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A Concept-Driven Framework for Organising Habitat Monitoring Knowledge

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The gap

Habitat monitoring knowledge is scattered

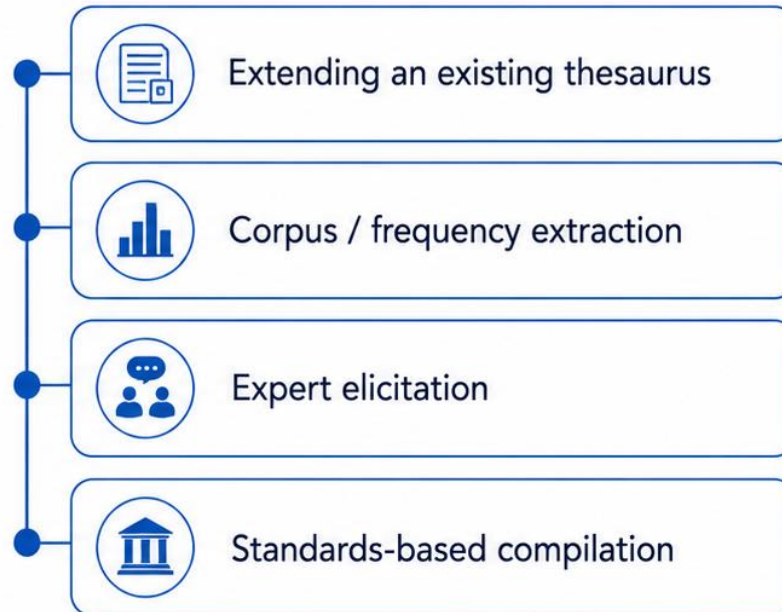
- Habitat monitoring generates rich ecological knowledge, but it stays scattered. Environmental Variables, indicators, species traits, habitat descriptors and sampling protocols are distributed across papers, datasets, reports and monitoring schemes.
- Similar concepts are often described with different terms, limiting discovery, comparison and reuse.

Semantic resources exist, but remain fragmented

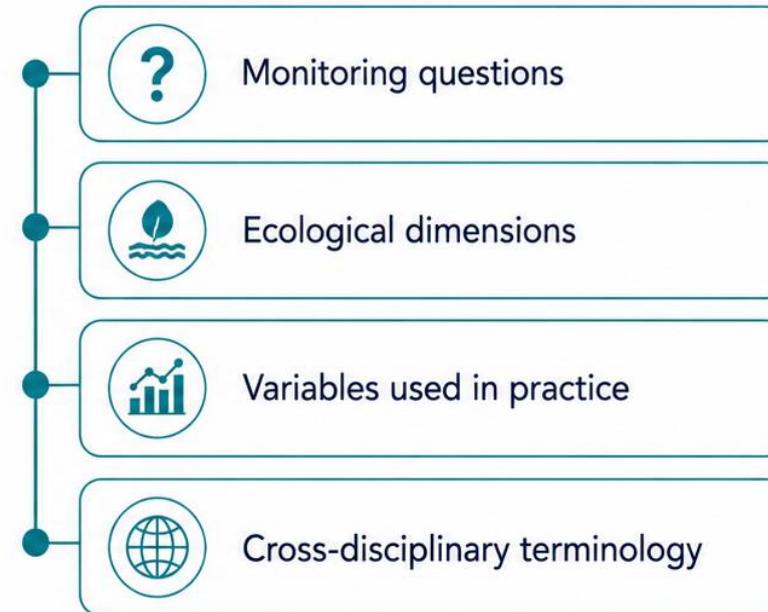
- Controlled vocabularies and standards support harmonisation, but they often cover different domains, scales or purposes.
- Habitat monitoring concepts are therefore scattered across multiple semantic resources and require mapping, alignment and domain-specific organisation.

How does this differ from common thesaurus-building approaches?

Common starting points

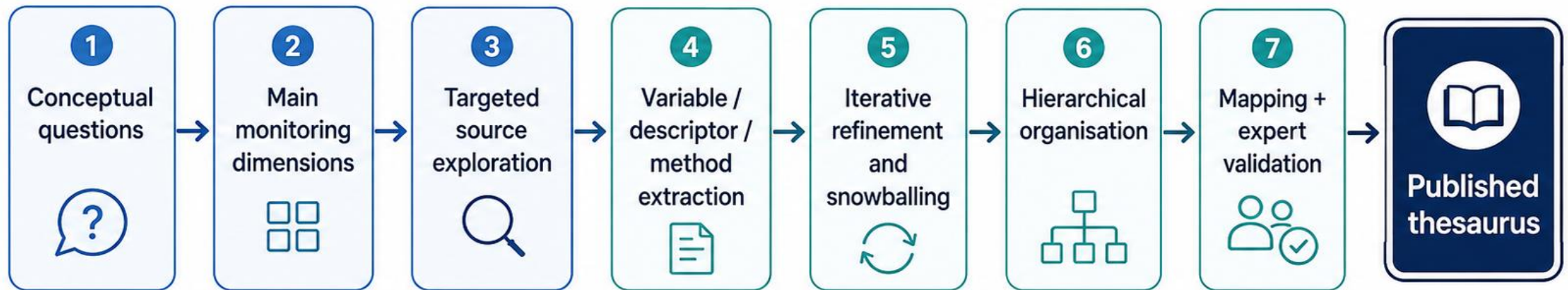


Our starting point



The approach is concept-driven: sources are selected and searched according to the monitoring concepts that need to be represented.

Concept-driven term extraction workflow



The workflow did not start from a single corpus or from term frequency.
It started from conceptual questions about how habitats are described, monitored and assessed.

Concept-driven approach

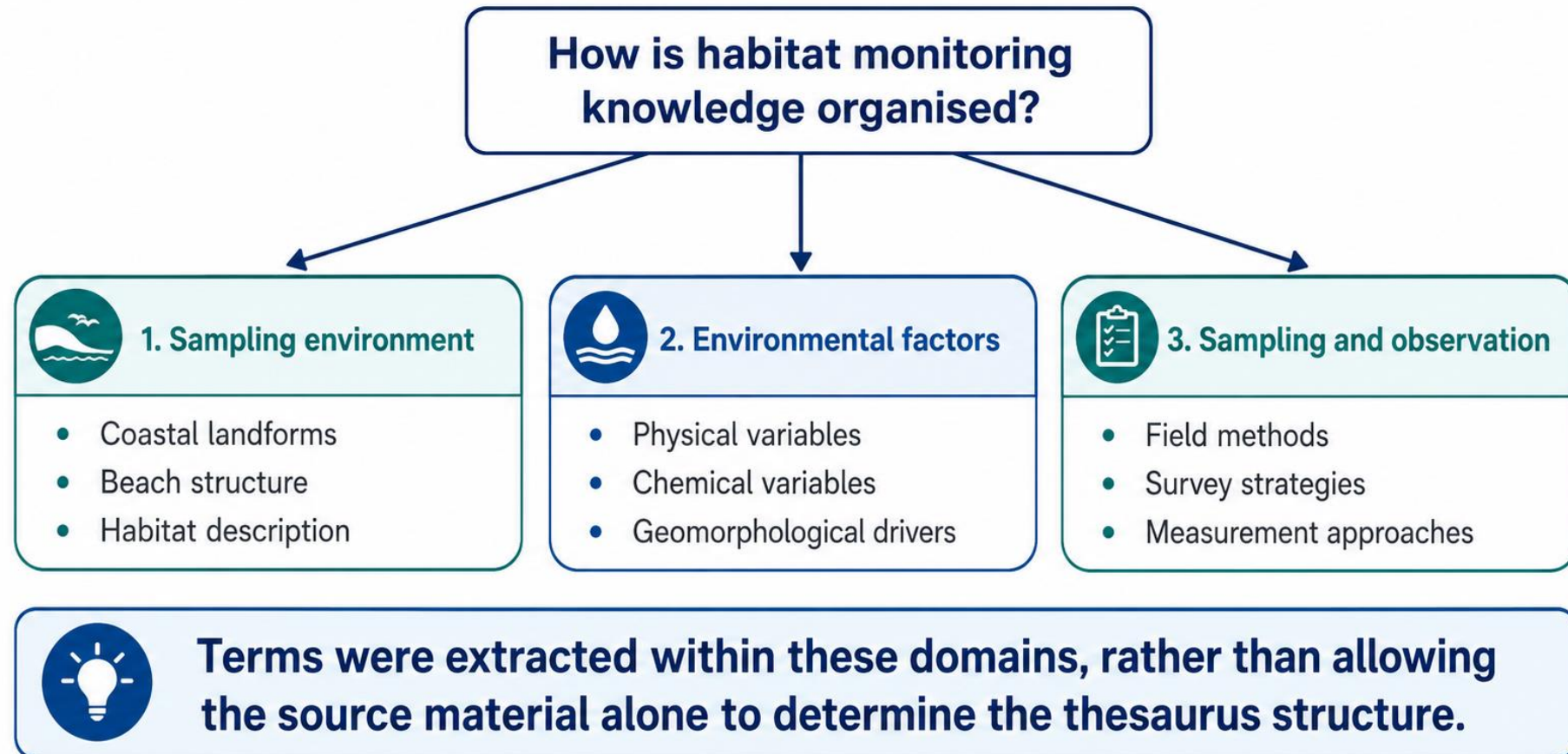
The process did not begin from one source type, but from conceptual questions about habitat monitoring:

- How is the sampling environment described and classified?
- Which environmental parameters influence the system?
- How are ecological observations and measurements conducted?
- Which biological, geomorphological or management-related attributes are recorded?
- Which pressures, impacts or restoration actions are relevant?

These questions defined the conceptual domains. Terms were then extracted within those domains from datasets, monitoring templates, protocols, literature, reports, policy documents and knowledge across ecology, geology, coastal engineering, oceanography and related fields.

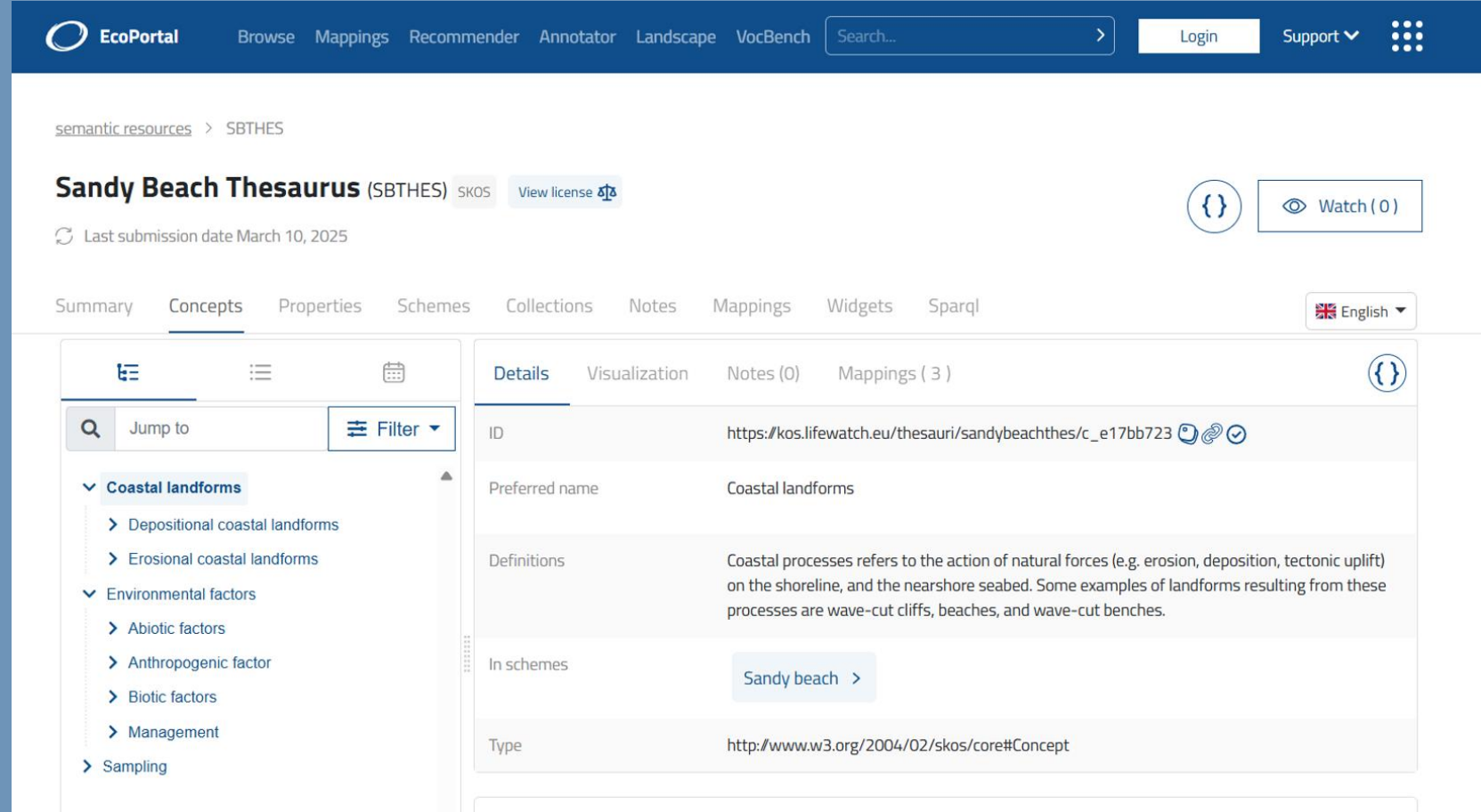
Case Study 1 ; Sandy Beach Ecosystems

From questions to conceptual domains



Case Study 1 ; Sandy Beach Ecosystems

- Habitat defined by geomorphological and physical descriptors, independent of species identity.
- 202 preferred terms, 109 definitions, 91 terms mapped to 21 controlled vocabularies.



The screenshot displays the EcoPortal interface for the Sandy Beach Thesaurus (SBTHES). The top navigation bar includes links for Browse, Mappings, Recommender, Annotator, Landscape, and VocBench, along with a search bar, Login, and Support options. The main content area shows the SBTHES details, including its ID (SKOS), a View license button, and a Watch (0) button. The last submission date is March 10, 2025. The interface is organized into tabs: Summary, Concepts, Properties, Schemes, Collections, Notes, Mappings, Widgets, and Sparql. The Concepts tab is active, showing a hierarchical tree of concepts. The left sidebar lists concepts such as Coastal landforms, Environmental factors, and Sampling. The main panel displays the details for the concept 'Coastal landforms', including its ID, preferred name, definitions, and mappings.

Sandy Beach Thesaurus (SBTHES) SKOS View license

Last submission date March 10, 2025

Summary Concepts Properties Schemes Collections Notes Mappings Widgets Sparql

English

Coastal landforms

- Depositional coastal landforms
- Erosional coastal landforms

Environmental factors

- Abiotic factors
- Anthropogenic factor
- Biotic factors
- Management
- Sampling

Details Visualization Notes (0) Mappings (3)

ID: https://kos.lifewatch.eu/thesauri/sandybeachthes/c_e17bb723

Preferred name: Coastal landforms

Definitions: Coastal processes refers to the action of natural forces (e.g. erosion, deposition, tectonic uplift) on the shoreline, and the nearshore seabed. Some examples of landforms resulting from these processes are wave-cut cliffs, beaches, and wave-cut benches.

In schemes: Sandy beach

Type: <http://www.w3.org/2004/02/skos/core#Concept>

Case Study 1 ; Sandy Beach Ecosystems

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RESEARCH



A thesaurus for improved communication and data integration in sandy beach ecosystem research

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Abstract

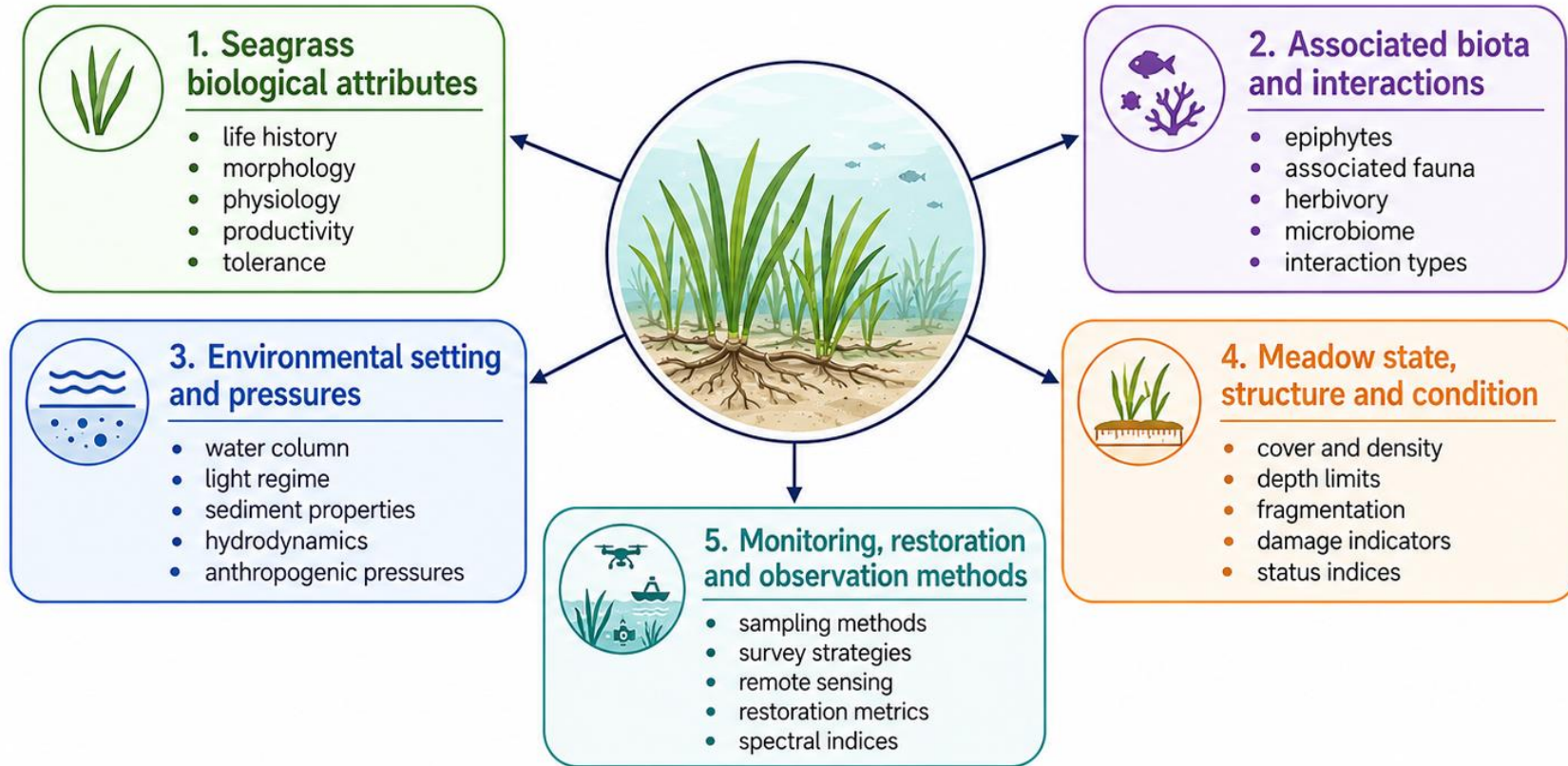
Sandy beaches are important interfaces between land and sea that support unique biodiversity and provide ecosystem services on which many coastal communities depend. However, beaches are under significant anthropogenic pressures, compounded by global change impacts. These contemporary challenges require greater multidisciplinary research and collaboration to develop management solutions that meet social, economic and ecological demands. Communication gaps among scientists from different disciplines can arise when similar variables or features are described using different terms, or when the same term is used with different meanings, thereby hindering progress in multidisciplinary research. To address this, we developed a Sandy Beach Thesaurus that provides a standardised set of terms and definitions for beach geomorphological features, environmental factors, and sampling methods. We followed a structured, multi-phase approach including: (1) literature review, (2) term extraction, (3) hierarchical organisation, (4) mapping and alignment, and (5) review and validation. The thesaurus was developed using VocBench, which follows the Simple Knowledge Organisation System (SKOS). Finally, the Sandy Beach Thesaurus was published on EcoPortal, a platform of LifeWatch ERIC, where it supports data and metadata comparability and facilitates data integration across studies.

Keywords Controlled vocabulary · Sandy shores · Data harmonisation · Interoperability · Findable · Accessible · Interoperable · Reusable (FAIR) data principles

Case Study 2 : Seagrass Habitats

Seagrass monitoring knowledge: core conceptual domains

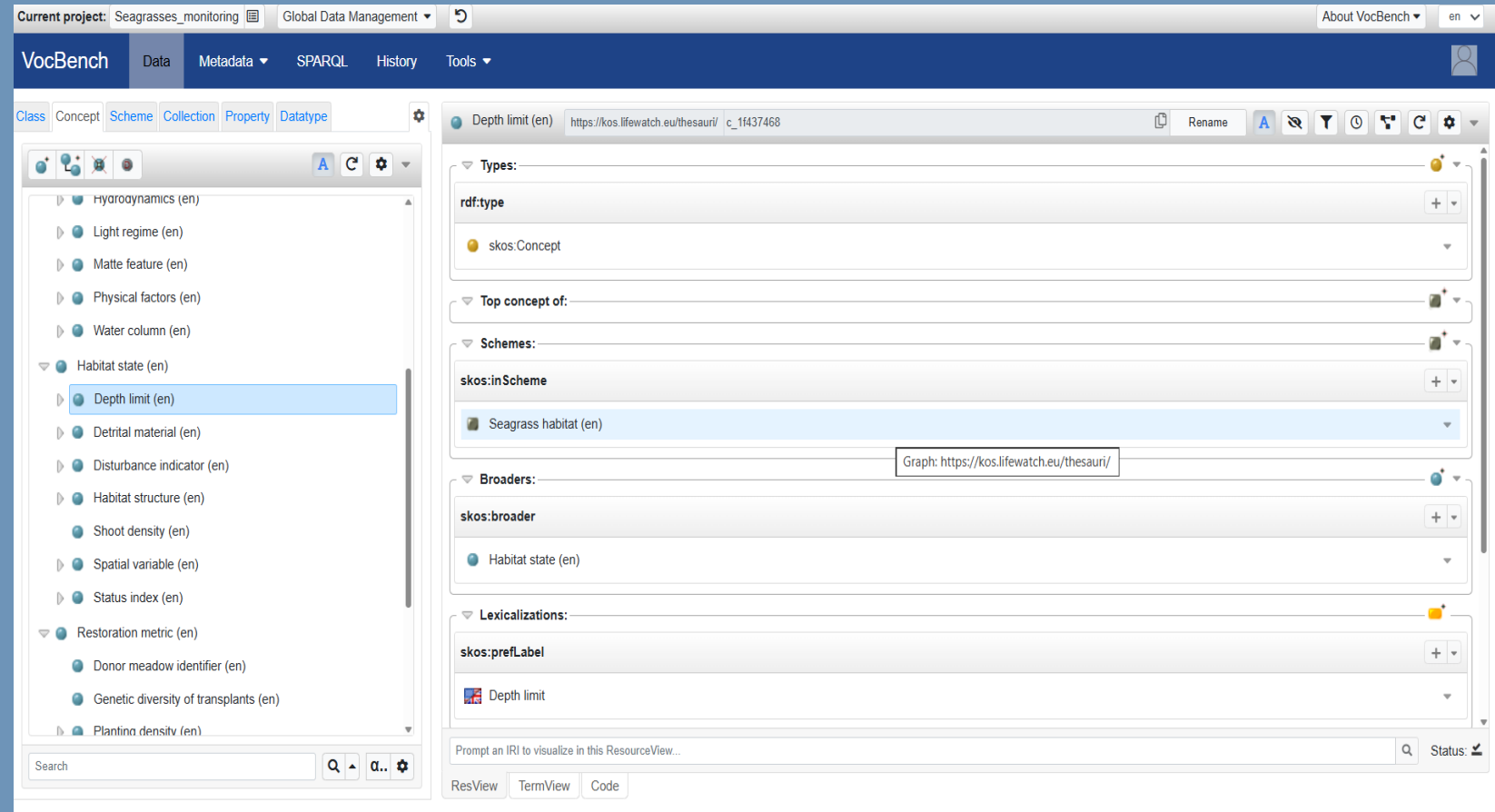
A concept-driven structure for standardising habitat monitoring knowledge



Conceptual domains are defined first, and seagrass monitoring terms are organised within them.

Case Study 2 : Seagrass Habitats

- Habitat defined by the presence, traits and condition of a foundation species.
- ~309 concepts (current working list) across 5 categories: biological trait, biotic interaction, environmental factors, habitat state, sampling (in progress).



The screenshot displays the VocBench web application interface. The top navigation bar includes 'Current project: Seagrasses_monitoring', 'Global Data Management', and a language dropdown set to 'en'. The main navigation menu has tabs for 'VocBench', 'Data', 'Metadata', 'SPARQL', 'History', and 'Tools'. Below this, a sub-menu shows 'Class', 'Concept', 'Scheme', 'Collection', 'Property', and 'Datatype'. The left sidebar lists a hierarchy of concepts, with 'Depth limit (en)' selected under 'Habitat state (en)'. The main content area shows details for 'Depth limit (en)' with an IRI of 'https://kos.lifewatch.eu/thesauri/c_1f437468'. It includes sections for 'Types' (rdf:type: skos:Concept), 'Top concept of:' (empty), 'Schemes' (skos:inScheme: Seagrass habitat (en)), 'Broaders' (skos:broader: Habitat state (en)), and 'Lexicalizations' (skos:prefLabel: Depth limit). A search bar and a 'Status' dropdown are at the bottom.

Same Workflow, Two Ontological Logics

Concept-driven thesaurus development applied to two coastal habitats, resulting in different knowledge structures.



SANDY BEACH



Habitat defined by: Landform, environmental factors, sampling



Dominant terms: Geomorphology, physical descriptors



Role of species: Mostly occupant, not habitat-defining



Ontology: Habitat-as-physical-structure



SEAGRASS



Habitat defined by: Foundation species (living organism) biological trait, biotic interaction, environmental factors, habitat state



Dominant terms: Plant traits, condition, health status



Role of species: Habitat-defining, inseparable from it



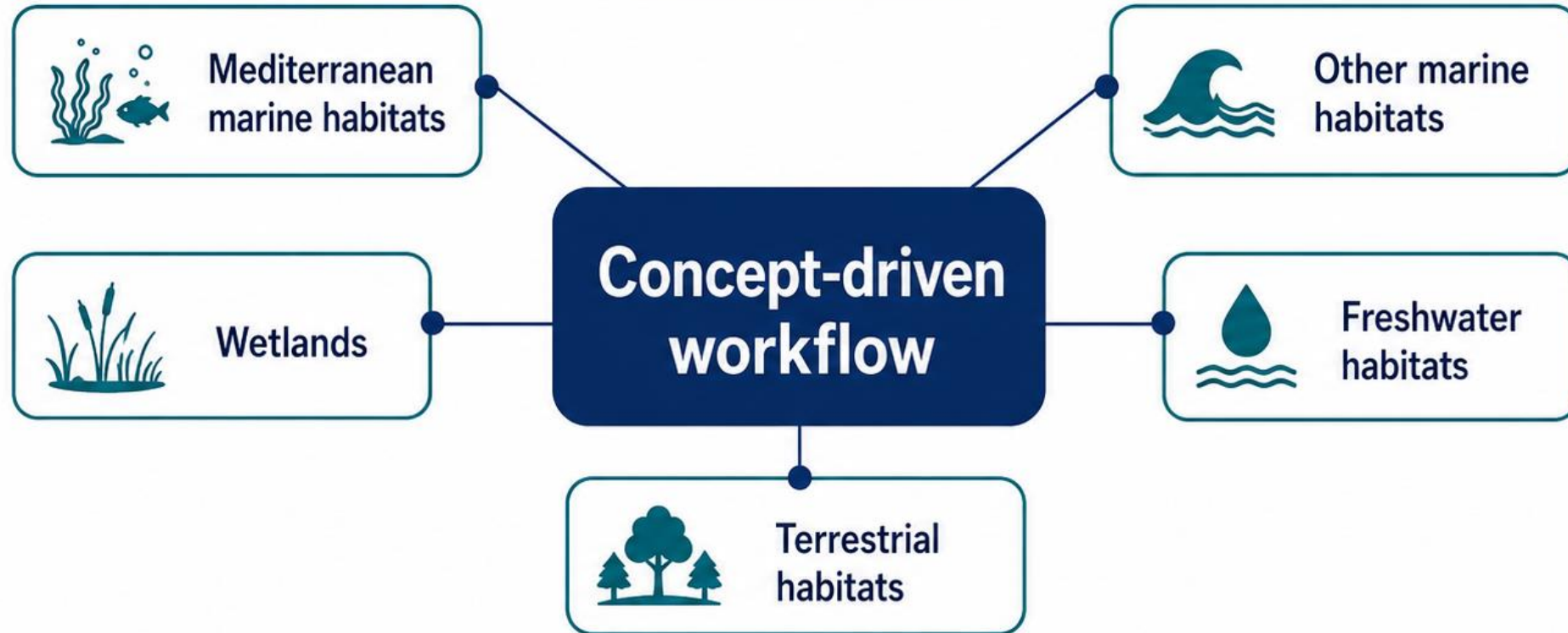
Ontology: Habitat-as-biogenic-structure



The same concept-driven workflow was applied, but the resulting domains reflect the different ecological and structural nature of each habitat.



Why this matters beyond the case studies



Habitat monitoring thesauri are still limited.



Data must be harmonised to support assessment, restoration and policy.



Other expert communities can adapt the workflow to their own monitoring questions.

A transferable workflow for organising monitoring knowledge across habitats.



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THANK YOU!

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