Masterproject in ecological modelling:

Costs and benefits of a warm core: do the physiology of tuna drive their migration patterns?

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The Atlantic Bluefin tuna migrates across the Atlantic to feed on pelagic prey – they even come to the Norwegian Sea to eat mackerel and herring in the summer. But as autumn comes they seem to move south and forage on less profitable deep water fish and squids – and when it comes to spawning, they go to ocean deserts in the Mediterranean Sea (Muhling et al. 2017).

One benefit of eating fat fish like mackerel may be that they have excess energy to fuel their high core temperature, and then be faster and more agile than their cold bodied prey (Grady et al. 2019), even if the temperature is quite low. However, with shorter days and colder temperatures, the benefit may decline and at some point, they need to migrate further south and find other prey to feed on. To assess these limits, we will develop an individual-based model of tuna physiology, including foraging mechanics, metabolic costs, gut-dynamics, and growth. We have some existing models to start from (Kirby et al. 2000, Chapman et al. 2011), but one element of the project is to review the literature and develop a state-of-the-art simulation model for growth dynamics of Atlantic bluefin tuna. There are lots of data from tagging programs – and it may be interesting to compare use the model to interpret patterns seen in these data.

The thesis is theoretical and require an interest in working with models and numerical computation. Even if you have little prior experience with modelling, this is a skill that you can learn during your master.

Chapman EW, Jørgensen C, Lutcavage ME (2011) Atlantic bluefin tuna (Thunnus thynnus): a state-dependent energy allocation model for growth, maturation, and reproductive investment. Can J Fish Aquat Sci 68:1934-1951

Grady JM, Maitner BS, Winter AS, Kaschner K, Tittensor DP, Record S, . . . Brown JH (2019) Metabolic asymmetry and the global diversity of marine predators. Science 363:366-+

Kirby DS, Fiksen Ø, Hart PJB (2000) A dynamic optimisation model for the behaviour of tunas at ocean fronts. Fish Oceanogr 9:328-342

Muhling BA, Lamkin JT, Alemany F, García A, Farley J, Ingram GW, . . . Carrion RL (2017) Reproduction and larval biology in tunas, and the importance of restricted area spawning grounds. Rev Fish Biol Fisher 27:697-732