Travel: Trip report

Part A: Trip details

Staff Name:	Joe Scutt Phillips
Division	FAME-OFP-FEMA
Purpose of trip	Travel to Copenhagen DTU Aqua for spatiotemporal tag modelling workshop
Travel Dates	2/5/2025 to 20/5/2025
Where visited	DTU Aqua, Copenhagen

Key people met	Anders Nielson, Tobias Mildenberger

List of trainees if training provided	

Link to evaluation report analysis if training or workshop with evaluations done	Not yet posted
Links to presentations or other key docs presented.	

Is follow up needed? (if so, then with whom)	Follow up with DTU Aqua team on possibilities for collaboration and potential resourcing, after discussion with OFP senior management
What was accomplished?	• Understanding of IATTC-used spatiotemporal tagging model • Knowledge exchange of methods, particularly SEAPOYM as used in the WCPO • Potential workplan for WCPO application of model developed • “First cut” of simple, preliminary model estimated using WCPO data
Reflective Observations/Lessons Learned/Conclusions	See below

Part B: Description

This is the first trip report I've written in a while. I can't remember the protocol, so I have decided to divide it into the following sections: Facts, Feelings, and The All-Important Vibe.

Facts

Following several discussions regarding the recent developments integrating conventional tagging data into IATTC tuna stock assessments, myself, Arni M and Inna S travelled to DTU Aqua in Copenhagen for a workshop with the team responsible for a new spatiotemporal tagging model: Anders Nielson and Tobias Mildenberger. The objective was to learn more about their method (which remains yet unpublished), make a critical comparison of their approach and outputs with our existing tools, and to draw up a potential work plan for implementing the method with WCPO tagging data. The workshop took place over one week, with all participants also taking some breaks to continue their 'day-job' work.

A full workshop report was drafted by the workshop participants, which Arni will hopefully share with relevant people soon, but here I will be briefly outline the workshop activities and my personal view on the matter.

Day 1
- Current use of tagging data in WCPO tuna stock assessments, their influence and uncertainties in abundance indices
- Overview of the Mildenberger-Nielsen spatiotemporal tagging model
- Overview of SEAPODYM, with a focus on its integration of tagging data

Day 2
- Overview of data issues, quality and use in WCPO/EPO
- Discussion on differences between advection-diffusion movement models
- Development of proposed models for a WCPO application of the Mildenberger-Nielsen model

Day 3
- Overview of momo R-package and use
- Data selection and preparation for proposed models
- Preliminary work on simplified model using WCPO data

Day 4
- Continued preliminary model development
- Presentation of IATTC models and results

Day 5
- Preliminary model results
- Wrap up and next steps

For context, there has been increasing discussion to re-examine the way in which tagging data are integrated into WCPO tuna assessments, particularly in the case of skipjack tuna where they are highly influential on the estimation of natural and fishing mortality, and are critical for model convergence.

Due to the lack of sensible CPUE indices in the purse seine fishery, the possibility of externally analysing tagging data to provide such an index or individual abundance estimates at points in time, has been raised at WCPFC forums. Additionally, given the problems of tag mixing assumptions in MULTIFAN-CL,

which routinely results in many tags being excluded from input data, a more appropriate approach to informing stock assessments would be beneficial.

Again, a more detailed summary of the model will appear in the workshop report, but here is a brief summary of my understanding (Inna will no doubt have a few corrections! 😉). The modelling framework is designed to estimate the movement and population abundance of a species using mark-recapture data, with optional integration of catch and/or recovery effort information. At its core, the model simulates individual animal displacements through a continuous-space, continuous-time advection-diffusion process, incorporating spatial and temporal heterogeneity via environmental covariates.

The primary data input consists of conventional and/or archival tag release-recapture pairs. Each tagged individual's movement is modelled using taxis (directed movement) and diffusion (random dispersal) parameters that may vary as functions of spatiotemporally resolved environmental fields (e.g., sea surface temperature, current velocities etc.). These parameters are estimated using a Kalman filter within the Template Model Builder (TMB) framework, allowing efficient inference from large datasets and accounting for observation error and process uncertainty.

In its most basic form, the model uses only observed release-recapture data to estimate movement dynamics. When reliable and spatiotemporally standardised fishing effort data are available, the model can be extended to include tags that were never reported, enabling the estimation of spatially and temporally varying fishing mortality rates.

When usable effort data from fisheries recapturing tags, such as was the case for the IATTC application, the model is probably restricted to release-recapture information. Here, the fitted advection-diffusion model is used to forecast the spatial distribution of tags over time on a fixed grid (e.g., 5° x 5° resolution). These predicted tag distributions are then combined with observed catch data at the same resolution in a Lincoln-Petersen-style estimator to derive absolute abundance estimates.

Of course, this simplified approach assumes perfect mixing of tagged and untagged individuals within each spatial cell. Due to high uncertainty, abundance estimates are considered reliable primarily in years following large-scale tagging events. In the IATTC's application to the Eastern Pacific Ocean (EPO), this method has yielded approximately five regionally aggregated abundance estimates over a 20-year period, using SST and eddy kinetic energy as the environmental forcing data.

During the workshop, we discussed what potential model development for a WCPO application might look like, with a list of incrementally more complex models that would allow comparison with parameter estimates with SEAPODYM (by using a comparable suit of environmental data), all the way to a full examination of different environmental and fisheries data for the potential to create an index of fishing mortality. Tobias successfully estimated an initial test model using a subset of PTTP data and two environmental fields from SEAPODYM, but this remained chiefly a training exercise for the moment, given the amount of data used.

Feelings

It was excellent to finally understand the approach used by the IATTC for these analyses. However, it is also clear that the movement model R-package is very much a gamma-version of the model, and even our first foray into estimating a toy model using WCPO data threw up several technical areas that will need development. Any potential WCPO application will require a formal project and resourcing with DTU Aqua.

Having finally got a good understanding of the method, and exactly what was developed for IATTC, I do however feel that the potential outputs of such approach has been somewhat oversold by some members of the WCPFC. In order to use all tag releases in the estimation, and thus get fishing mortality estimates, sensible and understandable effort data are needed. There is something of a circular argument in claiming that, due to a lack of good effort data and thus CPUE indices, then we should externally analysis tagging data to estimate a fishing mortality index…but this requires good effort data. One can't help but feel that the fundamental problem of poor effort data would simply be moved outside of the main population dynamics model, an analysis which a critic might say is subject to less scrutiny…

I believe that abundance estimates using the Peterson-style estimator approach should definitely be explored. However, we already have an advection-diffusion movement model that integrates release-recovery paired data from conventional tags, and has been developed using WCPO data and detailed and physically consistent Pacific ocean model data since 20-odd years: seapodym. While I think there is value in independent estimates of movement and abundance (indeed, this a mandate of the PTTP ToRs), this should be explored using both SEAPODYM and the DTU aqua movement model, and the more immediate win would be to use the existing movement model of SEAPODYM.

The Vibe

Tobias and Anders were very generous with their time, and our workshop led to lots of stimulating discussion on the difference between their movement model and seapodym. We spent a lot of time during the week discussing some of the fundamental differences between these two advection-diffusion models, which perhaps ate up a lot of time and got a little bit tense at times, but I think this was a useful exercise when considering the cost/benefits of a potential application and how that would compare to the analytical tools that we already possess. We should definitely continue our collaboration and try to follow the proposed model development plan we put together during the workshop, if resourcing can be found.

For accommodation, Anders recommended we stay at Granny's House, a bakery near his house in suburbs allowing us to get a ride to the university most days. It was very reasonably priced, but quite strange and quite like staying the night at…well…your Granny's house… We had one evening in Copenhagen city centre which was excellent- I can recommend WARPIGS for anyone that finds themselves there in the future.

9 hour delays in Singapore, and 12 then 7 hour stopovers in London and Copenhagen respectively, definitely make this Europe journey a bit gutty… But, happy to be serving the members, in economy class of course.

Pacha's presence was, as ever, excellent value! His beautiful trolling of the workshop barbeque with comments such as "you guys are always talking about likelihoods and probabilities and bullshit… can't you just count all the fish in one kilometre square and multiple up to the size of the ocean or something?" definitely deserves further consideration in the OFP workplan.

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“So, will these arrows be on the github repository?”

The evening working vibe at “Granny’s house”

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Part C: Attestation/other stuff

Aside from delayed flights, all travel was carried out as planned. For two days travelling over the weekend, I will reclaim travel comp leave…whatever that amounts to.

Figure 1. Boarding passes