ON THE TERMAL CONTROL OF *COTYLORHIZA TUBERCULATA* JELLYFISH POPULATION

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Abstract

Cotylorhiza tuberculata is a jellyfish generating outbursts in the coastal lagoon of Mar Menor since mid-90s. Ups and down of the population proceeded along different years without a clear scientific understanding of its origin. In this manuscript we hypothesize that the tight control exerted by temperature on the life cycle of *Cotylorhiza tuberculata* is the origin of such fluctuations. Temperature triggers the strobilation process and cold waters generate high mortalities to the benthic phase. Modelling this thermal control results in simulations of medusa stocks closely resembling its weekly landings in the coastal lagoon. Conclusions derived from this closed population are a fore-signal of future evolution of jelly fish species in a Mediterranean with milder winters an longer summers.

Keywords: Medusae, Models, Coastal Processes

The Mar Menor is a large (135 Km^2) and shallow (3.5 m average depth) lagoon almost isolated from the western Mediterranean by a 22 Km long sandy bar. Progressive increase of both human pressure on the shores and agriculture forcing on the draining waters modified original communities during the 80s [1]. Parallel to this degradation, and coherently with an habitat-deterioration triggering of jellyfish blooms [2], *Cotylorhiza tuberculata* (CT) first appeared in the lagoon and started to build massive outbreaks in early 90s [3]. Highs and lows of CT abundance in the Mar Menor progressed since its first appearance without scientific understanding of the fluctuation origin. The societal alarm and the economic impact on bathing activities activated a program to extract medusa from the lagoon and generated a time series of capture per unit effort data.

A Bayesian model was implemented to assimilate these data in the mechanics driving the life cycle of exploited populations [4], The model tested the hypothesis that fluctuations have their origin in the tight control that temperature exerts on the life cycle of CT. Based on controlled experiments, all phases of the life cycle except strobilation and polyp mortality were found insensitive to the range of physical conditions present in the lagoon. Strobilation is triggered when the water temperature first rises over ~18ºC with negligible ephira production later on. Therefore, the summer spam for the medusa phase can be accounted in terms of the time the lagoon is >18ºC. Longer summers imply longer periods for medusa somatic growth and for population biomass to accumulate. Owing to the annual life-span of CT, polyps are responsible to transfer the population across winters but their survival is very sensitive to cold waters. Temperatures bellow 16ºC result in mortalities that, when accumulated along the winter, heavily impact the remnants individuals available for strobilation and medusa generation in the subsequent summer. The model is then articulated on the basis of successive stages of polyp and medusa that alternate under the control of lagoon temperature and the progress of seasonal cycles. The simulated medusa stock in the lagoon reproduces an intra and inter-annual evolution coherent with the observed abundances of CT. This includes the massive outbursts during the long summers from 2000 to 2004 as well as the dramatic collapse of medusa population in 2005, after a previous very severe winter. The capacity of a thermally-forced life-cycle to explain *in situ* changes indicates the severe control that temperature exerts on CT abundance. Once the ecosystem-degradation conditions for jellyfish outbreaks are met, and the homeostasis of the system decreased, CT seems to fluctuate under the simple rule of the warmer the better.

Though the link between environment and scyphozoa populations has been extensively explored before (e. g. [5]) they mainly investigate statistical correlations between environmental indexes and jellyfish abundance rather than identifying the cause-effect control in the mechanics of jellyfish life-cycle and population dynamics. This mechanics offers a more solid ground to understand past periods of jellyfish occurrence and to project future expectations in a Mediterranean where milder winters and longer summer will modify the community balance of winners and losers.

References

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