Call for applicants for PhD bursary on artificial intelligence and tropical tuna purse seine fisheries

May 17, 2021

This announcement is also available in French.

1 Basic information

- **Thesis project acronym:** DYNASTIA
- **Full title in French:** DYNamique spatio-temporelle de l'Abondance des Stocks de Thons tropicaux et de le stratégie d'effort de pêche à la senne par Intelligence Artificielle
- **Full title in English:** Artificial intelligence for a better understanding of stock size and fishery dynamics in the Indian Ocean purse seine tropical tuna fishery
- **Application deadline:** June 25, 2021

2 Description of the project

2.1 Context

France has a large purse seine fleet in the Atlantic and Indian Oceans that catches more than 100,000 tonnes of tropical tunas per year. Careful management of this fishery is essential to its sustainability. However, assessing the status of stocks on the basis of catch-per-unit-effort (CPUE) indexes is complicated. The fishery consists of two distinct fishing modes that are both carried out during a single fishing trip: one on "free swimming" tuna schools composed of primarily mature fish, and the other on schools associated with floating objects dominated by smaller individuals. Furthermore, catch rates are impacted by significant environmental fluctuations that lead to both long term variation in stock size, and short term changes in tuna vulnerability to fishing [1,2]. These factors make it complex to interpret catch rate fluctuations as changes in stock size, thereby limiting their use for management. Analyses based on more sophisticated statistical tools are needed to tease apart these effects.

2.2 Project objectives and expected methodology

The overarching objective of this study is to analyze a complex amalgam of fine scale environmental and French purse seine fishery data using artificial intelligence to more fully understand the intertwined dynamics of stock size fluctuations and changes in fishing and fish vulnerability, thereby improving our ability to estimate abundance of tunas for stock assessment. Within this overall objective, we expect to look at two specific questions. First, measures of purse seine fishing effort have long been unsatisfactory because there is no simple way to separate free school from floating object fishing effort as both modes of fishing occur on each fishing trip [3] and some floating object fishing closely resembles random searching activities characteristic of free school fishing [4]. Recent work has allowed us for the first time to separate floating object fishing sets into random versus directed searching [4]. Using artificial intelligence, this information will be combined with data on the spatio-temporal distribution of floating objects to classify sections of vessel trajectories

of French purse seiners in the Indian and Atlantic Oceans into different fisher "behavioral modes" so as to better quantify each component of purse seine fishing effort.

Second, two major "golden years" periods during which catch rates increased by a factor of two are evident in historical catch data from the Indian Ocean: 2003-2005 and 2018-present. These periods are significant impediments to the use of CPUE as an abundance index for stock assessment as it is poorly understood to what extent these changes are driven by stock size fluctuations due to long term favorable environmental conditions, versus changes in catchability due to short term environmental conditions [1,2] and/or changes in fishing strategy or technology. We will apply artificial intelligence pattern analysis to catch data during and around these "golden years" in relation to environmental indexes and data on fishery technological changes and management changes to better understand the impact of environmental drivers and fishery evolution. This will give us the ability to eliminate variability not associated with stock size from CPUE indexes, thereby providing better indices of abundance for stock assessment.

3 Context of the thesis project

3.1 Project direction

- David M. Kaplan (david.kaplan@ird.fr), UMR MARBEC, IRD, Sète, France
- Daniel Gaertner (daniel.gaertner@ird.fr), UMR MARBEC, IRD, Sète, France
- Francis Marsac (francis.marsac@ird.fr), UMR MARBEC, IRD, Victoria, Seychelles
- Loreleï Guéry (lorelei.guery@cirad.fr), UMR PHIM, CIRAD, Montpellier, France

3.2 Hosting laboratory

The student will be based at the UMR MARBEC in Sète, France and will be employed by the French National Research Institute for Sustainable Development (IRD). The student will also interact with Loreleï Guéry, CIRAD researcher in at the UMR PHIM located in Montpellier, France.

3.3 Available data

For more than 50 years, the IRD has studied tropical tuna fisheries in the Atlantic and Indian Oceans. This work is currently carried out by the UMR MARBEC. It includes fishery data collection and management, scientific research and expert advice to management. Fine scale data on fishing activities, fishing vessel trajectories and floating object deployments will be available for this thesis project, as well as data on environmental variability in the study area.

3.4 Expected start date and duration

The thesis project should begin before the end of 2021 and will be for a duration of 3 years.

3.5 Funding

The student bursary is funded by the Region of Occitanie and the Ob7 pelagic ecosystem observatory based at the UMR MARBEC.

4 How to apply

4.1 Desired qualifications

The ideal student for this project will have a Masters in biostatistics, computer science or marine science that includes significant exposure to artificial intelligence. Knowledge of marine science and fisheries is a plus, but not essential provided that the student has strong computational, mathematical and/or statistical skills and is open to learning about marine science, and specifically tuna fisheries, over the course of the thesis project. Previous use of R, Python, Matlab and/or SQL databases is highly desirable.

4.2 Application materials

Interested applicants should send an email on or before **June 25, 2021** with subject "DYNASTIA application" to david.kaplan@ird.fr containing the following materials:

- A letter of motivation, including discussions of the applicant's interest in this particular project and aspects of the applicant's background that make him or her particularly appropriate for the project
- A detailed CV
- Names and contact information for 2-4 professional references
- Most recent course grades and class rankings

Cited references

1. Fonteneau A et al. (2008) *Aquatic Living Resources* **21**:109–121. doi:10.1051/alr:2008028
2. Ménard F, Marsac F, Bellier E, Cazelles B (2007) *Fisheries Oceanography* **16**:95–104. doi:10.1111/j.1365-2419.2006.00415.x
3. Bez N et al. (2011) *Canadian Journal of Fisheries and Aquatic Sciences* **68**:1998–2010. doi:10.1139/f2011-114
4. Wain G, Guéry L, Kaplan DM, Gaertner D (2020) *ICES Journal of Marine Science*. doi:10.1093/icesjms/fsaa216