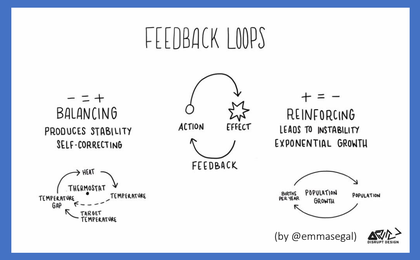
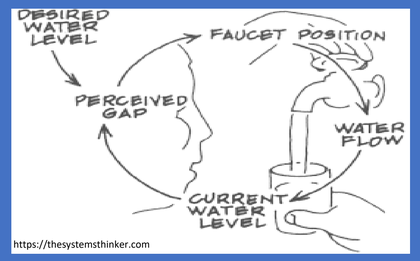
Systems thinking (in 3 minutes)

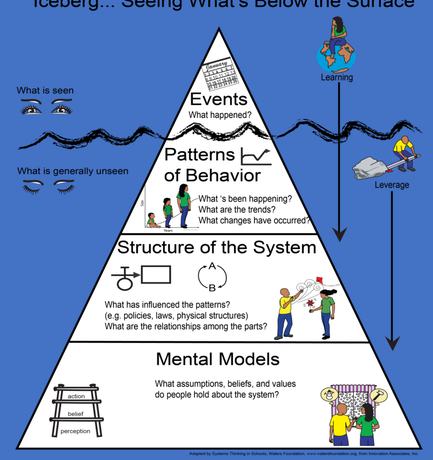
All dynamics in ecological and social systems are embedded to causal feedback loops.



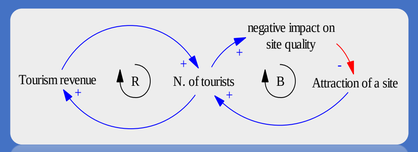
All decisions are part of a balancing feedback loop, such as filling a glass of water, generally depending on the difference (gap) between a current state and a desired state.



The systems (and the reality) are multi-layered, their behavior is guided by changes (or forces) operating on the lower (less visible) levels.



Causal Loop Diagrams (CLD) are effective tools for sharing hypotheses, explaining causal relationships and exploring the complexity of systems; here an example, with a Reinforcing and Balancing feedback loop.



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Conflicts and ~~Vicious~~ virtuous dynamics illustrated by a systems thinking approach

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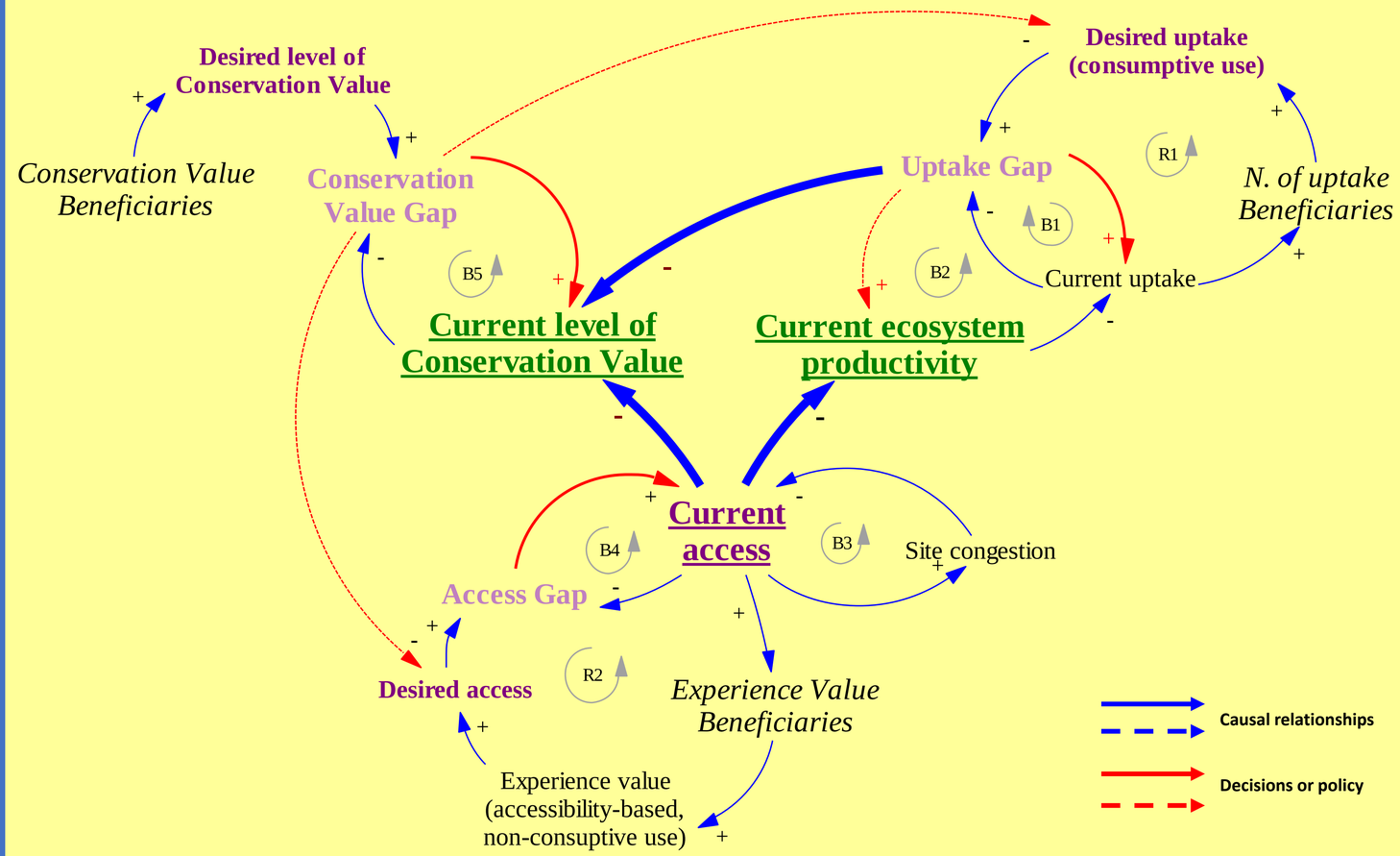
We need ways to progress **beyond linear thinking**. Concerning ecosystem services management, we need to discover which **feedback loops can cause undesirable dynamics** to define the effective initiatives.

Such initiatives should target the "**leverage points" functional to move systems** towards desirable and sustainable behavior; these are generally not very visible, being positioned at "deeper" levels, they often require **strengthening specific existing feedback loops or creating new ones**.



References
Thinking in systems, Donella Meadows | *Group model building*, Jac A. M. Vennix
Transformative Scenario Planning, Adam Kahane
Enhancing Ecosystem Services Management in Protected Areas Through Participatory System Dynamics Modelling, Landscape Online, Rocco Scolozzi, Uta Schirpke, Davide Geneletti

Quiz for experts!
The CLD contains some systems archetypes, such as:
Resistance to policy | *Fix that fails* | *Overshooting and collapse*
Can you identify them?

Explanations of and lessons from the simplified model

Here we refer to simplified categories of CES related to different uses and values, such as: **consumptive** (related to taking up something, e.g. mushrooms, wood), **non-consumptive** (related to simply accessing to the site, e.g. hiking or biking) and **existence values** (related to the conservation of resources or species, without direct use or consumption).
The **terms are generic to be adapted** in different contexts, e.g. "ecosystem productivity" may refer to production of raw materials, herbs, mushrooms, etc.

Arrows: stand for **causal relationships** between two variable, **with a polarity** (+) and (-), to be read, for example: an increase in the N. of beneficiaries will increase the "desired uptake"; an increase in "current uptake" will decrease the "uptake gap" (any "gap" is the difference between a current state and a desired state).

The **red arrows are associated to decisions or policy**, e.g. when "access gap" increase, the local actors may intervene to increase the "current access", e.g. building new roads or hiking trails.

The **bold blue arrows shows potential conflicts** between different uses, values, and (indirectly) beneficiaries.

B1, B4, B5 are **balancing feedback loops** associated to specific GAP, representing possible actors' response to the current state considering their own objectives, acting on the superficial level of events.

R1, R2 are **reinforcing feedback loops**, potentially causing exponential dynamics, which may threaten the CES if not recognized in advance, e.g. before (irreversible) negative impacts, that is before the system "reacts" through the balancing feedbacks B2 and B3

The **dashed red arrows** are possible more effective (and systemic) initiatives, **acting on the desirable state** of decision variable (uptake, access, conservation value), **working at deeper levels** (of mental models, individual values, expectations); these will cause wider and longer lasting results (but are the most difficult).

Tips for all!
Donella Meadows suggest a variety of specific approaches to face each of such systems traps.
Systems thinking (and systems literacy) helps!