

SPC FAME scientists participate in Japanese research cruise on tuna food webs, and on freshwater eel larval migrations



Hakuho Maru berthed in Noumea at the start of Leg 2 of its research voyage through the South Pacific.

During August 2016 two scientists from the Pacific Community's (SPC) Fisheries, Aquaculture and Marine Ecosystems (FAME) Division, Dr Tim Pickering and Elodie Vourey, participated in a South Pacific research expedition on board the University of Tokyo's oceanographic research vessel, Hakuho Maru.

Ms Vourey boarded the *Hakuho Maru* for the third leg of the voyage between Pago Pago in American Samoa and Papeete (French Polynesia) to work on micronekton (small organisms such as fish, squid, crustaceans and gelatinous organisms) that are consumed by tuna.

Ms Vourey said 'SPC's Oceanic Fisheries Programme took this opportunity to collect micronekton across the Pacific to acquire knowledge on the spatial distribution and species composition of the tuna forage. By increasing our understanding of the tuna forage, we are in a better position to forecast the tuna movements which are in permanent quest for food.' She added 'This is the second Japanese research cruise we are involved in, the previous one being in 2013, and by collecting micronekton in the region on a regular basis it gives us a tool to monitor the changes occurring in the ecosystem and to understand the impact of those changes on the tuna resource.'

During the voyage's second leg from Noumea, New Caledonia to Pago Pago, Dr Pickering joined an international team of expert scholars to help study South Pacific freshwater eels, which undergo long migrations between freshwater growth habitat and marine oceanic breeding habitat.

One of the objectives of this scientific exploration is to discover the spawning grounds of South Pacific freshwater eels, and to obtain genetic samples of eel larvae in an effort to better understand the genetic relationships and evolution of eels. Knowledge of breeding and life cycles is fundamental

to science-based fisheries management but to date, there has not been any systematic research done on South Pacific eels.

Dr Pickering said 'The South Pacific is the last frontier of freshwater eel research. SPC member governments and administrations need scientific information or capacity to make policies for conservation and management of eels, so international collaboration is necessary,' and that 'SPC has been participating in a South Pacific eels research network of international experts and recently hosted the third meeting of this network in collaboration with the University of the South Pacific. Our involvement in this network and our facilitation of Pacific students to study in Japan on eel topics led to an invitation to join prominent eel experts and participate in this research.'

The eel researchers for Legs 2 and 3 included Katsumi Tsukamoto and Michael J Miller of Nihon University in Japan, Mari Kuroki of University of Tokyo, Noritaki Mochioka of Kyushu University, Robert Schabetsberger of Salzburg University, Yu-San Han from Taiwan, Pierre Sasal of CNRS CRIOBE Moorea, and Eric Feunteun and Anthony Acou of the Muséum National d'Histoire Naturelle in France. Among a group of post-graduate students working in eel projects on-board was a Fijian PhD candidate, Chinthaka Hewavitarane, who is enrolled at Kyushu University.

The search is being undertaken for the spawning areas of tropical South Pacific eels in order to better understand the spawning ecology and environment of the tropical eels, and

• SPC activities •



Leptocephalus larvae hunt. Each plankton haul has to be carefully examined by the scientific team to find the transparent, ribbon like eel leptocephalus larvae among all the other sea creatures in the plankton catch.



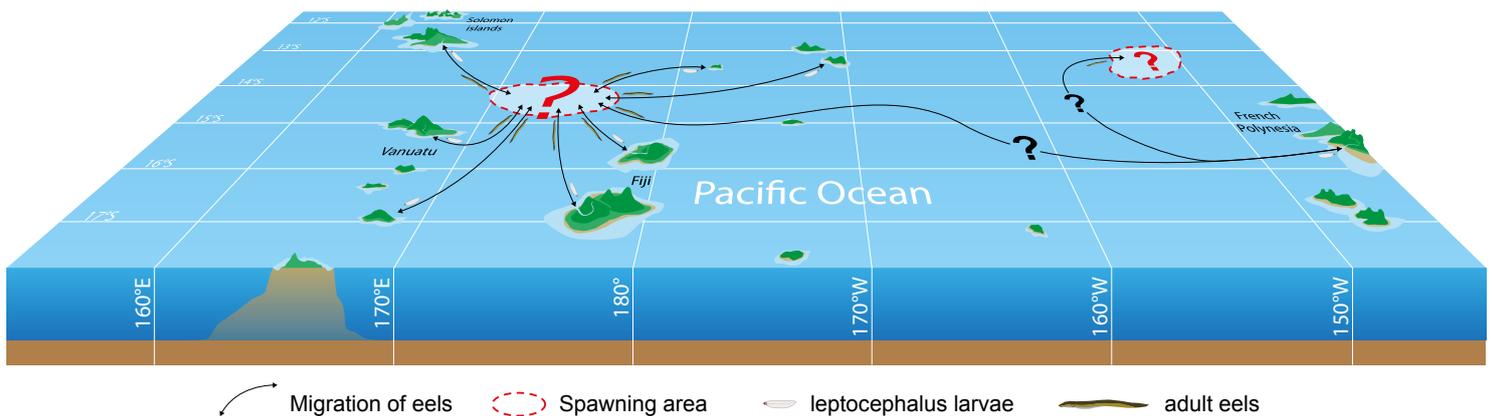
Work on deck to deploy the sampling gear continued day and night. This is the CTD with Niskin bottles, about to be lowered to 1000 m depth.



Freshwater eel leptocephalus larva caught in the oceanic waters north of Fiji.



Close-up of the head of a freshwater eel larva.



Adult eels migrate from island rivers to oceanic spawning areas; leptocephalus larvae swim from these spawning areas back to island rivers. The red question marks signify that the location of the spawning area(s) are not yet known. The black question marks signify that it's not known whether the eels of biogeographically remote French Polynesia spawn together with other eels of the tropical Pacific, or have a different spawning area (illustration: Boris Colas, SPC).

their migration ecology. A similar and successful search by *Hakuho Maru* for the spawning ground of the Japanese eel in the north Pacific during the 1990s had strong commercial motives behind it, because there are valuable industries based upon utilisation of eels in Japan and China.

By contrast, such a costly expedition by a Japanese vessel to study South Pacific eels is motivated mainly by scientific curiosity – particularly because the ecology of tropical eels appears to be quite different from temperate eels. For SPC members, the spin-off benefit is that this research will assist the understanding of the mechanisms of between-year resource size fluctuations and thus help the management of eel fisheries.

Life on board *Hakuho Maru* revolved around a four-hour watch system, with all scientists rostered to complete two of these watches per day. The vessel was thus operating around the clock, day and night. Everybody was expected to work alongside the ship's crew and perform every task related to the deployment of the sampling gear and processing of collected samples.

Eel leptocephalus larvae were caught by setting an Isaacs–Kidd midwater trawl (IKMT) net that was towed behind the vessel. This delivered a bucket-full of plankton on each haul that then needed to be carefully sorted piece-by-piece to find the eel larvae, which could be as small as 5 mm or as large as 200 mm. Most of the eel larvae found was not freshwater eels but rather of the marine eel families like morays or congers, which are themselves worthy topics for research. A vertical-tow North Pacific Standard (NORPAC) net collected nekton for the tuna food web analysis. A conductivity, temperature, and depth (CTD) recording instrument with Niskin sea water collection bottles was deployed at each sampling station to describe the oceanic conditions at each layer of the water column down to 1000 m depth.

The method that eel scientists use to locate eel spawning grounds is to first collect freshwater eel leptocephalus larvae across a wide area of ocean and look for the place where larvae are smallest and youngest. This box of sea area is next searched for newly spawned eel eggs. Finally, once the 'box' is better defined, techniques like underwater video can be used to confirm the presence of spawning adult eels. The August 2016 cruise of *Hakuho Maru* has commenced with the first of these steps for the South Pacific tropical eels.

By the end of Leg 2 on 19 August 2016, the team had collected 7 freshwater eel larvae. A surprise was the collection of 4 larvae of the Australian shortfin eel *Anguilla australis*, which is a temperate eel species, in a sea area north-west of Fiji Islands. These larvae were only 10–12 mm long and therefore less than three weeks old. They were found moving westward in the Southern Equatorial current, so must have been spawned somewhere east of Fiji and north of Tonga.

This sets a new record for the smallest *A. australis* larvae ever collected (the previous record was 20 mm). This is a major discovery, with important implications for understanding the early life cycle ecology of the Australian shortfin eel. It raises more questions, such as: how do the adult eels find their way from Australia and reach the correct place in the vast ocean to aggregate for breeding?

All pictures in this article by Tim Pickering.

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