

Natural Aquariums for Ecological Literacy and Ecosystem Modeling

Natural aquariums: Sustainable, low-tech, low-maintenance, low-cost aquariums (ecological aquariums)

This is a **project idea** that I developed in September 2021 to discuss it first with some organisations in Switzerland. You can use it, change it, improve it, and if you like, please share your ideas with me (see [contact](#)).

Natural (ecological) aquariums are very much like natural garden ponds that require very little technology and maintenance. Here are some examples of natural and semi-natural freshwater aquariums that I've set up so far:

1) [Biotope in my study, a low-tech natural aquarium](#) (blog article)



This [low-tech natural aquarium in its first months](#) (YouTube video, 2007)

2) [Semi-Natural Freshwater Aquarium in our Dining Room \(2012\)](#)



3) [Semi-Natural Freshwater Aquarium in our Kitchen \(2017\)](#)



Natural aquariums resemble **ecological farms** as (almost) complete poly-cultural artificial ecosystems with different kinds of plants and animals. The more complete the ecosystem with its complex physical and biochemical cycles, the less human intervention (maintenance) and technology will be required. Hence, we have a low-tech and low-maintenance living system, once the ecosystem has matured properly, like in a permaculture garden (see [my tweets](#) for similarities).

There is but an important difference: the biological maturing process of the sand in an aquarium is much faster (about 6 to 12 months) than the maturing process in barren soil without humus (10-15 years). In fact, almost everything seems to happen much faster in an aquarium ecosystem compared to a farm. Ideal ecosystem models for aquariums are of course lakes, rivers and ponds in nature.

Main principle of a natural aquarium can be summarized as “**maximum ecology minimum technology**”. In other words, as much ecological automation (distributed organic intelligence) as possible, instead of as much mechanical automation (centralized artificial intelligence) as possible.

Natural aquariums typically have small fish and other small animals like shrimps, snails and amphipods, and lots of plants, and especially marginal plants for sufficient water purification. Typically, I don't have any filters or heaters in my natural aquariums. This is how I define “**sustainable aquariums**” which is open to dispute: Every plant and animal species in the aquarium must be able to live healthily, and multiply itself over multiple generations, for at least 5 years.

With this definition, if any animal or plant species disappears within 5 years, the aquarium is not sustainable. I had once such a sustainable aquarium with Ancistrus catfish, guppies and dwarf shrimps. I had another sustainable aquarium without fish, with amphipods

(*Hyalella azteca*), snails and plants (*Najas marina* and *Lemna minor*). Very interesting would be setting up a sustainable aquarium that can accommodate small cichlids like *Apistogramma borellii* as the largest predator (i.e. at the top of the food web).

Generally, one of the biggest challenges of setting up a sustainable aquarium is keeping the aquarium sand healthy in the long term (i.e. more than 5 or 10 years). So far, my experience showed me that marginal plants with strong roots and tower snails that bury themselves in the sand are quite useful for this purpose. In nature, many different kinds of crustaceans, worms and snails live in the bottom substrate.

The amount of **regular water changes** could be a good indicator of the completeness of the aquarium ecosystem. For example, weekly water changes of 10% should be enough for the sustainable health of the aquarium. If more water changes are required for the health of animals, this means, the aquarium ecosystem (i.e. biochemical cycles, biological diversity etc.) is not complete or balanced enough.

Project Idea

This project is about developing and setting up different kinds of natural aquariums to use them for multiple purposes, such as:

- 1) Ecology education for children (practical experience with small and simple ecosystems for **ecological literacy**; learning what a living system or economy requires for sustainability; contact educational organisations and schools...
- 2) Test and develop models for aquaculture (**ecosystem modeling**). For example, how can we keep the soil substrate healthy in the long term with plants and small animals like snails, worms and crustaceans? Environmental enrichment, species-appropriate keeping and breeding...
- 3) Maybe with proper analogies and mappings, certain aspects of even a terrestrial ecosystem like an ecological farm could be simulated and tested with natural aquariums (**ecosystem mimicry** with broader application).
- 4) Exhibitions (**public aquariums**); recreation and culture, entertainment value
- 5) **Breeding and sale** of sustainable plant and animal species that are suitable for natural aquariums (with species-appropriate husbandry; artgerechte Haltung)
- 6) Education, **courses** and certification for setting up and maintenance of natural aquariums
- 7) Scientific research about **animal and plant behaviour**, dynamic ecosystems etc.
- 8) Using aquariums as training for **ecological gardens and farms**; overcoming **mental barriers** like [industrial paradigm](#) (mechanistic and reductionist worldview) and technological fundamentalism (dogmatic belief that one can solve every kind of social and ecological problem with artificial human technology)

Implementation

- 1) Evolutionary and incremental development with small steps, and small investments in terms of money and voluntary workforce
- 2) Question: What kind of infrastructure do we already have? Some space in a tropical greenhouse, subtropical greenhouse, winter-garden?
- 3) Possible scenario: Begin with setting up 4-5 natural aquariums (based on well-known simpler models that were already tested for sustainability) before contacting schools for educational or recreational purposes. Each aquarium may require 3-6 months for maturity. Some of them can really be small and simple models without fish. At least one aquarium should contain small cichlids with interesting behaviour.
- 4) Prepare detailed information and web presence with videos (like short documentaries) about every natural aquarium: Natural habitats of the animals and plants, existing model aquariums and other inspirations (i.e. culture), ecosystem successions, interesting observations and hands-on experience etc.
- 5) Prepare education packages for schools, children, visitors
- 6) Exhibition may also include an aquaponic system
- 7) Contact potential research and organization partners like zoos, museums, EAWAG, universities; formulate projects for aquaculture (ecosystem mimicry, animal welfare, environmental enrichment), ecosystem and behaviour research, ecology education...

Potential Support for the Project (money, information exchange, voluntary work)

- 1) Schools, Ministry of Education (Bildungsdirektion, Volksschulamt Kanton, Gemeinde) and other educational organisations
- 2) Support for research (aquaculture, ecosystem mimicry, ecosystem and behaviour, environmental enrichment, fish welfare etc.) from different organisations
- 3) Income from visitors and sales (animals and plants for natural aquariums)
- 4) Income from guided tours, courses, certifications and consulting
- 5) In future: Income from books and videos (e.g. books and videos about natural aquariums)
- 6) To be investigated: Potential synergies with ecological farming, tourism, recreation for elder people, therapeutic activities...

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