MECHNICAL HARVEST AND SEEDING

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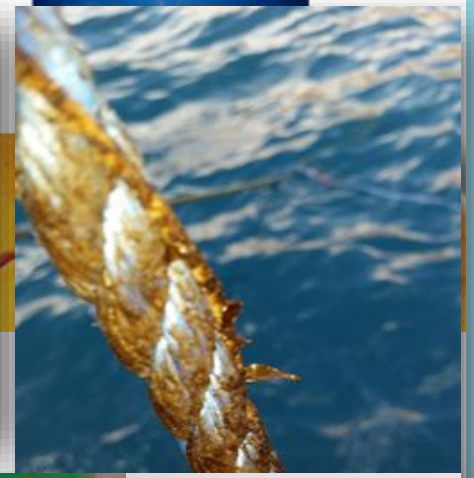
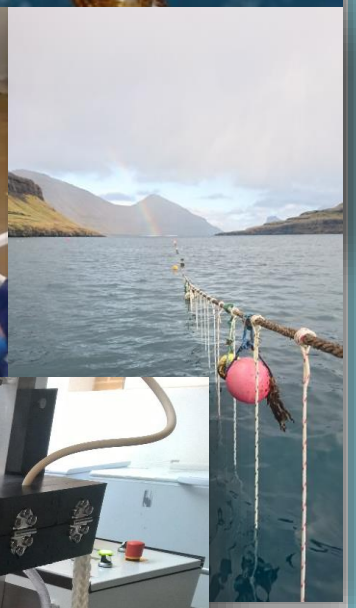
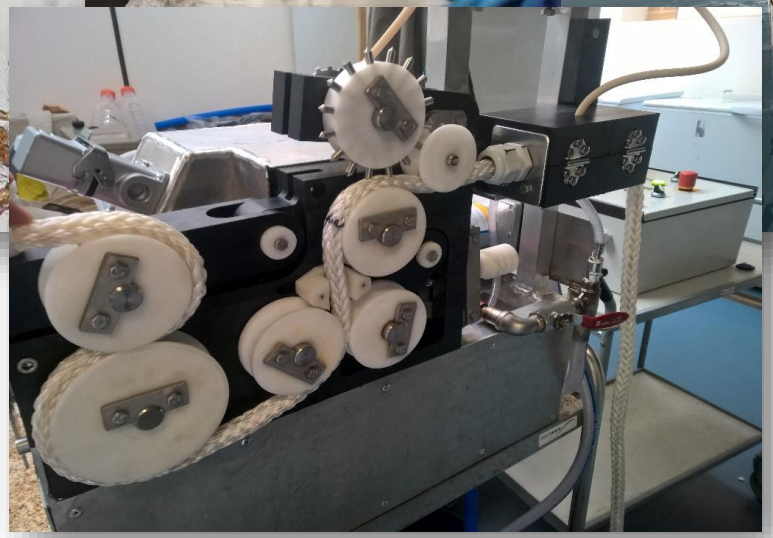
Seeding (&



- Method
  - String seeding
  - Direct seeding
- Cost of hatcery
  - 22.000m vs. 1,2 Mio. M. in a 20 ft. container
- Quality & speed
  - Precision/density
  - Type of substrate
  - Glue “ability”
  - Meter/hour
- Timing
  - Deployment
    - Optimal time site dependent
  - Harvest
    - Direct seeding takes longer to grow

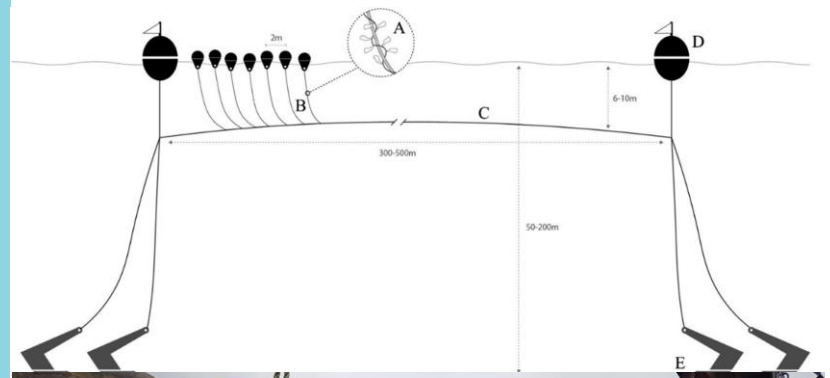




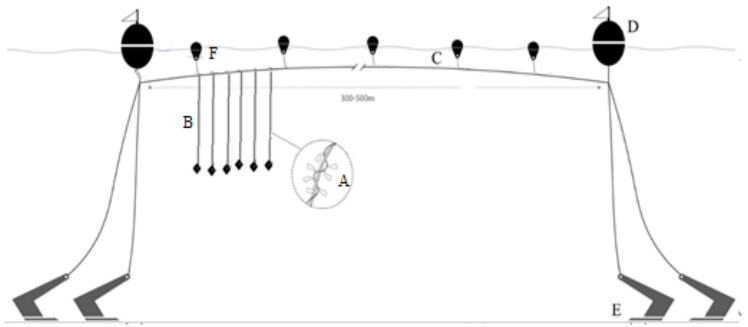
- Species
  - Floating
  - Sinking
- Grow line system
  - Continues (e.g. horizontal)
  - “Batch” based (e.g. vertical)
- Harvest strategy
  - Single or multiple/seeding
  - Manuel or mechanical
- Harvest window
  - Months/year

Culitvation systems in the Faroes

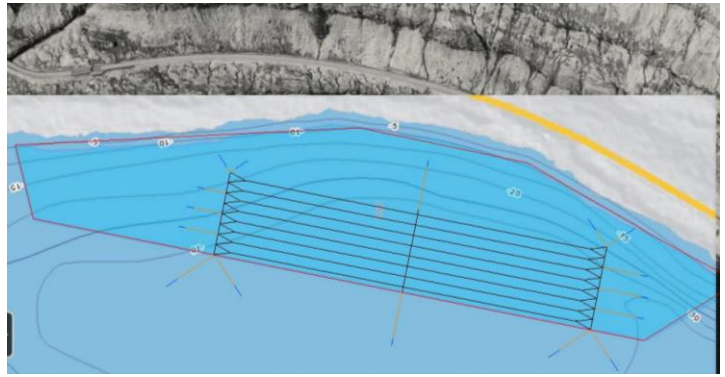
Exposed – high wave/strong current



Sheltered – moderate wave/current



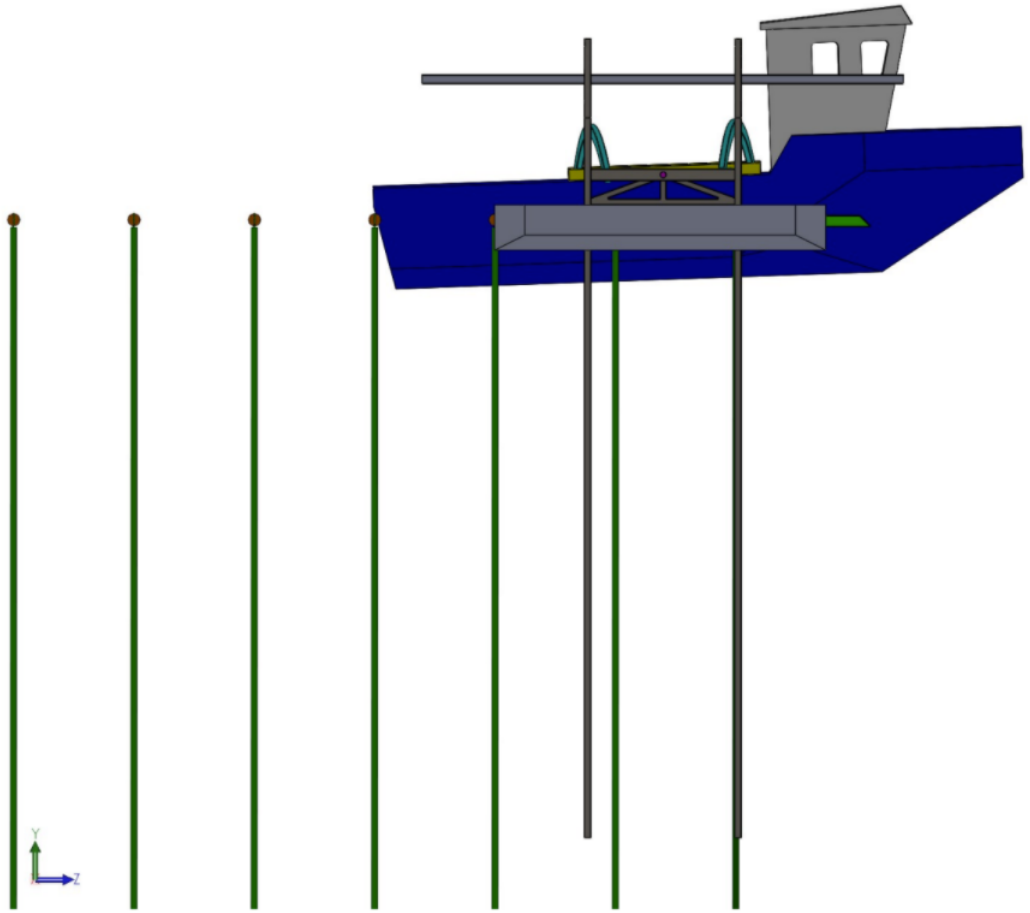
MACR-2 – second generation

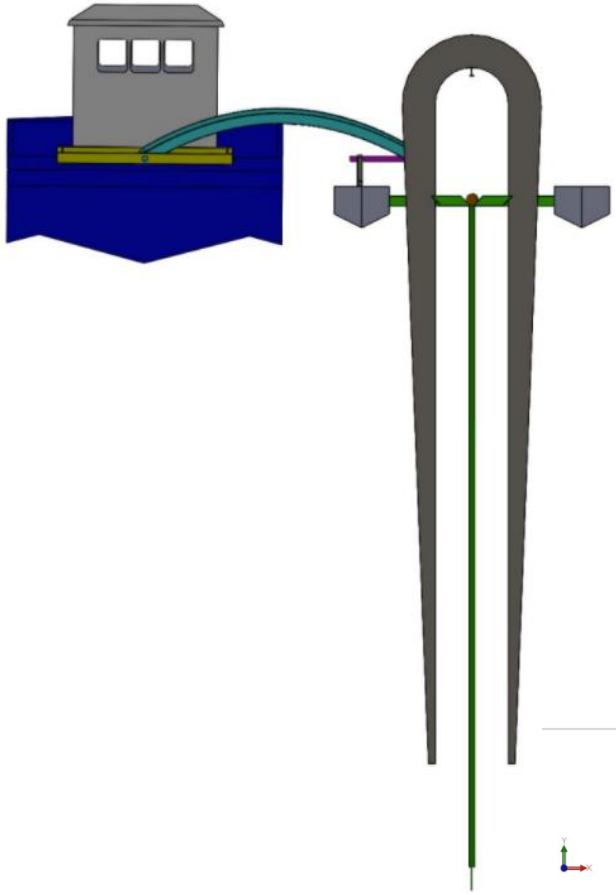


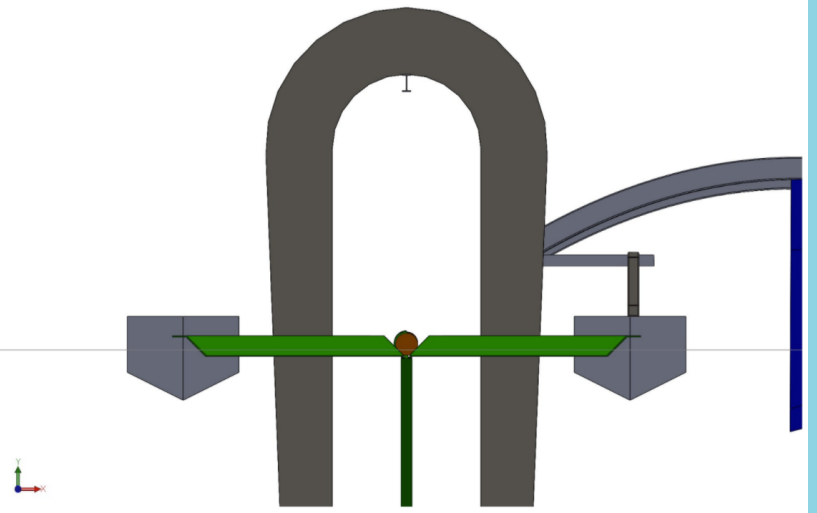
Mechanical harvest and multiple partial harvest


OCEAN

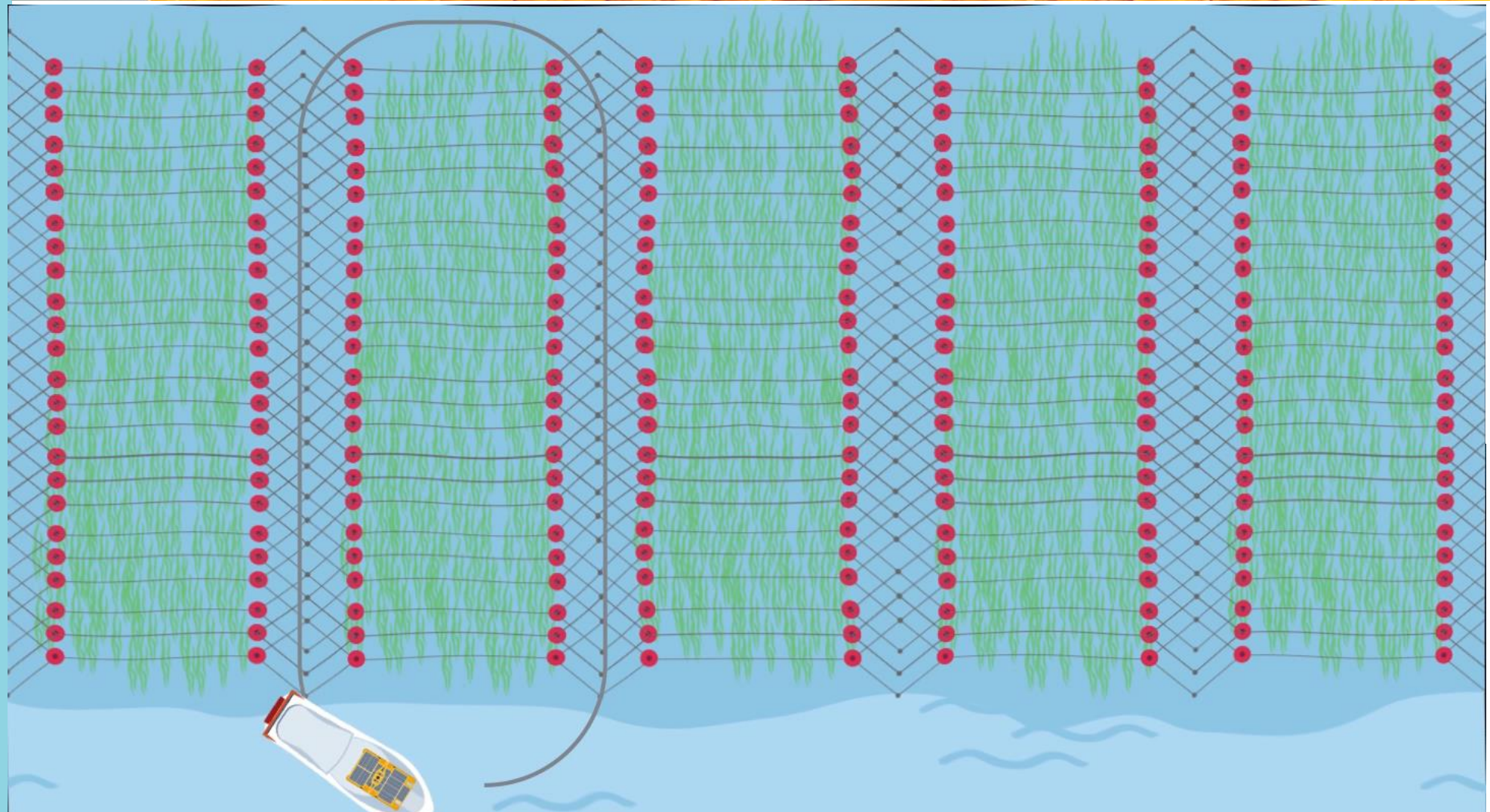
Underwater harvest – 1st concept







Underwarer harvester, cont.



MACRO SYSTEMS

Deliverable 1.3 on cost

	Manual harvest	Mechanical harvest
Handling time (lines/hour)	17	30
Line length (m)	7	7
Yield (kg ww/m)	3.09	3.09
Yield per hour (kg ww/hour)	367.71	648.90
Crew (persons/vessel)	3	2
Yield per person (kg ww/hour/person)	122.57	324.45
Salary (€/hour/person)	30	30
Costs (€/kg ww)	0.24	0.09

Yield has a direct impact on cost

Table 3. Assessment of annual capacity assuming mechanical harvest of 30 lines per hour, 10 meter growth lines, harvest shifts of 7 hours and a harvest season of 120 days (April – October). Annual capacity = yield per meter * length lines * lines per hour * work hours per day * producing days per year

yield/meter / hours/day	1.5 kg	3 kg	6 kg
7 (1 shift)	378 **ton/year**	756	1512
14 (2 shifts)	756	1512	3024
21 (3 shifts)	1134	2268	4536

Harvesting – logistics & cost

A practicable seaweed biorefinery requires 10 ton ww per hour

Comparing four harvest scenarios based:

1. Summer 2019;
2. Current situation
3. New situation (improved harvest machine);
4. Underwater harvester (implementation of a harvester that is able to harvest lines without taking them up from the sea, launch within a few years from now).

Harvesting – logistics & cost

Harvesting scenario	Summer 2019	Current situation	New situation		Underwater harvester
harvest speed (lines/hour)	17	30	60		240
length lines (m)	7	10	10		10
yield (kg ww/m)	6	6	6		6
harvest hours per day	21	21	21		21
yield (kg/vessel/day)	14994	37800	75600	> x19	302400
crew (persons/vessel)	3	2	2		3
harvest period (days)	120	120	120		120
salary (€/hour/person)	30	30	30		30
crew costs (€/day/vessel)	2160	1440	1440		2160
vessel costs (€/day)	1500	1500	1500		3000
total costs (€/day)	3660	2940	2940		5160
costs (€/kg)	0.24	0.08	0.04		0.02
biorefinery requirements (kg/day)	240000	240000	240000		240000
required vessels	16	6	3		1
total costs (€/day)	**58583.43**	**18666.67**	**9333.33**	- 86 %	**4095.24**

Table 4. Cost comparison between four harvest scenarios at Ocean Rainforest; [1] summer of 2019, [2] current situation (expected situation for harvest season 2020 including harvest machine, as a result of MacroCascade), [3] new situation (improved harvest machine) and [4] underwater harvester (implementation of a harvester that is able to harvest lines without taking them up from the sea, launch within a few years from now).

Transport

- Tubs
- Nets
- Barge
- Pre-processing on-board

Conclusion

- Direct seeding is efficient, but requires longer harvesting window compared to string seeding
- Mechanization of seeding is underway. Target is 2000m/hour
- Substrates and glue are important parameters
- Mechanical underwater harvester is most suitable. Target is 2400m/h
  - Potential cost reduction from €240 to €20/tons wet weight
- Yield has a direct impact on OPEX of harvest – higher yield/m → lower cost/kg
- Logistics has to take into account
  - Transport distance between farm and processing
  - Throughput capacity/day to process fresh material into storage stable condition
  - A biorefinery will require 50-200 tons wet weight/day

Acknowledgement

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https://www.macrocascade.eu/