



Are fishes good candidates for space colonization?



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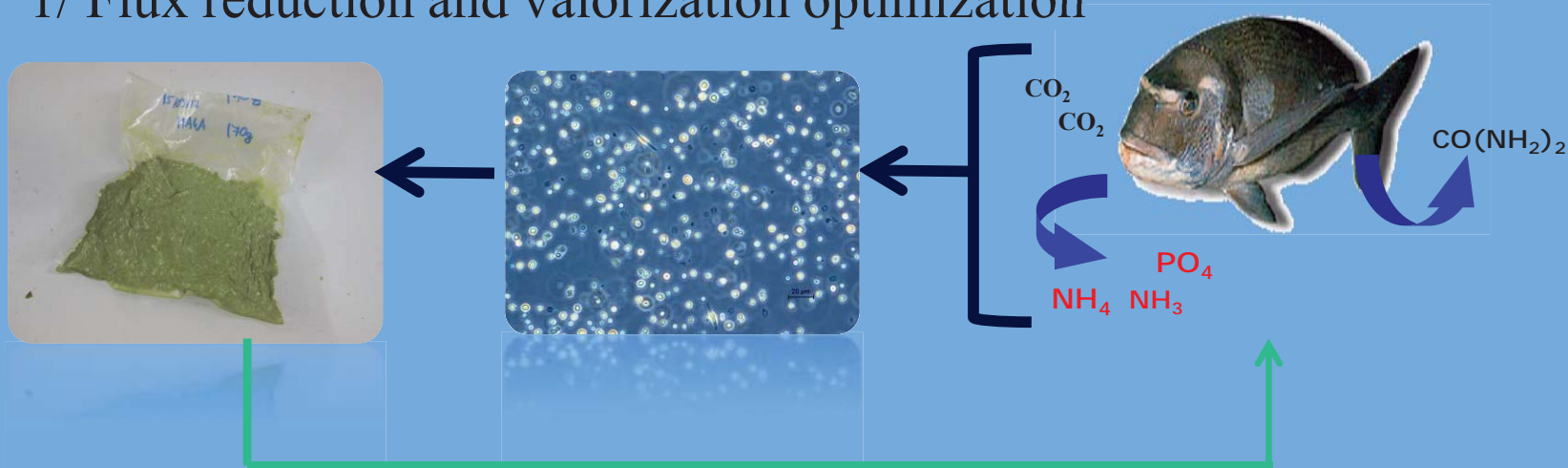


Field of research

Aquaculture in closed system.

Integrated Multi-Trophic Aquaculture (IMTA).

1/ Flux reduction and valorization optimization



2/ Alternative protein and lipids sources for fish.

Yeasts

Algae

IMTA in extreme environment (valorized dissolved matter).



Why aquatic organism in BLSS*?

- To provide lipids and proteins of interest to the base residents. (food autonomy and varied diet).
- Large biodiversity for the aquatic life (but reproduction have to be mastered).
- Better feed conversion ratio, less management of feed.



Aquatic organism
=
less than 2 Kg of feed
↓
for 1 kg of growth

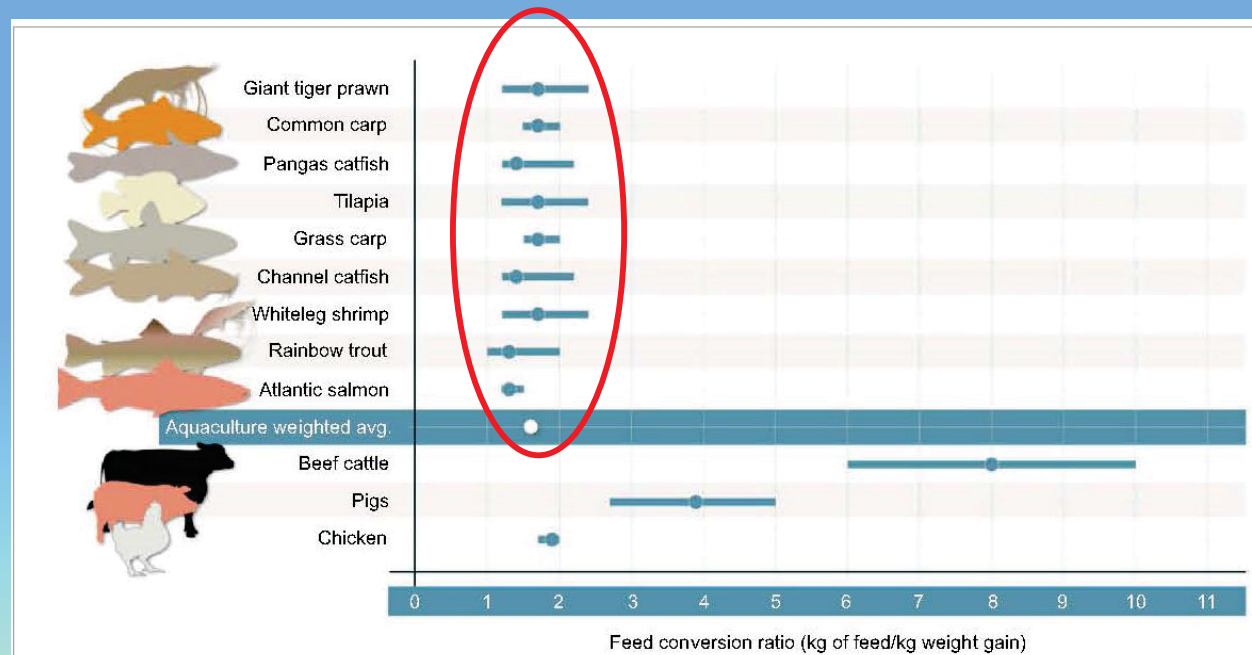


Figure 1. Feed conversion ratios for selected aquatic and terrestrial farmed animal species. Dots represent means and bars indicate range. Lower values signify higher efficiency. Sources: Tacon and Metian (2008) [12], Smil (2013) [13], Shike (2013) [14], Zuidhof *et al* (2014) [15], and Rabobank Research (2015) [16].



Why aquatic organism in BLSS*?

- Low gas exchange.

CO₂ production (kg) per kg produced



1,8 - 3,3 (Kg_[CO₂]/Kg)



3 - 6 (Kg_[CO₂]/Kg)



16-40 (Kg_[CO₂]/Kg)

- Low oxygen needs



Lunar hatch project.

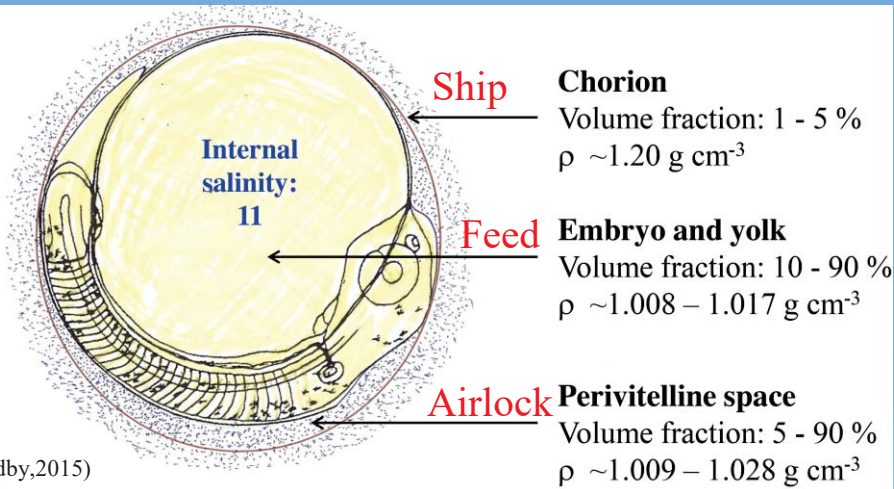


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For developing IMTA in BLSS* ...

...fertilized eggs have to be sent from Earth to the Moon.

The Lunar Hatch project propose to prospect the Earth **aquatic life biodiversity** for selecting an organism able to **hatch** after a space ship launch and a trip to the moon.



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Eggs are in a total autonomy, no human intervention is needed during the flight.

* BLSS : Bioregenerative Life Support System.

Lunar Hatch project : Parameters studies and questions.

Launch and flight environment.

- Temperature et pressure variation.
- Eggs resistance to cosmic radiations exposure.
- Preparation and flight duration.
- Human flight or cargo version.

Hypothesis of Moon base water quality.

- Regolith hydroxyl extraction.
- Deep lunar ice (ongoing exploration).
- Water reuse from *Bioregenerative Life Support System*.

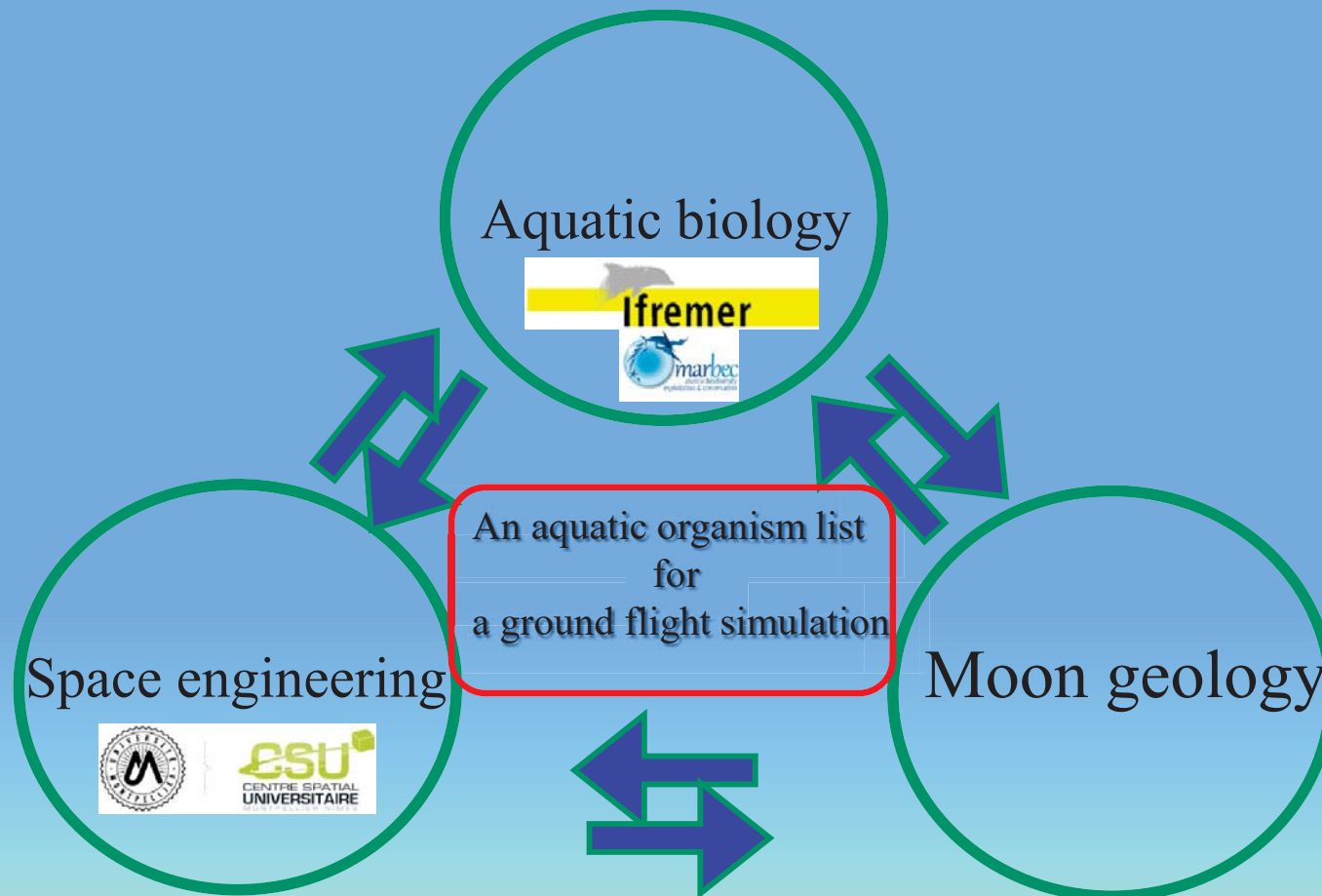


Around 3 days



Lunar Hatch project : Partnership.

Based on a bibliographic work and the partners expertise.



What next to the Moon?

Fish flight to Mars?

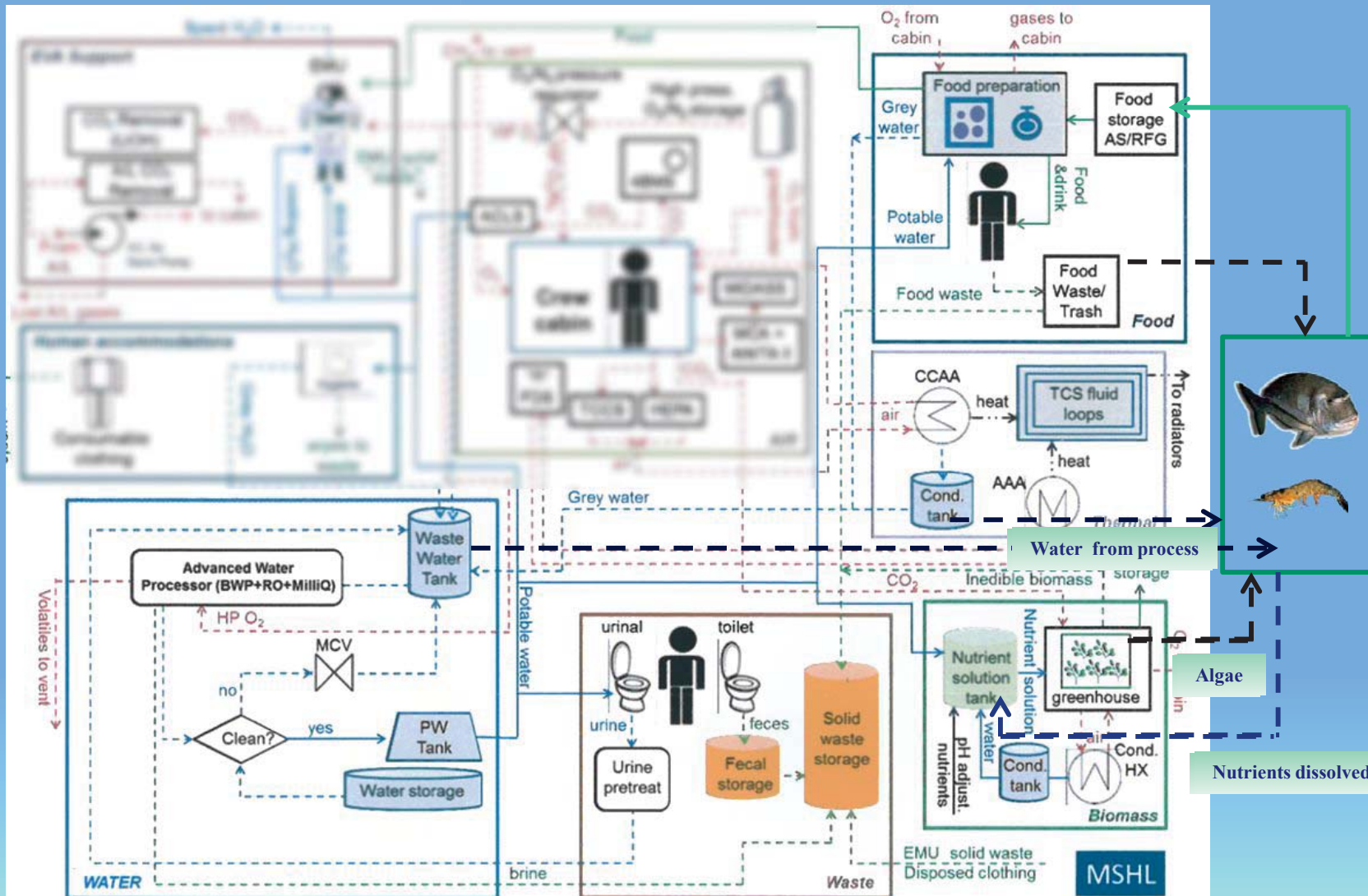


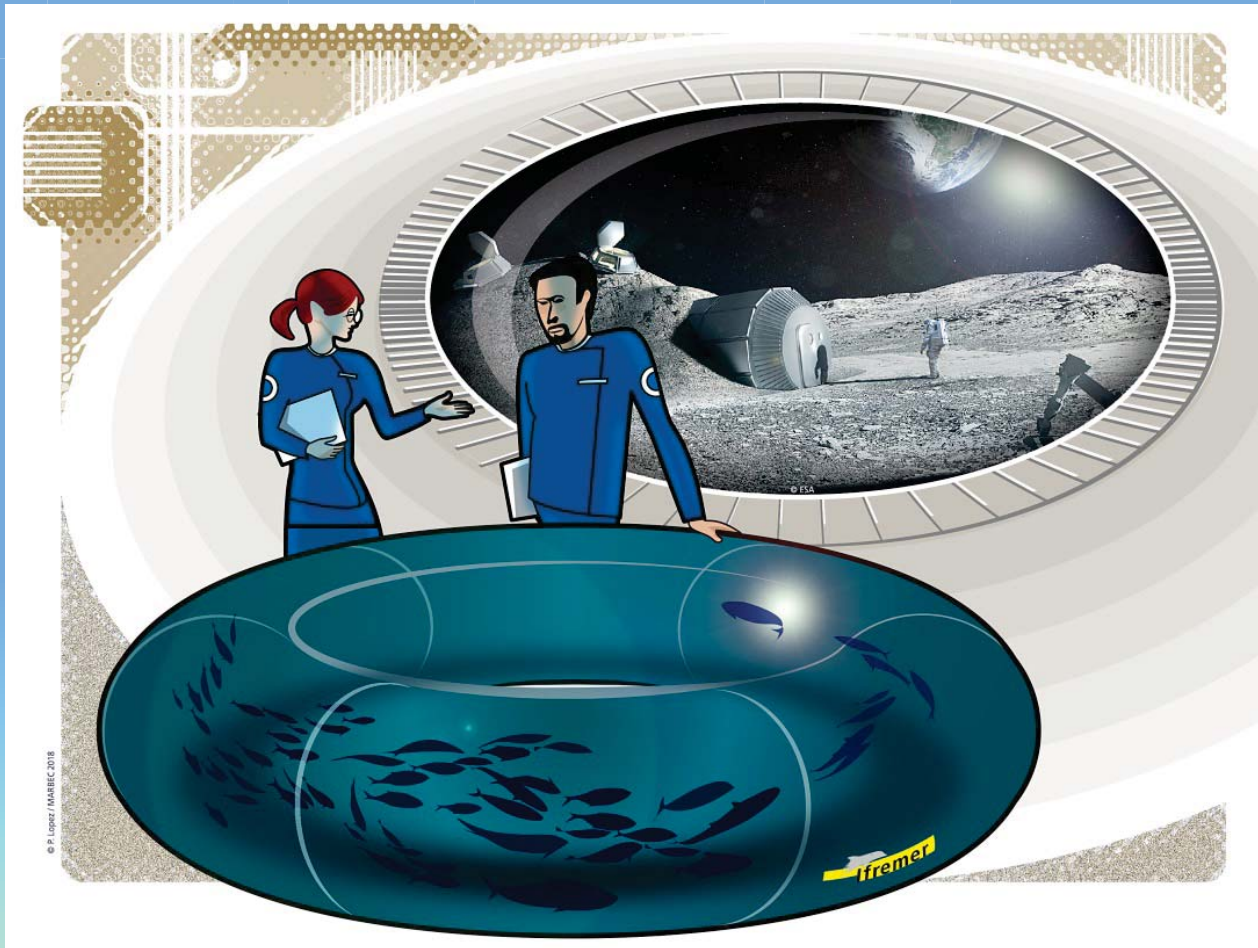
Figure 2. Technological architecture schematic for Mars Surface Habitat Lander.



Current and future ways to Closed Life Support Systems
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Thank you for your attention.



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