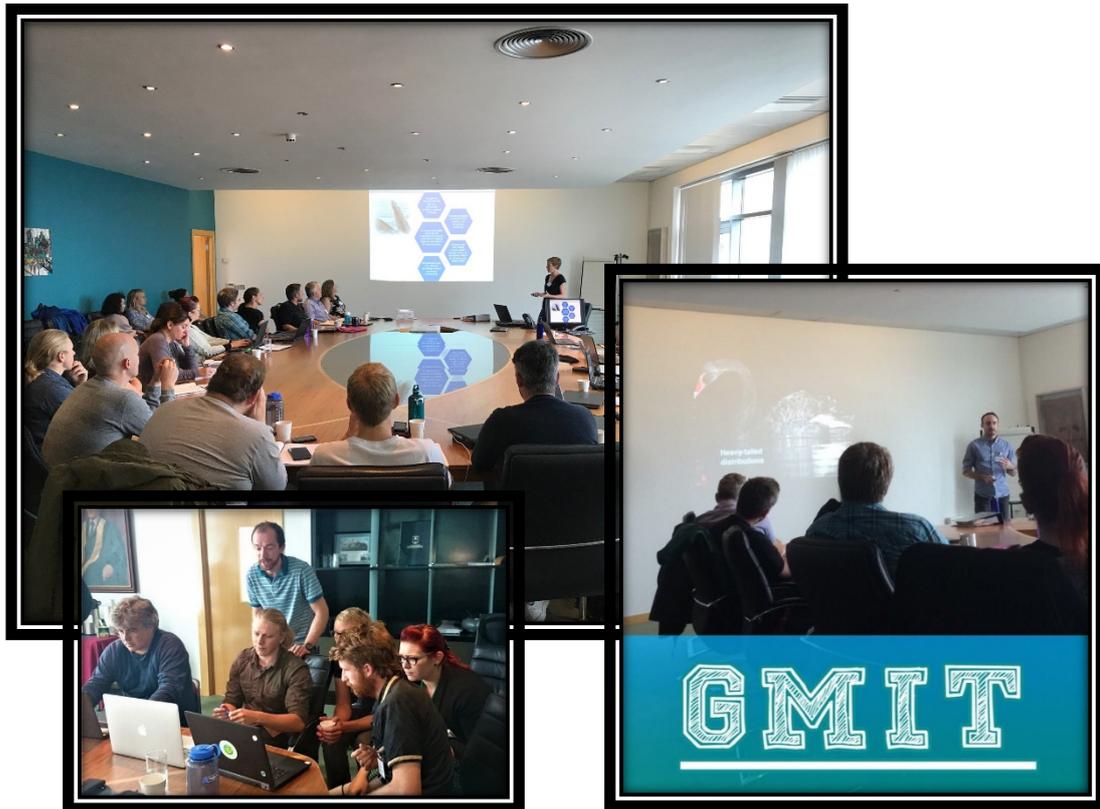# WORKSHOP REPORT
Time Series Analysis

Marine and Freshwater Research Centre,
Galway-Mayo Institute of Technology,

4-5th September 2017

Ecosystem Tipping Points: Learning from the Past to manage for the Future
(EPA Strive, 2015-NC-MS-3)

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Funding

Background

International collaboration and online data sharing has made long time series of biological and environmental data increasingly accessible. This new infrastructure has the potential to support research into marine ecosystem change. It will allow us to better understand and potentially predict the impacts of external pressures, which will allow the development of new and more appropriate management responses.

Unravelling this historic data and projecting future trends will require appropriate statistical methodologies and ecological modelling tools. Scientists are currently looking to effectively extract clear signals from what is complex and often noisy multivariate data and to describe relationships that may be non-linear and interactive.

This workshop was organised as part of the EPA funded project; Ecosystem Tipping Points: Learning from the Past to manage for the Future (EPA Strive, 2015-NC-MS-3). The scientists in the project are exploring long-term biological and environmental datasets from the Celtic Sea. The workshop was set up to share the project results to date and discuss new potential statistical and ecological modelling options with a targeted audience of scientists working in the marine and related areas who are also using long-term datasets to build understanding of ecosystem functioning.

Objectives of the workshop

- To bring together marine researchers who work with ecological and environmental time series to discuss current approaches and exchange ideas

- To present to potential users, analytical tools currently under development as part of the Ecosystem tipping points project (EPA Strive, 2015-NC-MS-3) for the detection of step changes in ecological time series

- To provide a forum for invited international researchers to deliver seminars on the detection of extreme events and ecosystem tipping points

- To host a preliminary meeting of the International Working Group in Integrated Time Series Analysis and Modelling (WGITSAM).

Methodology

Due to the nature of the topic and the specific aim and objectives, attendance at the workshop was by invitation. The target audience included scientists from across Academia, Non-Governmental Organisations (NGO's) and Governmental bodies and Statutory agencies. An acceptance rate of c.40-50% was expected; forty individuals from across Ireland were invited with the ambitious aim to host 30 participants. Prior to the workshop, participants were sent some journal articles of relevance to the workshop topics. The workshop provided a forum to discuss current statistical approaches to the analysis of long-term environmental datasets and exchange ideas. Emphasis was placed on detecting step changes and potential regime shifts.

The workshop was delivered through a combination of invited presentations, discussions and a hands-on data analysis session to explore datasets. Active involvement of the participants is critical to the success of any workshop. To allow and encourage the participants to share opinions and ideas, the workshop was divided into three groups. Each group comprised a mix of participants from the various target groups and possessed a diverse range of knowledge and experience. Three facilitators with knowledge of the statistical modelling and directly involved in the project worked with the groups on the analysis of the data during the breakout working sessions. The group participants were also moved around between breakout sessions to stimulate group interaction, which helped to integrate different opinions towards varied outcomes. The groups were brought together to hear the results from the other groups and to offer an opinion on the methodologies they applied after each breakout session. To relate all the discussions, the plenary session was on the different topics was facilitated by each of the individual experts on the various topics.

Results from the Workshop

Fifty people were invited to the workshop and 60% of these attended. Although the workshop was not advertised a number of people contacted the organisers to try to secure places. The demand for places was unexpected and demonstrated the need for such workshops in Ireland. The invited attendees were scientists from higher education institutes (DkIT, UCC, GMIT), state agencies (Marine Institute), independent public bodies (EPA) and non-governmental organisations (Birdwatch Ireland, IWDG).

The primary objective of bringing together marine researchers who work with ecological and environmental time series to discuss current approaches and exchange ideas was achieved.

The funding provided by the Networking Grant facilitated the participation of three key international speakers (Dr Sean Anderson [Canada], Dr Jennifer Coston-Guarini [France], Dr Jean-Marc Guarini [France]). Their participation served to capture international expertise to the benefit of Irish marine researchers and to foster international collaboration.

The oral presentations provided participants with an overview of current approaches to the analysis of environmental time series and the detection of extreme events allowing the participants to increase their knowledge of statistical approaches and their application to marine ecosystem research. The workshop provided a platform for disseminating the Ecosystem tipping points project (EPA Strive, 2015-NC-MS-3); in-house speakers presented the analytical tools currently under development as part of this project for the detection of step changes in ecological time series.

During the hands-on data analysis session participants worked in groups and used the approaches introduced in the presentations to analyse a provided dataset. This gave them the opportunity to develop their quantitative skills. Each group presented the outcome of their analyses. Following this the relative merits of the various approaches and their applicability to different research questions were discussed.

The group activities and discussions facilitated cross-sectoral interaction and exchange of ideas. The participants developed their quantitative skills and increased their knowledge of statistical approaches and their application to marine and freshwater ecosystem research and looking at the potential for exploring datasets currently held to detect step changes and potential regime shifts. This enabled them to contextualise their research interests and to align advances in quantitative methods and marine ecosystem research with current management priorities.

The workshop served to build national capacity in the statistical analysis of biological and environmental time series and to foster national and international collaboration in this area, thereby strengthening national capacity to leverage additional EU funding and to respond to legislative drivers (e.g. Common Fisheries Policy, Water Framework Directive, Marine Strategy Framework Directive, Habitats and Birds Directives, OSPAR).

The workshop was a success and the stated objectives were achieved. Demand for places indicated that the workshop fulfilled a need nationally and that future initiatives in this area are warranted. The broad benefits of the workshop included:

- Transfer of knowledge with international partners and between national sectors (academia, NGO's, state/semi-state)
- Development of research networks
- Development of human capacity in biostatistics
- Fostering of multidisciplinary collaboration

Follow up Action plan / Recommendations

Since the workshop researchers from the Marine and Freshwater Research Centre in GMIT have been invited by Jean-Marc Guarini to collaborate on a Horizon 2020 Marie Skłodowska-Curie research proposal.

The participants were encouraged to host other such workshops and to include them in funding applications to continue to build on the capacity within this area in Ireland and to promote further international collaboration.

Following on from the workshop saw the launch of the 1st Irish Environmetrics Forum, held in the Marine Institute in April 2018, co-organised by Dr Cóilín Minto a lead researcher from the EPA funded project: Ecosystem Tipping Points: Learning from the Past to manage for the Future. This forum involved a number of the Time Series Analysis workshop participants. This new forum brought together the expertise of more people interested in applying statistical modelling to questions regarding natural resource management and conservation and continued to build capacity in this area.

Annexes

Annex 1 Workshop Programme

Day 1 (Monday 4th):

Registration

10:00 to 10:30   **Tea and coffee available**

Start time   **10:30**

10:30 to 10:40	Welcome/housekeeping– Roisin Nash
10:40 to 11:15	Ecosystem tipping points project overview – Deirdre Brophy
11:15 to 11:45	Ecological time series for the Celtic Sea – Olga Lyashevska
11:45 to 12:15	Methods for analyzing step changes in ecological time series - Cóilín Minto
12:15 to 12:30	Round Table Q&A

12:30 to 2:00   **LUNCH**

2:00 to 2:45	Invited speaker: Sean Anderson
2:45 to 3:30	Invited speaker: Jennifer Coston Guarini
3:30 to 4:00	**Tea and coffee available**
4:00 to 4:45	Invited speaker: Jean Marc Guarini
4:45 to 5:30	Round Table Q&A

7:30   You are welcome to meet up with us for Food and Drinks
at the **Oslo Bistro Bar** in Salthill

Day 2 (Tuesday 5th):

Start time   **9:30**

9:30 to 10:00	Introduction to state space models – Coilin Minto
10:00 to 11:00	Hands on session: fitting a linear state space model using the dlm package
11:00 to 11:30	**Tea and coffee available**
11:30 to 1:00	Live coding session: introduction to Template Model Builder

1:00 to 2:00   **LUNCH**

2:00 to 3:30	Black swan model fitting – Sean Anderson
3:30 to 4:00	Live coding session: Markov switching models
3:00 to 4:00	Breakout groups (STARS, dlm, TMB, black swan)
4:00 to 4:30	Results from breakout groups
	Tea and coffee available
4:30 to 5:00	Round Table Discussion/Future
5:00 to 5:15	Closing Remarks