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The 'Natural Laboratory', a tool for deciphering growth, lifetime and population dynamics in larger benthic foraminifera

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The shells of symbiont-bearing larger benthic Foraminifera (LBF) represent the response to physiological requirements in dependence of environmental conditions. All compartments of the shell such as chambers and chamberlets accommodate the growth of the cell protoplasm and are adaptations for housing photosymbiotic algae.
Investigations on the biology of LBF were predominantly based on laboratory studies. The lifetime of LBF under natural conditions is still unclear. LBF, which can build >100 chambers during their lifetime, are thought to live at least one year under natural conditions. This is supported by studies on population dynamics of eulittoral foraminifera. In species characterized by a time-restricted single reproduction period the mean size of specimens increases from small to large during lifetime simultaneously reducing individual number. This becomes more complex when two or more reproduction times are present within a one-year cycle leading to a mixture of abundant small individuals with few large specimens during the year, while keeping mean size more or less constant. This mixture is typical for most sublittoral megalospheric (gamonts or schizonts) LBF. Nothing is known on the lifetime of agamonts, the diploid asexually reproducing generation. In all hyaline LBF it is thought to be significantly longer than 1 year based on the large size and considering the mean chamber building rate of the gamont/schizonts.
Observations on LBF under natural conditions have not been performed yet in the deeper sublittoral. This reflects the difficulties due to intense hydrodynamics that hinder deploying technical equipment for studies in the natural environment. Therefore, studying growth, lifetime and reproduction of sublittoral LBF under natural conditions can be performed using the so-called 'natural laboratory' in comparison with laboratory investigations.
The best sampling method in the upper sublittoral from 5 to 70 m depth is by SCUBA diving. Irregular sampling intervals caused by differing weather conditions may range from weeks to one month, whereby the latter represents the upper limit: larger intervals could render the data set worthless. The number of sampling points at the location must be more than 4, randomly distributed and approximately 5m apart to smooth the effects of patchy distributions, which are typical for most LBF.
Only three simple measurements are necessary to determine chamber building rate and population dynamics under natural conditions. These are the number of individuals, number of chambers and the largest diameter of the individual. The determination of a standardized sample surface area, which is necessary for population dynamic investigations, depends on the sampling method.
Reproduction and longevity can be estimated based on shell size using the date where the mean abundance of specimens with minimum size (expected after a one month's growth) characterizes the reproduction period. Then the difference to the date with the mean abundance of specimens characterized by large size indicating readiness for reproduction marks the life time.
Calculation of the chamber-building rate based on chamber number is more complex and depends on the reproduction period and longevity. This can be fitted with theoretical growth functions (e.g. Michaelis Menten Function).
According to the above mentioned methods, chamber building rates, longevity and population dynamics can be obtained for the shallow sublittoral symbiont-bearing LBF using the 'natural laboratory'.