

Trophic subsidy through ecosystems : role and dynamics of nearshore subtidal detrital accumulations of *Laminaria hyperborea*

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STUDY CONTEXT

- Kelp forests form highly productive habitats, ranging from temperate to polar rocky reefs. *Laminaria hyperborea* is the most abundant kelp species on European subtidal reefs.
- Direct grazing on fresh *L. hyperborea* is low and major part of production enters in the detrital pathway via erosion, fragmentation and dislodgement,
- Decaying material can be retained within the forest and contribute to the diet of local benthic consumers but large fragments are exported and can settle onto adjacent ecosystems.
- Accumulations of detrital kelps have been observed on subtidal sandy bottom habitats but little is known on the dynamics of such subsidy, the mechanisms of degradation and the impact on recipient ecosystem.

STUDY SITES

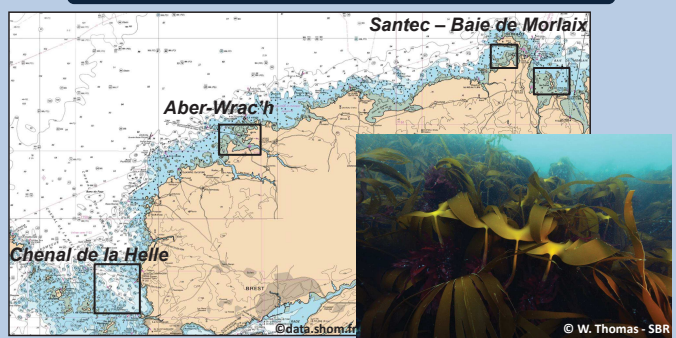


Fig. 1 : Nearshore subtidal prospection sites along Northwest French Brittany coastline where accumulations have been observed or reported. *Laminaria hyperborea* forests are predominant on subtidal rocky reefs in Brittany

AIMS :

- Describe accumulation areas and characterize the temporal dynamics
- Assess the degradation kinetics of kelp tissues within accumulations
- Describe assemblages inhabiting the accumulations and the trophic food web of recipient ecosystems / accumulations

MAIN PROJECT TOPICS

① DESCRIPTION AND TEMPORAL DYNAMICS OF ACCUMULATIONS

- Location : adjacent habitats, depth, bathymetry ?
- Timing of formation : seasonality ? matching with hydrodynamic conditions ?
- Residence time & Supply frequency ?
- Composition & Extent : % *L. hyperborea*, surface, thickness, biomass ?

Prospection & Regular monitoring	First prospections & Actual knowledge
<ul style="list-style-type: none"> ➤ Nearshore subtidal : depth 15-40m, sandy bottom ➤ Extent, biomass, algal composition, kelp quality 	<ul style="list-style-type: none"> ➤ 3 sites, seasonal accumulations (March-June) ➤ Santec : sandy bottom, -15m ; 100m² ; 30 cm

④ KELP HARVESTING AND EXPORT

- Dislodgment when seaweed trawl is overloaded ?
- Dislodgment without harvesting ?
- Wounded kelp after the haul ?

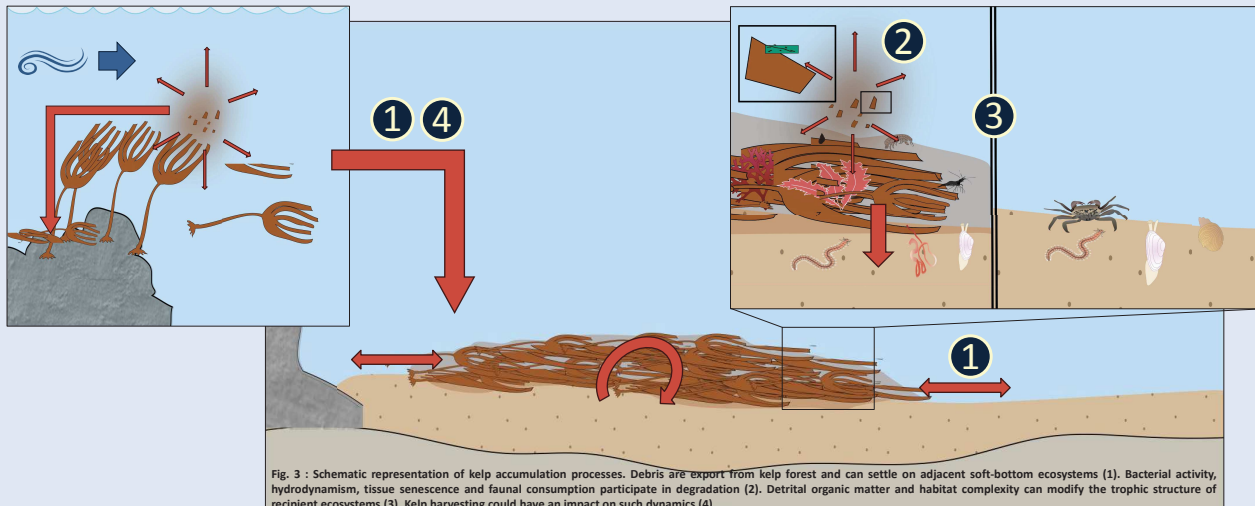


Fig. 3 : Schematic representation of kelp accumulation processes. Debris are export from kelp forest and can settle on adjacent soft-bottom ecosystems (1). Bacterial activity, hydrodynamism, tissue senescence and faunal consumption participate in degradation (2). Detrital organic matter and habitat complexity can modify the trophic structure of recipient ecosystems (3). Kelp harvesting could have an impact on such dynamics (4).

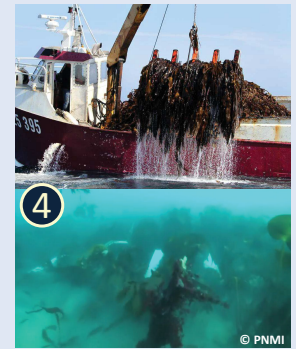


Fig. 2 : The Iroise sea and Bay of Morlaix are the principal kelp exploitation areas in France. The harvest of *L. hyperborea* by seaweed trawl can dislodge kelps, wound tissues and could enhance export

② DYNAMICS OF DEGRADATION

- Material degradation : kinetics, isotope signature, nutritional quality ?
- Macrofauna colonization & Bacterial activity ?

In situ experiment	Prospect
<ul style="list-style-type: none"> ➤ Experiment with litter bags over time Biomass Nutritional quality : %C, %N, C/N Isotopic composition Chemical defenses Macrofauna assemblages Production measurement 	<ul style="list-style-type: none"> ➤ Effect of fragmentation ➤ Microbes density and functions ➤ Species shifts : Comparative study with <i>L. ochroleuca</i>

③ EFFECT OF TROPHIC SUBSIDY ON COMMUNITIES

- Macrofauna inhabiting accumulations : specific assemblages ?
- Modification of benthic recipient communities ?
- Temporal variability & Area of influence ?

Diversity structure	Trophic structure
<ul style="list-style-type: none"> ➤ Within & Under accumulations ➤ Adjacent benthic communities ➤ Temporal monitoring ➤ Specific detritivore assemblages ? 	<ul style="list-style-type: none"> ➤ Kelp detritus signature $\delta^{13}C$, $\delta^{15}N$ ➤ Accumulation food-web ➤ Recipient food-web

PROSPECTS & COLLABORATIONS

- Understand trophic subsidy from kelp beds and assess the influence of such productive ecosystem on coastal environments
- Explore the effect of species shift (*L. hyperborea* / *L. ochroleuca*) on trophic subsidy
- Potential collaborations : - Bacteria activity during degradation process - Laboratory of Integrative Biology of Marine Models - Norwegian research project KELPEX on *L. hyperborea* production and export on its northern distribution limit