Workshop Brazil-Germany
Cooperation in Ocean Science and Technology: Research and Capacity Building

The Syzygy Tide Inequality Cycle:

An ignored factor in plankton dynamics

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Coastal marine invertebrates typically spawn at syzygy high tides when currents are strong, thereby favouring larval export. However, tidal amplitudes are not always the same at new moon (NM) and full moon (FM) syzygies, but vary predictably according to the so far only rarely noticed "syzygy tide inequality cycle" (STIC). We recently observed that STIC is detected by the mangrove crab *Ucides cordatus* whose synchronized mating lead to larval release at the highest amplitude tide of the two monthly syzygy tides (Schmidt et al., 2012). This finding raised the hypothesis that synchronization with STIC is ubiquitous among mangrove crabs (and possibly other invertebrates too), which strongly depend on larval export to offshore waters, where environmental conditions are more favourable for larval survivorship. To test this, we reviewed plankton data collected in 2008 at Caravelas estuary, Bahia. Samples of zoeae were collected with a 200μm net in estuarine surface waters from January to March, one day after NM and FM, at daytime and night time, 1h after high tide. Abundance of

zoea I larvae was higher at NM than at FM, during day and night. At night, the percentage difference between abundance at NM and FM increased along time (43% on January, 191% on February and 200% on March). This matched the tendency of increasing tidal amplitude at NM from January to March (Fig. 1) and the observations of mating and spawning of *U. cordatus* at NM periods of 2008. In addition, the high abundance and diversity of the zoeae indicates that other species are also synchronized with STIC. In fact, our results suggest that STIC is an important factor for temporal variation of abundance of meroplankton, however, to date, no plankton study has mentioned this cycle. The knowledge about STIC opens a wide field for large scale cooperative projects, since tidal regimes vary with latitude. In 2014 we established a wide research network (REMAR) for monitoring the synchrony of reproductive activities of coastal crabs (e.g. *U. cordatus* and *Cardisoma guanhumi*) that will help to improve the placements of capture bans. In addition, the recent finding of a sub-population of the estuarine crab *Goniopsis cruentata* at rocky coasts of the Abrolhos Archipelago will help to understand the ultimate causes of the synchrony of reproduction with STIC. Since on oceanic islands the need for larval exportation does not seem as important as in estuaries, we hypothesize a lower synchrony of the Abrolhos crabs with STIC. Regarding the proximate causes, we are studying the behaviour and physiology of crabs in the laboratory, simulating different tidal conditions. We aim to understand how the entrainment of the synchrony with STIC is achieved and we also assess the impacts of environmental changes, such as meteorological tides caused by climate change, on the timing of reproduction with STIC and, consequently, on the effectiveness of larval release, transport and survivorship.

Reference: Schmidt, A.J., Bemvenuti, C.E. & Diele, K. (2012). Effects of geophysical cycles on the rhythm of mass mate searching of a harvested mangrove crab. Animal Behaviour 84: 333-340.

Key-words: crab, estuary, larvae, mangrove, plankton, Syzygy Tide Inequality Cycle

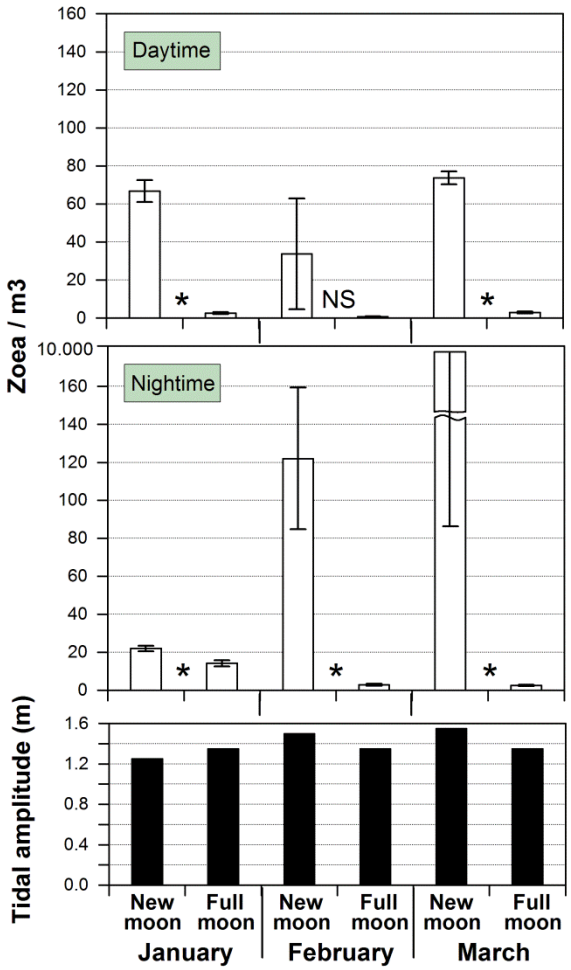

Figure 1 – Mean and standard error of abundance of zoea larvae at new moon and full moon, at (A) daytime and at (B) night time. (C) tidal amplitude at full moon and new moon. *: significant differences between mean zoea abundance at new moon and full moon of each month ($P<0.05$, 2df, with t test with Welch correction); NS: not significant.