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[1] Document will be a draft until it was approved by the coordinator

[2] PU: Public, PP: Restricted to other programme participants (including the Commission Services), RE: Restricted to a group specified by the consortium (including the Commission Services), CO: Confidential, only for members of the consortium (including the Commission Services)

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**Deliverable D7.4**

# Material in learning content management system

21/12/2016

# Executive Summary

This report is a Deliverable of Work Package 7 (WP7 – Synthesis & training development) of the FP7 MareFrame research project. In this report we introduce tutor-web, the Learning Content Management System (LCMS) chosen to store MareFrame learning material, and subsequently outline the available content and explain where it can be downloaded from. Finally, we show some examples of the output available on the tutor-web.
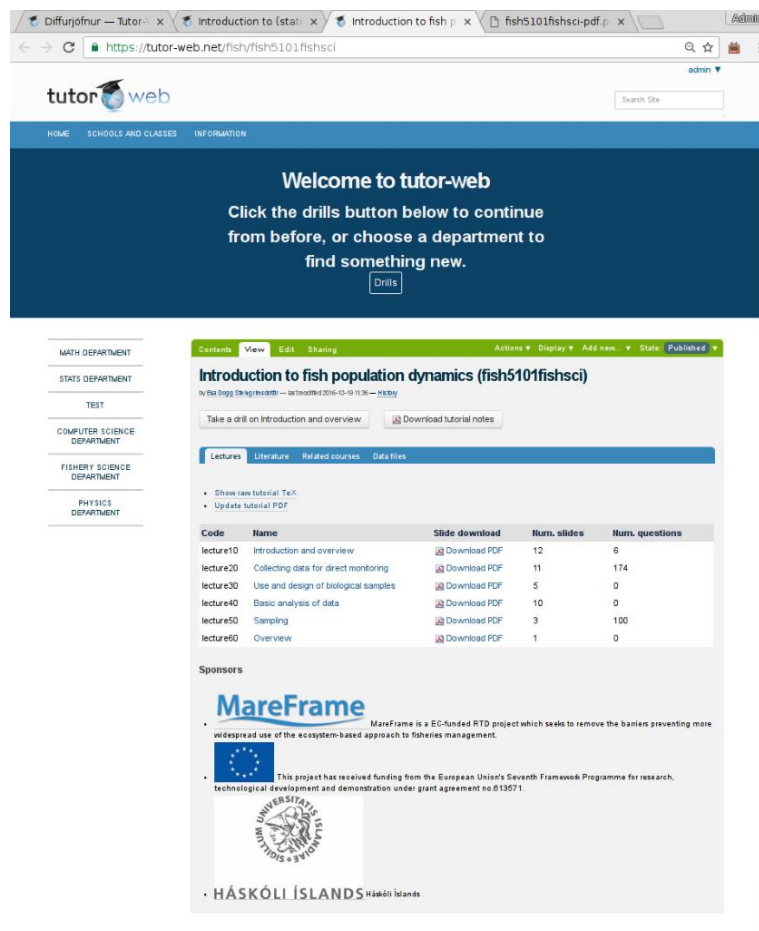
# Contents

# Tutor-web introduction

The learning material for MareFrame has been incorporated into an existing LCMS, tutor-web. Tutor-web is both a learning tool for students and a research platform into e-learning. Tutor-web has been used for approximately 4000 students, at the University of Iceland as well as further afield; its capabilities for working off-line have proven invaluable for teaching in Kenya, where internet connections are not readily available.

Tutor-web provides facilities for producing lecture slides, handout material for students to study, and a drill environment for students to study interactively by answering questions.



**Figure 1:** Tutor-web interface

The drill environment adapts to the student's capabilities, ensuring the student has questions to match their skill level to enhance learning. Many aspects of the system are parameterised, and can be assigned random values for each student, allowing experiments to be performed.

The drill environment, whilst working within a browser, is designed to continue working even without an internet connection, so a student can keep going when the connection to the server isn't possible, e.g. if the wireless network in the auditorium is struggling, a student is trying to work on a train, or a student isn't allowed permanent internet access---there are tutor-web students currently in prisons, for example. In the extreme case, the Kenyan installations allow students to take a tablet home and

![MareFrame]

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continue working until their next visit to the classroom, which could be as much as a month away, at which point their work can be uploaded.



**Figure 2:** Tutor-web drill interface

Students can either be part of a class where lectures are assigned to them and a teacher will be able to monitor their progress, or they can choose any tutorial for self-directed learning. A key tenet of tutor-web is open accessible learning, there is no restricted material.

Tutor-web is also integrated with the cryptocurrency Smileycoin (https://tutor-web.info/smileycoin), giving awards for students when they finish lectures and tutorials. This then allows the creation of a wider economy of places where these can be spent. To date a game has been developed with in-app-purchases in SMLY, a chat system where students can pay others in SMLY for help with lecture questions, paying for coffee from the student canteen in SMLY, and buying gift vouchers in SMLY.

All Tutor-web content is organised into courses, tutorials and lectures. A course contains a set of tutorials, and a tutorial is made up of a list of lectures. Course material is stored as a list of slides within a lecture. This content is then transformed into:

- PDFs containing presentation slides for each lecture
- PDFs for long-form handout content for an entire tutorial, including extra content that is used as lecturer's notes when presenting.

Questions are also saved per-lecture, and can be bulk imported and exported, allowing them to be generated by an R script, for example.

# Content developed as part of MareFrame

As opposed to developing a dedicated "MareFrame tutorial", the content has been organised together with the output of other projects. This makes more sense for any future students and increases dissemination potential for MareFrame---for example the Discard material developed as part of the MINOUW project is integrated with MareFrame EAFM content. So students will learn about the outputs of both projects.

The content developed as part of MareFrame is spread over 3 courses, an outline of the tutorials and lectures within those tutorials of each is below. For further detail, please visit the links provided.

Samples of this content can be found in the appendix, for full content, you can visit https://tutor-web.net and download content, or follow the links in the outlines below.

## math612 - Computing and calculus for applied statistics

This course can be found at https://tutor-web.net/math/612 and contains the following tutorials & lectures:

- Numbers, arithmetic and algebra: https://tutor-web.net/math/math612.1/@@download-pdf
  - Numbers, arithmetic and basic algebra
  - Data vectors
  - More on algebra
  - Discrete random variables and the binomial distribution
  - Functions
  - Polynomials
  - Simple data analysis in R
  - Indices and the apply commands in R
  - Functions of functions and the exponential function
  - Inverse functions and the logarithm
- Elements of calculus: https://tutor-web.net/math/math612.2/@@download-pdf
  - Continuity and limits
  - Sequences and series
  - Slopes of lines and curves
  - Derivatives
  - Applications of differentiation
  - Integrals and probability density functions
  - Principles of programming
  - The Central Limit Theorem and related topics
  - Miscellanea
- Some notes on statistics and probability: https://tutor-web.net/math/math612.3/@@download-pdf
  - Multivariate probability distributions
  - Some distributions related to the normal
  - Estimation, estimates and estimators
  - Test of hypothesis, P values and related concepts
  - Power and sample sizes
- Linear algebra, multivariate calculus and multivariate statistics: https://tutor-web.net/math/math612.4/@@download-pdf
  - Vectors and Matrix Operations

- o Some notes on matrices and linear operators
- o Ranks and determinants
- o Multivariate calculus
- o The multivariate normal distribution and related topics
- Topics in statistics and probability: https://tutor-web.net/math/math612.5/@@download-pdf
    - o Independence, expectations and the moment generating function
    - o The gamma distribution
    - o Notes and examples: The linear model
    - o Some regression topics

## fish510 - Introduction to (statistical) fish population dynamics

This course can be found at https://tutor-web.net/fish/fish510 and contains the following tutorials & lectures:

- Introduction to fish population dynamics: https://tutor-web.net/fish/fish5101fishsci/@@download-pdf
    - o Introduction and overview
    - o Collecting data for direct monitoring
    - o Use and design of biological samples
    - o Basic analysis of data
    - o Sampling
    - o Overview
- The development of a year-class: https://tutor-web.net/fish/fish5102stockcatch/@@download-pdf
    - o The development of a year-class
    - o Catch curve analysis.
    - o Natural mortality
    - o Stock and catch equations
- Modelling length at age and length distributions: https://tutor-web.net/fish/fish5103growth/@@download-pdf
    - o Lack of age data - background
    - o Growth models
    - o Models of length distributions
    - o Case studies in analysis of length data
    - o Length-weight relationships
    - o Modelling the development of a length distribution
    - o Using length data in population models
- Assessment methods based on back-calculations: https://tutor-web.net/fish/fish5104vpa/@@download-pdf
    - o Simple back-calculation techniques
    - o Virtual Population Analysis (VPA)
    - o Cohort analysis
- Yield per recruit analysis: https://tutor-web.net/fish/fish5105yieldrec/@@download-pdf
    - o Introduction
    - o Yield per recruit analysis
    - o Spawning stock biomass per recruit
    - o Yield per recruit case studies
    - o Effect of assumptions on yield per recruit analysis

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- Spawning stock, recruitment and production: https://tutor-web.net/fish/fish5106stockrec/@@download-pdf
    - o Spawning stock and recruitment
    - o Estimation methods
    - o Production and replacement
    - o Yield potential
    - o Harvest control rules
    - o Stock-recruitment functions in relation to ecological theory
    - o More general analyses of interactions
- Prediction of stock and catch: https://tutor-web.net/fish/fish5107stockpred/@@download-pdf
    - o Introduction
    - o The issue of harvest control laws
    - o Short-term prediction
    - o Medium-term predictions
    - o Linking assessments and all projections
    - o Case study
- Statistical stock assessment methods: https://tutor-web.net/fish/fish5108statass/@@download-pdf
    - o Statistical techniques for stock assessments
    - o Production models
    - o Fitting criteria
    - o Formal statistical stock assessments in dynamic bulk production model
    - o Case studies of stock-production models
    - o Models with internal age structure
    - o Finicky details
    - o Some case studies
- Principles of utilization: The precautionary approach: https://tutor-web.net/fish/fish5109pa/@@download-pdf
    - o Principles of utilization
    - o Reference points
    - o Harvest control rules
    - o Case studies

## fish610 - Ecosystem Approach to Fisheries Management

This course can be found at https://tutor-web.net/fish/fish610 and contains the following tutorials & lectures:

- Introduction to the Ecosystem Approach to Fisheries Management: https://tutor-web.net/fish/fish610.1/@@download-pdf
    - o Introduction to Fisheries Management
    - o Introduction to EAFM
    - o Principles of EAFM
    - o Benefits of EAFM
    - o Further Reading
- Ecological Considerations of EAFM: https://tutor-web.net/fish/fish610.2/@@download-pdf
    - o Individual Considerations
    - o Habitat Considerations
    - o Community Considerations
    - o Climatic Considerations

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- Societal Considerations of EAFM: https://tutor-web.net/fish/fish610.3/@@download-pdf
  - o Fleet Considerations
  - o Regulatory Considerations
- Trade-offs: https://tutor-web.net/fish/fish610.8/@@download-pdf
  - o Ecological Trade-offs
  - o Economical Trade-offs
  - o Societal Trade-offs
  - o Further Reading
- Applying the EAFM: https://tutor-web.net/fish/fish610.9/@@download-pdf
  - o Developing an EAFM Management Plan
  - o Writing an EAFM Management Plan
  - o Implementing an EAFM Management Plan
  - o Applying Adaptive Management to an EAFM Management Plan
  - o Further Reading

## Features developed as part of MareFrame

Tutor-web has also been expanded as part of MareFrame to provide extra features to support the extra content. Some examples of new features include:

- HTML view of lecture content integrated into the drill interface
- Handout PDF output fully managed by tutor-web
- Slide output for presentation in lectures, both in HTML view and PDF downloads.
- Colour output of examples
- Generating graphic output for both handouts and slides from R code.
- Improvement of code listing outputs

## Research component

The tutor-web provides a research environment. Examples of research outputs include Stefansson and Jonsdottir (2015), who investigate how the on-line drilling system should be designed to improve knowledge, whether in the EAFM or elsewhere and Jonsdottir *el al*. (2015), who investigate the on-line students' behaviour with a goal of redesigning the system to lead to improved learning.
Lentin *et al.* (2014) provide an overview of the mobile version of the system.

## Conclusion

There is now a reasonable breadth of EAFM and related content freely available in Tutor-web. Further depth will be added to the content in the future as part of other projects, building on the legacy of MareFrame.

# References

Jonsdottir, A. H., Jakobsdottir, A., & Stefansson, G. (2015). Development and Use of an Adaptive Learning Environment to Research Online Study Behaviour. Educational Technology & Society, 18 (1), 132–144.

Lentin, Jamie; Jonsdottir, Anna H; Stern, David; Mokua, Victoria; Stefansson, Gunnar; ,A mobile web for enhancing statistics and mathematics education,arXiv preprint arXiv:1406.5004. 2014.

Stefansson, Gunnar; Jonsdottir, Anna Helga; ,Design and analysis of experiments linking on-line drilling methods to improvements in knowledge,Journal of Statistical Science and Applications. 2015.

## Appendix: Samples of extra content



*Example of slides generated in Tutor-web, this is the introduction to the EAFM course*

- Explain what good governance is and the role of stewardship within an EAFM framework

## 2.2 What is EAFM

- What is EAFM

- 3 components of EAFM



The three components of EAFM (figure adapted from Staples et al. [2014]).

### 2.2.1 Details

EAFM is the application of ecosystem management to a fishery by integrating the socio-ecological system. Thus, within an EAFM framework managers work to balance human well-being (food, income, livelihood, etc.) and ecological well-being (biodiversity conservation, ecosystem structure and function, etc.). To obtain this EAFM maintains three primary components: ecological well-being, human well-being, and good governance. These primary components are the building blocks of all EAFM management plans. More specifically, these three components are looked at as the foundation of EAFM and therefore must be balanced in order to achieve true ecosystem management. As a result, EAFM uses good governance, or rules and regulations, as a way of balancing ecological well-being and human well-being. More detail on the 3 primary components will be addressed in the following slides.

**Further Reading**

Much of the information in this lecture is adapted from Staples et al. [2014]. However, Staples et al. [2014] goes into much more depth on the 3 components of EAFM then what will be covered in this course.

## 2.3 Ecological Features of EAFM

- Definition of ecological well-being

- 5 major ecological features of EAFM

*The same section as above, but in handout form. Note the additional material which otherwise would be lecture notes.*

crucial, however, since it is possible to set yearly catch levels which will seem reasonable in the short-term but are catastrophic in the long run.

## 1.5 Typical stock areas, c.f. redfish



Typical redfish areas stretch across several economic zones.
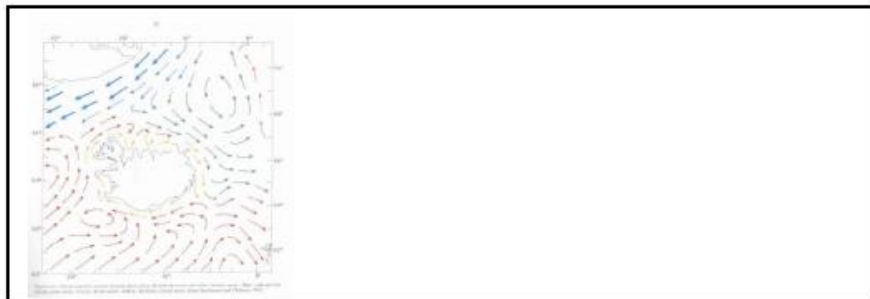
### 1.5.1 Details

The primary focus of most scientific research is first to obtain an overall picture and later to fill in detail. Thus, one should always begin by trying to understand how a species behaves, then how a stock is likely to respond to things like fishing pressure, and finally, at a much later stage, worry about stock components.

Ignoring stock components can certainly lead to problems, but it is much more serious to go into such detail initially as it can render advice on the utilization of fish stocks useless.

### 1.5.2 Examples

**Example 1.1.** When determining fisheries advice for redfish (*Sebastes marinus* and *S. mentalla* and others) in the central north Atlantic, one initially considers large areas, such as the one in the figure, East-Greenland-Iceland-Faroe Islands.

## 1.6 The physical environment



### 1.6.1 Details

It is of considerable importance to have some knowledge of the driving forces in the ecosystem. This includes the basic biology of the species including spawning grounds,

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*Example from the fish population dynamics course, showing available techniques*

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seen that three year old capelin can be from 13 to 16.5 cm long. The example shows that when a year-class dominates a fishery, then the length interval for that year class can reach as far into the upper length groups as an older age group does. The reason is that there are more three year old fish than other year classes. For this reason it is usually desirable to obtain measurements of age as it would otherwise be difficult to see that there is more than one year class in this sample. The last line in the table contains $K_{l.}$ and the rightmost column contains $K_{.a}$.

This table can be obtained in R by using the following commands:

http://tutor-web.net/fish/fish5101fishsci/lecture40/capelin-age-length-from-otolith.r

## 4.4  Age composition from age and length data

- May have age samples stratified by length

- Need to use length distribution with an age-length key (ALK)

### 4.4.1  Details

The information from the age samples and length measurements can be used together to compute the mean length and proportions in each age group.

**Definition 4.5. Age-length key equation:**
In the age samples, length group $l$ comes from the various age groups in such a way that the proportion

$$\frac{K_{la}}{K_{l.}}$$

of length group $l$ is in age group $a$.

*Note 4.1.* Tables comprised of the proportion of known age fish in a particular age-length group is referred to as an age-length key (ALK).

It is natural to expect the length distribution to be split into the age groups in the same way. Thus the otolith/scale sample is used to separate the length distribution into age groups and obtain an improved estimate of the number of fish of age $a$ and length $l$.

**Definition 4.6. Age-length distribution equation:**
Estimate of the number of fish of age $a$ and length $l$ from length distributions separated by age groups:

$$K'_{la} = \frac{K_{la}}{K_{l.}} L_l$$

*Note 4.2.* The revised numbers, called the age-length distribution (ALD), are then used to compute the proportion in each age group as well as the mean length at age, as was done earlier.

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*Example from the fish population dynamics course, showing definitions and formula*