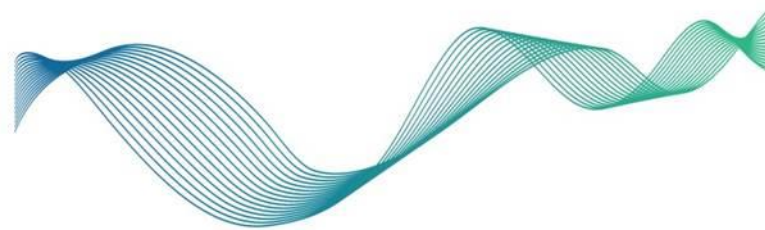


MarineBiotech



META-MINE

Mining the microbiomes from marine wood-digesting bivalves for novel lignocellulose depolymerizing enzymes

Bjørn Altermark
Gustav Waaje-Kolstad
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Rolf Daniel
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ERA-MBT 3rd Transnational Joint Call: Metagenomics

21st November 2017



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December 2013 - November 2017

THE CONSORTIUM

PRINCIPAL INVESTIGATOR	INSTITUTION	COUNTRY
Bjørn Altermark	UiT – The Arctic University of Norway	NO
Gustav Waaje-Kolstad	Norwegian University of Life Sciences	NO
Luisa Borges	L ³ Scientific Solutions	DE
Rolf Daniel	University of Göttingen	DE
Ana-Maria Tanase	University of Bucharest	RO
Raul Bettencourt	University of the Azores	PT

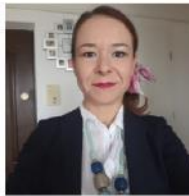
Project period: Spring 2018 to spring 2021

THE CONSORTIUM



Bjørn Altermark

- Structural biology
- Protein production
- Cold adaptation



Ana-Maria Tanase

- Microbiology
- Bacterial taxonomy
- Genetics



Gustav Vaaje-Kolstad

- Lignocellulose
- Enzyme characterization
- Industrial enzymes



Raul Bettencourt

- Marine biodiversity
- Symbiosis
- Microbiology



Luisa Borges

- Marine wood-boring organisms
- Taxonomy
- DNA barcoding



Rolf Daniel

- Bioinformatics
- Metagenomics
- Microbiology

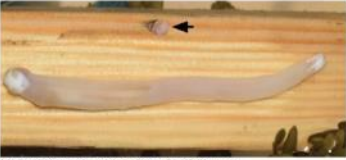
RATIONALE

- Today, enzymatic depolymerization of cellulose & lignocellulose is being increasingly studied.
- However, current model-systems are complex (Fungus, cow rumen, termite guts).
- The shipworm-symbiont system is simple, easy to sample, has few players and is cheap to maintain.
- This marine system might outcompete its terrestrial counterparts.




AIMS & OBJECTIVES

Xylotrophic lifestyle



Xylophaga sp. (arrow) and shipworm

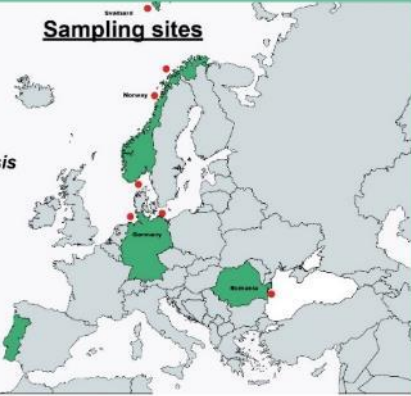


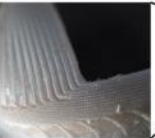


Fresh faecal pellets from shipworm

Species

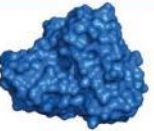
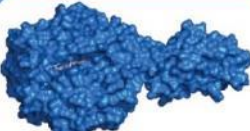
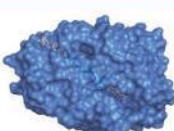
- Psiloteredo megotara*
- Nototeredo norvagica*
- Teredo navalis*
- Lyrodus pedicellatus*
- Bankia carinata*
- Teredothyra dominicensis*
- Teredo bartschi*
- Xylophaga dorsalis*
- Xylophaga atlantica*
- Xylophaga* sp.
- Xyloredo* sp.

Sampling sites



Shell closeup *Psiloteredo megotara* Pallets closeup

LPMO Endo/exoglucanase with carbohydrate binding module Cellobiase

- Wood eating bivalves as a model system for lignocellulose depolymerization
- Bacterial symbiosis
- Metagenomics
- Metaproteomics
- Enzyme discovery & characterization
- Industrial enzymes

WORK PACKAGES



META-MINE

Norway Germany Romania Azores





Mining the microbiomes from marine wood-digesting bivalves for novel lignocellulose depolymerizing enzymes

WORK PACKAGES

<div style="text-align: center;">  <h3>WP1</h3> <p>BIVALVES</p> <ul style="list-style-type: none"> Deployment and retrieval of wood panels Bivalve dissection/anatomy DNA isol. and sequencing Phylogeny, mitogenome </div>	<div style="text-align: center;">  <h3>WP2</h3> <p>BIOINFORMATICS</p> <ul style="list-style-type: none"> Assembly of metagenomes Binning & gene annotation Comparative analysis Gene mining, CAZymes CBMs, linkers, new tools </div>	<div style="text-align: center;">  <h3>WP3</h3> <p>SYMBIONT TAXONOMY</p> <ul style="list-style-type: none"> Bacterial composition in gill, caecum & faeces Quantitation of symbionts Phylogenetic variation Host vs symbiont phylogeny </div>
<div style="text-align: center;">  <h3>WP4</h3> <p>ENZYME PRODUCTION</p> <ul style="list-style-type: none"> Target selection Recombinant expression & enzyme purification Crystallization & structure determination </div>	<div style="text-align: center;">  <h3>WP5</h3> <p>CHARACTERIZATION</p> <ul style="list-style-type: none"> Determine & quantify ship-worm caecum metaproteome Enzyme characterization In-depth analysis of most promising enzyme candidates </div>	<div style="text-align: center;">  <h3>WP6</h3> <p>MANAGEMENT</p> <ul style="list-style-type: none"> Management of project Outreach & dissemination Networking Industry contact </div>

- Six partners
- Four countries
- Access to the seas of Europe
- Work is divided into six WPs

POTENTIAL IMPACTS AND PERSPECTIVES

- A holistic view of lignocellulose depolymerization: – The shipworm gut as an evolutionary perfected bioreactor. (Redox potential, pH, dry matter content, fecal analysis, enzyme blend, etc.)
- Increased knowledge regarding enzymatic depolymerization of lignocellulose.
- New enzymatic tools & solutions for research & industry. New jobs.
- Savings In terms of costs & energy.
- Enzymes contributes to a greener chemistry.
- Improved sustainability and contribute to a circular economy.

Future directions and needs/gaps in this area

- Simpler model-systems for enzymatic biomass degradation in general, are needed.
- Explore enzyme cocktails. Acting together on complex substrates – synergy effects.
- More enzyme tools to diversify the amount of products. Combine enzymes with organic synthesis.
- Understand the industry's needs.
- Fate of lignin in the ocean?



META-MINE



Mining the microbiomes from marine wood-digesting bivalves for novel lignocellulose depolymerizing enzymes



- Shipworms as a model system
- Metagenomics & metaproteomics
- Enzyme discovery & characterization
- Improve biomass conversion
- Create new solutions
- Reach out to the industry – new jobs



Bjorn Altermark

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