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LIFE Good Water IP

EU LIFE Programme integrated project
"Implementation of River Basin Management Plans of Latvia towards good surface water status"

International conference "Nature-based solutions for improvement of water quality and river basin management"

26-27 October 2022, Riga, Latvia

National scale assessment and mapping of lake ecosystem services in Lithuania

Miguel Inácio & Paulo Pereira

Environmental Management Laboratory
Mykolas Romeris University, Lithuania

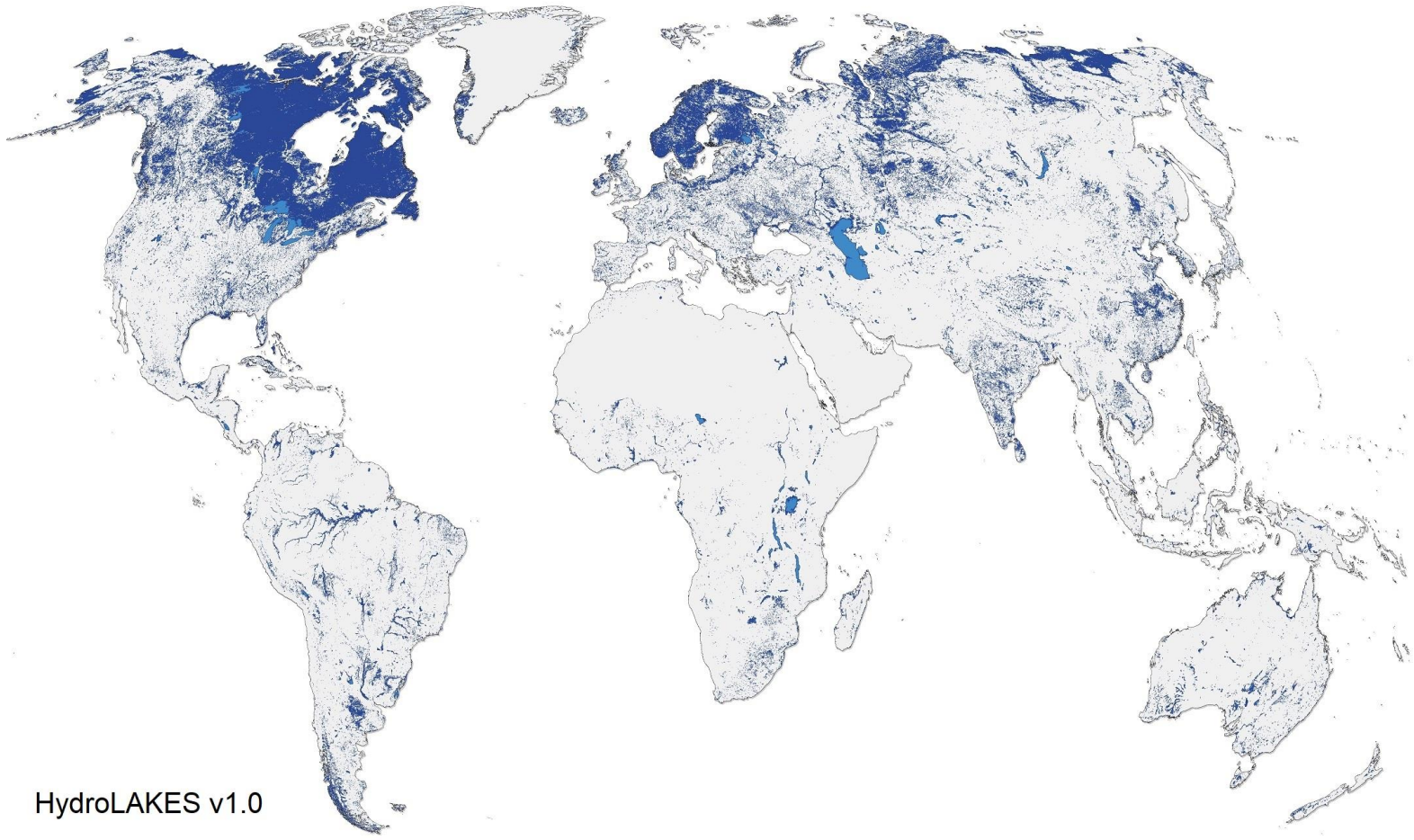
rinacio.miguel@gmail.com

This study was conducted under the framework of the "Lithuanian lake ecosystem services: impacts of climate and land-use change" (LACLAN) Project. This project receives funding from the European Social Fund under the No 09.3.3-LMT-K-712 "Development of Competences of Scientists, other Researchers, and Students through Practical Research Activities"

Lake ecosystems - *distribution*

HydroLAKES database:

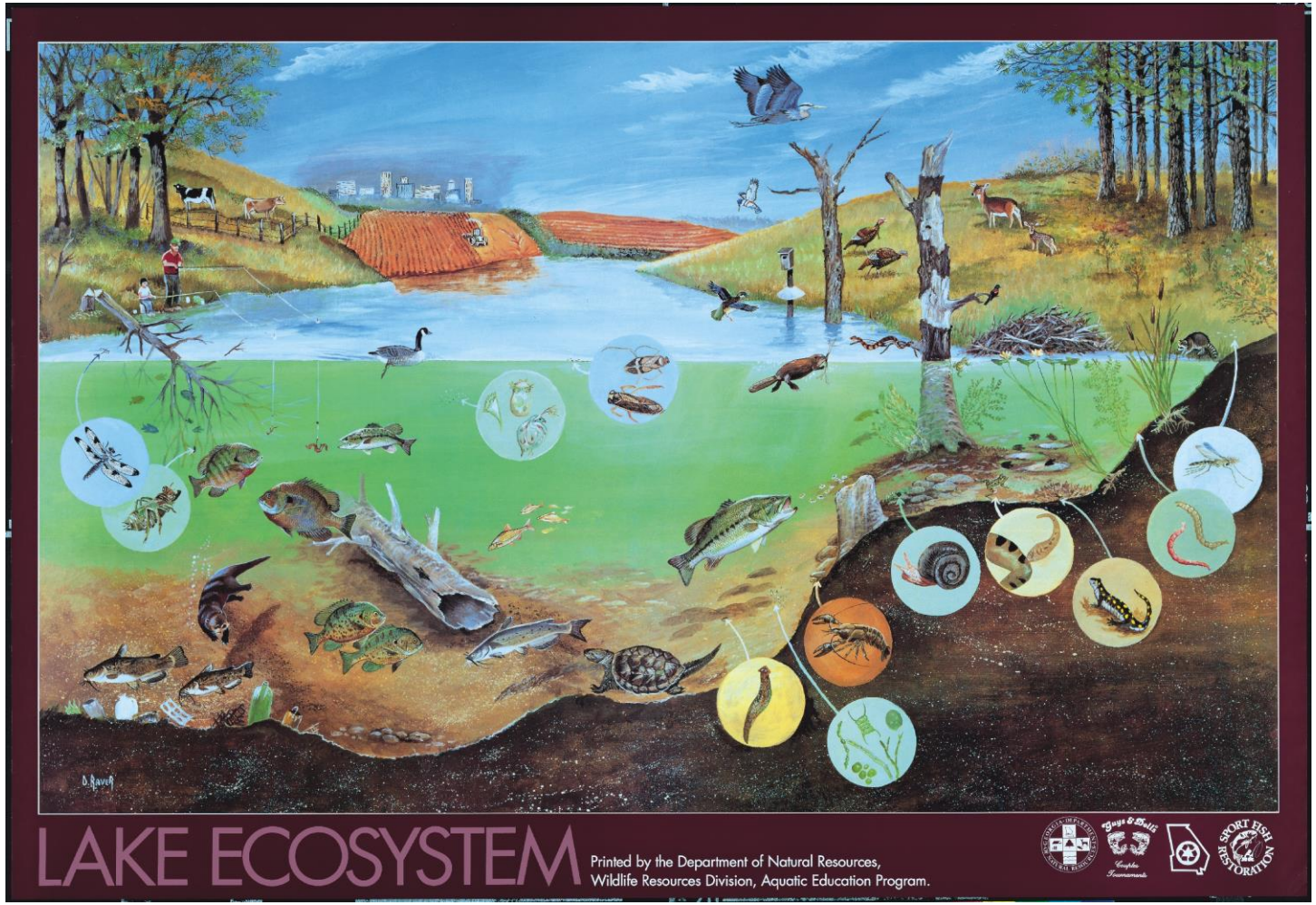
- Lakes above **1 ha**
- **1.4 million** individual lakes
- **2.67 million km²** surface area
- **7.2 million** km of shoreline
- **181,900 km³** water storage



hydrolakes.org

Lake ecosystems - *importance*

- Support a **high biodiversity** (aquatic and terrestrial)
- Support **numerous ecological processes** (terrestrial, aquatic, atmospheric)
- Support **socio-economic development** (different spatial scales)
- Places **of cultural identify**



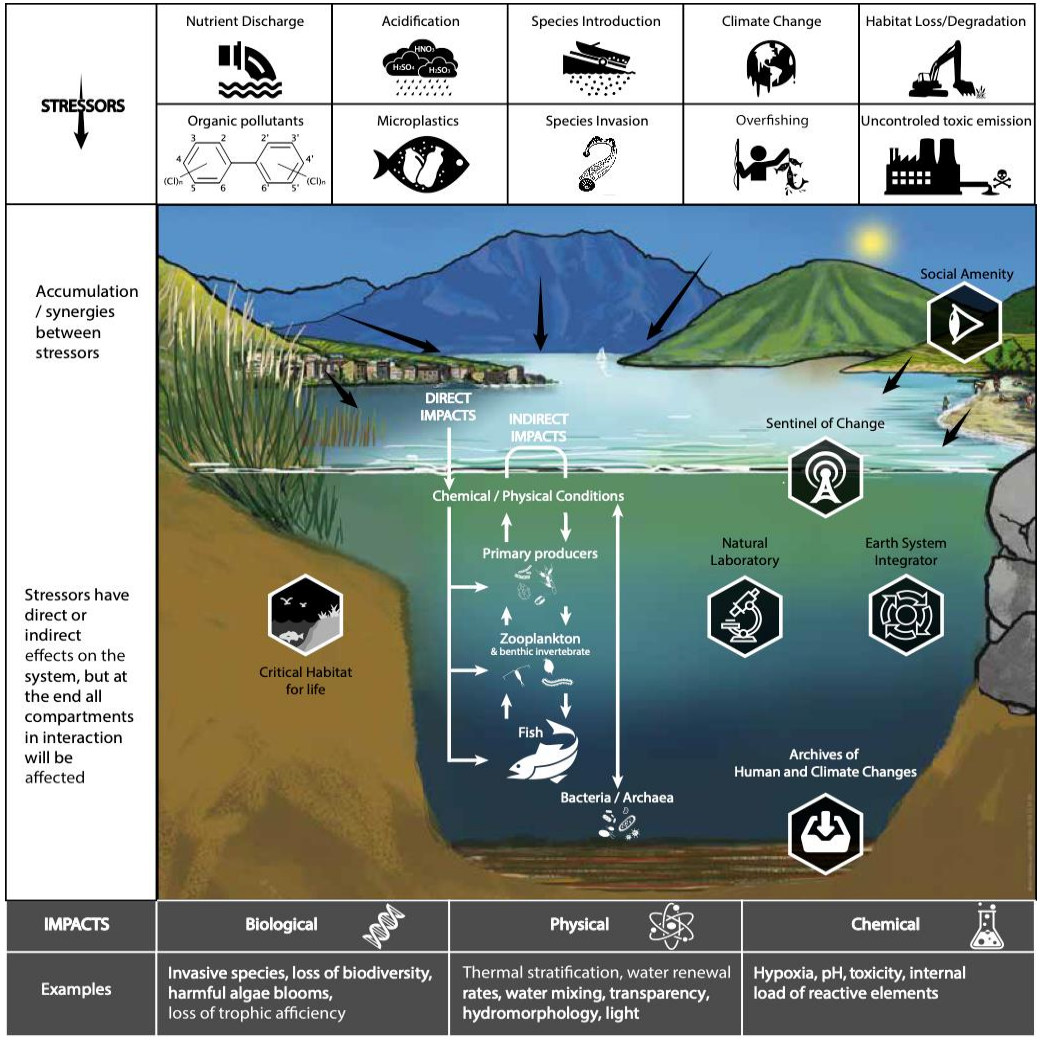
https://sites.google.com/site/trogdonjoshua4thper/part-4-ecological-relationships-among-organisms/ecosystem

Lake ecosystems - *threats*

- Over the last decades, **climate and land-use change**s emerged as drivers causing biodiversity and ES loss (IPBES, 2019)

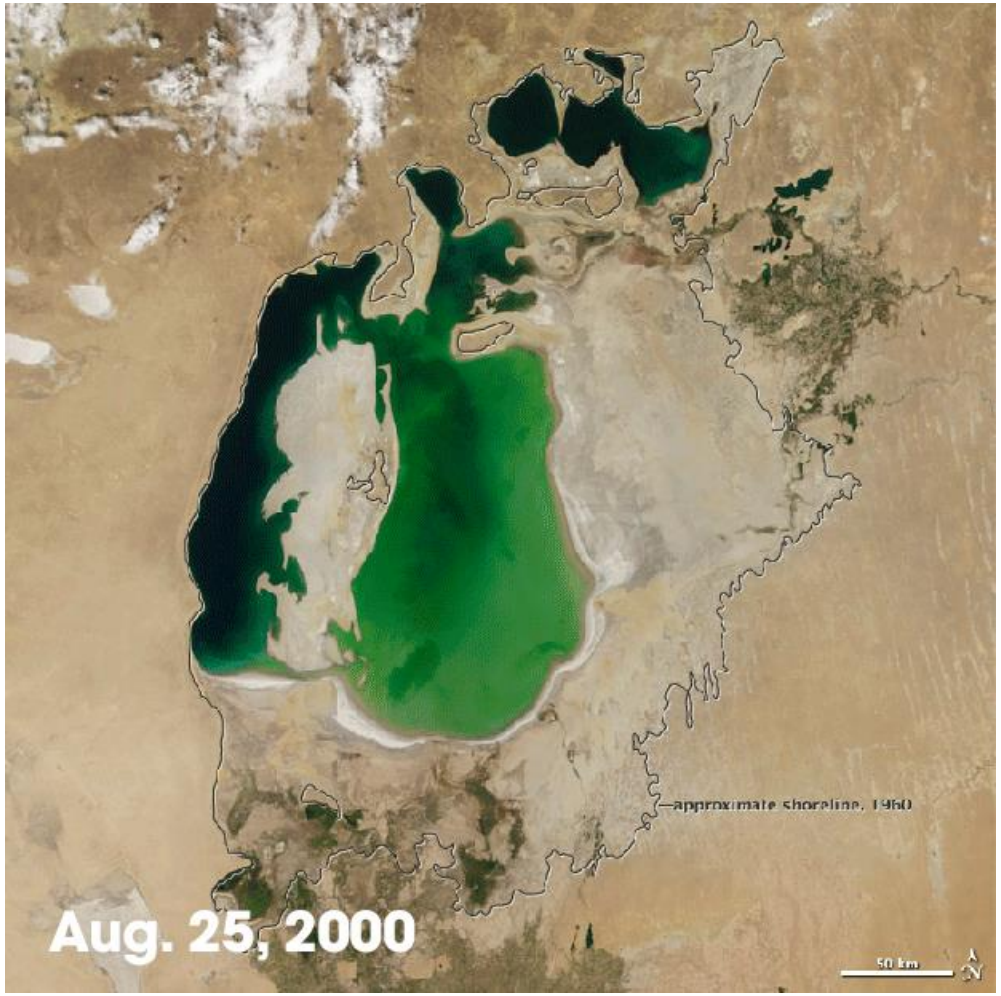
- The main consequence was the **environmental degradation** (e.g., eutrophication) and consequent **decrease of ecological status**

- Different **environmental agendas** aim to **restore ecological status and subsequently the provision of ES** (EU Green Deal, Biodiversity 2030, WFD, SDGs, UN Decade for Restoration, Paris Agreement)



https://www6.lyon-grenoble.inrae.fr/carrtel/Research-Teaching

Lake ecosystems - *threats*



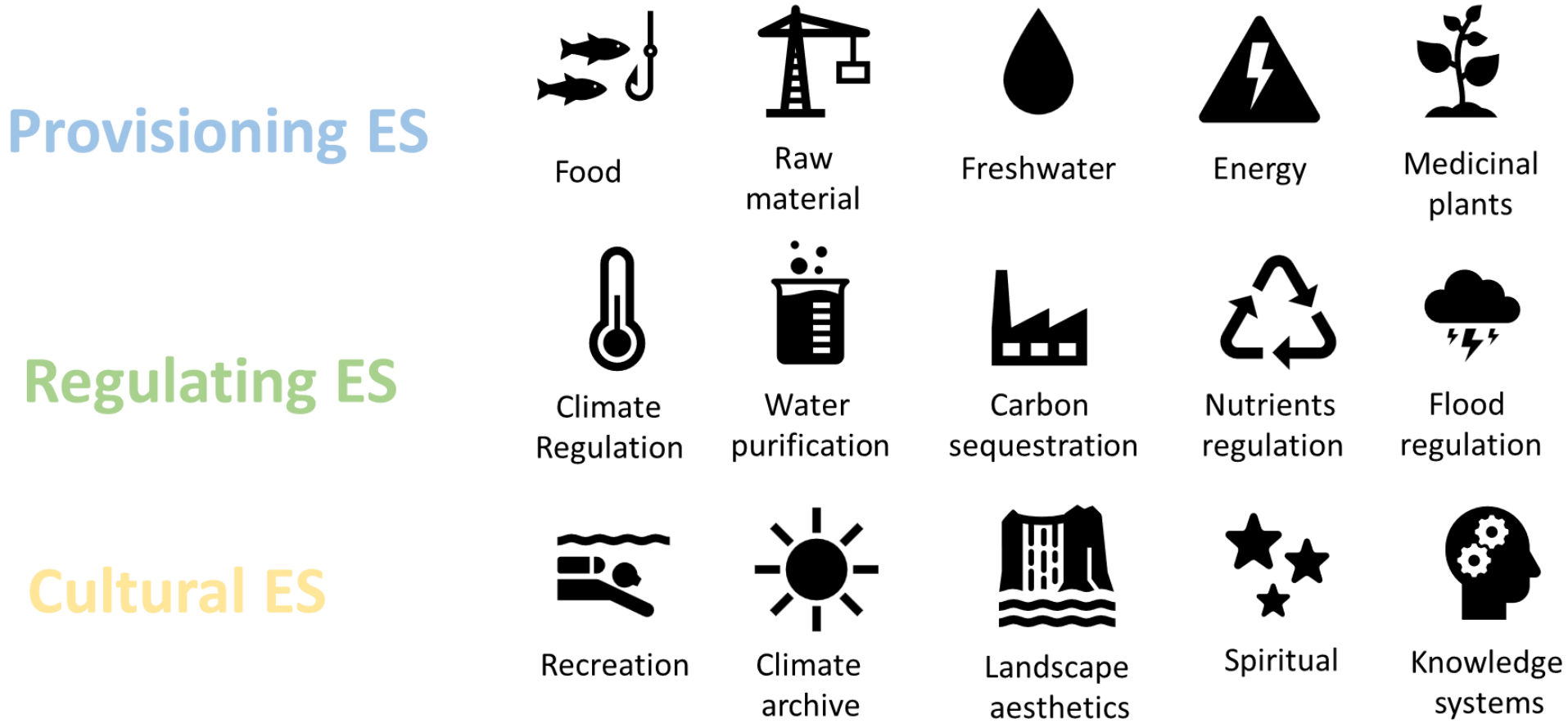
https://www.cbsnews.com/news/satellite-photos-aral-sea-disappearing/

reverse

Ecosystem services

Lake ecosystems – *ecosystem services*

Ecosystem services *– benefits people obtain from the environment (MEA, 2005)*



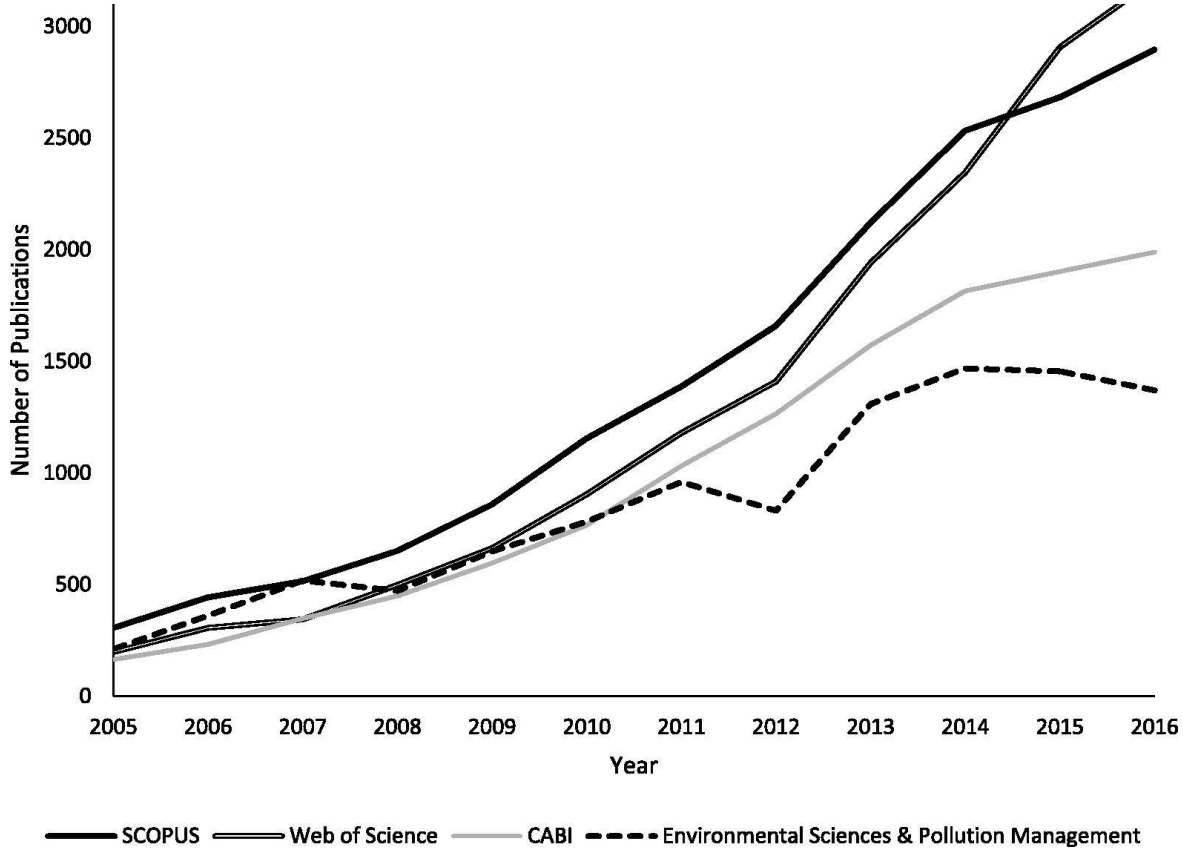
Lake ecosystems – *ecosystem services*

Ecosystem Services
Volume 25, June 2017, Pages 82-88

Analysis of publication trends in ecosystem services research

Kelsey McDonough [a], Stacy Hutchinson [a], Trisha Moore [a], J.M. Shawn Hutchinson [b]

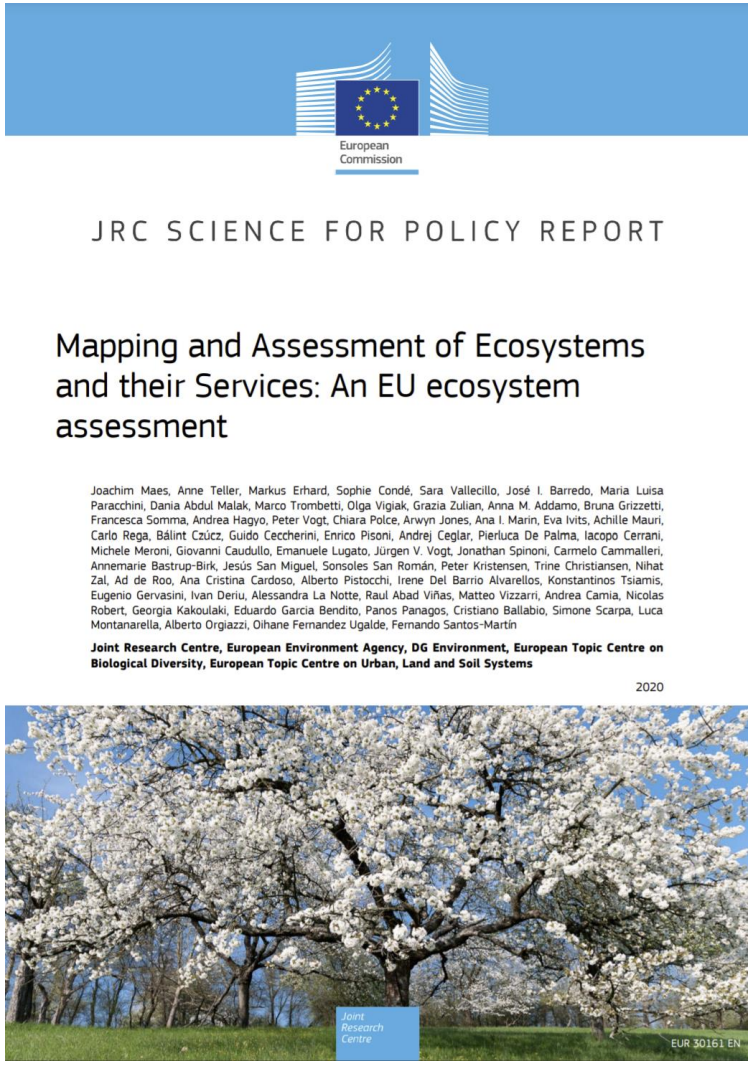
"Scholarly journal publications on the topic of ecosystem services **have substantially grown throughout the past decade**, (…). However, several **challenges** in the field of ecosystem services **still remain**, including conflicting approaches to ecosystem services terminology, classification schemes, research methods, and reporting requirements.



Lake ecosystems – *research needs*

"**major knowledge gaps remain** in assessing **current rivers and lakes condition across Europe** and **changes over time** in pressures linked to **climate change**, **chemicals** and **biodiversity issues**, and on the response of ecosystems to **multiple pressures**." (Maes et al. 2020)

Mapping current and future freshwater ecosystems services is imperative to bridge these gaps and achieve environmental targets



Lake ecosystems – *nature-based solutions*

Planning nature-based solutions: Principles, steps, and insights

Christian Albert, Mario Brillinger, Paulina Guerrero, Sarah Gottwald, Jennifer Henze, Stefan Schmidt, Edward Ott & Barbara Schröter

Ambio **50**, 1446–1461 (2021) | Cite this article

11k Accesses | **41** Citations | **28** Altmetric | Metrics

Lake ecosystems – *nature-based solutions and ES*

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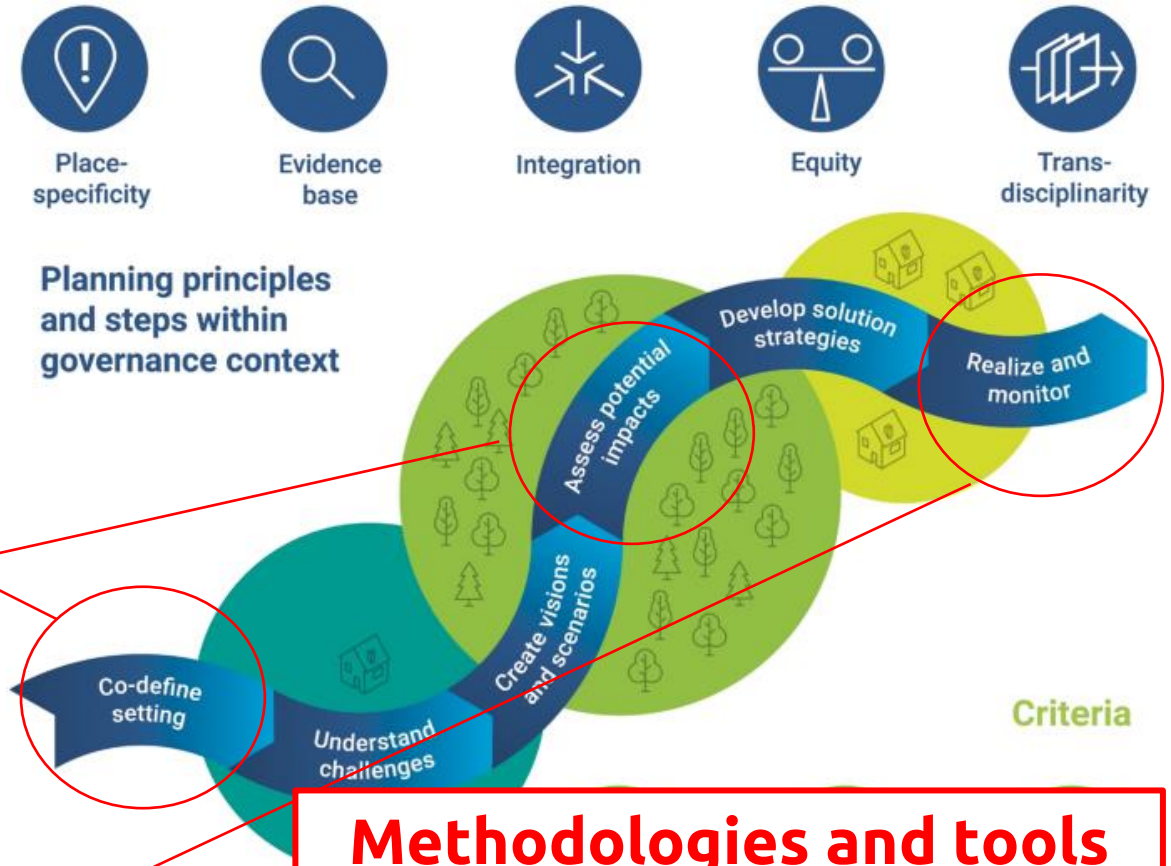


- Define the setting by **listing existing/potential ES**
- Assess the **potential impacts of the NBS on the ES** in the affected area
- Assess the **potential impacts of the NBS on the ES** in the affected area

Methodologies and tools are needed for ES assessment and mapping

Lake ecosystems – *what does the research says?*


Science of the Total Environment 847 (2022) 157561

Contents lists available at ScienceDirect

Science of the Total Environment

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

Review

Mapping lake ecosystem services: A systematic review

Miguel Inácio [a,*], Damià Barceló [b,c], Wenwu Zhao [d,e], Paulo Pereira [a]

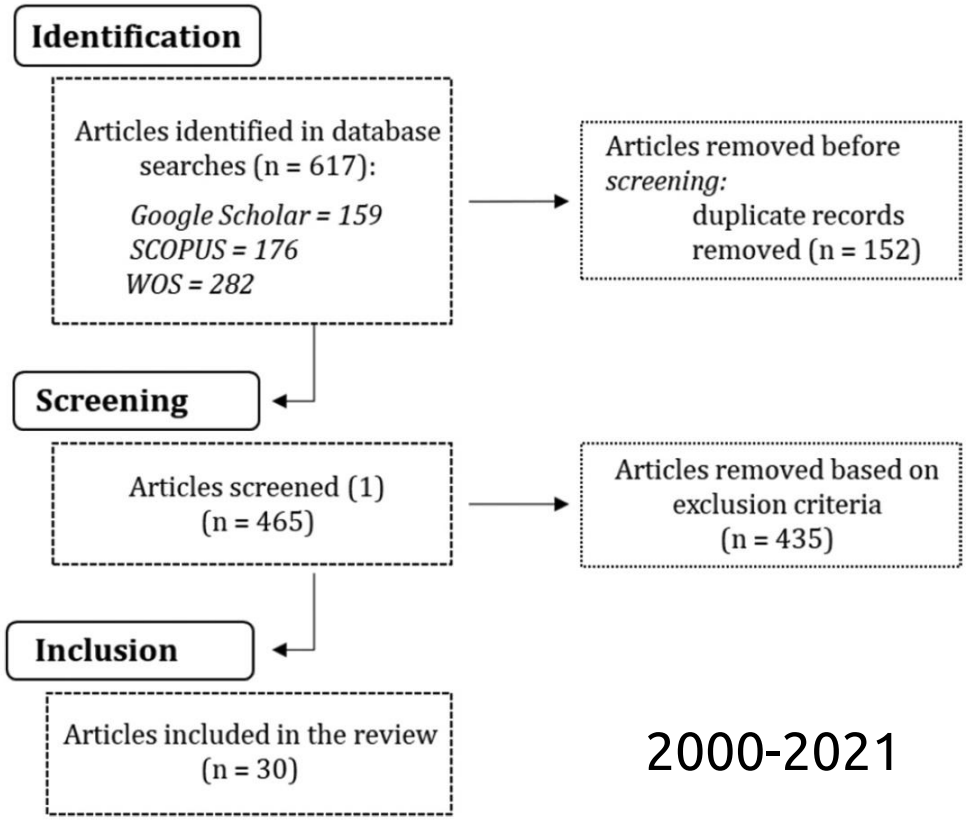


Fig. 1. PRISMA flowchart.

2000-2021

CICES V5.1 ES classification at section level.

Regulating & Maintenance, Provisioning and Cultural.

- Temporal/spatial perspective
- Spatial extend
- ES classifications and dimensions
- ES sections assessed
- Methods applied
- Lake ES types mapped and validation of the results
- Objective of the study and drivers of change

Lake ecosystems – *what does the research says?*

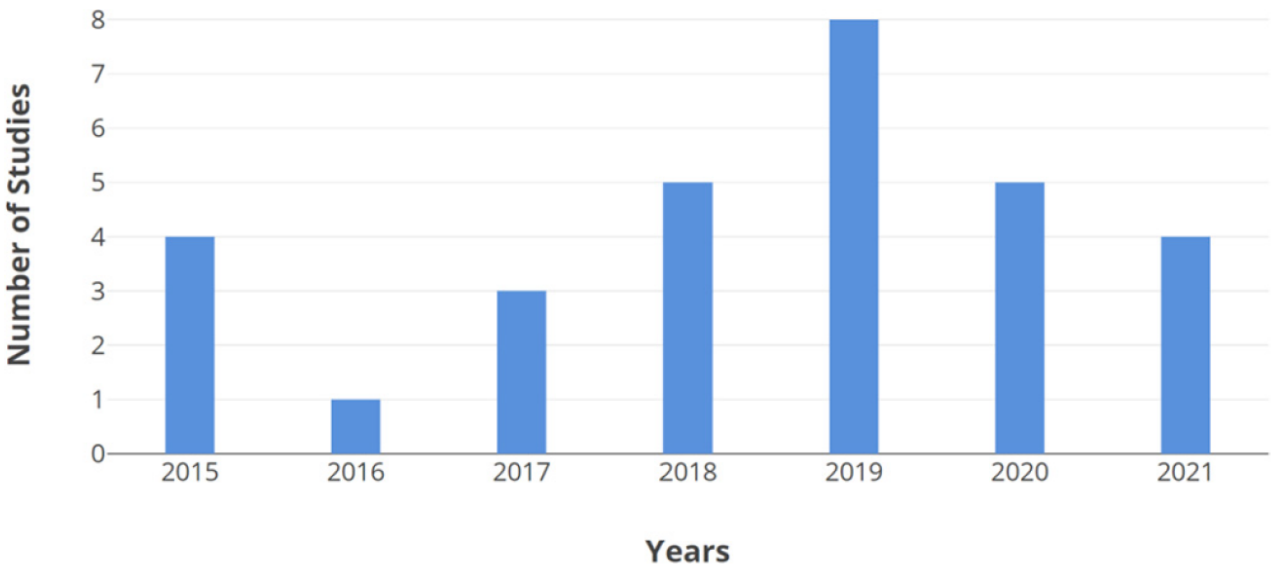


Fig. 2. Number of studies per publication year.

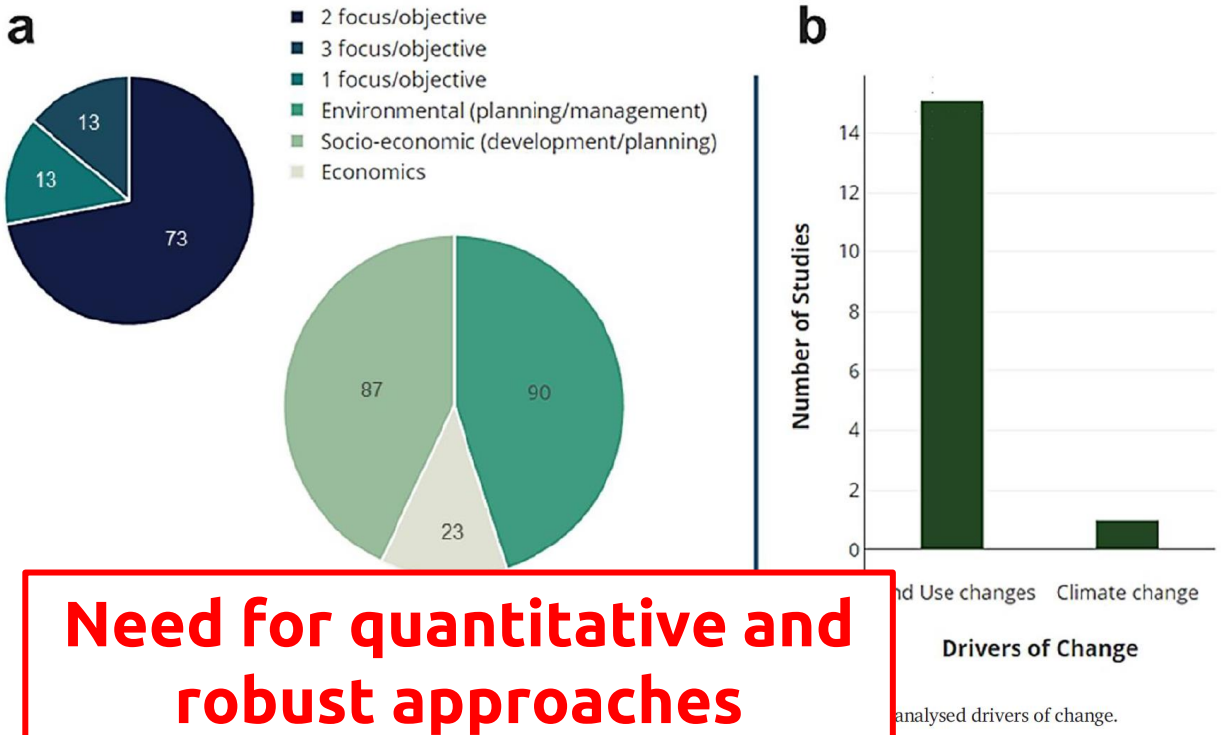
- Most of the studies **are very recent**
- Studies focused on mapping lake ecosystem services **have been clearly overlooked**
- There is an **urgency in developing studies on mapping lake ecosystem services**

Lake ecosystems – *what does the research says?*

From 29 studies only **1 validate the models**

Poor **results exploitation**

Reduced credibility of the outputs



Need for quantitative and robust approaches

"Environmental (planning/management)" was the focus of 27 works (90 %), 26 (87 %) had a "socioeconomic" focus and 7 (23 %) an "economic" focus

Lithuanian lake ecosystem services: impacts of climate and land-use change (LACLAN)

Develop a quantitative methodological framework to assess multi-temporal provision of lake ES

→

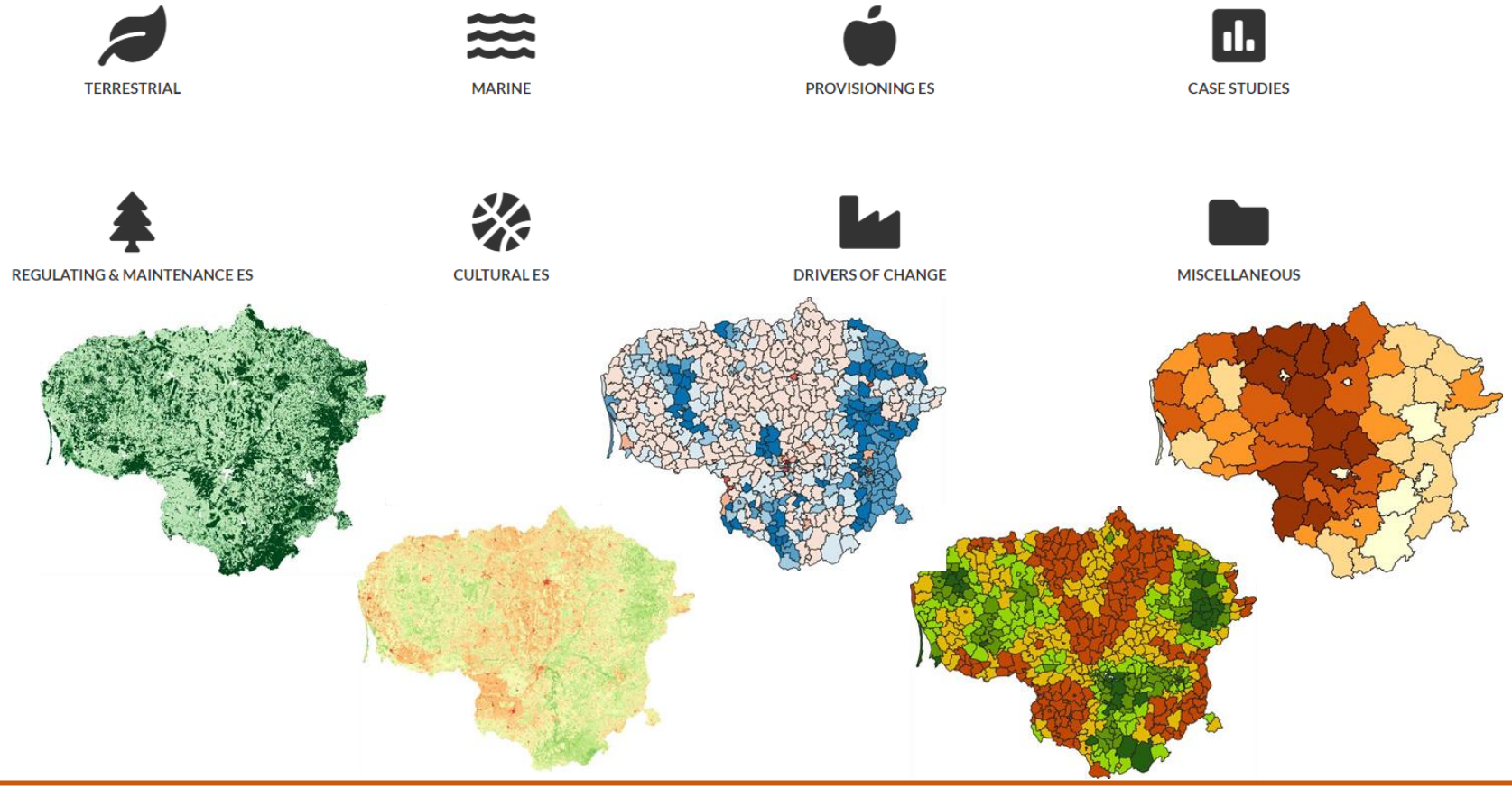
6 ES *(stakeholders)*:
2 Provisioning
2 Regulating & Maintenance
2 Cultural

↓

3 time periods:
Past – Present - Future

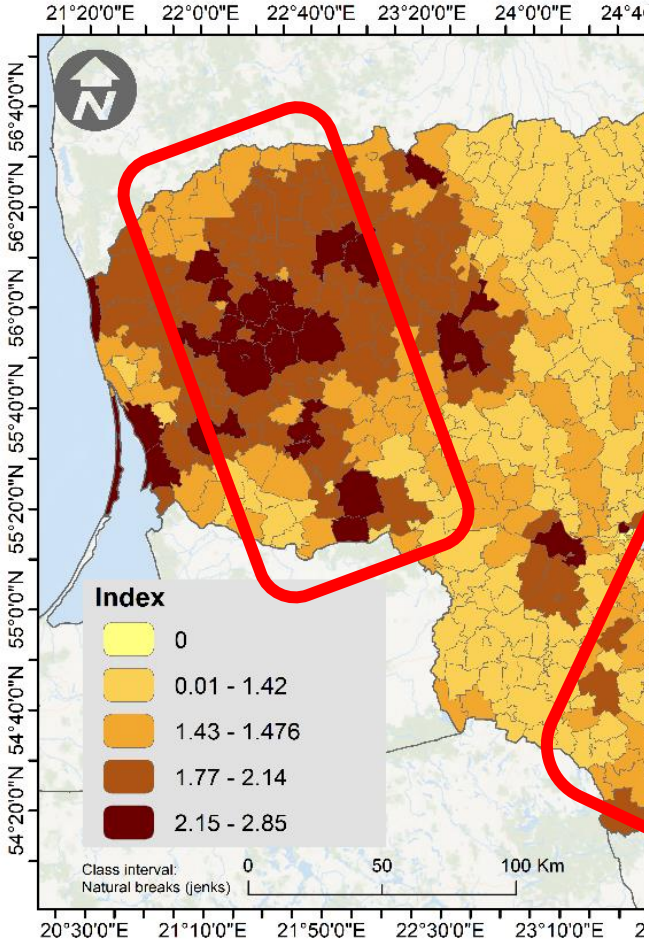
Lithuanian lake ecosystem services: impacts of climate and land-use change” **(LACLAN)**

Lithuanian National Ecosystem Services Assessment and Mapping

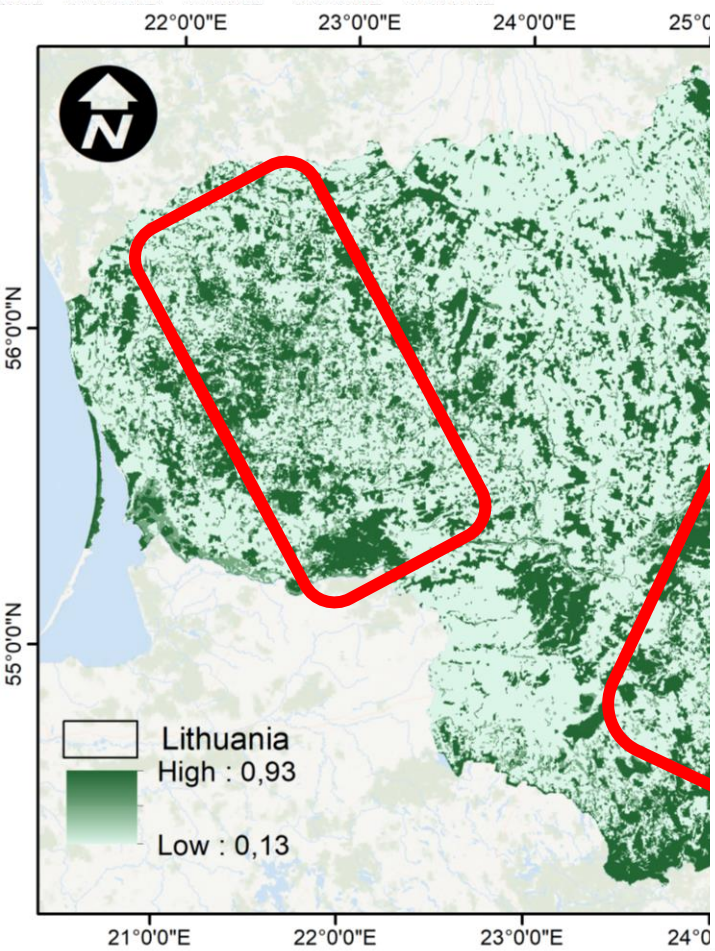


linesam.mruni.eu

Lithuanian lake ecosystem services: impacts of climate and land-use change" **(LACLAN)**

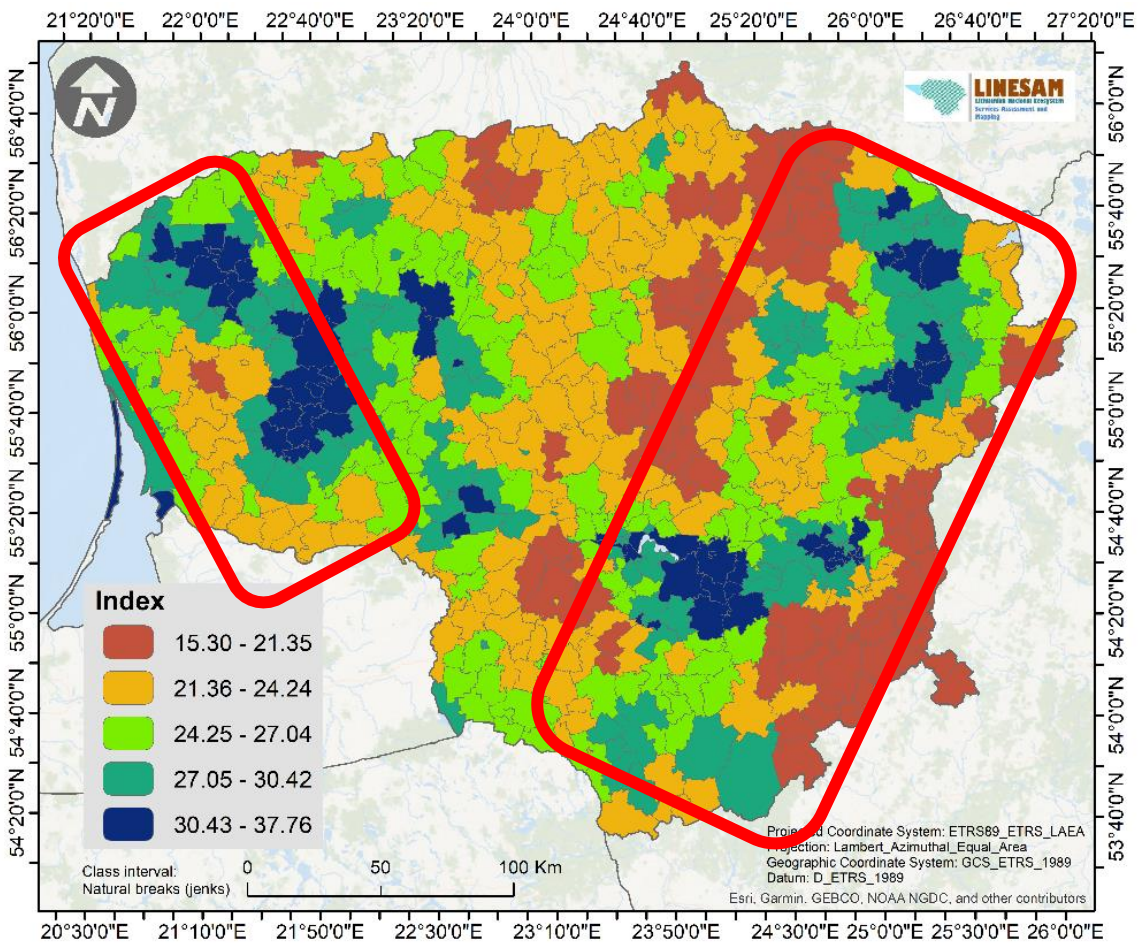


CARBON SEQUESTRATION



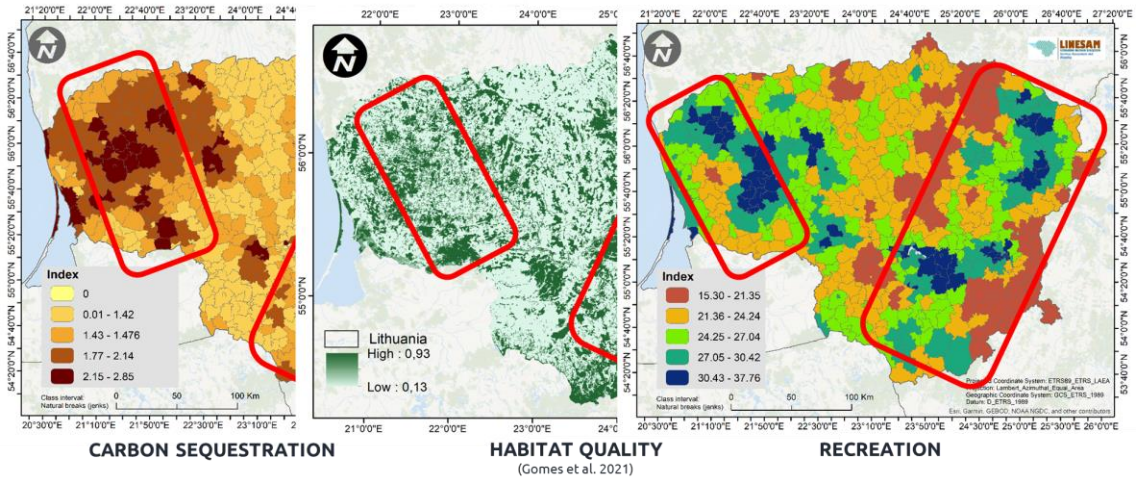
HABITAT QUALITY

(Gomes et al. 2021)



RECREATION

Lithuanian lake ecosystem services: impacts of climate and land-use change” **(LACLAN)**

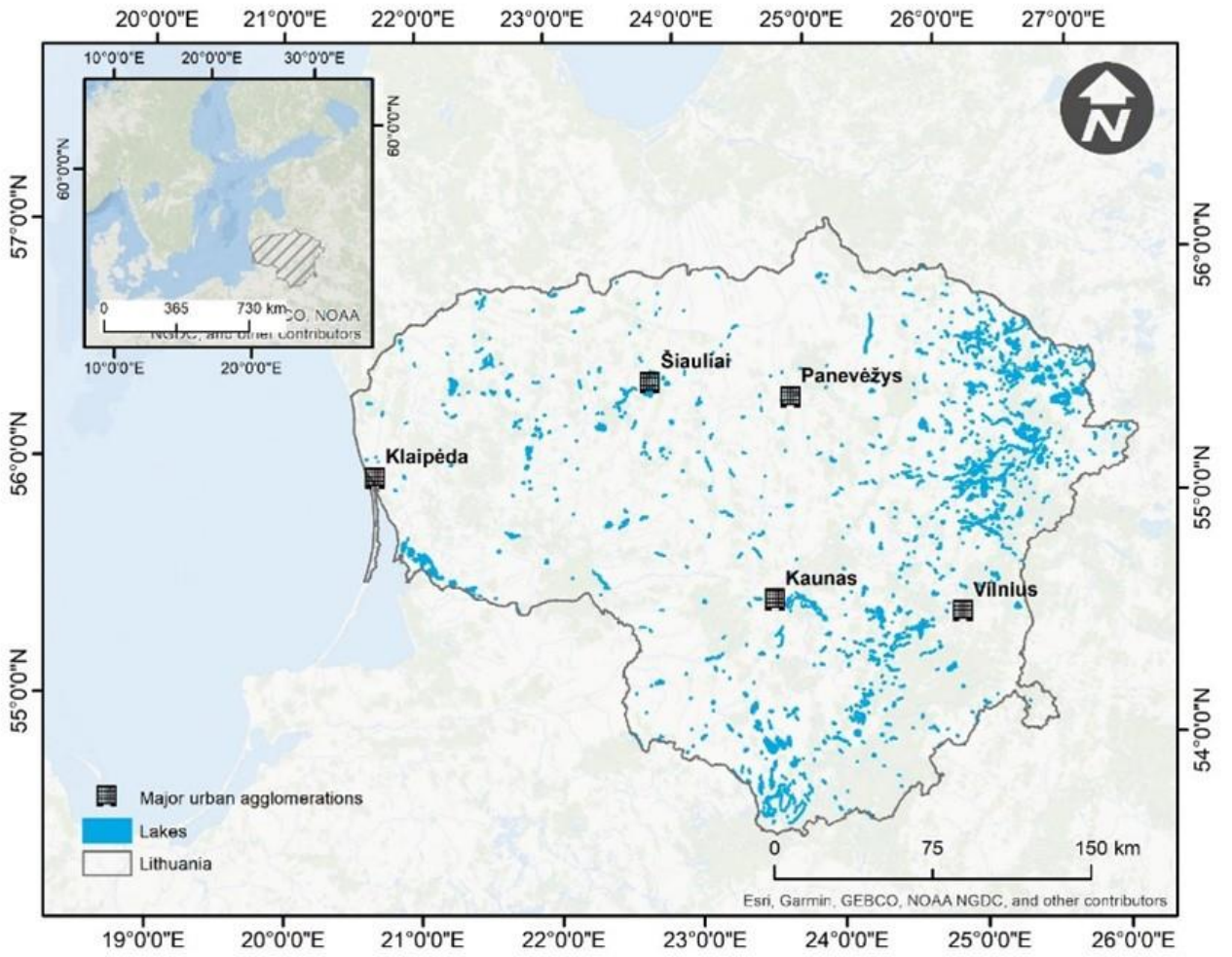


(Gomes et al. 2021)

LINESAM

Lithuanian National Ecosystem Services Assessment and Mapping

- **Terrestrial**
- **Marine**
- **Freshwater**



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International conference “Nature-based solutions for improvement of water quality and river basin management”
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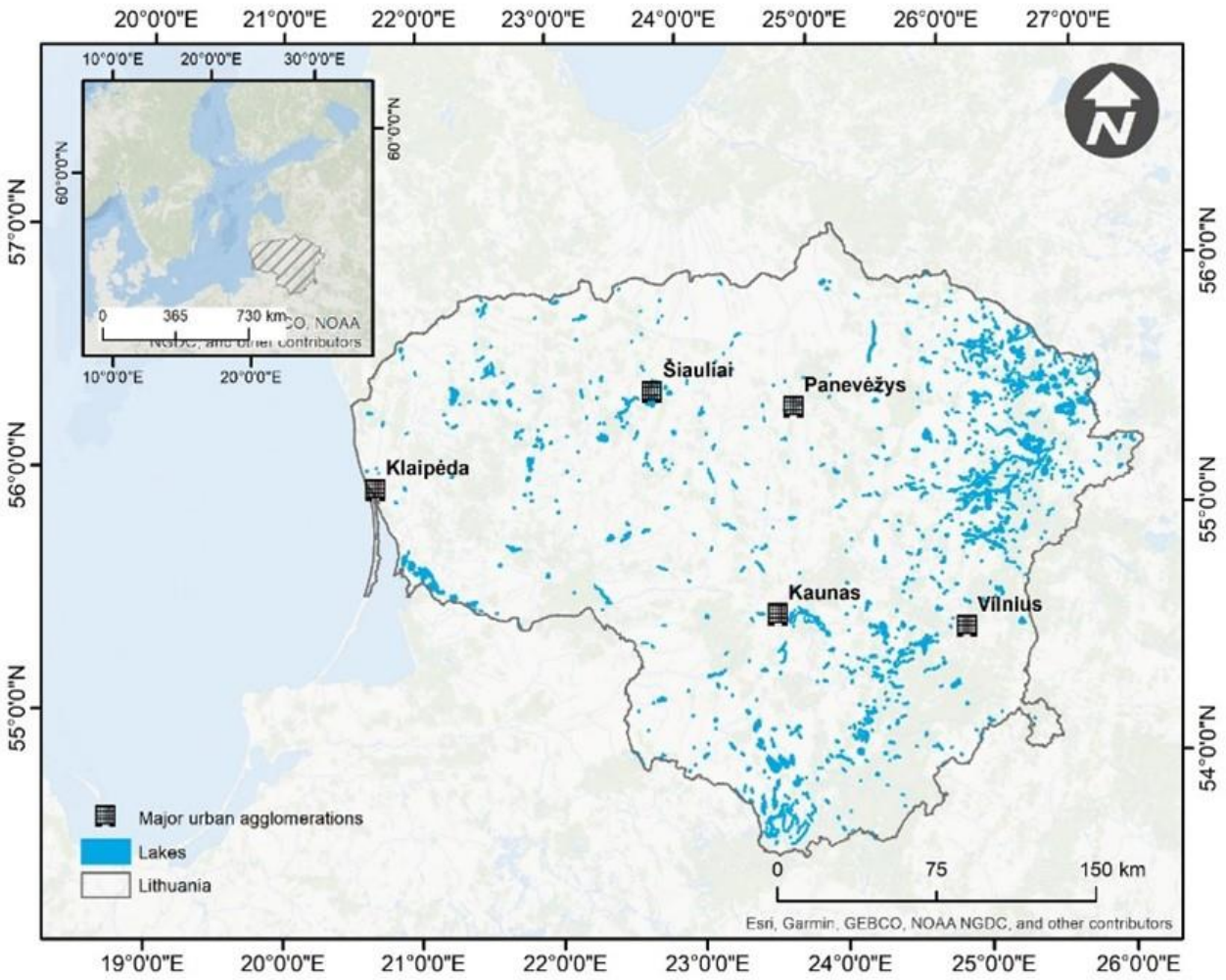
Lithuanian lake ecosystem services: impacts of climate and land-use change" **(LACLAN)**

- Located in **Northeast Europe**
- Area of **65,300 km²**
- Population of **2.8 million**, of which **67% lives in urban areas**
- Low population density of ~ **42 inhabitants per km²**
- Predominant **land cover is agricultural areas,** grassland and forests
- **More than 1000 lakes**



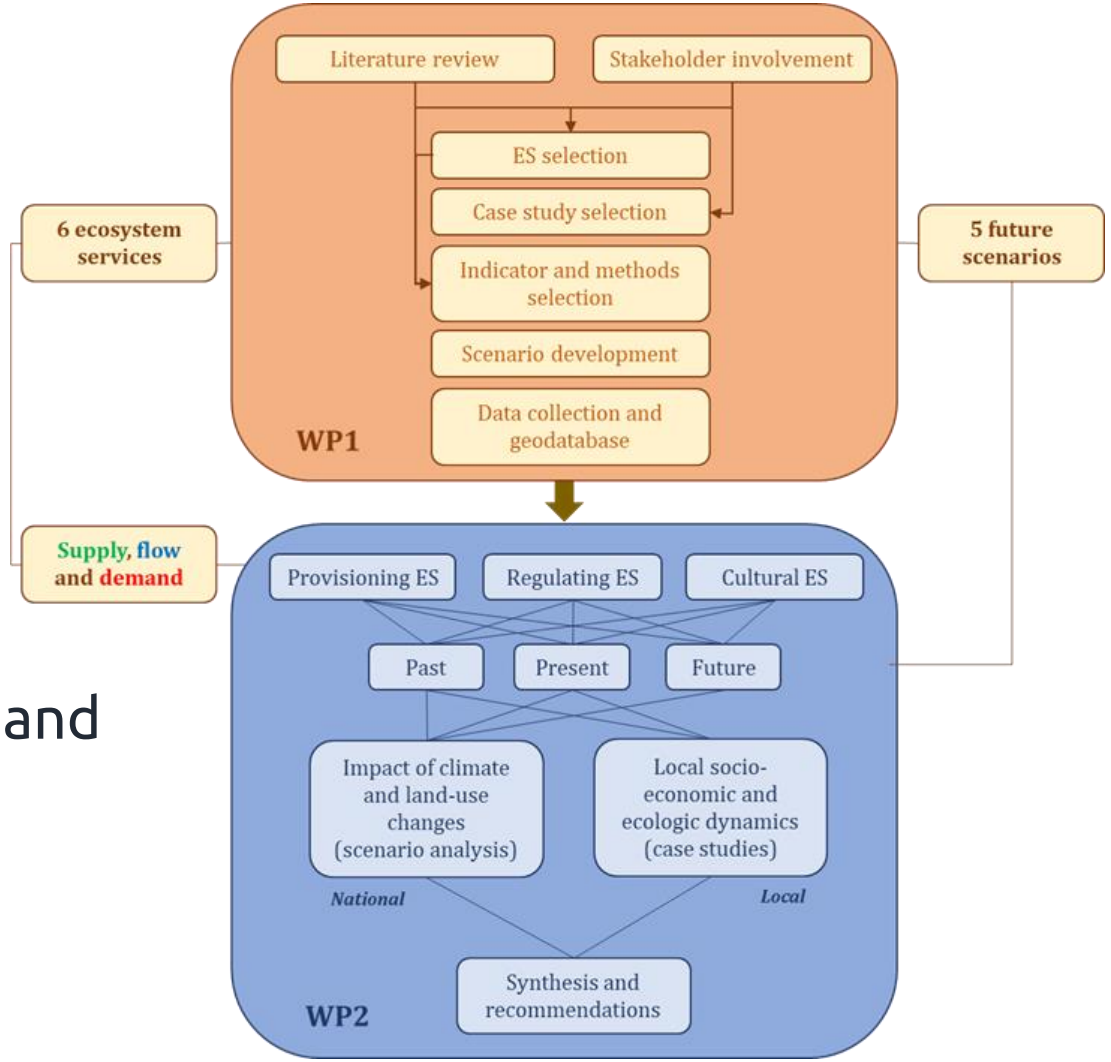
Lithuanian lake ecosystem services: impacts of climate and land-use change" **(LACLAN) -** *workflow*

WP1

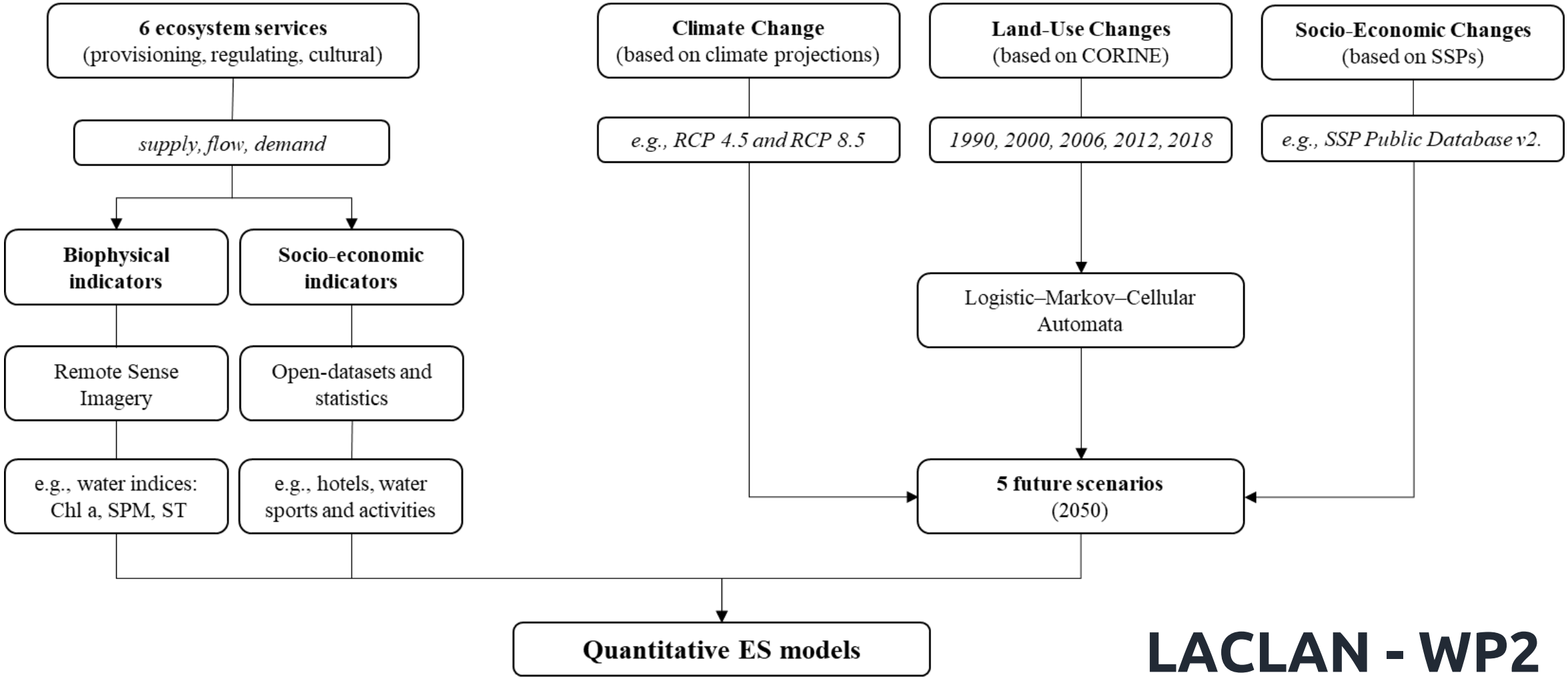
- Literature Review
- ES and case study selection
- Indicators and methodology
- Scenario development

WP2

- Data collection and analysis
- Assessment and mapping (multi-temporal and multi-scale)
- Recommendations and synthesis

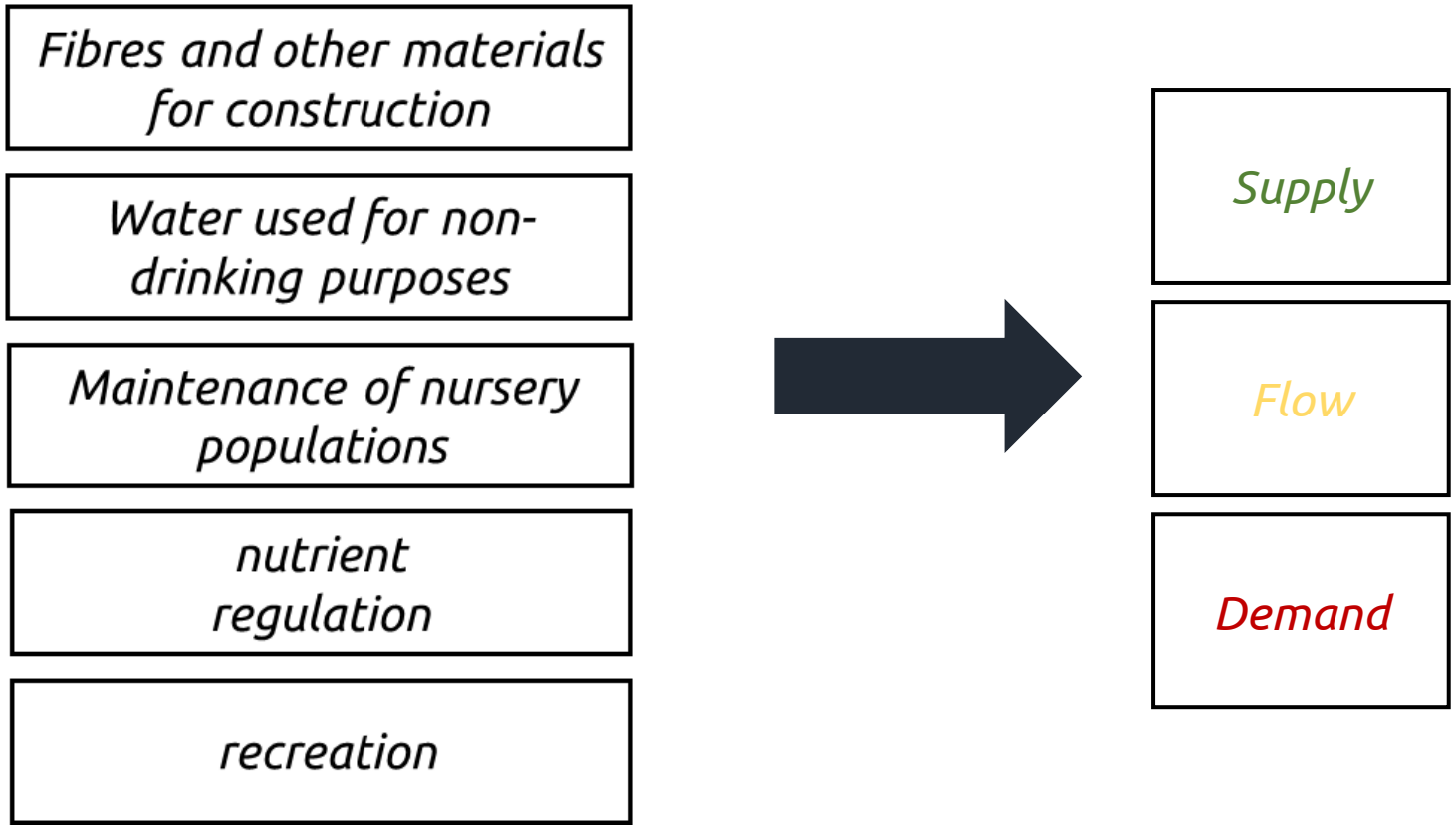


Lithuanian lake ecosystem services: impacts of climate and land-use change" **(LACLAN) –** *workflow*



LACLAN - WP2

5 Ecosystem Services: P, RM, C



Fibers/and other materials for construction - ***Supply***

Reed areas (other vegetation)

1990 – 2000 – 2006 – 2012 - 2018

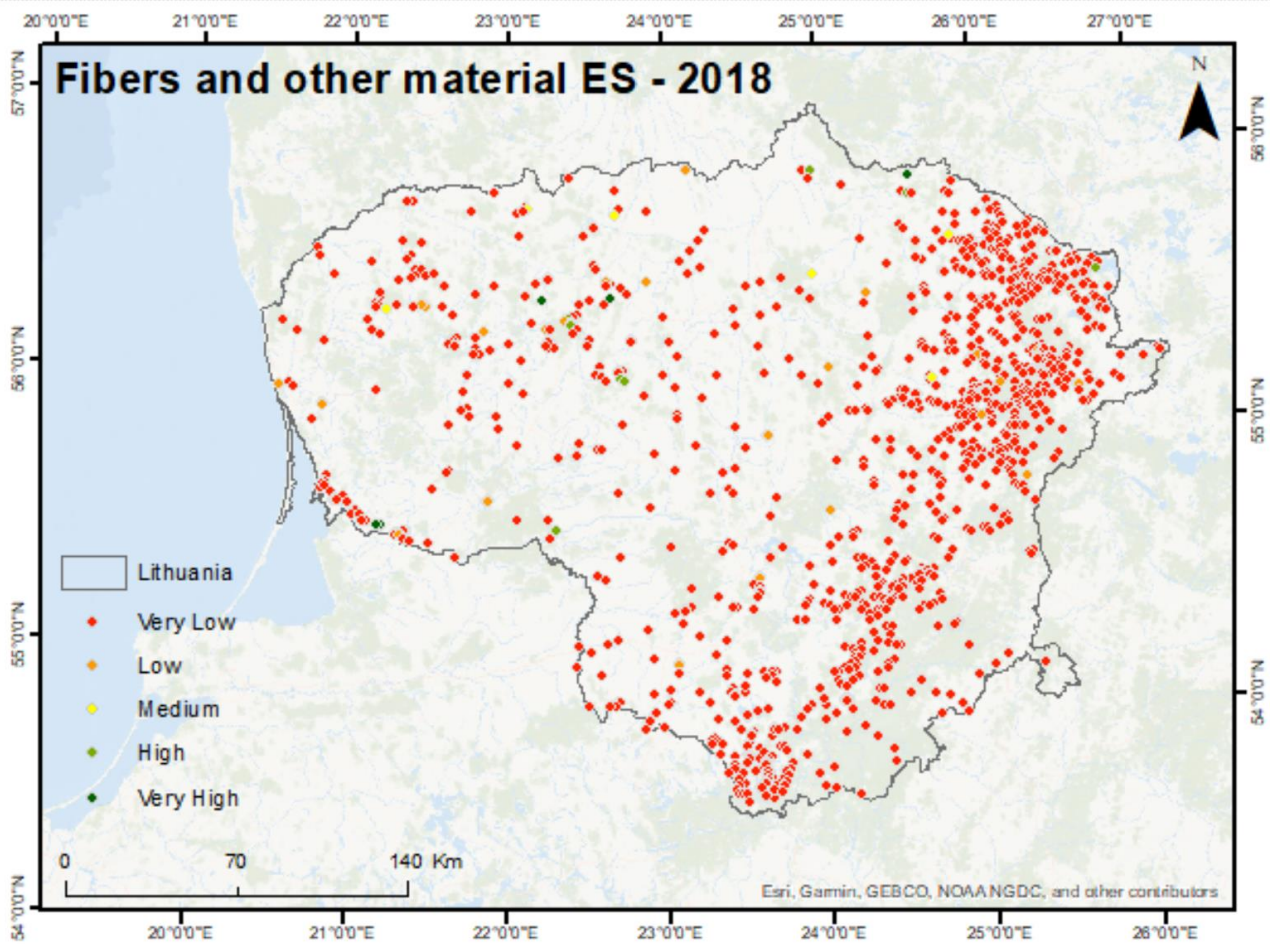
Normalized aquatic vegetation index (NDAVI)

Google Earth Engine

Landsat 5 – Landsat 7 – Landsat 8

Remove misclassified pixels (ortophoto maps)

Fibers/and other materials for construction - ***Supply***



Water for non-drinking purposes - ***Supply***

Water occurence (area)

JRC Global Surface Water

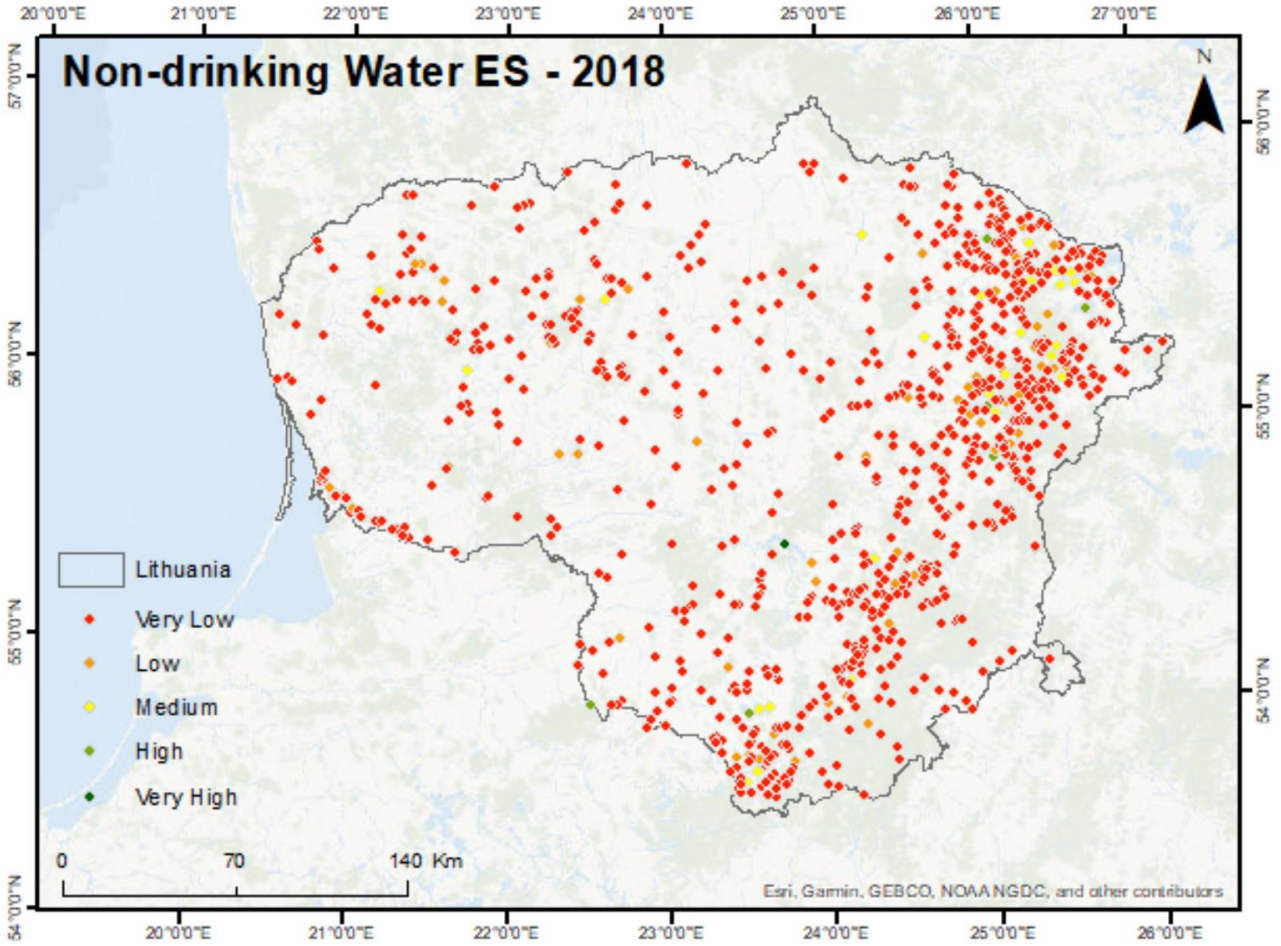
1990 – 2000 – 2006 – 2012 - 2018

Hydrolakes Database

Average depth per lake

Water Volume

Water for non-drinking purposes - ***Supply***

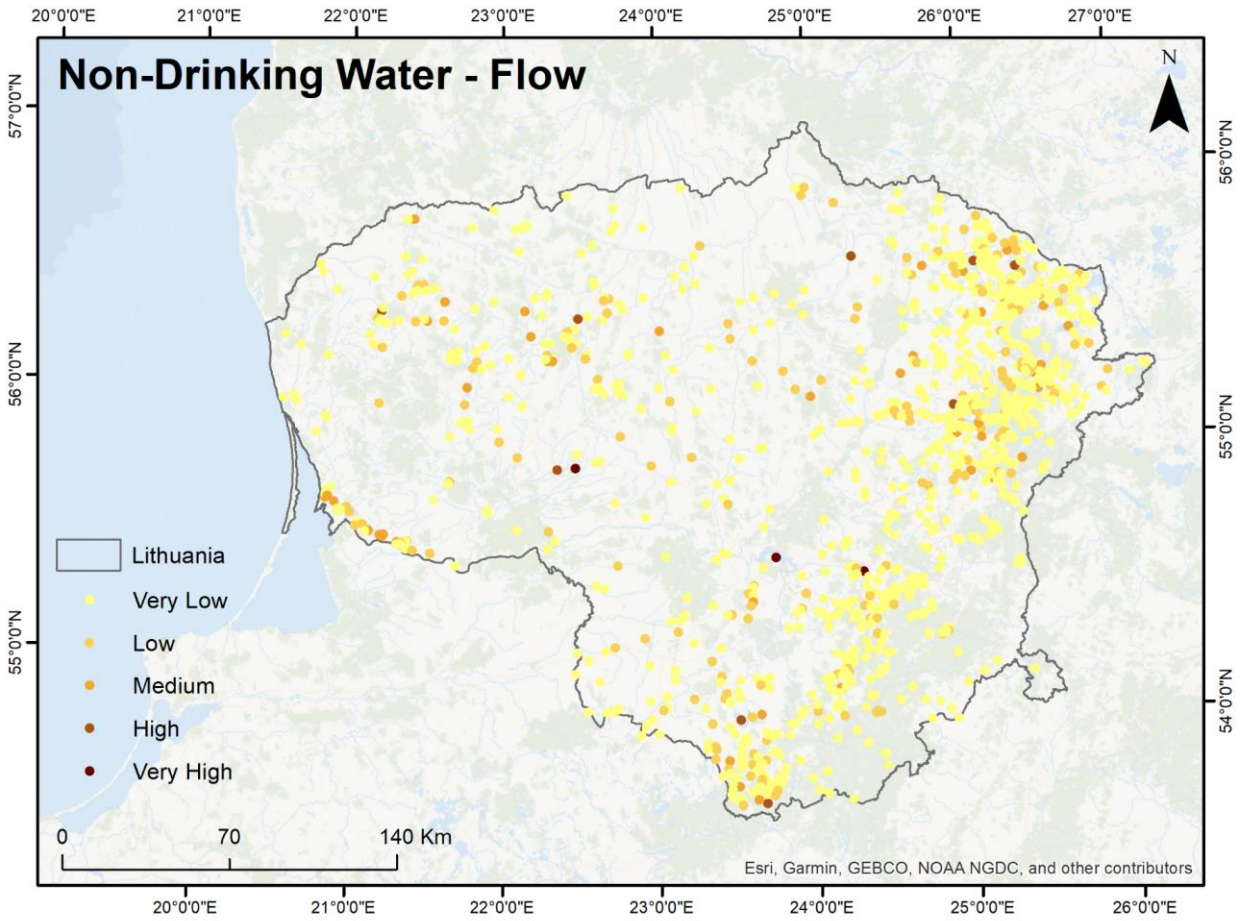


Water for non-drinking purposes - ***Flow***

Irrigation channels

Length of connections

Number of connections



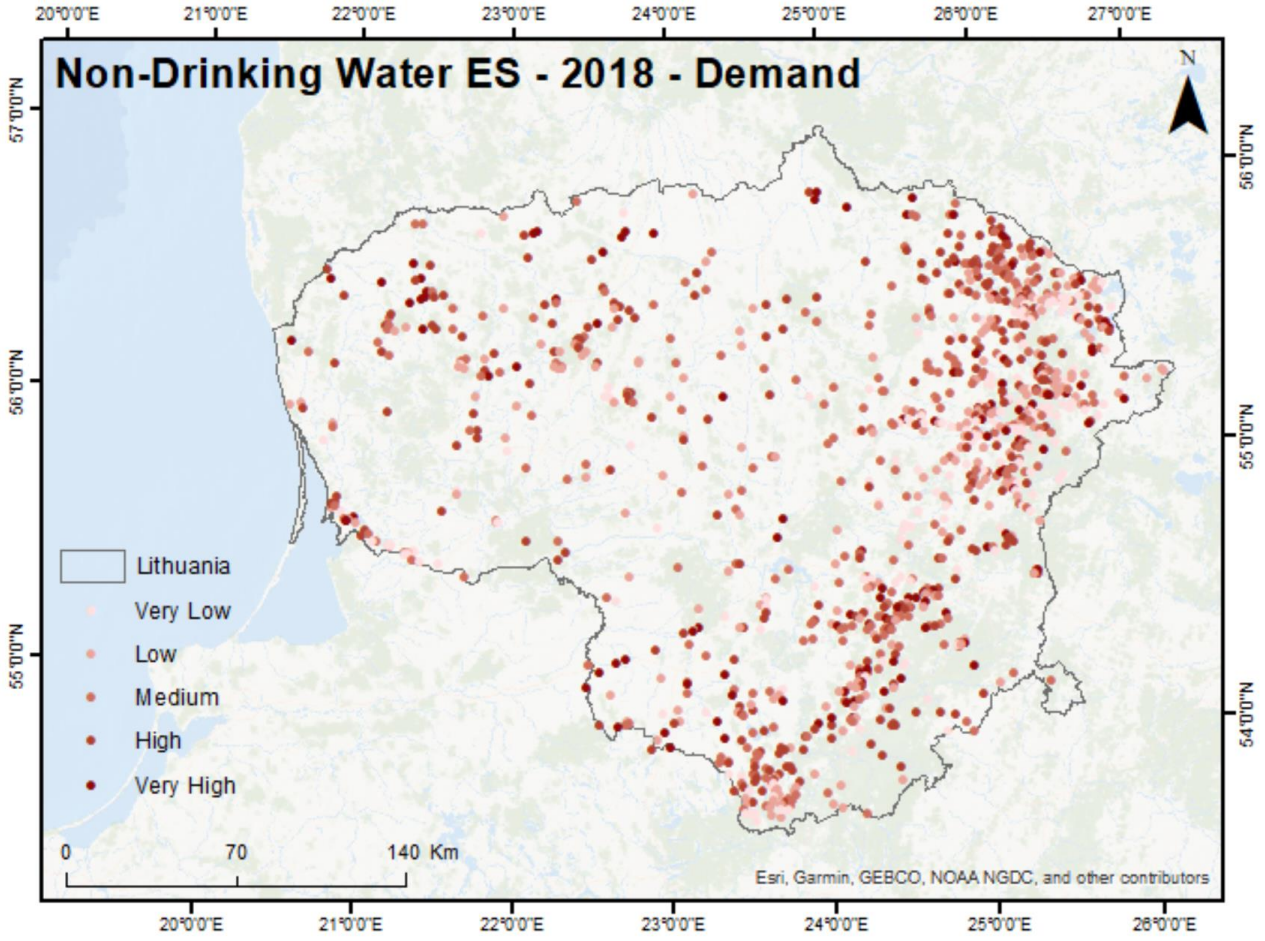
Water for non-drinking purposes - ***Demand***

↓

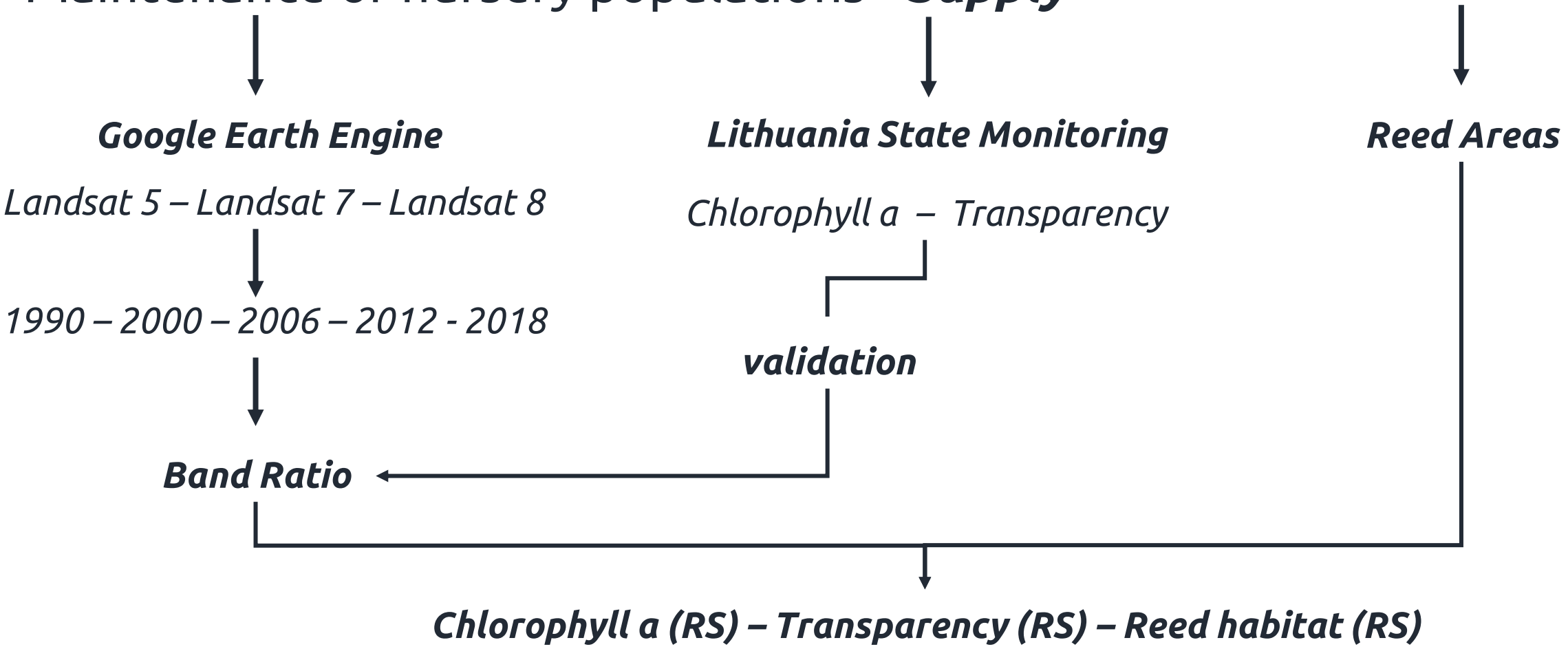
Agricultural Areas
(Corine LC)

↓

% of croplands per lake (buffer)

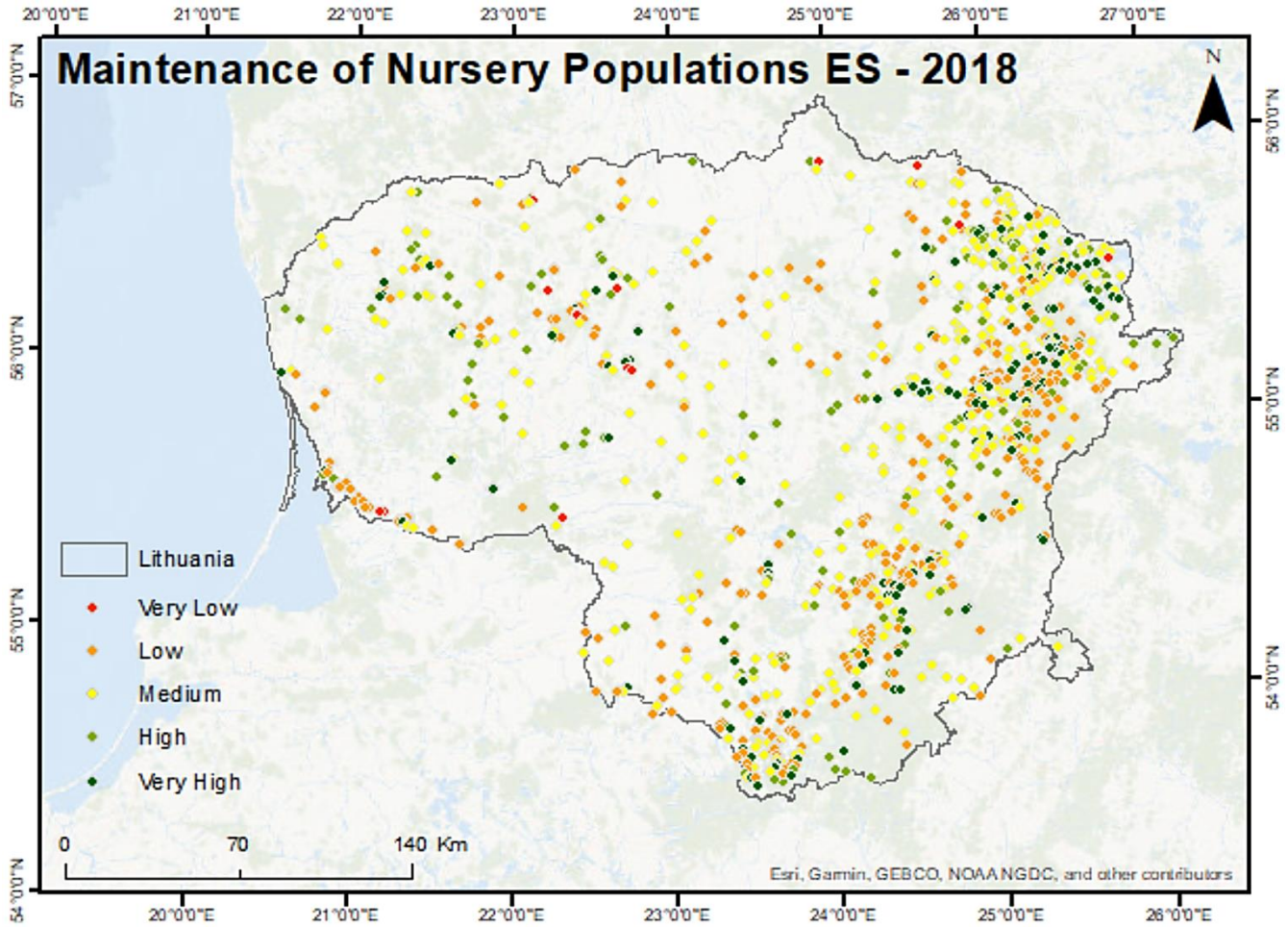


Maintenance of nursery populations - ***Supply***



Lithuanian lake ecosystem services: impacts of climate and land-use change" **(LACLAN)**

Maintenance of nursery populations - ***Supply***

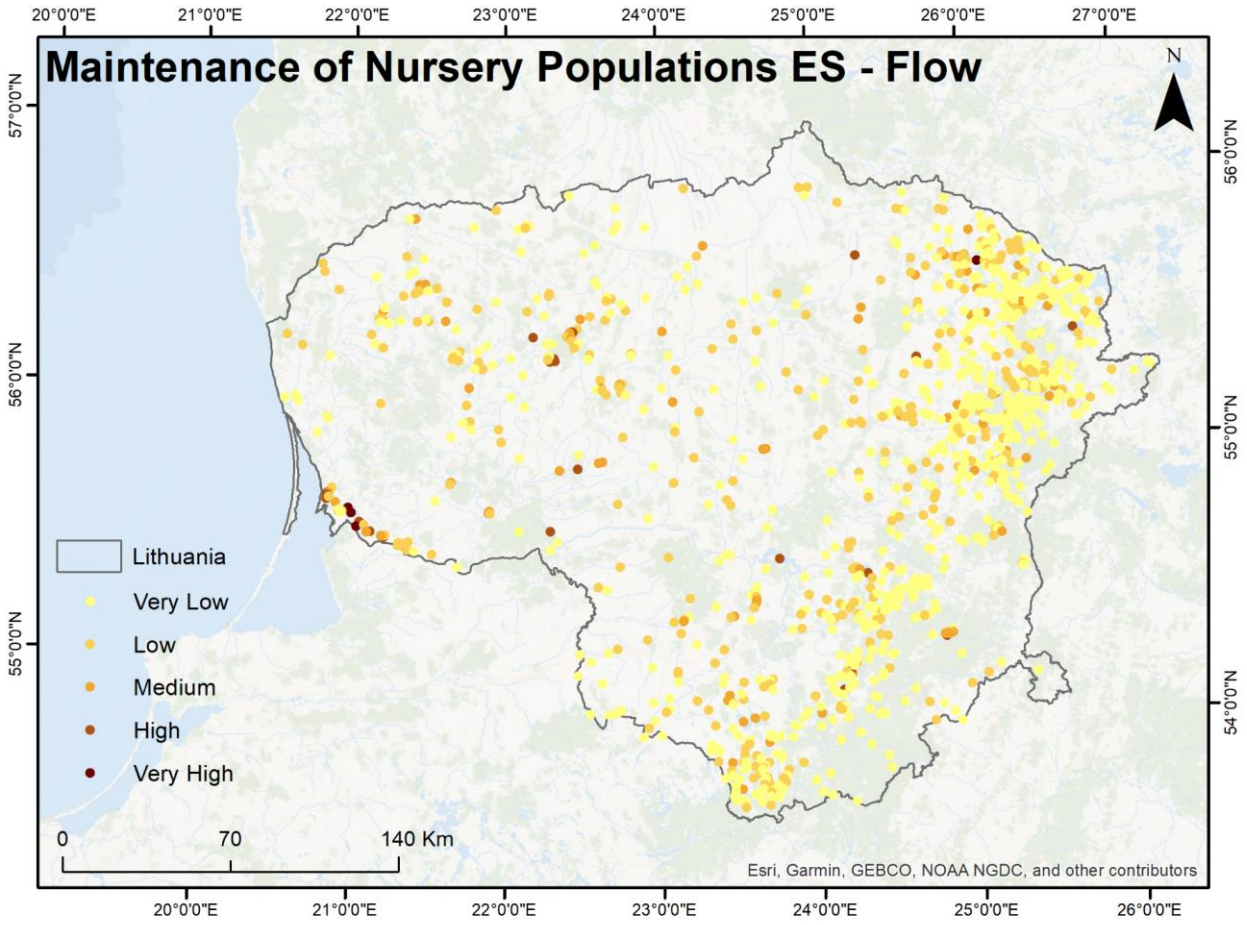


Maintenance of nursery populations - ***Flow***

Irrigation channels

Number of connected lakes

Number of connections



Maintenance of chemical conditions- ***Supply***

Google Earth Engine

Landsat 5 – Landsat 7 – Landsat 8

1990 – 2000 – 2006 – 2012 - 2018

Band Ratio

Lithuania State Monitoring

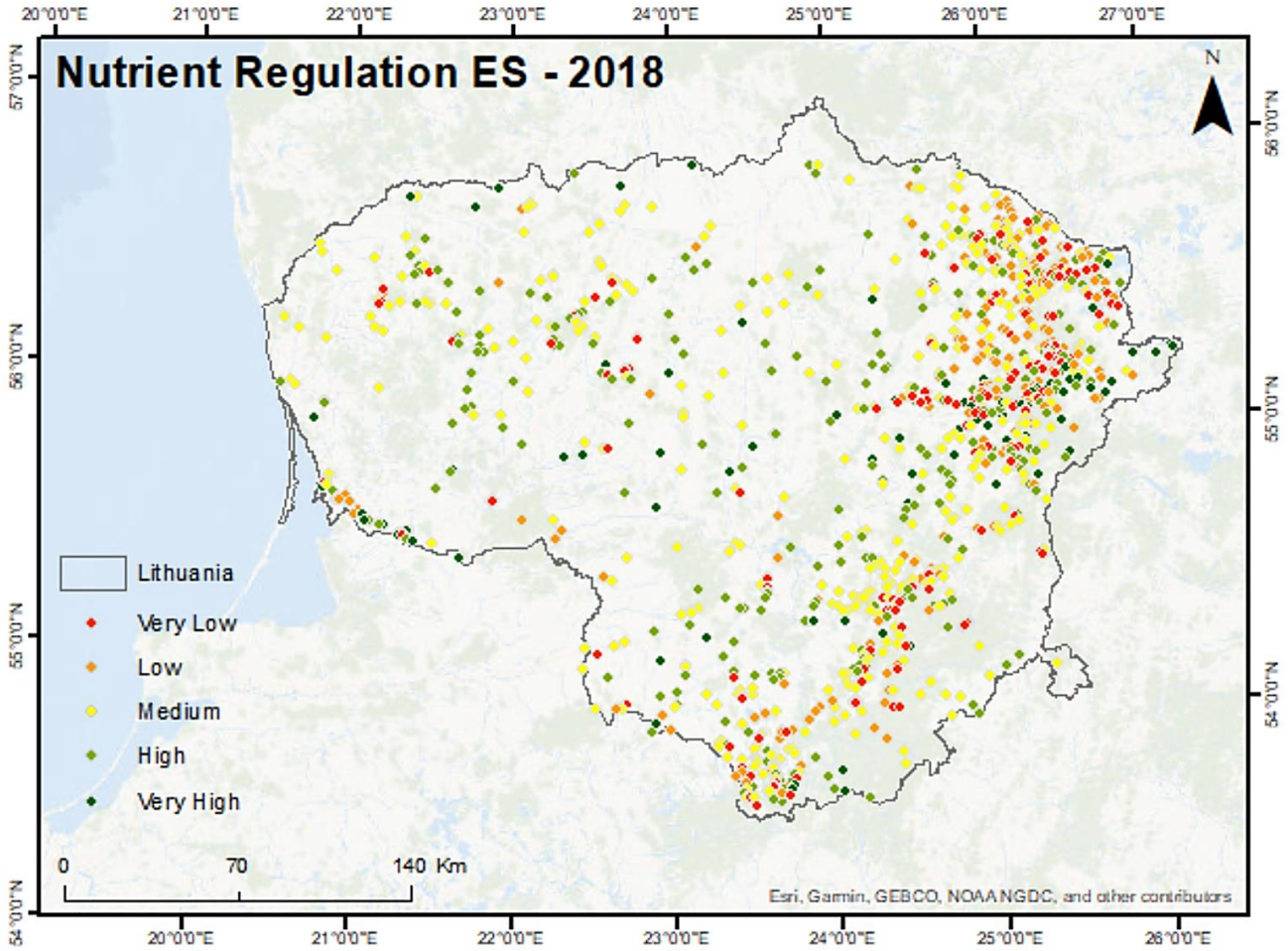
Chlorophyll a – NO3

Total N – Total P

validation

Chlorophyll a (RS) – NO3 (RS) – Total N (RS) – Total NP(RS)

Maintenance of chemical conditions- ***Supply***

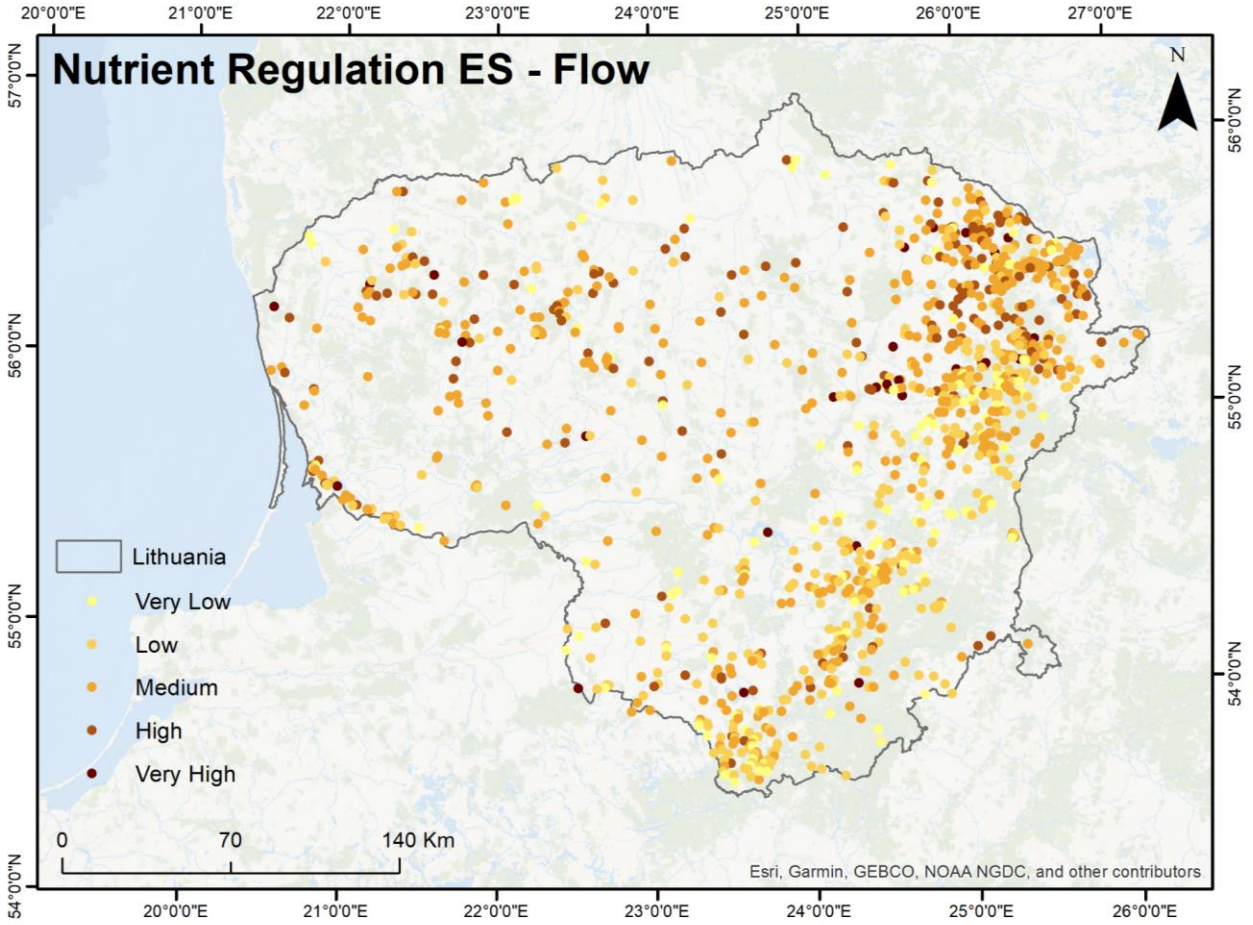


Maintenance of chemical conditions- ***Flow***

Slope

Number of connections
(irrigation lines)

Watershed Area



Maintenance of chemical conditions- ***Demand***

Agricultural Areas
(Corine LC)

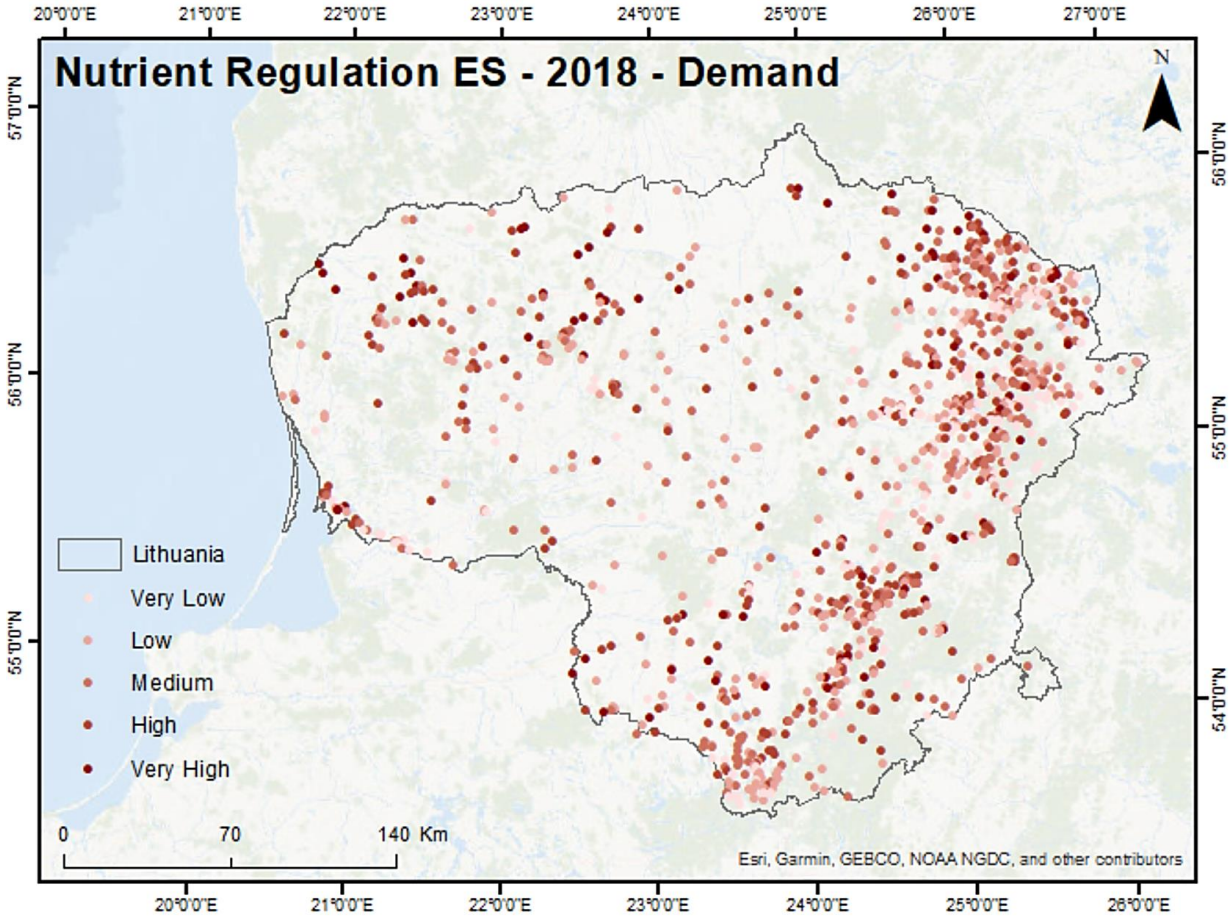
↓

% of croplands per lake (buffer)

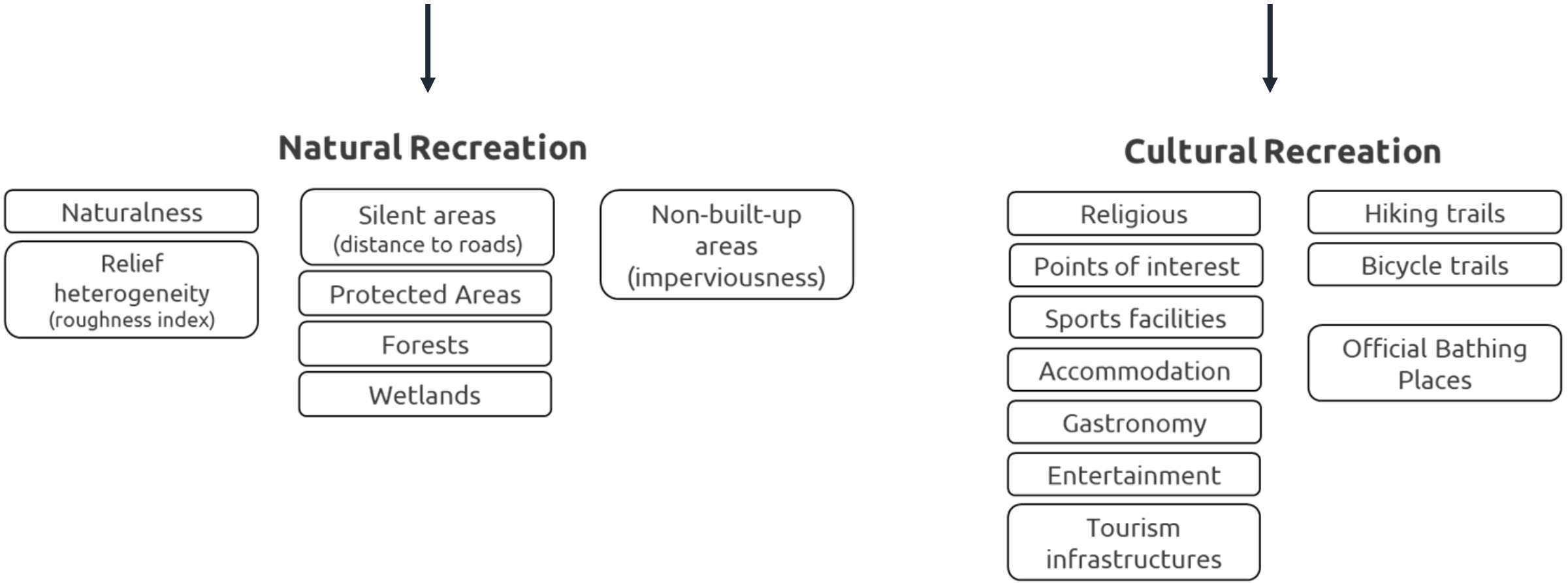
Urban Areas
(Corine LC)

↓

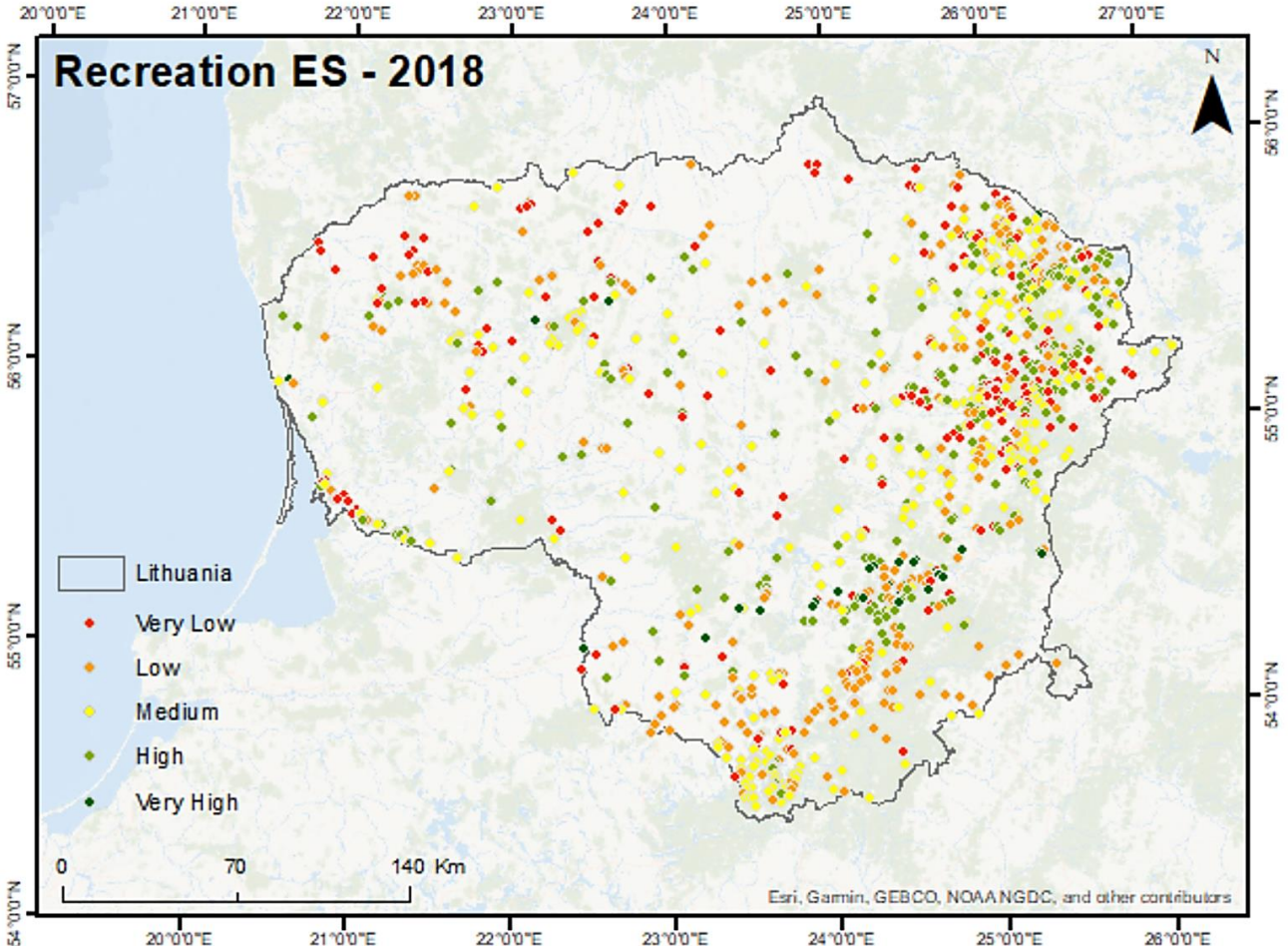
% of urban areas per lake (buffer)



Direct and indirect cultural outputs (recreation) – ***Supply***



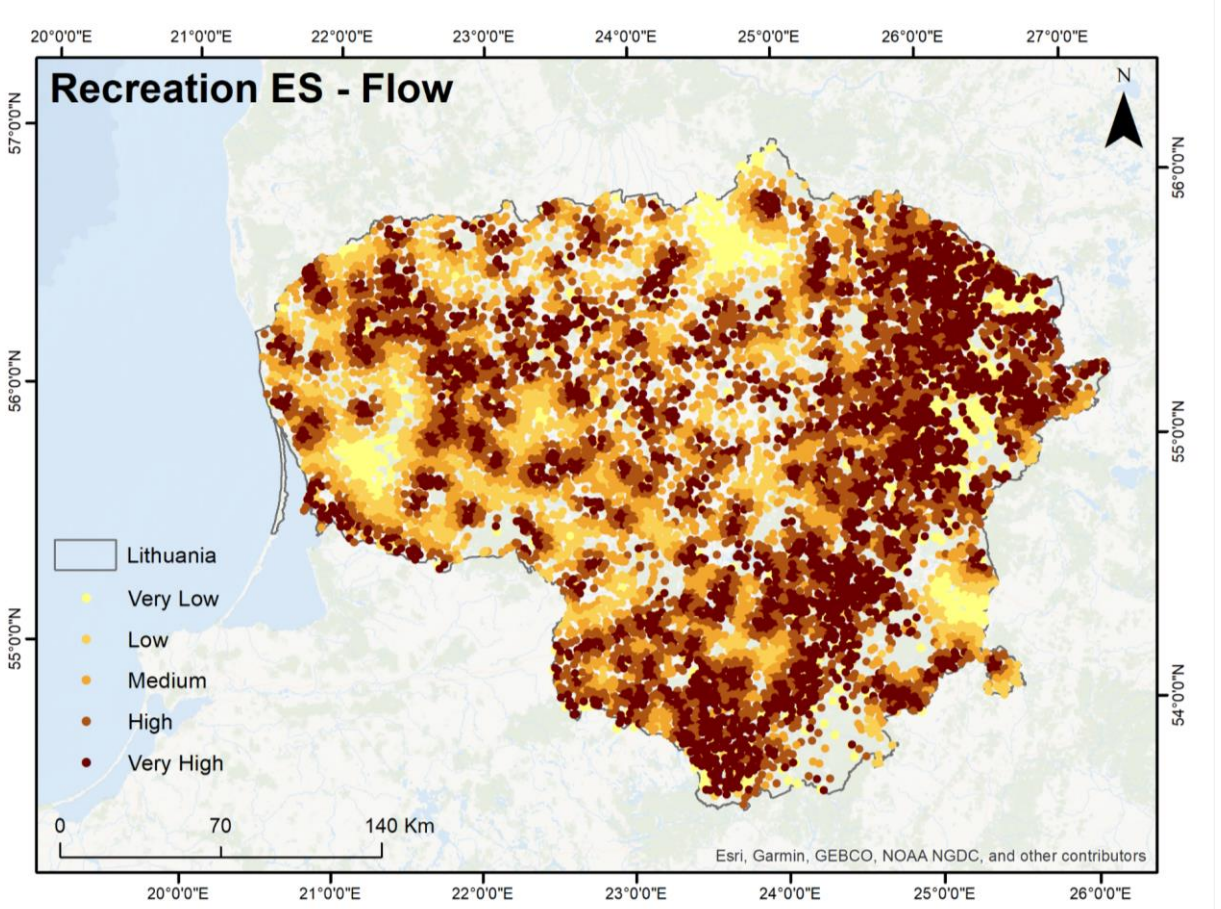
Direct and indirect cultural outputs (recreation) – ***Supply***



*Direct and indirect cultural outputs (recreation) - **Flow***

Locations
(villages / cities / etc)

Distance to lake areas



Lithuanian lake ecosystem services: impacts of climate and land-use change" **(LACLAN)**

Mapping and assessment of freshwater ES (lakes) allows to understand their role in:

- **socio-ecologic systems**
- supporting the implementation of **European Policies** and **international environmental Agendas**
- supporting **regional environmental management** and **spatial planning**
- predicting (**via scenario analysis**) the **impact of future climate and land use changes**
- support **various NBS process steps**

Mykolas Romeris University

Thank you for your attention!

rinacio.miguel@gmail.com

“Lithuanian lake ecosystem services: impacts of climate and land-use change” (LACLAN) Project, receives funding from the European Social Fund under the No 09.3.3-LMT-K-712 “Development of Competences of Scientists, other Researchers, and Students through Practical Research Activities” measure.

Mykolas Romeris University
Ateities st. 20, Vilnius, LT-08303 Lithuania

www.mruni.eu