Optimal Processing Routes for a Marine Biorefinery

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INTRODUCTION AND OBJECTIVES

20 Mt/year of unwanted/non-targeted species and specimens are discarded

TWO APPROACHES

- Reducing unwanted catch
- Increasing unwanted catch/biomass utilisation

→ **Added-value products from discarded fish**

CHALLENGE → Species can be handled by more than one processing route

There is a need of **selecting the optimal processing routes** of the different biomasses in terms of sustainability.

- Utilities costs
- Market prices
- Production

Socioeconomic

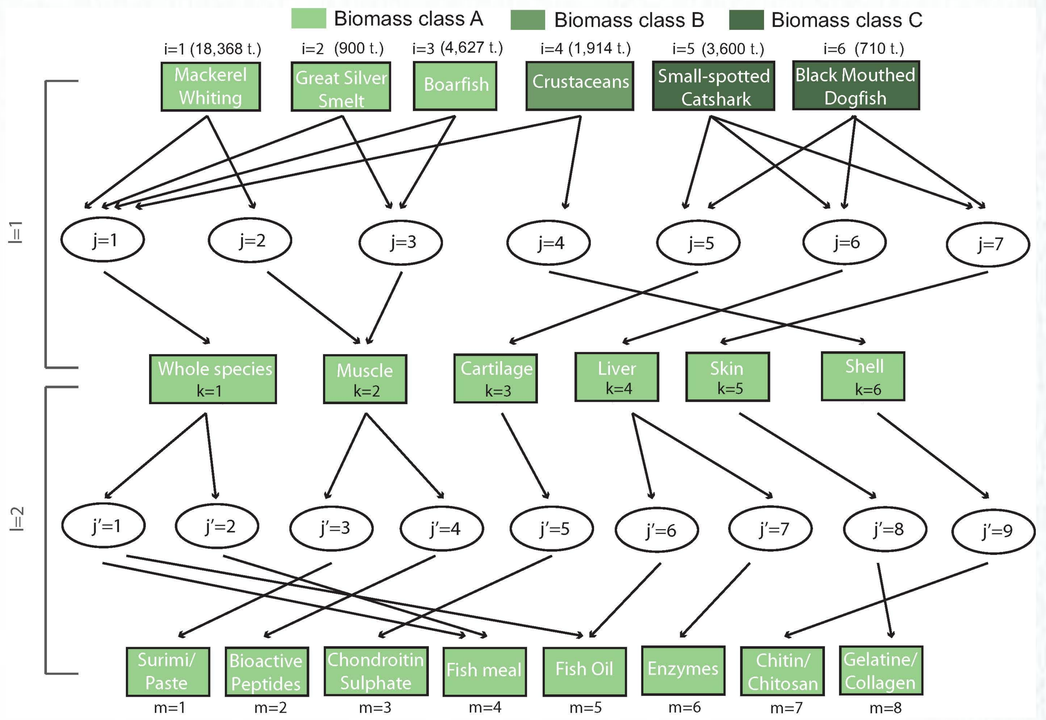
Environmental

- CO_2 emissions (electricity /fuel consumption)
- Water consumption
- Waste treatment

OBJECTIVES MUST BE CONSIDERED SIMULTANEOUSLY

CASE STUDY

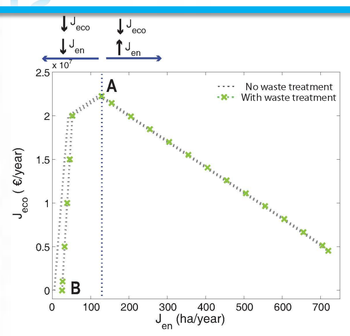
Fishing sector in Galicia (NW Spain) → One of the largest in the European Union.



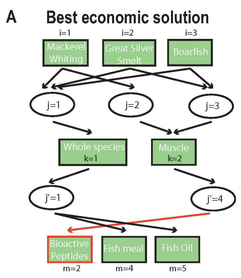
Pathways analysed for the valorisation of discards (scheme generated using the state of art literature)

RESULTS

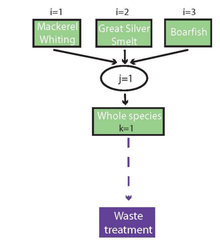
Biomass A



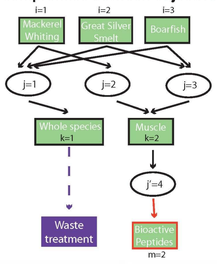
A Best economic solution



B Best enviromental solution



Typical set of pathway configuration with best compromise between objectives.

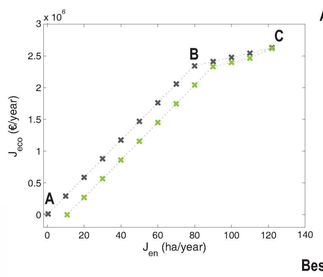


Environmental view
- Optimal scenario corresponds to the no processing of biomass.

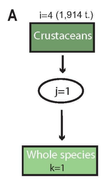
Economic view
- Valorisation of specific fish fractions (muscle)
- Muscle is used to obtain BP at maximum plant capacity.
- Excess of RM is used to produce FM/FO.

Best compromise
- BP and as main products, and the remaining biomass being left as unprocessed muscle.

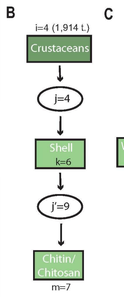
Biomass B



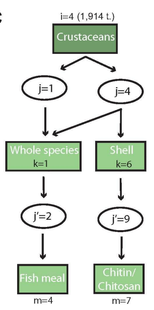
A



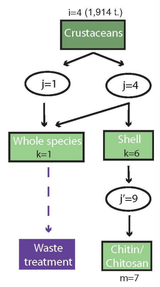
B



C



Best compromise between objectives



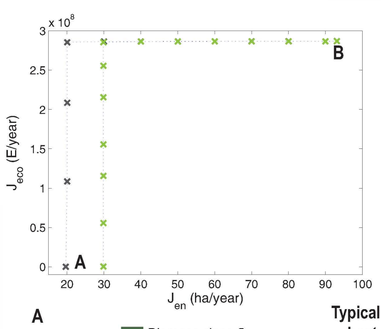
Environmental view
- No processing of biomass.

Economic view
- Production of chitin.
- If non-used parts are incorporated to a crustacean meal line, there is an increase on the profit and also on the environmental cost.

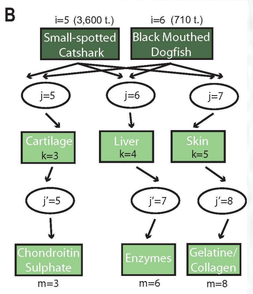
Best compromise
- Low chitin production and waste treatment

→ **RE-DESIGN / ALTERNATIVE TECHNOLOGIES**

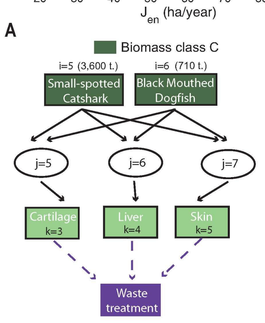
Biomass C



B



A



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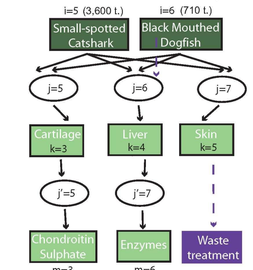

Environmental view
- Optimal scenario corresponds to the no processing of biomass.

Economic view
- Valorisation of livers (fish viscera) as enzymes and the production of CS and gelatine from cartilage and skin, respectively.

Best compromise
- Transform as much as liver as possible into E and cartilage into CS, and sends the unprocessed material to solid waste treatment.
- Gelatine as final product.

CONCLUSIONS

- In general, the valorisation of **specific fish parts** rather than the use of the whole specimen is more optimal from both points of view.
- Most suitable products: **biopeptides, chondroitin sulphate** and **fish enzymes**, due to their high sales price and relative low environmental impact.
- **Alternative technologies** should be considered for the production of **chitin, gelatin** and **fishmeal** due to their high environmental cost.
- **Solid waste** must be included in the economic and environmental costs.

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