Travel: Trip report

Staff name	Arni Magnusson
Division	FAME
Purpose of trip	SPC-DTU (Technical University of Denmark) meeting to initiate collaboration on developing a spatio-temporal model to analyze tuna tagging data
Travel dates	10-23 May 2025
Where visited	Meeting in Copenhagen (Denmark), followed by a trip to Stuttgart and Karlsruhe (Germany, two vacation days)

Key people met	Meeting attendees: Anders Nielsen and Tobias Mildenberger (DTU model developers), Joe Scutt Phillips and Inna Senina (SPC team), Mark Maunder and Rujia Bi (IATTC remote attendees), and Colin Millar (ICES expert). Further networking: Kasper Kristensen, Casper Berg, Vanessa Trijoulet, Molly Brooks (additional DTU model developers)

List of trainees if training provided	

Link to evaluation report analysis if training or workshop with evaluations done	
Links to presentations or other key docs presented	https://github.com/PacificCommunity/ofp-sam-transition-plan/tree/main/workshops/2025-05-copenhagen

Is follow up needed? (if so, then with whom)	Arni and Joe will meet with Paul and Graham to discuss the best strategy to secure funding for the DTU team to work on the spatio-temporal model development and analysis. Prioritization of WCPFC funding will be discussed before or at SC21 in Tonga in August 2025.
What was accomplished?	With SPC and DTU presentations and discussions, we laid the foundation of a collaborative project to analyze the SPC tagging data using the DTU spatio-temporal model. During the workshop, Tobias developed an early prototype demo model, using a small subset of the SPC tagging data. This confirmed that the data are in the right format, ready for the upcoming analysis.

Reflective observations **Lessons learned** **Conclusions**	Establishing collaborative ties with the team of statisticians at DTU in Denmark will be beneficial for the future SPC tuna stock assessments. The DTU lab has become a leading force in next-generation stock assessment methods, the inventors of the programming environments TMB and RTMB, the state-space stock assessment platforms SAM and SPiCT, and a variety of spatio-temporal models. Another important partnership for future SPC stock assessments is the multi-level collaboration with IATTC. SPC and IATTC already conduct shared assessments, exchange reviewers, and regularly discuss new methods relevant for tuna assessments. This workshop was a direct follow-up from a discussion with Mark Maunder at IATTC in December 2024, who recommended that SPC consider using a spatio-temporal model that is currently being developed at DTU to analyze tagging data, outside the stock assessment model. The DTU team had worked with IATTC to analyze the EPO skipjack tags. The DTU movement model was used to produce abundance indices that are easy to incorporate into any stock assessment software. In the EPO skipjack case, the stock assessment is a Stock Synthesis model, and the abundance indices from the tagging data were incorporated for the first time in the official 2024 assessment. The interest among SPC scientists in the DTU movement model goes back further than the December 2024 conversation with Mark. The interest of Joe Scutt Phillips and Inna Senina was based on their professional expertise and focus on tagging data analysis and movement models. The DTU movement model only became directly relevant for Project 123 (next tuna stock assessment software) after Mark suggested that the approach used for EPO skipjack (external analysis of tags to produce abundance indices) could also be adopted for SPC assessments, to prepare for the post-MFCL era. One observation during and after the workshop is the overall similarity or commonalities between SEAPODYM and the DTU movement model. Some of the relevant differences include the design objectives and research focus of these models, the team composition behind the two models, and the availability of the team to conduct a study that aims to produce abundance indices and other stock assessment uses.

	Another important point discussed during and after the workshop is the possibility of extending the DTU movement model to become a full stock assessment model. Currently, the model's use for a stock assessment is to generate abundance indices and estimate movement rates. Within the model, it already keeps track of quantities that would be relevant in a stock assessment, such as natural mortality and fishing mortality, e.g., by 1x1 degree squares. The extensions required for the DTU movement model would include fitting to length composition data, CPUE biomass indices (or other formats of CPUE data), estimating recruitment, and so on. These extensions are a longer-term possibility that is worth keeping in mind for Project 123 (next tuna stock assessment software). The development would be lead by the DTU team, which has a high level of expertise and involvement in a wide variety of stock assessments. Now that the collaboration between SPC and DTU has been established, it's worth noting that the other tuna RFMOs also collaborate with the DTU team on related research projects. We might consider whether it would be beneficial to coordinate and synchronize these research and development efforts under a larger inter-RFMO project, or whether research and development makes the best progress in the current form of 'loosely coupled' collaboration projects.

Part B. Description/other information *(content and detail determined by programmes)*

Workshop participants

Anders Nielsen, Arni Magnusson, Colin Millar, Inna Senina, Joe Scutt Phillips, Tobias Mildenberger, Mark Maunder (remote), and Rujia Bi (remote).

Workshop activities by day

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

The DTU model is implemented as an R package called 'momo' (Movement Model). The model estimates a number of parameters describing the effect of environmental variables on movement, in the form of preference functions using splines.

The prototype model developed during the workshop does not produce biomass indices, which is a subsequent step in the analysis. For that step, an important question is whether reliable and useful effort estimates are available for the WCPO skipjack tuna purse seine fisheries. In the IATTC analysis of EPO skipjack tuna tags, effort estimates were not considered reliable enough to be incorporated, so effort was effectively assumed to be uniform and constant in time and space.

Exchanging emails with John Hampton during the workshop week and discussing the options with Mark Maunder, the SPC team concluded that estimates of WCPO skipjack tuna purse seine effort can be extracted from the spatio-temporal CPUE analysis of the free-school purse seine fisheries. These effort estimates will be helpful for the DTU model to produce biomass indices.

After the completion of this initial workshop, the spatio-temporal analysis of WCPO skipjack tags will be on hold until funding has been secured for the DTU team to work on the spatio-temporal model development and analysis. The timeline of the project will be aligned with the 2028 SKJ assessment, so the final model results should be delivered by the end of 2027. Intermediate milestones will be planned after funding has been secured, possibly organizing a second workshop to discuss and decide on model options.

More detailed notes from the workshop, along with a prototype analysis demonstrating the use of the model can be found at

https://github.com/PacificCommunity/ofp-sam-transition-plan/tree/main/workshops/2025-05-copenhagen

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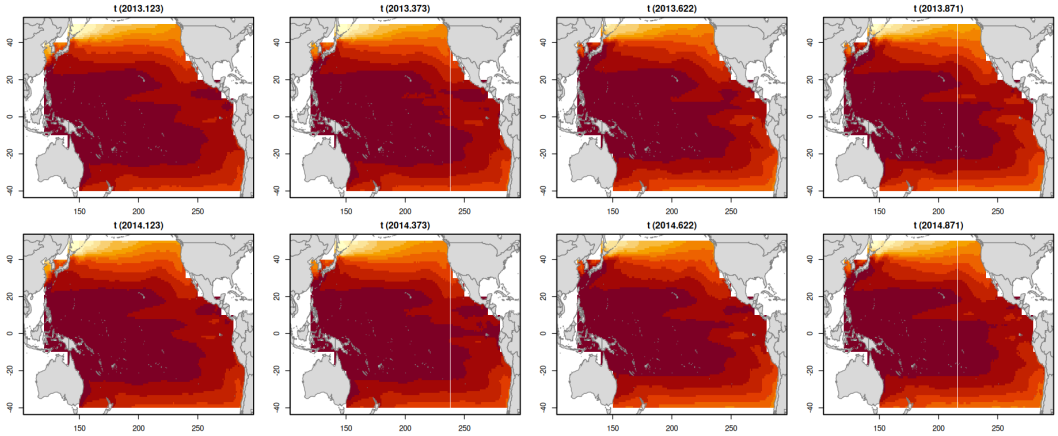
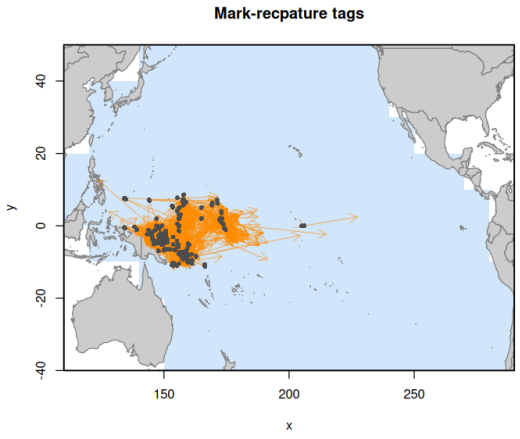
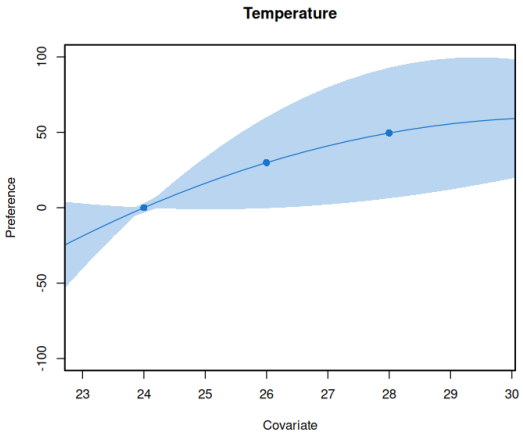
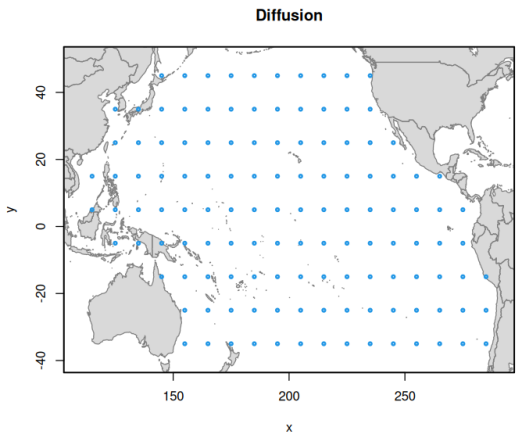
Further insights from the workshop can be found in Joe's and Inna's trip reports.

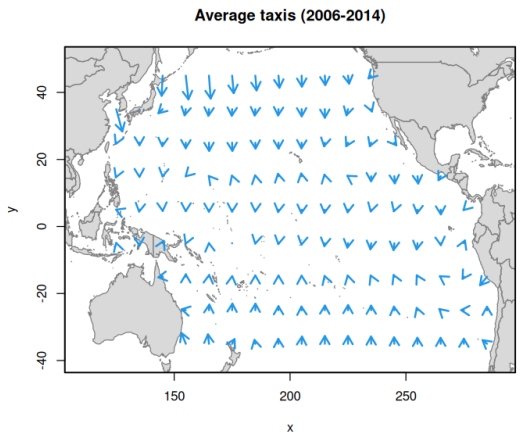
Early figures from prototype analysis conducted at the workshop:











Part C. Attestation (other stuff)

For travel over the weekend (Sat 10 May) I am claiming 0.5 day travel compensation leave.

For non-working weekends in Copenhagen (Sun 11 Aug) I am claiming 0.25 days.

Tickets and boarding passes

Aircalin

CARTE D'EMBARQUEMENT / BOARDING PASS

Magnusson / Arni Mr

Information sur votre vol / Flight Information

VOL / FLIGHT	SIÈGE / SEAT	EMBARQ. / BOARDING	PORTE / GATE
500	23F	00:50	A2

DE /FROM Noumea La Tontouta — 10 May 2025 01:30

VERS / TO Paris Charles De Gaulle — 10 May 2025 17:35

Boarding pass

SKY PRIORITY

SEC. AF1350:034

MAGNUSSON Arni

Flight AF1350
Departure 21:00 / 10 MAY

Paris CDG → Copenhagen CPH

Operated by AIR FRANCE

Boarding	20:25	Gate -
Gate closed	20:40	Zone 2
Seat	28D	Economy
Arrival	22:55	Terminal 3

After this time, you will no longer be allowed to board.

RESERVATION: 5TX36S
E-TICKET: 057 3021371835

AIRFRANCE

SAS

BOARDING PASS

PNR: RL46DU FQTV/SK

Mr Arni Magnusson

FLIGHT	DATE	TIME	FROM	TO	CLASS	GATE	SEQ#	GROUP	SEAT	BOARDING
SK1655 Operator Citylet	16 maj 2025	18:10	Copenhagen CPH Terminal 3	Stuttgart STR Terminal 3	M (T) SAS GO		26	4	15A	17:40

Ticket# 1172530599244

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VOL / FLIGHT	SIÈGE / SEAT	EMBARQ. / BOARDING	PORTE / GATE
501	36F	21:20	A Vérifier / Check monitors

DE /FROM Paris Charles De Gaulle — Terminal 2C, 21 May 2025 22:00

VERS / TO Noumea La Tontouta — 23 May 2025 06:45

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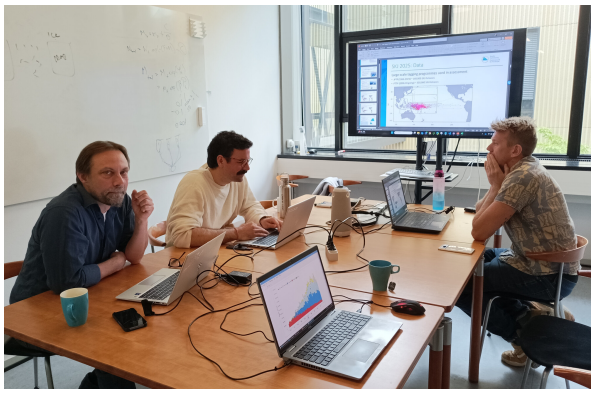
Anders is an amateur carpenter and built a shed in his garden. The sign says Daddy's Workshop.



Anders and Tobias learning about the SPC data.

Joe at Granny's House. He did not want to leave.

Workshop participants and the Chef.