# Coilin Minto

## Including unclassified individuals in sex-specific life-history models

Estimating sex-specific life-history models typically proceeds by fitting to individuals recorded as male or female. Yet, for many animal species sex may not be apparent until the onset of maturation. As a result, sex-specific life-history models are often only fit to known-sex individuals that occupy a limited region of the fitting space. This results in biased parameter estimates. We propose an alternative approach whereby the sex of the unclassified individuals is treated as a classification problem to be estimated simultaneously with the sex-specific life-history models.

Dimorphism, EM algorithm, missing data, partial classification

# Yvonne Leahy

# Elvira de eyto

## Coupling seasonal weather forecasts with long term ecological data to inform water management

Water resources are closely dependent on the services supplied by ecosystems that maintain both water quantity and quality. Climate Extreme Events (CEE), like heat waves, droughts and floods, stress ecosystems and compromise their capacity to provide key services related to water. This implies huge economic and social impacts, which are expected to be even more relevant in the future. There has been limited development of solution-oriented tools integrating climate services (CS) and ecosystem impacts modelling for efficient adaptation to CEE. Here, we present the intila work of the WATExR project, which aims to integrate state-of-the-art seasonal climate predictions and water quality simulations, enabling efficient decision making and adaptation of water resources management to an increasing frequency of CEE. The work will be carried out in seven representative catchments across Europe. In each case study, WATExR will build an original, standardized modelling workflow system programmed as a QGIS plug-in. The Irish case study is based in the Burrishoole catchment, Co. Mayo, where the Marine Institute manage one of the key index sites in the north Atlantic for diadromous fish stocks. As a stakeholder in this project, the MI seeks to couple fish production and phenological models with seasonal forecasts to aid management and conservation goals.

Cimolate forecasts, extreme events, diadromous fish

# Claire Moore

# Martin McGarrigle

# Hannah White

## Biodiversity and resilience at the macro-scale

Investigating the resilience of ecosystem functions is vital for informing management so that we can adapt to minimise the impact of ongoing environmental change on ecosystem functioning. It has been established that biodiversity promotes resilience at local scales. Studying this relationship at larger scales could enable the investigation of landscape biodiversity effects on resilience, however, this has proved problematic due to the challenges of measuring both biodiversity and resilience at large spatial scales. Using remotely-sensed data allows us to obtain time-series data of a vegetation index (EVI) at these large scales and can be used to quantify multiple components of resilience. We present methods to calculate the resistance, variability and recovery (three components of resilience) of a particular ecosystem function, productivity, across the island of Ireland. We use a temporal moving window algorithm on EVI anomalies to account for seasonal cycles and noise within the community-level measure of productivity which can be used to identify periods of environmental perturbations. The relationship of resilience with biodiversity was investigated using biological recordings data of vascular plants to estimate species richness using statistical methods to account for variation in recorder effort. Although investigating resilience and biodiversity at large scales presents unique challenges with regards to the spatial and temporal accuracy of the data, using statistical methods to account for these show that the biodiversity-resilience relationships previously observed at small, experimental scales are maintained at large spatial scales.

resilience, macroecology, productivity,

# Roisin Nash

# Jenevieve Hara

# Mohammad Khalil

## Integrating GIS and modelling approaches for precise assessment of organic carbon stocks and changes in Irish agricultural soils

The Paris Agreement emphasises enhanced mitigation measures, reducing GHG assessment uncertainties, better quantified sinks, and the tailored use of different offsetting mechanisms. The SOC pool has the potential to act as a major source or sink of GHGs. Due to the lack of spatially explicit activity data, Ireland is mainly using the IPCC Tier-1 methodology for inventory reporting. To attain Tier-2, data generated previously through overlaying land use (LU) and soil maps using ArcGIS were reprocessed to develop depth-distribution models and pedotransfer functions (R2=0.53-1.00) for estimation of SOC concentrations and bulk densities. Then, databases/maps for two soils and a historical agricultural LU (2000-2014) were overlaid to categorize key LUs on mineral, organo-mineral and organic soils. Empirical approaches and IPCC default density change factors (DCFs, %) were applied to calculate SOC density/stock (SOC<U+03C1>/s) and their changes. The range of SOC<U+03C1> was in the order, rough grazing (R)>grassland (G)>rotation/ley (GT)>tillage (T), and was highest in the organic soils. For the 0-30cm soil layer, the SOC<U+03C1> (t-C-ha-1) measured in 2006 was 242 (R), 207 (G), 162 (GT) and 80 (T). The reference year (1990) value (SOC<U+03C1>ref), predicted using two-phase models, was 238 (R), 198 (G), 166 (GT) and 99 (T), t-C-ha-1. Based on the SOC<U+03C1>ref values, G and R were sinks, whilst T and GT were sources. The DCFs overestimated the SOC<U+03C1> change by 42-156% and the corrected one for the four LUs combined, over 25 years, was 0.23, 0.42 and 0.53 t-C-ha-1 yr-1 for the 0-10, 0-30 and 0-100cm layers. The corresponding national agricultural SOCs measured in 2006 were 316, 838 and 1679 Tg. An estimated potential of offsetting GHGs through SOC sequestration was 24, 59 and 106% of the total emitted from Irish agriculture. The findings imply that the integrated approaches can provide robust estimates of SOC<U+03C1>/s and their changes overtime.

GIS, Empirical modelling, SOC density/stocks, agricultural land uses, Ireland

## Integrating GIS and modelling approaches for precise assessment of organic carbon stocks and changes in Irish agricultural soils

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GIS, Empirical modelling, SOC density/stocks, agricultural land uses, Ireland

# Willson Gaul

## Species Distribution Modeling Using Biological Records Data: The effect of uneven sampling in Irish National Biodiversity Data Centre datasets

Opportunistic biological records datasets, such as those held by the National Biodiversity Data Centre (NBDC), can be successfully used in species distribution modeling. However, spatially uneven sampling is expected to introduce bias into models, especially when the intensity in sampling effort is correlated with important environmental gradients. We first describe the geographic and environmental sampling biases present in NBDC records. We then use simulations to test the effect on model performance of varying amounts of spatial sampling bias using several species distribution modeling methods. The different intensities of spatial bias used for simulation scenarios are empirically derived from the NBDC datasets, giving simulation results that can directly inform the use of NBDC datasets for species distribution modeling.

biological records, spatial bias, species distribution model, citizen science, virtual ecology

# Sean Kelly

# Louise Vaughan

## "Unlocking the Archive" - Using advanced statistical techniques to investigate drivers of Atlantic Salmon and European Eel growth.

Investigations of both intrinsic and extrinsic drivers of fish growth require detailed long-term datasets. The Newport Research Facility (NRF) holds an extensive collection of Atlantic Salmon scales and European Eel otoliths collected as part of national and international monitoring programmes. The NRF has been monitoring the Burrishoole Catchment for over 55 years and detailed meteorological data is available over this time period. The “Unlocking the Archive” project aims to develop advanced statistical techniques to analyse these datasets efficiently and in doing so build capacity for future research endeavour. More specifically it aims:   
  
- To use scale growth trajectories from Atlantic Salmon to investigate declines in marine growth and survival and potential climate impacts.  
- Relate patterns in annual growth increments of European eel to temperature, productivity and meteorological conditions within the Burrishoole catchment.   
  
Available datasets will be reviewed and built upon. Time series data of fish growth and environmental conditions will be combined and analysed to make inferences on how individuals and populations respond to environmental change. Results from the “Unlocking the Archive” project will be used to develop recommendations for future management plans of Atlantic Salmon and European Eel.

Atlantic Salmon, European Eel, Climate Change, Fish Growth,

# Joseph McGovern

## Macroalgae modelling for nutrient load allocation in the Tolka estuary

The occurrence of macroalgae blooms in the intertidal zone of estuaries subjected to nutrient enrichment from point and diffuse pressures is a persistent issue nationally and internationally. In response to the issue, modelling and management tools are necessary to determine the conditions which may lead to restoration of good status.   
A pre-existing high resolution finite difference hydrodynamic, solute transport and water quality model has been adapted to include macroalgae growth and decay, alongside the existing trophic status parameters of pelagic chlorophyll\_a as a proxy for phytoplankton, inorganic N and P and dissolved oxygen. Macroalgae growth has been modelled as a function of temperature, tissue N and P, salinity, bed stress and proximity to an upper bed capacity limit, whilst macroalgae decay comprises a baseline rate and a DO stress component. The resultant model was applied to the system comprising the Tolka estuary and the adjoining Liffey estuary and Dublin Bay.   
Here, we compare the results of high resolution water quality model with results generated by applying the DCPM tool (Aldridge et al., 2010), developed for the UK Environment Agency, to the same system.

Macroalgae, eutrophication, growth model, nutrient load allocation

# Andrew French

# Andrew Jackson

## Tracking Ecological Perturbations Through Stable Isotope Analysis

Ecosystem-based approaches that consider more than just the target species are becoming the norm in the management of harvested ecosystems such as fisheries or forestry. Indeed, the approach is growing in popularity for managing and restoring impacted ecosystems in general. A major challenge we face is collecting sufficient data on the non-target (or less charismatic) species in order to elaborately describe the dynamics of the wider community and to judge our management strategies. Monitoring directly the abundances of all the species in the community in response to perturbations such as harvesting (but more generally to any perturbation) is the ideal, but likely impossible, approach. Stable isotopes move through ecological communities and are predictably altered by key trophic ecological processes of consumption and assimilation. Using a mathematical framework of Lotka-Volterra community dynamics coupled with models of stable isotope dynamics, we show that the effects of perturbations are theoretically detectable in the stable isotope data alone. This opens up the possibility that, with further understanding and validation, resource-efficient stable isotope analysis could be deployed to act as a near-real-time method for monitoring impacted systems at community or ecosystem scales.

population dynamics, food webs, stable isotopes

## I can offer the same talk as listed above if thats suitable... on movement of isotopes through foodwebs

# Cian White

# Ryan Mckenna

# Mikel Aristegui-Ezquibela

## Modelling the effects of mesh size on gillnet selectivity in the hake fishery to the South and West of Ireland

Recent changes to the European Common Fisheries Policy, including the Landing Obligation (LO), require a reduction in discarding. Selectivity of fishing gear has a large influence on the retention of fish of varying sizes with the potential to partly mitigate for the impacts of the LO. Here, the effects of different mesh sizes (80, 100, 120, 140mm) on the retention of hake were investigated from a gillnet selectivity trial conducted by Bord Iascaigh Mhara in the south and west of Ireland. Selectivity models for the data were compared, including: traditional logistic regression models, additive variants, alternative distributional assumptions and an exploration of the application of a recently developed multinomial catch comparison method. Considerable differences in estimated selectivity were found under fixed or varying spread normal selectivity function assumptions. Similar selectivity curves were estimated from lognormal and gamma functional forms. Results suggest that mesh sizes of 80 or 100mm caught large quantities of non-marketable fish less than 60cm length. The 120 or 140mm mesh size caught very few hake under 60cm. A multinomial catch comparison method may be more appropriate for these data than selectivity models as assumptions on geometric similarity were not fully met. We discuss the advantages and disadvantages of selectivity or catch comparison of these data and resulting inference.

selectivity, gillnet, modelling, multinomial, Landing Obligation

# Luke Batts

## An EM algorithm to estimate inter-annual variation in fish growth from length-frequency data

Fish growth is a fundamental component of many commonly used fisheries stock assessment techniques. Obtaining accurate estimates of growth parameters can be key to the reliability of these assessments. Analysis of length frequency distributions from surveys is one well known method for obtaining growth parameter estimates and is often used where other methodologies are not practical or feasible. Length frequency distributions were modelled using mixture models, where the means of the components (normal distributions within the mixture model) were constrained to follow a re-parameterised von Bertalanffy growth function. An Expectation- Maximisation (EM) algorithm with an adapted M step was used to find maximum likelihood parameter estimates iteratively. The methodology incorporates bivariate random effects into the model. This allows for inter-annual variation in the first and final components for each year, accommodating some of the natural variation that occurs in spawning and growth of fish. Cohorts of fish are then grown through the years, according to the cohort specific random effects on the means of the first and final components and an overall growth rate. Testing on two fish species, haddock (Melanogrammus aeglefinus) and white-bellied anglerfish (Lophius piscatorius), we were able to successfully model and identify cohorts, as well as obtaining reasonable estimates of growth parameters. As often found, estimation is sensitive to starting values. Unrealistic parameter values (that give reasonable component means) are occasionally estimated - methods used to treat these cases are discussed.

EM algorithm, length frequency analysis, inter-annual growth variability