Evolution of complex asexual reproductive strategies in jellyfish

Many living organisms in terrestrial and aquatic ecosystems rely on multiple reproductive strategies to reduce the risk of extinction in variable environments. Examples are provided by the polyp stage of several bloom-forming jellyfish species, which can reproduce asexually using different budding strategies. These strategies broadly fall into three categories: (1) fast localized reproduction, (2) dormant cysts, or (3) motile and dispersing buds. Similar functional strategies are also present in other groups of species. However, mechanisms leading to the evolution of this rich reproductive diversity are yet to be clarified. Here we model how risk of local population extinction and differential fitness of alternative modes of asexual reproduction could drive the evolution of multiple reproductive modes as seen in jellyfish polyps. Depending on environmental parameters, we find that evolution leads to a unique evolutionarily stable strategy, wherein multiple reproductive strategies generally coexist. As the extinction risk increases, this strategy shifts from a pure budding mode to a dual strategy and finally to one characterized by allocation into all three modes. We identify relative fitness-dependent thresholds in extinction risk where these transitions can occur and discuss our predictions in light of observations on polyp reproduction in laboratory and natural systems.
The lives and times of jellyfish: Modelling the population dynamics and ecological role of jellyfish in marine pelagic ecosystems

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Modelling Jellyfish in marine ecosystems

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The global susceptibility of coastal forage fish to competition by large jellyfish

Competition between large jellyfish and forage fish for zooplankton prey is both a possible cause of jellyfish increases and a concern for the management of marine ecosystems and fisheries. Identifying principal factors affecting this competition is therefore important for marine management, but the lack of both good quality data and a robust theoretical framework have prevented general global analyses. Here, we present a general mechanistic food web model that considers fundamental differences in feeding modes and predation pressure between fish and jellyfish. The model predicts forage fish dominance at low primary production, and a shift towards jellyfish with increasing productivity, turbidity and fishing. We present an index of global ecosystem susceptibility to shifts in fish–jellyfish dominance that compares well with data on jellyfish distributions and trends. The results are a step towards better understanding the processes that govern jellyfish occurrences globally and highlight the advantage of considering feeding traits in ecosystem models.
Projects:

Modelling the role of competition between fish and jellyfish in marine pelagic ecosystems

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