

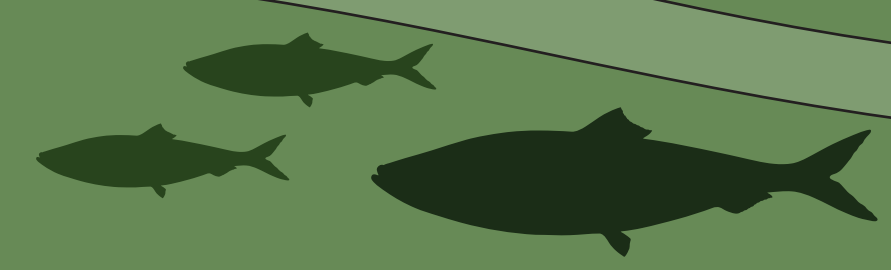
# GREEN MARITIME TRAFFIC: THE UNKNOWN IMPACTS OF EMISSION REDUCTION ON MARINE BIODIVERSITY

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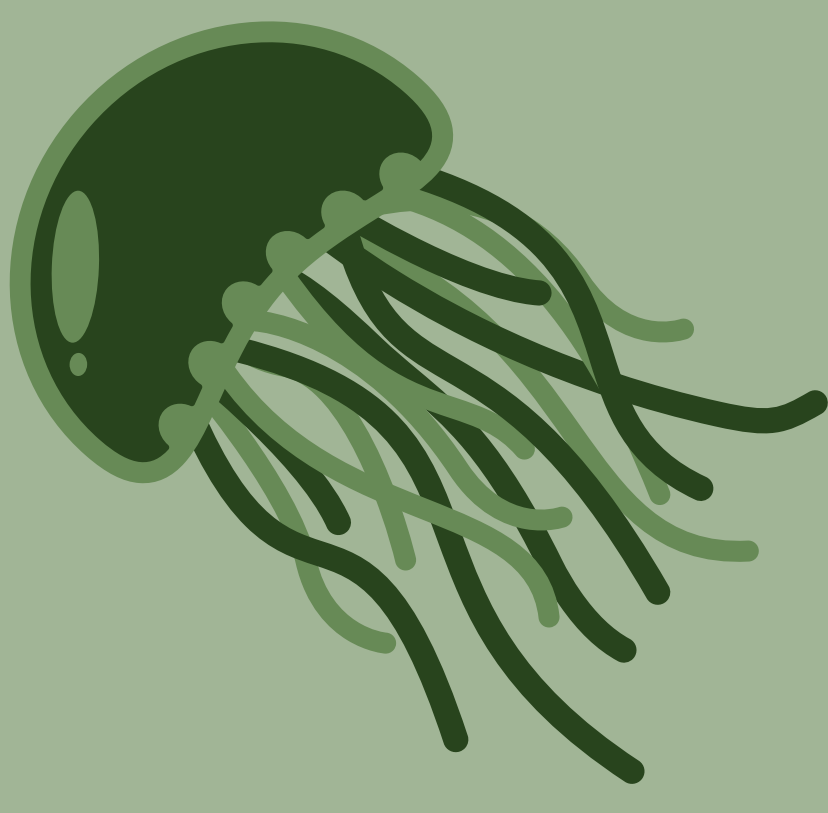


## STARTING POINT

- Maritime decarbonization cuts CO<sub>2</sub> and greenhouse gases (GHG) to mitigate climate change, but broader ecological effects on biodiversity and ecosystems remain unclear, even though research regarding these topics has grown since 2015.
- For example, some alternative fuels produce different types of emissions, and open-loop scrubbers discharge pollutants into the sea.
- This study reviews scientific literature to explore how emission cuts and biodiversity trade-offs are addressed.
- The study aims to identify knowledge gaps and support more sustainable maritime solutions.

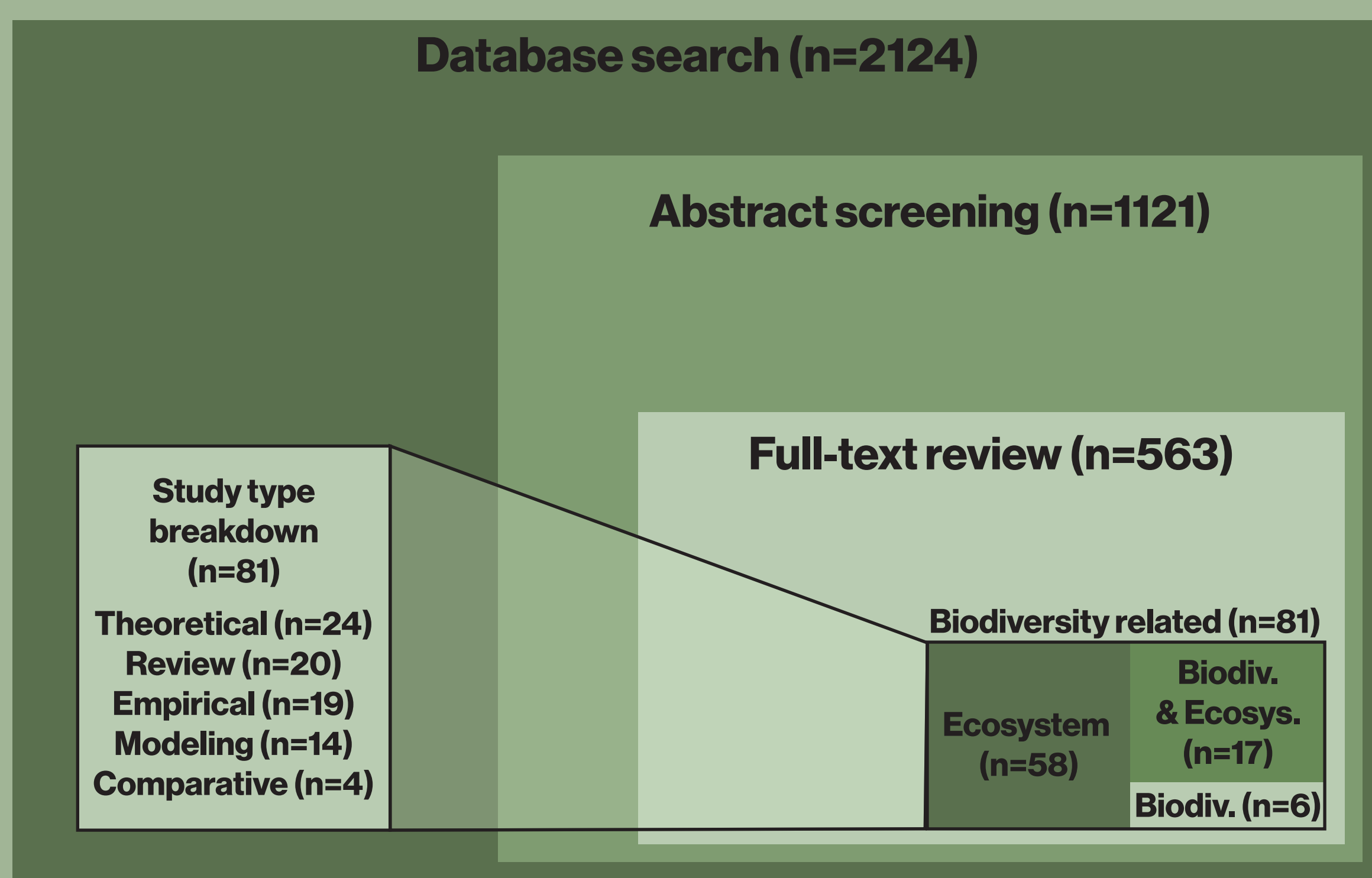
## METHODS

- A list of GHG emission-reduction solutions and measures was compiled from several sources.
- Solutions were grouped into four categories:
  - Energy efficiency in operations
  - Alternative fuels
  - Air emission mitigation technologies
  - Alternative energy sources.
- The categorization guided a systematic literature search, conducted in June 2024.



- Key pressures on marine biodiversity from emission reduction efforts:
  - Waterborne discharges (scrubber effluent, ballast water, antifouling paint, and chemicals).
  - Underwater noise.
- Biodiversity assessment methods varied. Direct metrics were rare, and biodiversity was often addressed indirectly within Life Cycle Assessment, Environmental Impact Assessment, or qualitative approaches.
- Regulatory tools for marine biodiversity risk assessment are constrained by data gaps (e.g., limited species and ecosystem monitoring) and uncertainties in technology adoption, fuel emissions, and evolving regulations.

## RESULTS



### SELECTED TRADE-OFFS IN THE BIODIVERSITY RELATED LITERATURE (n=81):

- Biodiesel and methanol:** Lower CO<sub>2</sub>, but higher NO<sub>x</sub> may increase eutrophication and acidification risks.
- Hydrogen and ammonia:** Reduce GHGs, but leaks could cause local toxicity and affect aquatic life.
- Antifouling coatings:** Improve fuel efficiency, but may leach biocides harmful to marine species.
- Battery-electric vessels:** Reduce underwater noise, but battery production and disposal may release heavy metals into coastal waters.

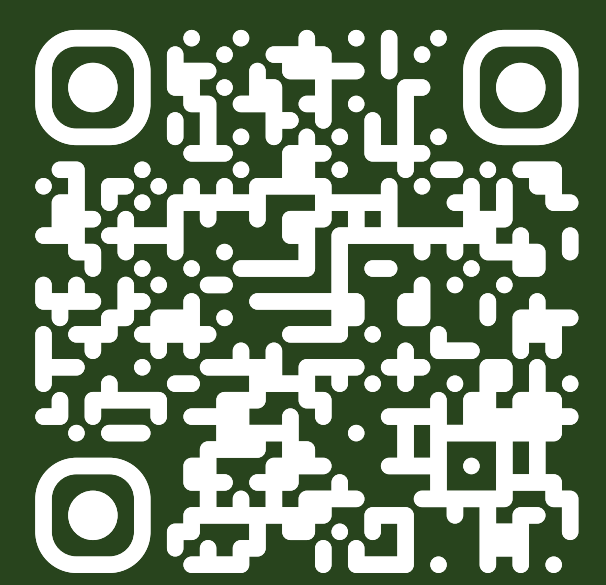
Figure 1: Systematic literature review workflow

**BIODIVERSITY SHOULD BE MORE EXPLICITLY  
INTEGRATED INTO MARITIME  
DECARBONIZATION RESEARCH AND FUTURE  
EMISSION REDUCTION EFFORTS.**

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