to help supply land required for restoration along river corridors and for riparian management.
- Restorative measures throughout Europe are diverse and there are many novel approaches being used.

**RS11 (5B 7 6B):
Fundamental and Applied
Ecology**

- When moving from science findings to management, legacy factors are important and need to be considered.
- Translating experimental results from meso and micro-cosms to real situations assumes that lower complexity used in these applications not always reflect the main effects occurring in real ecosystems.
- There is still room to improve our capability to produce effective and reliable indicators to assess the response of organisms to stressors.
- There are still many issues in freshwaters that need to be comprehended, these ranging from small particles to complex food webs; integration of new techniques is extremely necessary to produce noticeable advances.

**RS14:
Insights from long-term
dataset**

- Long-term data are necessary to investigate/discover/detect robust trends.
- Different sources of information can be useful: from historic data (e.g. herbarium records) to observational data or specific infrastructure.
- Ideally long-term data series should be open access.

**RS15:
Lakes as sentinel sites**

- Understanding past pressures using sediment archives and long-term records can help inform future management and give insights into how aquatic systems respond to pressures.