



Seaweed pathogens:
What impact do they have
on your crop?

Dr. Martina Strittmatter
Scottish Association for Marine Science

SW Grow Seminar 16 th June 2021

Seminar overview



**INTRODUCTION:
DEFINITIONS**



**EXAMPLES OF
PATHOGENS
FOUND IN
SEAWEED
AQUACULTURE**



**TOOL
DEVELOPMENT /
KNOWLEDGE
BASE**

Our team



**Dr. Claire
Gachon**



**Dr. Marie-
Mathilde
Perrineau**



**Dr. Janina
Brakel**



**Dr. Paola
Arce**



**Cecilia
Rad
Menéndez**



**Carla Ruiz
Gonzalez**

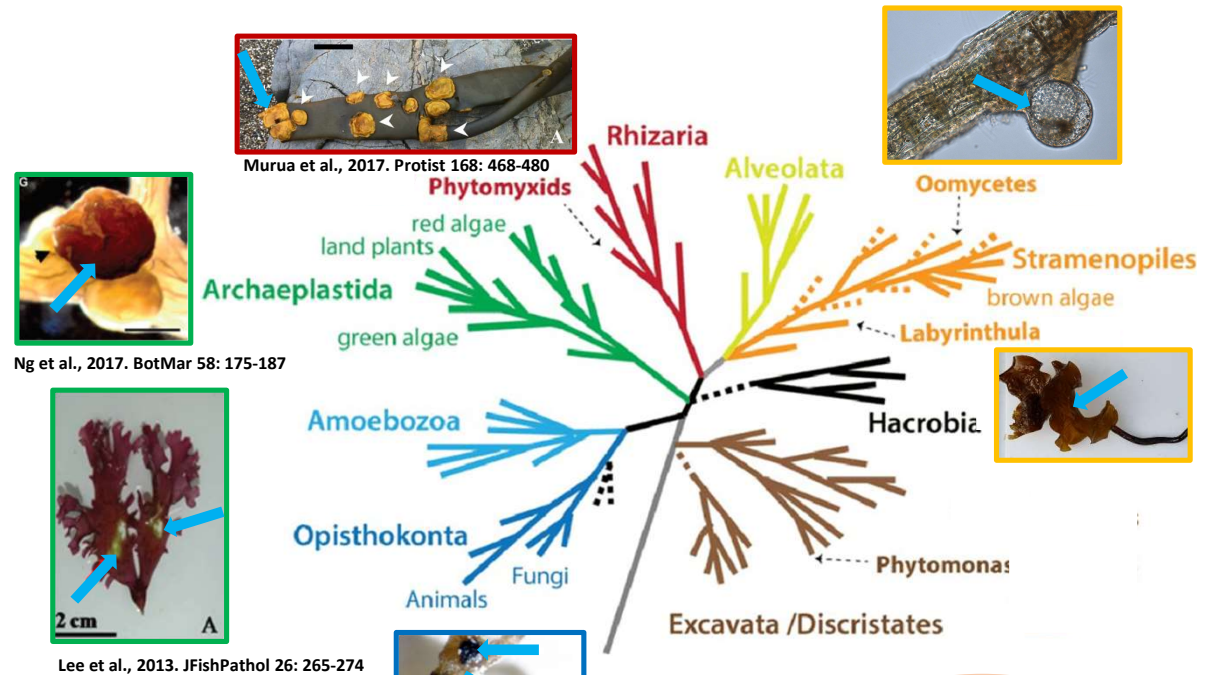


**QianYi
Zhang**



**+ alumni
and many
more**

Macroalgal Diseases

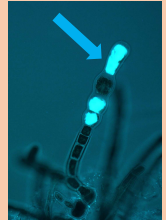


Prokaryotes



Li et al., 2020. JAP 32: 1323-1327

Viruses



Macroalgal diseases: Significance

Ecological impacts

J. Phycol. *, ***_*** (2021)

© 2021 Phycological Society of America

DOI: 10.1111/jpy.13180-20-278

MOLECULAR ANALYSIS OF A FUNGAL DISEASE IN THE HABITAT-FORMING BROWN MACROALGA *PHYLLOSPORA COMOSA* (FUCALES) ALONG A LATITUDINAL GRADIENT¹

Journal of Applied Phycology (2019) 31:1239–1250
<https://doi.org/10.1007/s10811-018-1641-9>

Marine Biology (2021) 168:47
<https://doi.org/10.1007/s00227-021-03853-8>

SHORT NOTES



Pathogen inferred to have dispersed thousands of kilometres at sea, infecting multiple keystone kelp species

Abigail L. Mabey^{1,2} · Elahe Parvizi³ · Ceridwen I. Fraser³

Economical impacts

Novel species of the oomycete *Olpidiopsis* potentially threaten European red algal cultivation

Yacine Badis¹ · Tatyana A. Klochkova² · Martina Strittmatter^{1,3} · Andrea Garvetto¹ · Pedro Murúa^{1,4} · J. Craig Sanderson⁵ · Gwang Hoon Kim⁶ · Claire M. M. Gachon¹



Review

Algae 2014, 29(4): 249-265
<http://dx.doi.org/10.4490/algae.2014.29.4.249>

Open Access



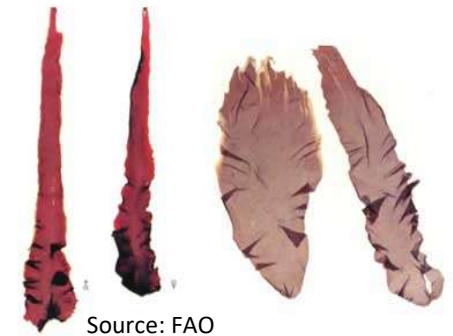
A revaluation of algal diseases in Korean *Pyropia* (*Porphyra*) sea farms and their economic impact

Porphyra industry in Asia: impacts of pathogens

important marine crop: annual market value 2 billion \$US (source FAO)

Commonly used in sushi (“nori”)

mainly cultivated in Japan, China and Korea

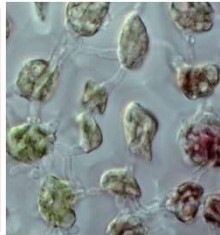


Porphyra industry in Asia: impacts of pathogens

Several organisms currently challenge the cultivation of *Porphyra*

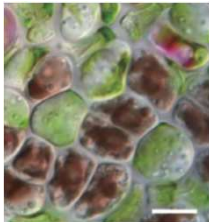
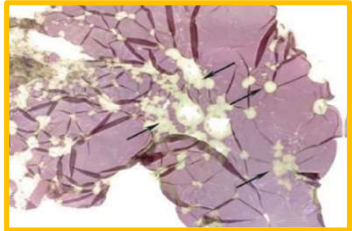
Pathogens:

Oomycetes: *Olpidiopsis* disease and red rot disease (*Pythium porphyrae*)



Red-rot disease

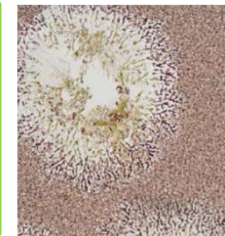
Pythium porphyrae



***Olpidiopsis* blight**

Olpidiopsis porphyrae

Bacteria/viruses: green spot disease

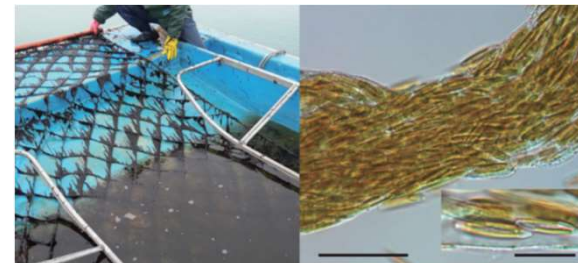


Green-spot disease

Viral infection

Fouling organisms

**Diatoms
cyanobacteria**



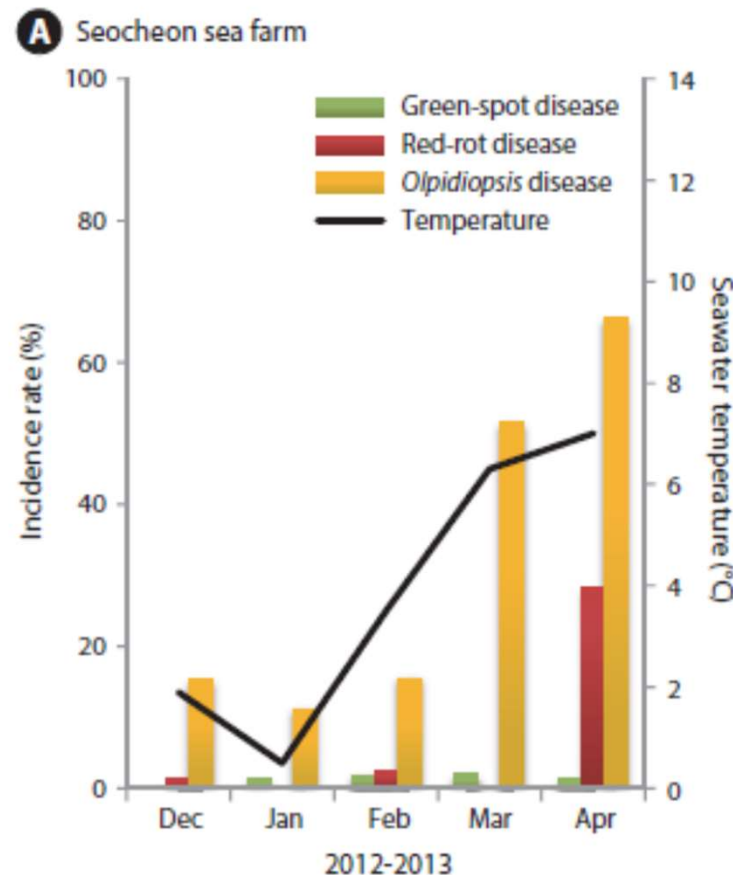
Some numbers....

Olpidiopsis disease in Seocheon Sea Farm in 2012/2013

- Early harvest (shorter growth period, lower harvest)
- Production loss estimated to 1.6 Mio US\$ (25% of annual sale in this area)

Diatom felt in Seocheon Sea Farm in 2011-2013

- Production unaffected, but lower auction price due to changes in taste and visual aspect of blade
- Price drop by 2/3 of the normal price



From Kim et al. 2014 doi.org/10.4490/algae.2014.29.4.249

Green-spot disease



Red-rot disease



Olpidiopsis disease



Carragenophyte farming and impact of pathogens

- Mainly Eucheumatoid species: *Kappaphycus sp.* , *Eucheuma sp.*
- Main producers: Indonesia, Philippines, Malaysia, China, Tanzania
- Biggest annual production of all seaweed crops: 11.1 Mio t (fresh weight), 1.6 bill US \$ (represents 41% of global annual production)



Source: ingredientsnetwork.com



Image: courtesy of Dr. Janina Brakel



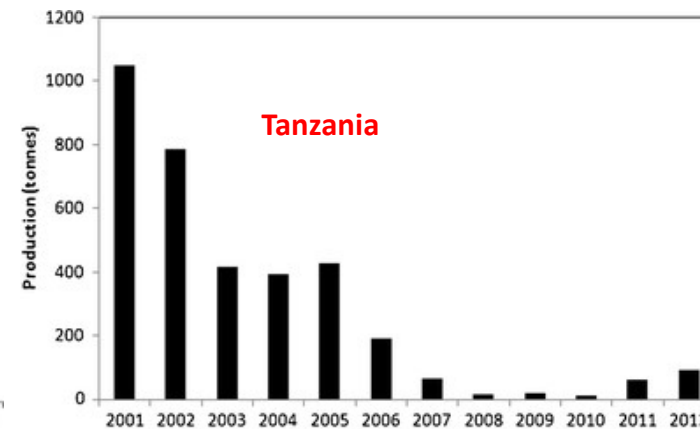
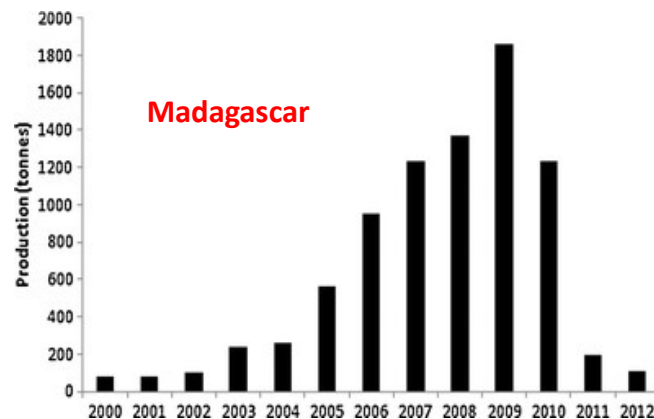
Carragenophyte farming and impact of pathogens

Two major diseases / pests occurring in eucheumatoid farming:

- Ice-ice syndrome
- Infestation by epiphytic filamentous algae

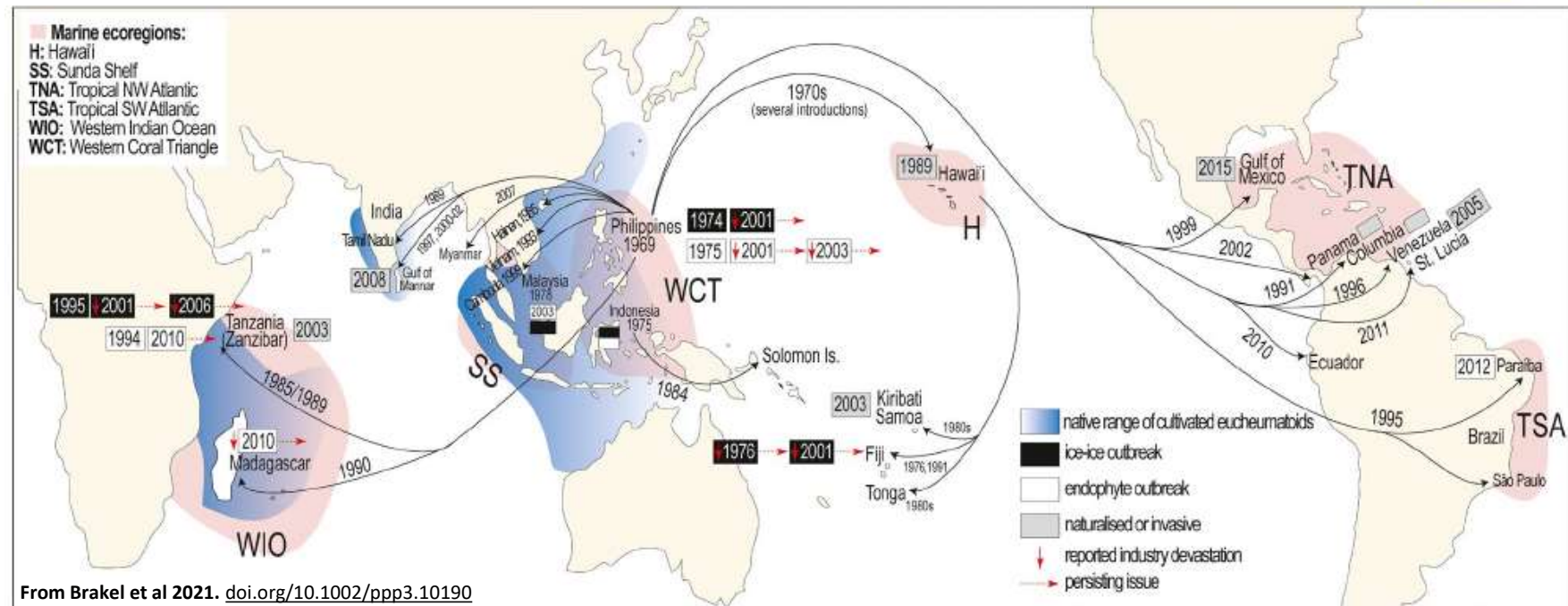


From Msuya et al 2014 doi.org/10.1007/s10811-013-0086-4



- ⇒ Major cause for production losses: e.g. Philippines yearly average production losses of 16.8% in 2012 to 2018
- ⇒ Varying annual production in Tanzania and Madagascar since begin of die-off

Global movement of seaweed germplasm for carragenophyte cultivation and occurrence of diseases

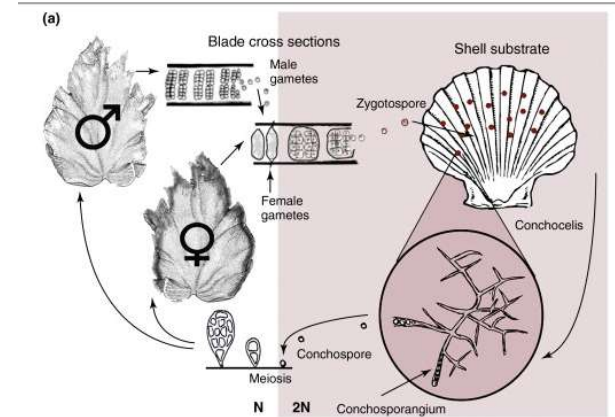


- unintentional transfer of pathogens by contaminated seed stock suspected
- known in other aquaculture sectors (e.g. oysters, crustaceans)

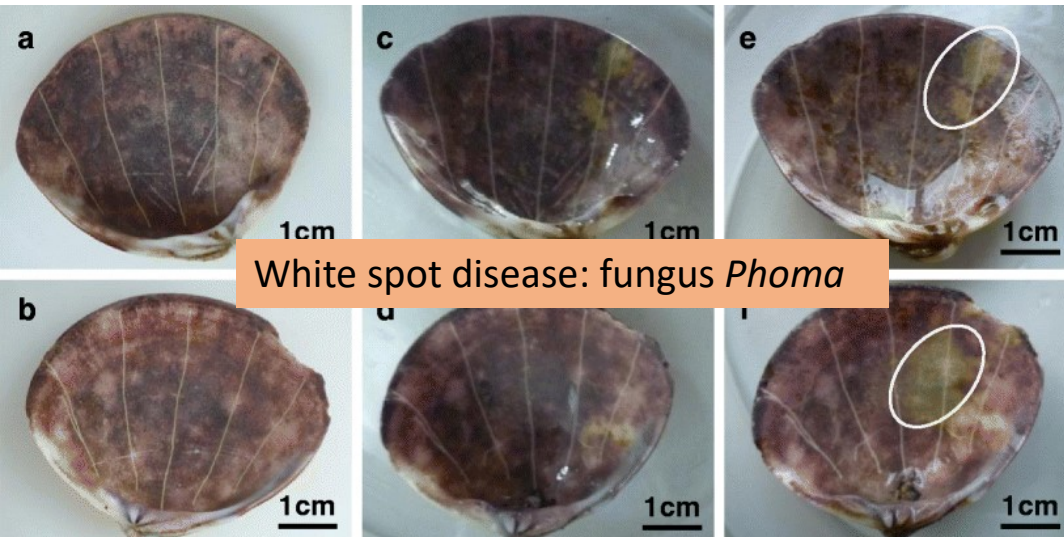
Risk to local, wild populations

Examples of pathogens in seaweed hatcheries (seeding facilities)

***Porphyra* :**
shell boring conchocelis stage cultivated in hatcheries
Also prone to pathogen infection

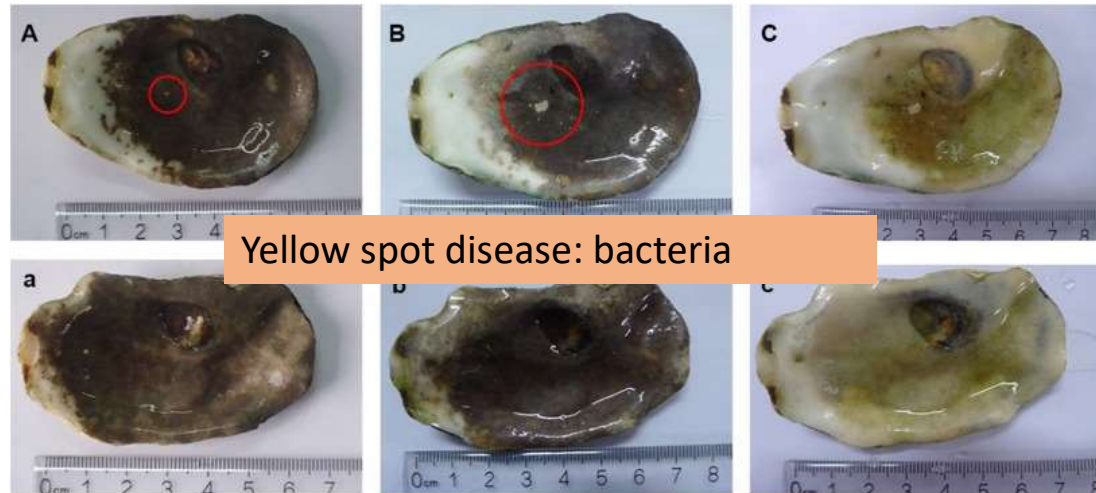


Blouin et al 2011 doi.org/10.1016/j.tplants.2010.10.004



White spot disease: fungus *Phoma*

Guan et al 2013 DOI [10.1007/s10811-013-9976-8](https://doi.org/10.1007/s10811-013-9976-8)



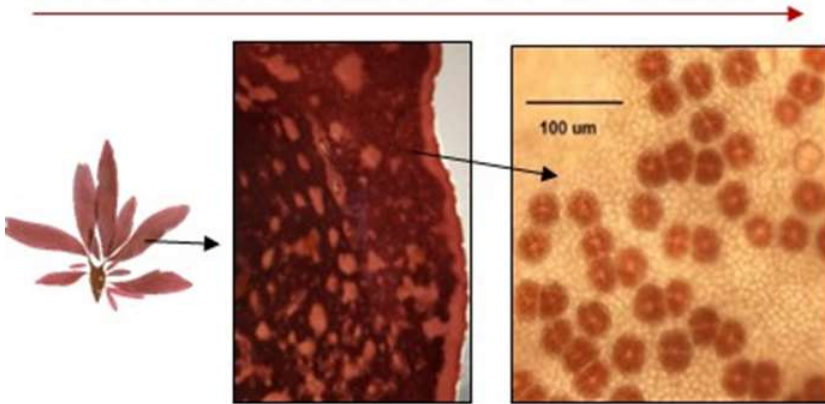
Yellow spot disease: bacteria

Yang et al 2020 doi.org/10.1016/j.aquaculture.2020.735372

Extent of pathogen-related damage not fully known

An example from European waters: Discovery of a new algal pathogen of dulse

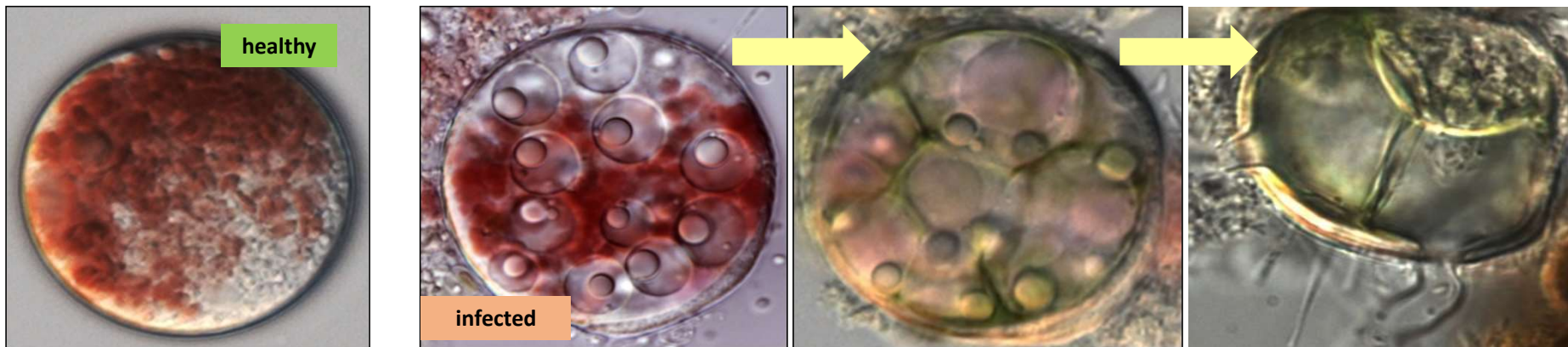
Normal hatchery steps cultivating *P. palmata*



From Schmedes et al 2019. doi.org/10.1016/j.algal.2019.101494

- Reported seeding failure
- Observation of *O. palmariae* in cultivation facility in Scotland
- New pathogen species *Olpidiopsis palmariae*

Effects on nascent Western aquaculture?

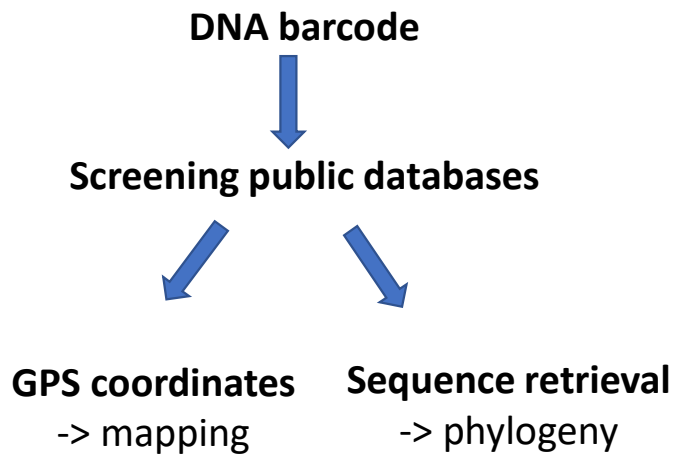


From Badis et al 2019 . doi.org/10.1007/s10811-018-1641-9

Underestimated diversity of algal pathogens: Example *Olpidiopsis*

Approach:

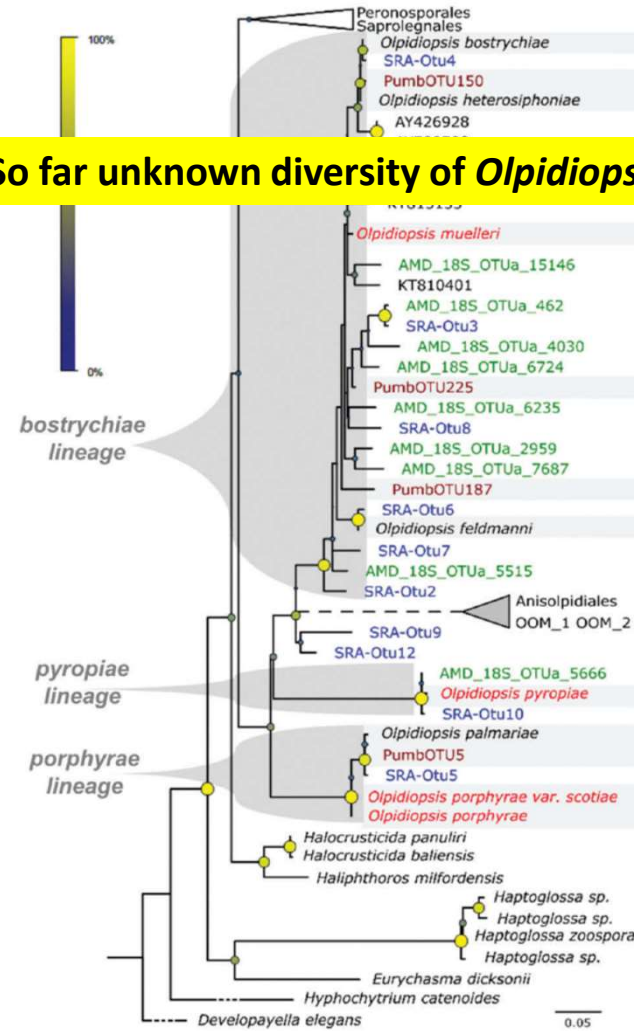
Data mining of public datasets (SRA etc)



Global distribution of *Olpidiopsis*



So far unknown diversity of *Olpidiopsis*



Diseases and pathogens of macroalgae

- ❖ Rising concern about macroalgal diseases (cultivation)
- ❖ Potential risk of spreading of pathogens between wild and cultivated species (biosecurity)

Currently

No baseline of pathogens in macroalgae including

- diversity
- biogeography
- host range
- ecology

→ **MSLW web portal**



MSLW participative web portal



https://www.globalseaweed.org/?page_id=902

Email: mslw@sams.ac.uk

❖ Online portal

❖ Platform to report observations of wild and cultivated algal diseases

❖ Available in three languages (English, Spanish, Portuguese)

❖ Confidentiality, acknowledgements

The screenshot shows the 'My Seaweed looks weird' web portal. At the top, there is a language selector set to 'English (United Kingdom)'. Below this is the title 'My Seaweed looks weird' and a paragraph of text explaining the project's purpose: to report and submit samples of potentially diseased algae. Below the text is a form titled 'About you' with two required fields: '1. Name' and '2. Last Name'. Each field has a text input box with the placeholder 'Enter your answer'. There is also an 'Enable Immersive Reader' button in the top right corner of the form area.

Possible indicators of pathogens and pests in seaweed

❖ galls/blisters/warts



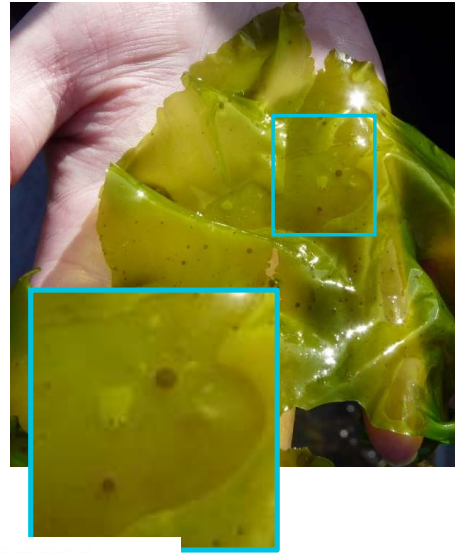
❖ spots



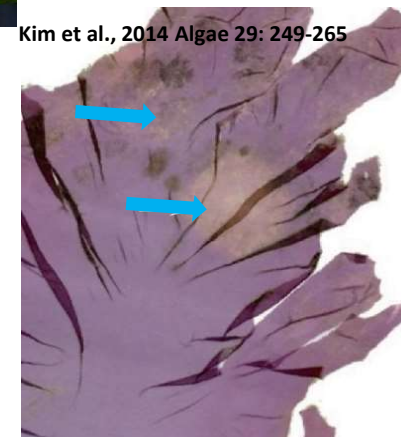
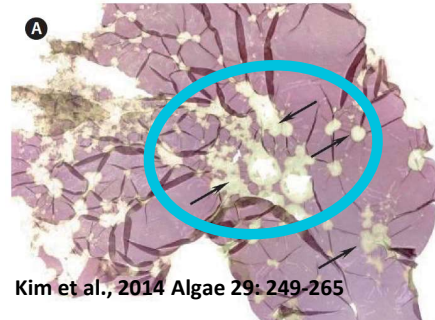
❖ bleaching/discolouration



❖ lesions/holes



❖ distorted morphology



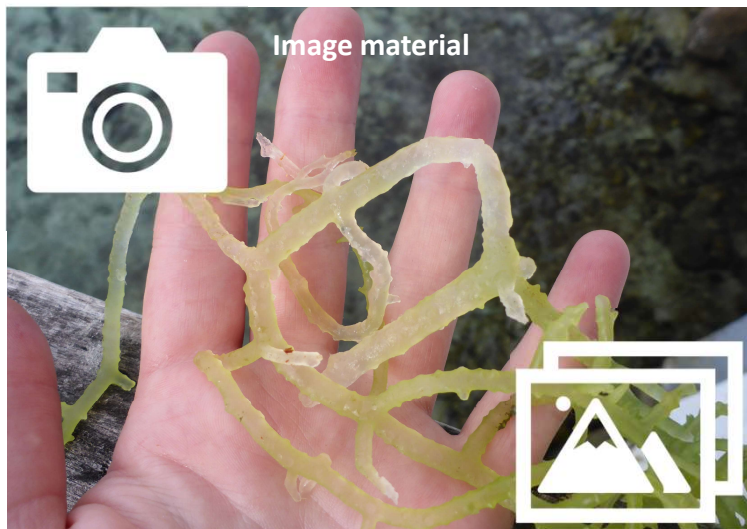
MSLW participative web portal



https://www.globalseaweed.org/?page_id=902

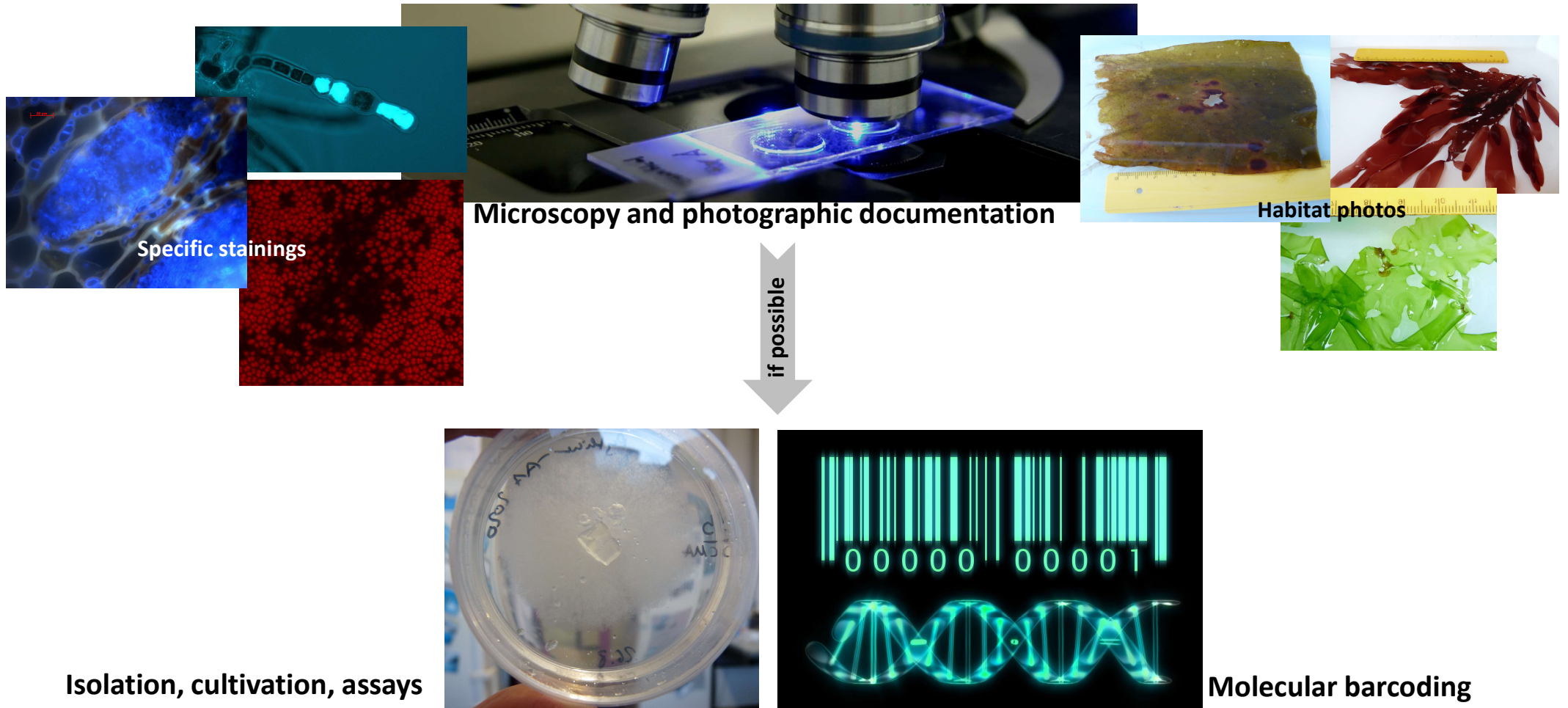
Email: mslw@sams.ac.uk

Submissions possible



Please get in contact prior to submission

MSLW sample processing



Offer in-kind diagnosis and report for submitted samples (when possible)

Objectives of the MSLW web portal



**Encourage participation
and invite sample
submissions**



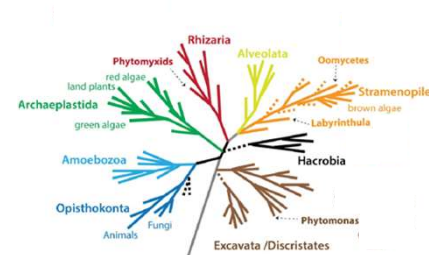
**Accelerate the
description and
identification of algal
diseases worldwide**



Badis et al, 2020. EJP 55:162-171



**Increase knowledge on
the diversity of algal
pathogens**



**Make information
available in an open-access
repository
(Algal Disease Atlas,
in progress)**



Online Digital Algal Disease Atlas

Data source

algaBLISTER
GSSTAR- funded
project

Literature

data from publications



Algal Disease Atlas:

- ❖ taxonomy of host and pathogens
- ❖ images
- ❖ interactions
- ❖ biogeography data
- ❖ literature
- ❖ protocols / manuals



Online Digital Atlas of Algal diseases

[Contact us](#)

Search...

☐ All ☐ Taxonomy



Objective:

Algal Disease Atlas V1 at the end of 2021

Thank you for your attention

Funding:
EU Horizon 2020 (project Genialg)
UKRI (project GlobalSeaweedSTAR)