Temporary streams: current management challenges and promising solutions

Vicenç Acuña

1. What are temporary streams?

2. Why are these features important?

3. What are the management challenges?

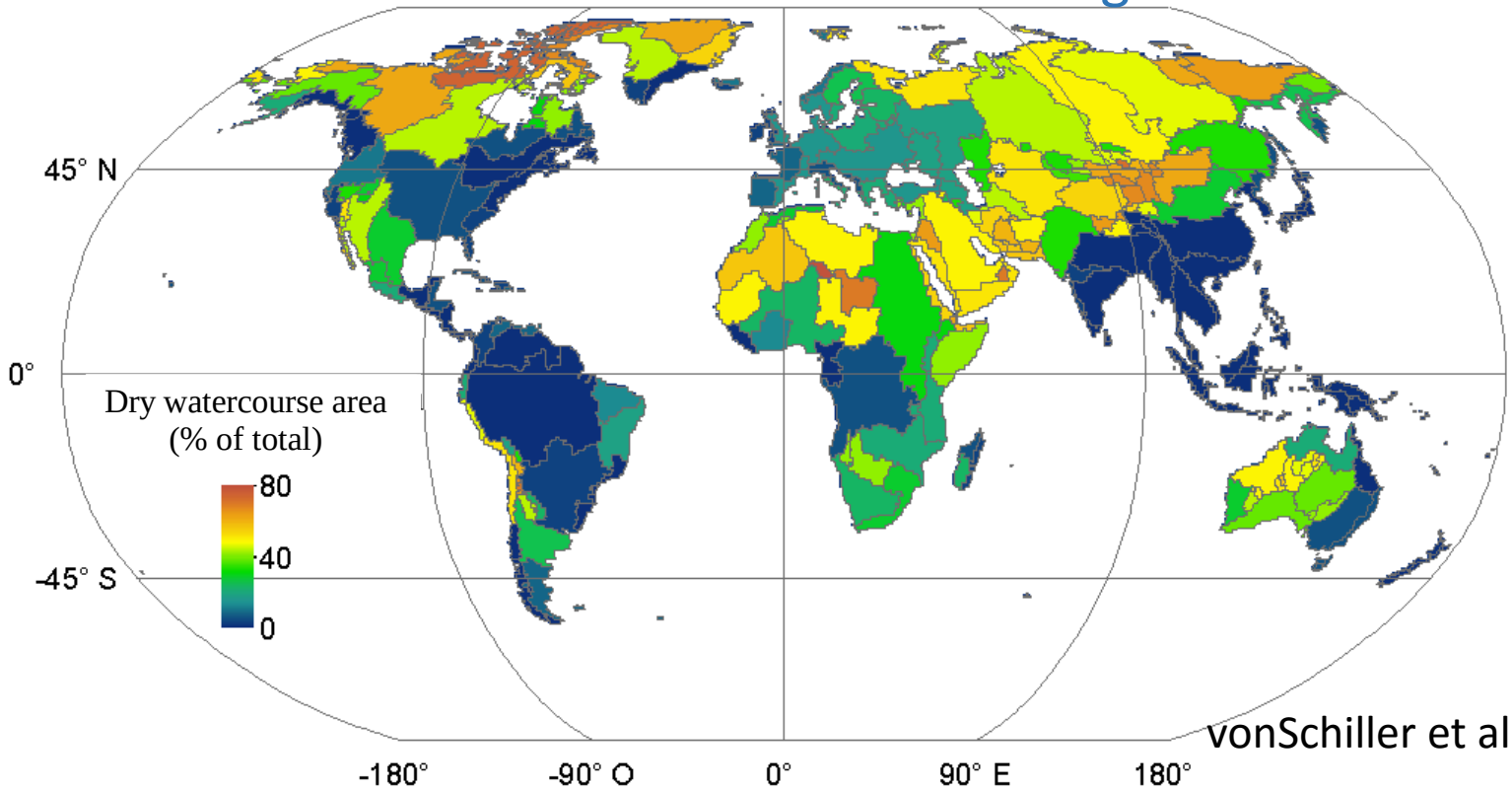
4. Innovative approaches

1. What are temporary streams?

- Streams that **cease to flow** at some points in space and time along their course, with alternating wet and dry phases.
- Dry phase characterized by **spatial** and **temporal components** (i.e., extent of dry reaches; frequency, duration, timing and predictability of the dry phase).

1. What are temporary streams?

- Temporary streams **occur in all biomes**, ca. 69% of 1st order streams below 60° latitude and 34% of 5th order rivers.
- Proportion of temporary streams in river networks ranges from 10 to 80 % in the different COSCAT regions.



vonSchiller et al 2014

2. Why are these features important?

2.1 Temporary streams are important for **biodiversity** because they harbor:

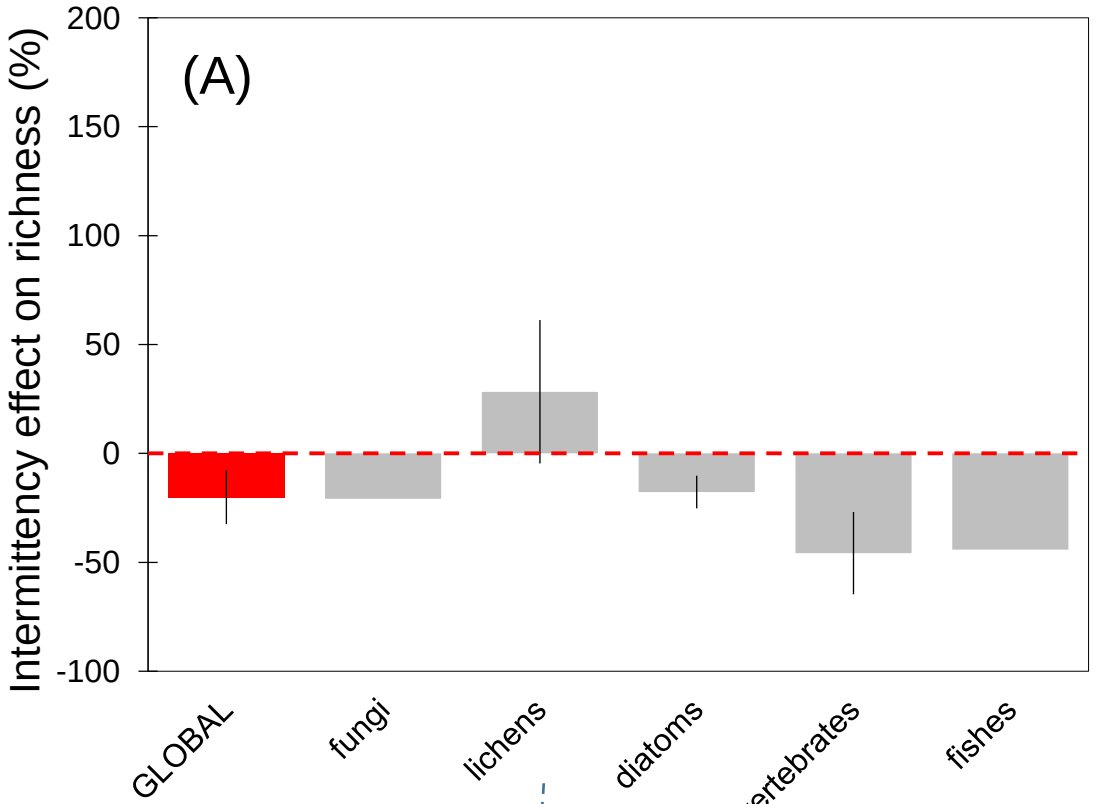
- **Specialist aquatic organisms** with strategies that favor resilience to, and resistance against, desiccation.

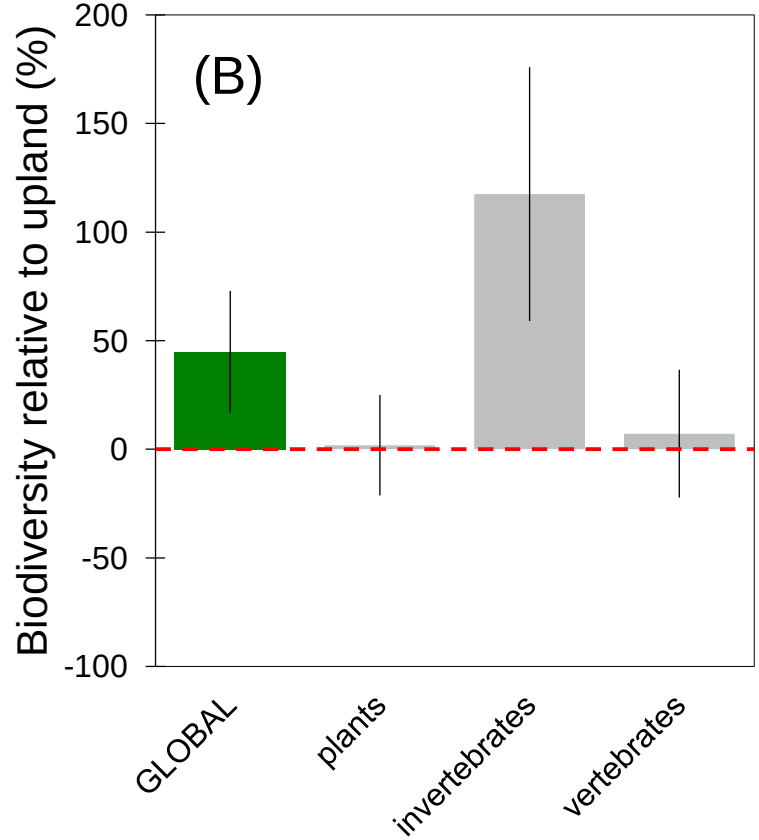
- **Opportunistic aquatic organisms** that take advantage of the effects of the environmental filter (the dry phase) on competitors or predators (e.g. amphibians escaping from fish predation pressure in permanent reaches).

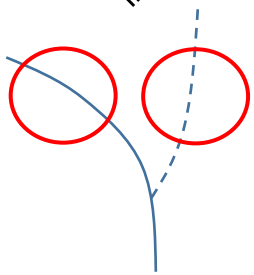
- **Terrestrial taxa** that use the dry riverbeds as a refuge and foraging habitat, or the riparian corridor as a dispersal and migratory route.

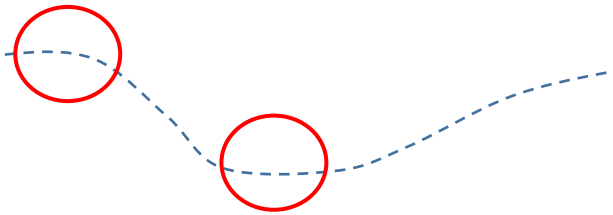
Albert Ruhi

2. Why are these features important?









…Environmentally-filtered communities,
but contributing greatly to regional biodiversity!

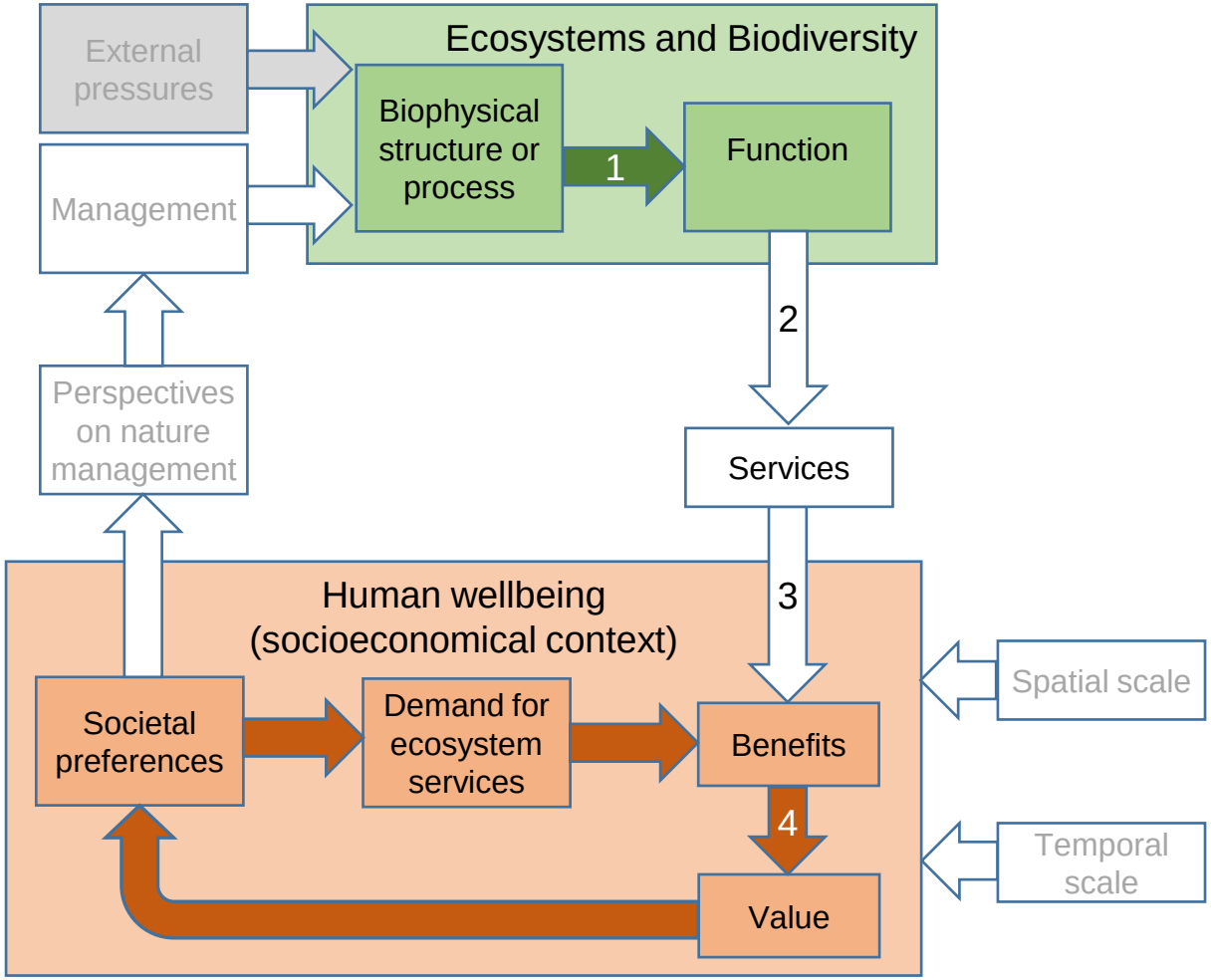
2. Why are these features important?

2.2. Streams that are naturally temporary **provide valuable ecosystem services**, such as:

- Water provisioning, often unaccounted.
- Opportunities for recreation and cultural services such identity, highly valued in arid regions.

Yarqon river, Israel

2. Why are these features important? The Yarqon



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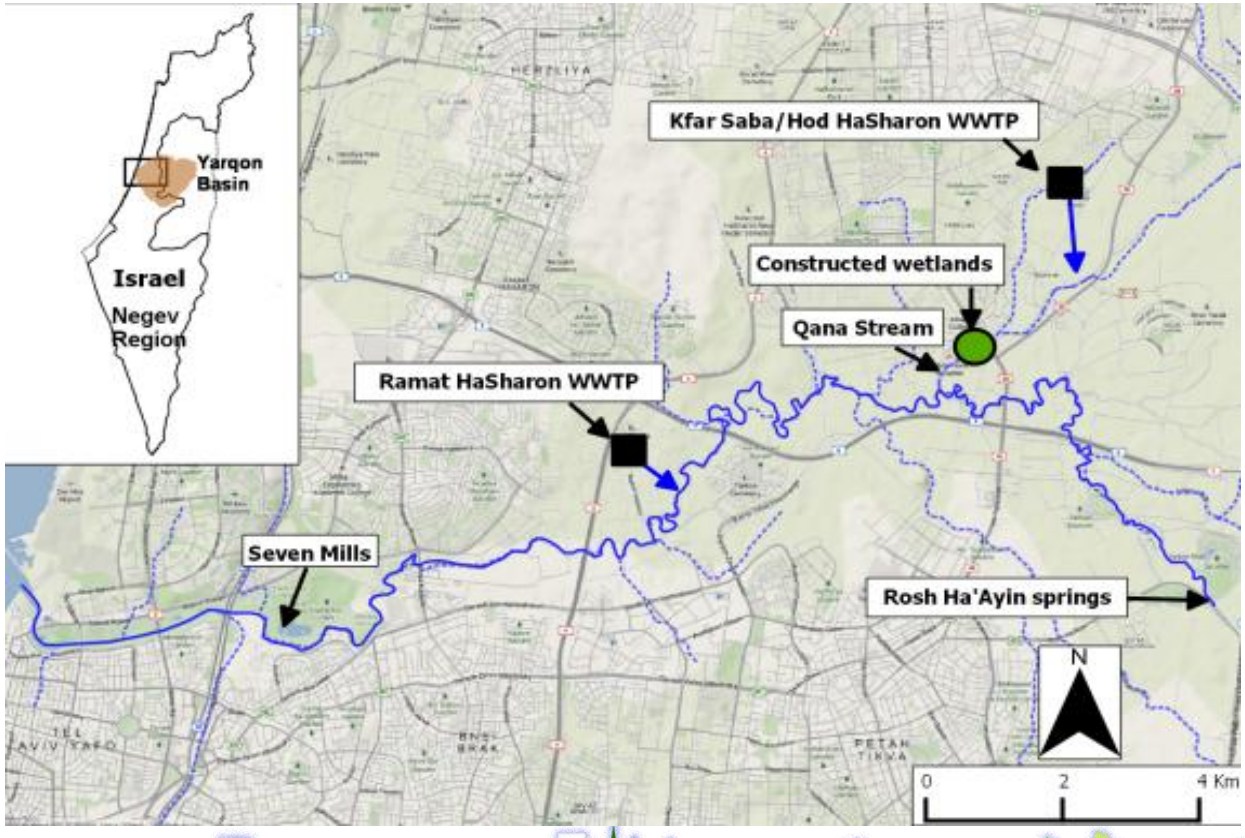
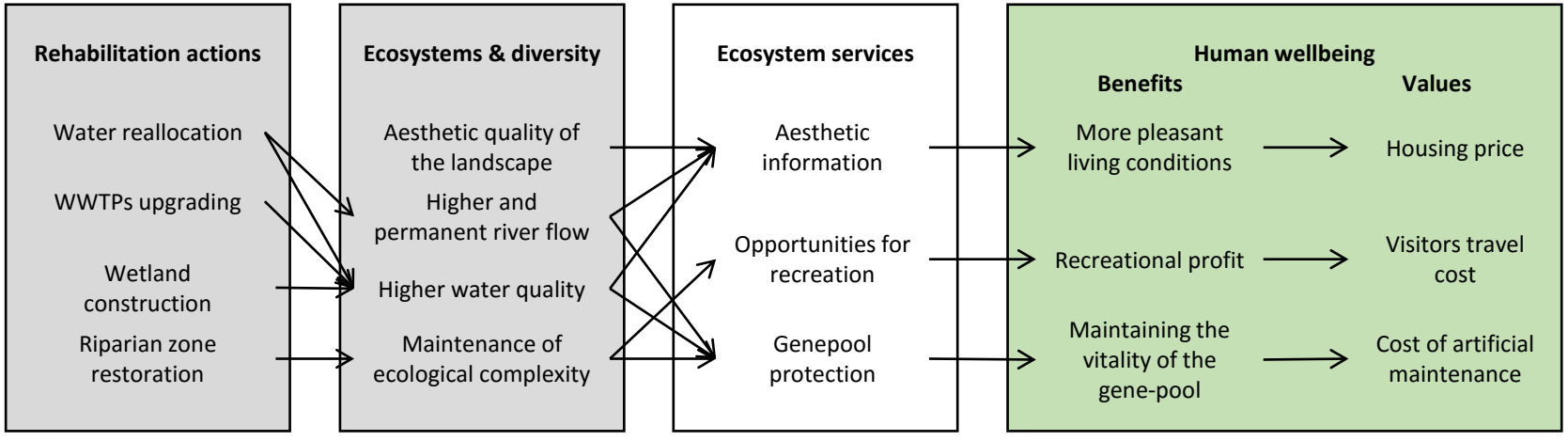
García-Acosta et al. 2014. Ecol Economics



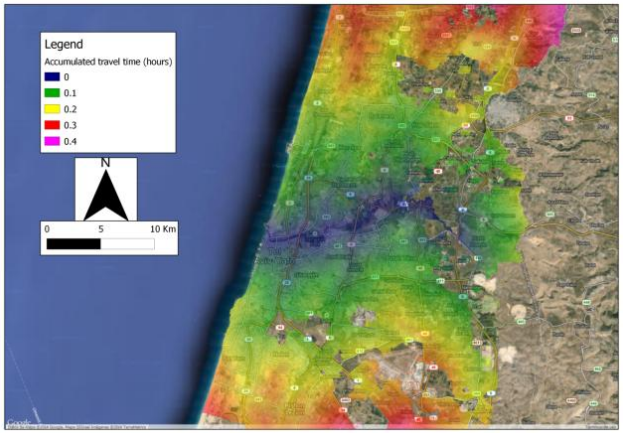
2. Why are these features important? The Yarqon

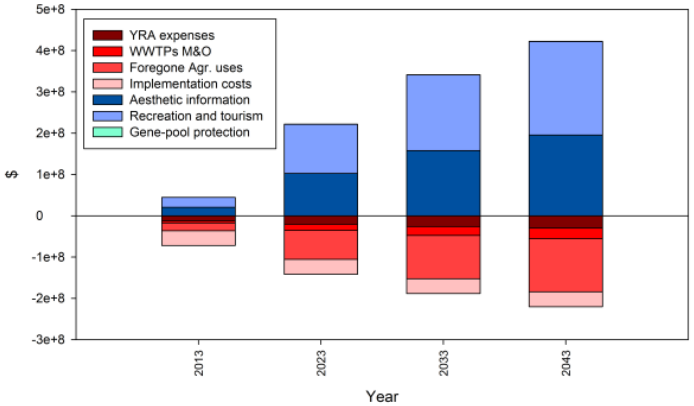
Main restoration action was water reallocation from inter-basin transfers for irrigation agriculture to river headwaters

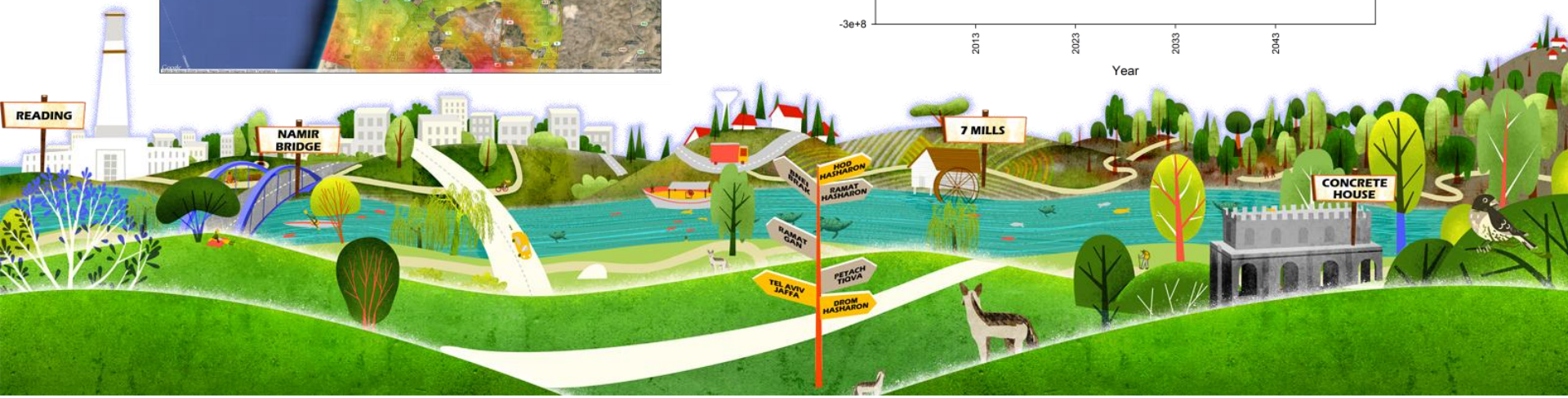


2. Why are these features important? The Yarqon

Benefits: aesthetic information (hedonic), recreation and tourism (travel cost), and gene-pool protection (maintenance cost).
Costs: implementation costs + opportunity costs of foregone users.
The rehabilitation provided positive net present values.







3. What are the management challenges?

1. To **manage** temporary streams **as temporary streams** rather than as permanent or terrestrial ecosystems; because:
    1. when considered as terrestrial, buried.
    2. When considered as permanent, discharge additions from WWTP that lead to permanency.
2. Vulnerability to **global change**, with alteration of spatio-temporal extents of flow intermittency. Diversity loss by:
    1. filtering through life cycle traits.
    2. reduction of meta-populations connectivity.
3. Availability of quality **data** on the **spatial and temporal components** of temporary streams.

3. What are the management challenges?

4. Availability of appropriate **metrics** to define and monitor their **ecological status**; e.g., most studies on biodiversity of these systems **focus** on:

- biota from the **wet phase.**
- in the **stream channel.**

…this **"restrictive view"** causes an important underestimation of their ecological values.

5. **Economic values** of temporary streams are currently widely **underestimated** by public users and stakeholders.

3. What are the management challenges? Definition

- Debate over how to treat temporary waterways in water policy frameworks is ongoing.
- The legal status of temporary waterways and the extent to which they are incorporated into policy, management, and regulatory decisions varies depending on how temporary waterways are defined by the authorities, as well as what kinds of protection are given to temporary waterways.
- Current legal frameworks in most of the western World (EU, U.S.A, Australia) do not consider them

Acuña et al. 2014. Science

3. What are the management challenges? Definition

Jurisdiction	Inclusion criteria	Implications of inclusion	Implications of exclusion
US	• Is navigable; • A tributary connected to a navigable waterway AND flows at least seasonally; OR, • Significantly affects chemical, physical or biological integrity of navigable waters	• Pollutant discharge allowed only where permits are issued and it is consistent with meeting water quality standards • Compensatory mitigation required if dredge or fill material discharged • Assessment of status every 2 years	• Unprotected • Potential to be designated as a regulated point source • No assessment of status
EU	• Depends on typology method used in a given River Basin District	• Human activities of any kind restricted by the River Basin Management Plan (RBMP) • Assessment of status every 1 year	• Likely restrictions on human activities based on the RBMP, if likely affecting downstream water bodies • No assessment of status
Queensland	• All waterways regardless of flow status. Example: Under the Queensland Water Act (2000) a watercourse is defined as "a river, creek or other stream, including a stream in the form of an anabranch or a tributary, in which water flows permanently or intermittently, regardless of the frequency of flow events", and so it is explicit in including temporary streams.	• Temporary rivers and streams are regularly included in water resource policy and management and in ecological status assessment	• not applicable

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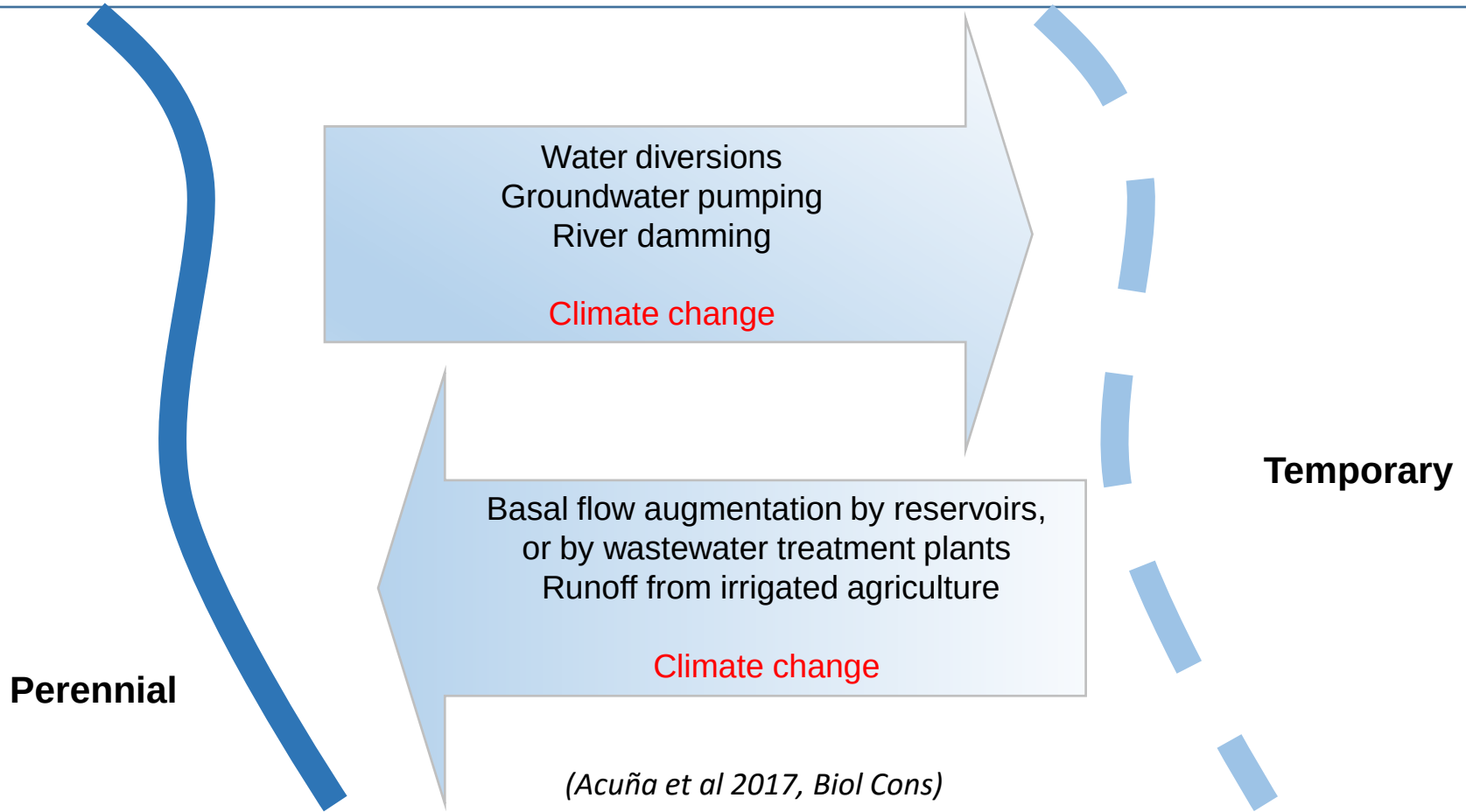
3. What are the management challenges? Definition

- It is crucial to differentiate **natural** temporary streams from natural perennial streams, as well as from **artificial** perennial and temporary streams.



(Acuña et al 2017, Biol Cons)

4. Innovative approaches

1. We need to **define** temporary streams as **unique ecosystems** in management plans, acknowledging them as specific management elements in environmental policies.
   - Flexibility in EU WFD implementation allows defining temporary streams as unique ecosystems.
   - New US EPA guidelines offer greater protection to temporary streams.
   - Naturally temporary waterways should be legally defined as part of the river network if (i) they **flow at some times and this flow connects them to a river network** or (ii) they are **habitat** for obligate aquatic organisms or terrestrial organisms unique to dry river beds.
   - Furthermore, **riparia** and **floodplains** must also be considered in management of temporary waterways.

4. Innovative approaches

2. It is crucial to **preserve the temporal components** of the flow regime unaltered.
   - flow regulation by reservoirs could be used to maintain flow regime (including wet and dry phases), as well as to mute “excessive” environmental variation.
   - enhancing connectivity by creating (or restoring) pools to enhance faunal metacommunity dynamics.
3. Promising approaches on the characterization of river networks, which are inclusive regarding temporary streams:
   - **social surveys** of temporary stream stretches.
   - **probabilistic models**.

4. Innovative approaches

4. Improvement of indicators could be achieved by:
   - quantifying and incorporating the sensitivity of the taxa to flow intermittency.
   - using hyporheic invertebrates as bioindicators.
   - considering aquatic and terrestrial species that rely in any way on temporary streams (**"inclusive view"**).
5. **Account** for the costs and benefits associated with temporary streams (EPA 2014), thus assessing current ecosystem services from these undervalued systems to support managers and policy-makers.
   - multiple evidences indicate that the cost of considering temporary waterways in current legal frameworks does not surpass the benefits.

Thanks for your attention!

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