SYLLABUS

1. Introduction

Proliferation of marine infectious diseases substantially impacts the structure and function of diverse ecosystems by causing significant mortalities in ecologically relevant populations of a wide range of marine organisms including mammals, corals, shellfish, finfish, and sea grass. This, in turn, threatens ecologically valuable habitats and the diversity of the shore, and results in substantial economic losses in fisheries and aquaculture.

Models that incorporate processes involved in pathogen transmission are important tools to explain and predict the epizootiology of marine diseases and support management strategies. This course provides an introduction to the study of the theoretical basis for modeling the transmission of marine infectious diseases.

2. Target learners and prerequisites

The course is aimed at degree, master and PhD students in engineering, environmental science and epidemiology programs.

It is desirable that students have some familiarity with ordinary differential equations (ODEs)and MATLAB. However, the course is build from simple concepts to more complex ideas (regarding both ODEs and MATLAB programming) in order to be motivate students with lower mathematical/programming skill levels.

3. Objective

This course provides the theoretical and computational basis for modeling the proceses and mechanisms involved in the transmission of marine diseases. That is, the objective of the course is to explore, analyze and describe the dynamics of a variety of host-pathogen marine systems via modelling.

4. Competencies

Completing this course students learning outcome will be building up disease models that simulate the transmission of pathogens in marine populations. Students will acquire new conceptual, mathematical and computational skills to analyze and determine the (1) mechanisms and processes that enhance and limit marine diseases and (2) pathogen and host population dynamics.

5. Course description and learning methods

This course provides the theoretical basis for modeling the transmission of pathogens in marine organisms. Emphasis is on the development of quantitative theoretical models. Concepts and modelling context are build up from simple models of the spread of infectious disease to more sophisticated models. The models represent the dynamics of a variety of host-pathogen systems including those unique to marine systems where transmission of disease is by contact with waterborne pathogens both directly and through filter–feeding processes. The analysis of the proposed single-population epizootiological models focuses on the most relevant processes that interact to drive the initiation and termination of epizootics. The theoretical models are developed in MATLAB. For this, a specific section with Matlab basics and learning resources is proposed. Alternatively, the similar and open source software GNU Octave can be used.

The didactic method of this course first provides students basic theoretical knowledge on the transmission of marine infectious diseases. Second, students will acquire basic notions about Matlab for modeling marine infectious diseases. Third, students will work on exercises to construct disease models with ordinary differential equations using MATLAB. Finally, students will have the opportunity to go through a set of self-evaluation exercises to assess the assimilation of theoretical concepts and the modeling skills they acquired on a variety of marine diseases. A GUI for exploring model outputs will be facilitated.

6. List of Topics

1. Basic concepts of marine disease transmission
2. Introduction to MATLAB for marine disease modelling
3. Matlab instructions to build and run marine disease models
4. Building up a contact-based marine disease transmission model
5. Formulation of the basic reproduction number Ro of a contact-based model
6. Sensitivity analysis of marine disease models

7. Timeline

This course is programmed to be completed in 80 hours (6-7 hours per week/12 weeks). The course timeline is structured as follows:

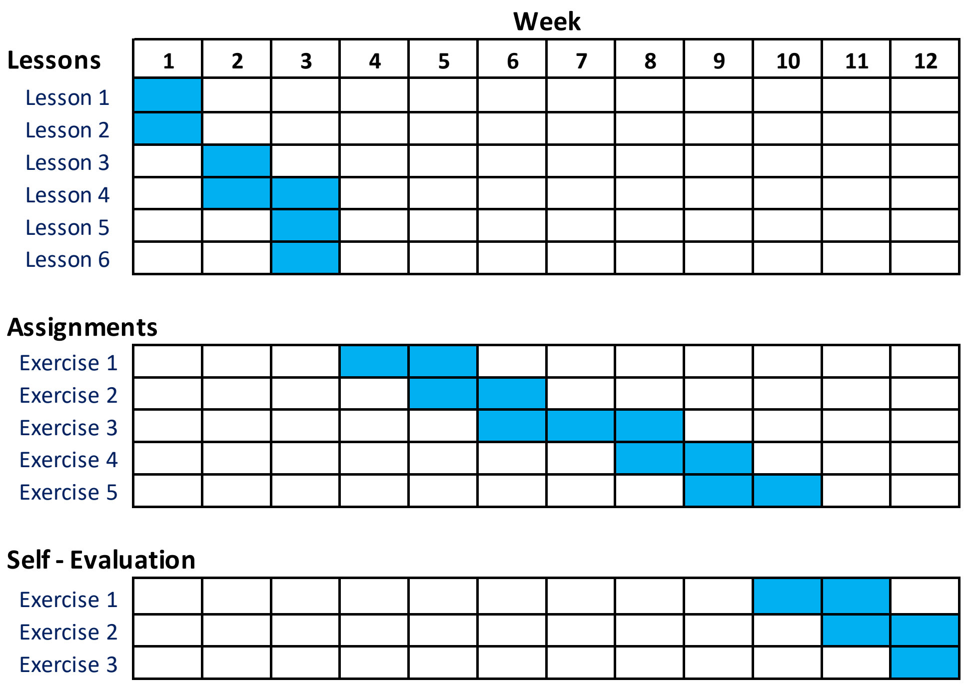

Figure 1: Timeline for Lessons, Assignments and Self-Evaluation exercises.

Study material (20 hours)

- **Lesson 1**: Basic concepts of marine disease transmission (3 hours)
- **Lesson 2**: Introduction to MATLAB for marine disease modelling (3 hours)
- **Lesson 3**: Matlab instructions to build and run marine disease models (3 hours)
- **Lesson 4**: Building up a contact-based marine disease transmission model (7 hours)
- **Lesson 5**: Formulation of the basic reproduction number Ro of a contact-based model (3 hours)
- **Lesson 6**: Sensitivity analysis of marine disease models (1 hours)

Exercises (45 hours)

- **Exercise 1**: Build up models for marine disease transmission through contact with environmental pathogens (10 hours)

- **Exercise 2**: Formulation of the basic reproduction number Ro of a particle contact-based model (6 hours)
- **Exercise 3**: Build up models for marine disease transmission through filtration of environmental pathogens (15 hours)
- **Exercise 4**: Formulation of the basic reproduction number Ro of a particle filtration-based model (6 hours)
- **Exercise 5**: Exercise 5: Sensitivity analysis (SA) of Ro for SIP, SIPD, SIPF and SIPDF models (8 hours)

Student Self-Assessment (15 hours)

- **Exercise 1**: Build up a SEIR contact-based model including Susceptibles, Exposed, Infected and Dead populations (5 hours)
- **Exercise 2**: Build up a SIPDB contact-based model including recruitment and natrual mortality of individuals. Transmission of the pathogen occurs by contact of susceptibles with Infected, dead infected and environmental pathogens (5 hours)
- **Exercise 3**: Using the GUI for self-assessing about acquired modelling skills by running a series of simulations with a variety of initial conditions and parameters (5 hours)