Agile training to help enable standardisation of phytoplankton sampling and gross gill terminology across the Scottish sector

Gill Health Initiative, Oslo 2023

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Today's talk

Standardisation: 2 projects funded by the UK Seafood Fund – Skills and Training Scheme

1. SAIC-SAMS: SOP for detecting and reporting harmful planktonic blooms in open coastal waters of UK

2. SRUC-SSF: Standardization of gross gill terminology

SOP for detecting and reporting harmful planktonic blooms in open coastal waters of UK

Scotland's Farmed Fish Health Framework

Aims:

- To improve farmed fish health, welfare, and survival
- To support and promote innovation in fish health management
- To identify options for managing fish health challenges

It is a collaborative forum, steered by representatives from the Scottish Government, salmon and trout producers, regulators, fish vets, and SAIC

Three workstreams: understanding mortality, climate change impacts, and medicines

Source: Scotland's Farmed Fish Health Framework, Scottish Government

SOP for detecting and reporting harmful planktonic blooms in open coastal waters of UK

FFHF climate change working group acknowledged the increased occurrence of HABs

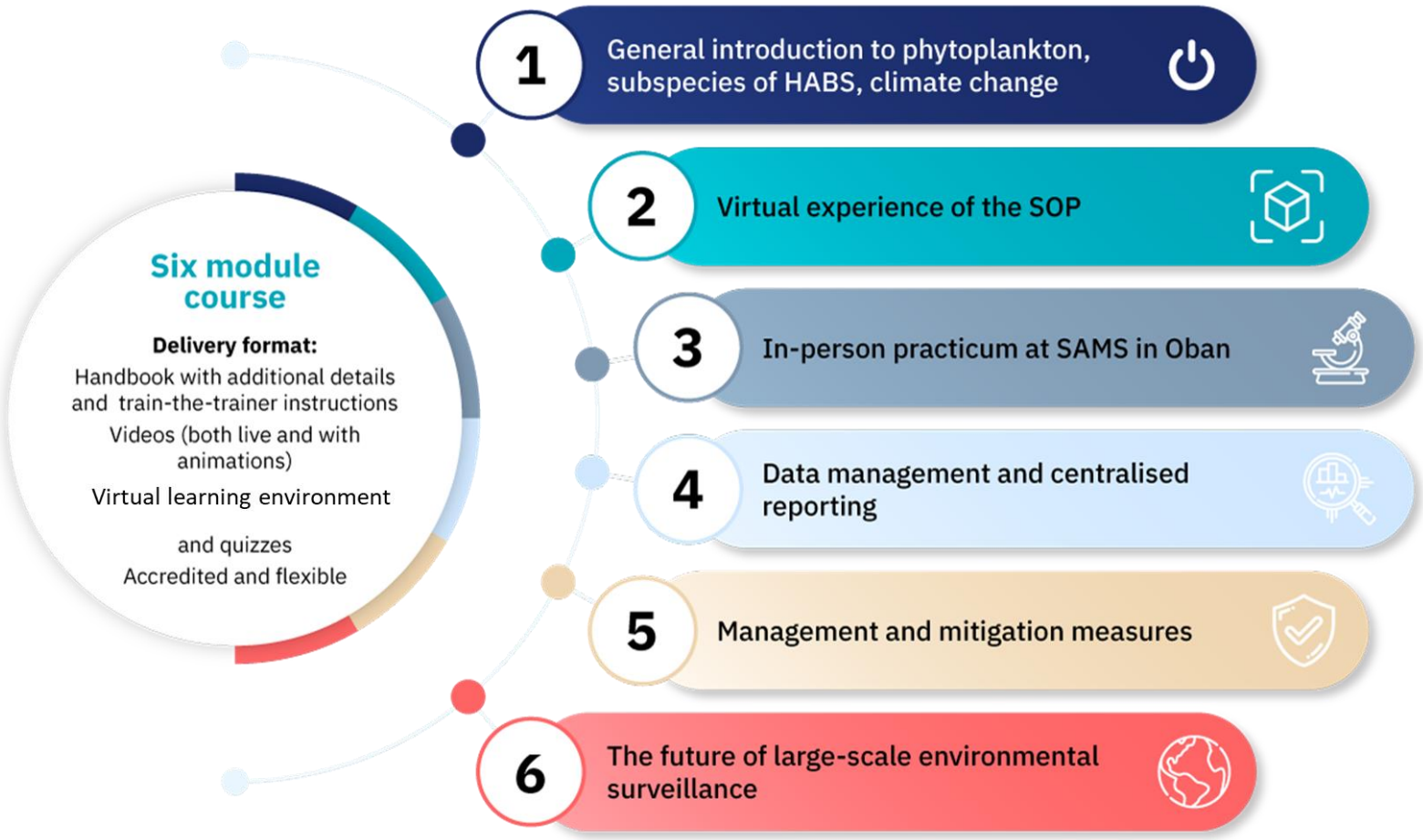
- Identified the need for:
  - consistent sampling methodology, species identification and centralised reporting: created a standard operating procedure (SOP) for sampling and established a list of 15th of the most important species
  - training for operators

SOP for detecting and reporting harmful planktonic blooms in open coastal waters of UK

SAIC partnered with SAMS and Lantra to design a course:

- For operational staff at marine sites, dealing with fish health and welfare.
- Training can be accessed remotely, and at any time, with minimal time spent off site.
- All operators will require some amount of training, and the course is designed to account for this.

SOP for detecting and reporting harmful planktonic blooms in open coastal waters of UK



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General

Introduction to Plankton

27%

Virtual Experience of the Standard Opera...

0%

Management and Mitigation Methods

0%

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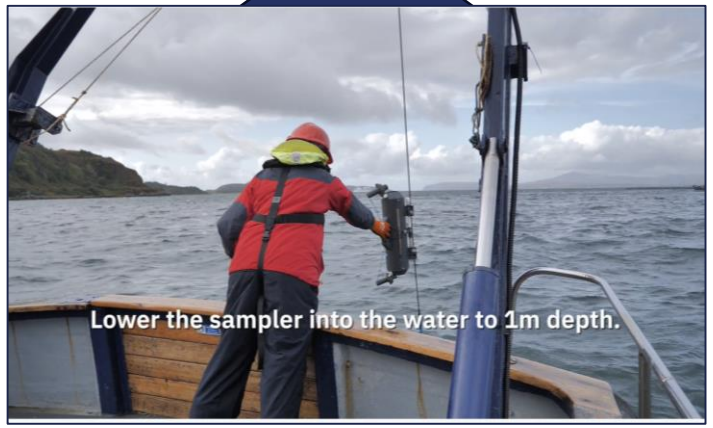
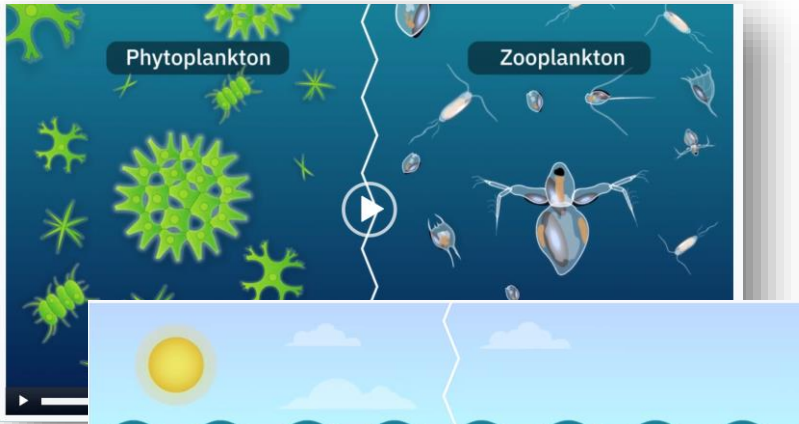




What size are microplankton?

- Between 1mm and 2mm
- More than 2mm
- Between 0.05 and 1mm
- Less than 0.05mm

Submit answer

Current Course Progress - manual

Module 1 – Introduction to Plankton

This module is a general introduction to plankton, harmful blooms (HABs), and their association with climate change.

On completion of this module, participants will be able to:

- Define what plankton is, including phytoplankton, zooplankton microplankton, and algae, why they are important, what they require to grow and seasonal growth patterns.
- Identify ways in which blooms can harm fish.
- Define how climate change is impacting the incidence of harmful blooms.

To complete this module, log onto our learning management system. Click on the module titled "Introduction to Plankton". This module contains short animated videos, as well as other materials. Watch these videos, and your knowledge will then be tested in some short quizzes.

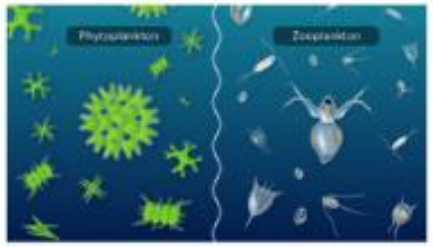
Plankton are marine drifters, which are organisms that get carried along by the tide and current.

They're usually microscopic, but can include larger species like crustaceans and jellyfish.

They can range in size from 1 micrometer to one meter!

They're classified by size, type, and how long they spend drifting.

The most basic categories divide plankton into two subgroups phytoplankton, which are plants, and zooplankton, which are animals.



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Let's start with phytoplankton, which are microscopic plants found near the water's surface. They contain chlorophyll, which enables them to carry out the process of photosynthesis, which uses energy from the sun to convert carbon dioxide into oxygen.

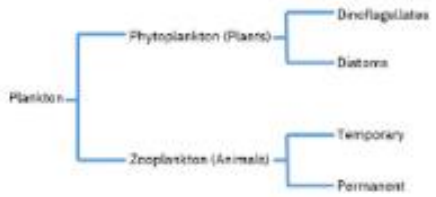
What is photosynthesis?

Photosynthesis is the process in which plants use sunlight, water and CO_2 to create oxygen and energy in the form of sugar.

Zooplankton are split into two groups, temporary and permanent. The temporary zooplankton are made up of planktonic eggs and larvae, while the permanent zooplankton includes all animals that live their life in a floating state.

Microplankton, also called net plankton, are between 0.05 millimeters and 1 millimeter in size. They are a mixture of phytoplankton and zooplankton. Nannoplankton, also known as dwarf plankton, are even smaller, less than 0.05 millimeters and are all made up of phytoplankton.

The two main classes of phytoplankton are diatoms, and dinoflagellates.



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There are 1000 millimeters in 1 meter. While plankton are typically microscopic, some are huge! For example, the lions mane jellyfish has tentacles that can grow to more than 30 meters (300cm, or 3000mm) long!

Diatoms are autotrophs, using chlorophyll to turn light energy into carbohydrates. They first appeared 180 million years ago during the Jurassic period. There are approximately 100,000 species of diatoms! They are single celled, although they often exist in colonies. Diatoms live within a silica box (SiO_2) known as a frustule, which is composed of two overlapping sections called thecae or valve.

There are approximately 1,500 species of dinoflagellates described in the scientific literature. Dinoflagellate are single celled. They can be autotrophic (acquiring their food from light), but can also be heterotrophic (catching their own prey) or they can be mixotrophic (a bit of both).

For the trainer:
Emphasise that whilst plankton are often microscopic, the word plankton is a general term encompassing any organism that cannot swim against a current, therefore jellyfish and other similar organisms are also considered plankton.

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Standardization of gross gill terminology: why do we need it?

"swollen gills"


(Boerlage, 2020)

"white spots"

- Communication challenges – what exactly do we mean when we describe gross gill abnormalities?
  - Communication between site staff and health team
  - Communication between companies
  - Comparisons - science
- Some terminology includes words appropriate for histopathology
  - E.g. necrotic gill (we can't see necrosis by gross gill observations)
- Lack of standardization in gill scores
  - Companies develop their own protocols

Standardization of gross gill terminology: a literature example

Table 1
Description of gross gill scores.

Score	Total gill
0	Gills appear healthy, with no visible lesions, abnormal colour, or excessive mucus
1	Focal lesion present on 1 or 2 gill arches only, 1–5% of total gill area affected
2	More than 1 lesion. 5–25% of total gill area affected
3	25–50% of total gill area affected
4	50–75% of total gill area affected
5	75–100% of total gill area affected
Focus	All gill surfaces

Boerlage *et al*. (2022). *Preventive Veterinary Medicine*, *204*, 105654. https://doi.org/10.1016/j.prevetmed.2022.105654

Table 1. Total gill scoring system to estimate severity of multifactorial gill disease in Atlantic salmon (*Salmo salar*).

Level of Infection	Total Gill Score	Description	Mean % of Gill Surface Covered
Clear	0	No visible pathology, healthy red coloured gills	0
Very light	1	Discrete focal white streaks or patches on individual filaments and slight erosion/damage to distal ends of filaments	1–5%
Light	2	More extensive coalescing white streaks or white focal patches on filaments, more extended erosion/damage to distal ends of filaments	5–20%
Moderate	3	Extensive multifilamental peripheral erosion, grossly swollen or thickened filaments with localised areas of necrotic epithelium	20–50%
Advanced	4	Extensive grossly swollen or thickened filaments, shortened filaments (>50% of filament length affected), pallor and areas of melanisation	50–75%
Severe	5	Widespread necrotic patches, extensive melanisation, almost total destruction of gill architecture due to severe loss of epithelium	>75%

Fridman *et al.* (2021). *Microorganisms*, *9*(12). https://doi.org/10.3390/microorganisms9122605

Standardization of gross gill terminology: The solution

But let’s start smaller

Standardization of gross gill terminology: Agile training

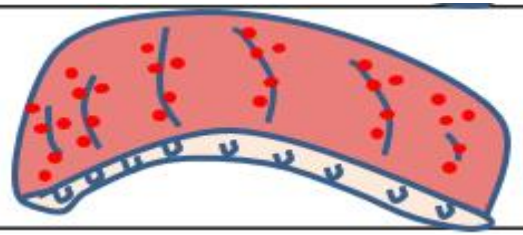
- **Online learning platform** moodle
- **Topics**
  1. Understand fundamental principles of fish gill functionality.
  2. Evaluate and recognize gross morphological characteristics of the gill that is healthy, diseased with a simple pathology, or diseased with a complex pathology.
  3. Use gross gill scoring schemes
- Companies can offer 2 and 3 to site staff remotely and repeatedly (perhaps 2x per year) → terminology will become standardized
- Certificates

Scottish Sea Farms PHARMAQ Analytiq SRUC defra Department for Environment Food and Rural Affairs seafish

Example: module 2 “gross morphology”

1. Theory on gross gills

2. Practical session using gill photo’s

Pin-prick haemorrages	Or… small red dots??		

3. Evaluation (test) using gill photo’s

   (minimum score required to pass the module)

Key in developing terminology
- user friendly
- unique to abnormality
- understandable by specialists
- true to condition

Considerations – SAIC and SRUC

- Better communication will improve
  - Surveillance and health management
  - Value of the information gathered
  - Abilities to analyse information and find patterns
- Across companies and country standardization challenging, but there are many benefits.
- Train the trainers
- Perhaps Gill Health Initiative network starting point for standardization discussions?