

Multi-specific synchronous spawning is a reproductive strategy used by scleractinian corals that has now been described from coral reefs in 23 locations globally. While high multi-specific synchrony in the reproductive condition of *Acropora* colonies has been documented in the Red Sea in April and/or May, multi-specific synchronous spawning has not been directly observed. In April 2011, we found mature oocytes in 81% of 92 colonies from 10 *Acropora* species as well as in some faviids on reefs near Thuwal, Saudi Arabia (22°18'N, 38°57'E). On the night of 16th April 2011, two nights before the full moon, we first observed egg-sperm bundles in *Acropora* polyps at 20:30 h. Between 22:30 h and 23:45 h, 43 colonies from 10 out of 13 surveyed *Acropora* species released egg/sperm bundles, including 3 species that had not been observed to spawn previously (*A. plantaginea*, *A. paraphraonis*, and *A. lamarcki*). This is the first documented multi-specific synchronous spawning event in the Red Sea. Our observations demonstrate that the asynchronous spawning pattern at Eilat in the Gulf of Aqaba is not representative of the Red Sea and provide further support for the prediction that these events are characteristic of all speciose coral assemblages. Nonetheless, spawning was not restricted to April with more acroporids and faviids containing mature gametes in May and June. Within these months we observed spawning in a further 9 species including *P. verrucosa* which spawned during the day.

12A Life histories & reproduction
Thursday 12 July, 1630, Sebel Bluewater

Environmental controls of fecundity of three Indo-Pacific coral species

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Among life functions of coral, reproduction appears to have the narrowest tolerance to stress, while being critical for maintenance of populations and evolution. However, relatively little is known about the effects of environmental stressors on reproductive output, especially in equatorial climes where corals exist close to their thermal tolerance limits. Gametogenic cycles and reproductive output were investigated in three common broadcasting scleractinian corals *Hydnophora exesa*, *Merulina ampliata* and *Echinopora lamellosa* at three fringing reefs, south of Singapore. All three species showed strong seasonality and broadly similar patterns of gametogenesis, with bi-annual peaks in fecundity occurring primarily in April, followed by a smaller secondary peak in October, although not all species necessarily complete this second gametogenic cycle. Both periods coincide with the inter-monsoon, during which

tidal flushing is poorest. Reproductive fecundity in all three species significantly declined from 2009 to 2011, although spatial effects in these were prominent. Results indicated that oogenesis occurred over three to four months, during which fecundity metrics showed strong links with water temperature, total organic carbon, organic phosphorus and nitrogen, faecal coliforms, enterococci and total petroleum hydrocarbons. The effects of a bleaching event in mid-2010 had large effects on reproductive output, with reproductive failure in all three species in October 2010. This suggests these corals are sensitive and susceptible to deteriorating water quality within relatively short time frames. Consequently, variations in fecundity are highly relevant indicators of sub-lethal stress and monitoring coral reproductive output is critical to successful coral reef management.

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Reproductive benefits of no-take reserves vary latitudinally for *Plectropomus leopardus*

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No-take marine reserves (NTRs) are expected to benefit fisheries via recruitment subsidy to fished areas. Quantifying the contribution of NTRs to egg production is the first step in evaluating the potential for recruitment subsidy. We quantified annual fecundity and egg production per unit area (EPUA) for the commercially important common coral trout, *Plectropomus leopardus*, between fished and NTR reefs in four Great Barrier Reef (GBR) regions. Reproductive potential between NTRs and fished reefs varied significantly among latitudes. Fecundity was approximately 200% greater and EPUA 260% greater on NTRs than fished reefs in the central GBR. Annual fecundity and EPUA were significantly greater on fished reefs than NTRs in the northern GBR. It was difficult to detect differences between NTRs and fished reefs in the southern GBR because of small numbers of spawners available to measure fecundity, despite overall greater abundances in the south. *Plectropomus leopardus* densities were 2-5 times lower in the central GBR than the north or south but higher proportions of reproductively mature females

meant EPUA on central GBR NTRs was 1800-4500% greater than on NTR reefs in the two southern regions and 530% greater than reefs in the northern region. Male biased sex ratios, infrequent spawning, and low annual fecundity in the southern GBR limited the prospective reproductive benefits expected from significantly higher population densities. This study highlights the importance of considering spatial variation in EPUA when assessing prospective benefits of NTRs, particularly if recruitment subsidy is an objective of NTR implementation.

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What is a weedy coral? Identifying life-history strategies of reef-building corals

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There is increasing concern that human impacts are causing a shift from historically dominant reef-building corals to assemblages of stress-tolerant and 'weedy' opportunistic species. However, there is currently no framework to classify Scleractinian corals into life-history strategies that would allow for testing of these predictions. We collected species-level trait information for all known species of Atlantic and Indo-Pacific reef-building corals from taxonomic monographs, identification guides and published literature. Our final database contained 11 characteristics related to colony growth form and size, reproduction, growth rates, predation, and zooxanthellae (*Symbiodinium*) diversity. Using hierarchical clustering and random forest analyses, we identified three life-history strategies consistent across Atlantic and Indo-Pacific taxa: 1) competitive species with a branching and plating growth form that grow quickly, reach large colony sizes and reproduce by broadcast spawning; 2) stress-tolerant massive species that grow slowly and reproduce by broadcast spawning, and 3) weedy species with small branching or submassive colonies and brooding reproduction. Interestingly, these groups bear a strong resemblance to primary life-history strategies in plants. We also compared the IUCN Red List assessments of species within each life-history strategy and found that competitive species have the highest risk of extinction followed by stress-tolerant and weedy species. The life-history strategies we have identified in reef-building corals identify 'winners' and 'losers' based on life-history traits and can allow us to predict shifts in coral assemblages on future reefs.

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Coral dynamics in space and time: modeling coral populations in Hawaii

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Corals have complex life-histories including sexual and asexual reproduction, fission and fusion of colonies, and a lack of discrete stage structure that makes demographic modeling a particular challenge. Previous studies have used matrix models for coral population dynamics; however, this approach is limited by arbitrary imposition of size classes and parameter estimation requirements that increase multiplicatively with the number of size classes. In contrast, integral projection models (IPMs) use biologically meaningful, continuous functions for growth, survivorship, and fecundity as a function of size, which can be fit from data using mixed-model approaches in a likelihood framework. Here, we compare population projections for coral populations across six sites around Maui (Hawaii, USA). At each site, individual coral colonies were tracked in five permanent photoquadrats over six years. We jointly fit individual growth, mortality, and recruitment at all sites, with site and depth and their interaction as fixed effects, and plot and year as a random effects. We explore site-specific differences in mortality and growth rate across years, compare growth rates between shallow and deep sites, and compare the relative magnitude in spatial and temporal variation in growth rate. We discuss how spatial patterns of variation relate to local site characteristics and management regime.

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Aspects of the early life history of *Montipora capitata* in Hawai'i

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Montipora capitata is a broadcast spawning hermaphroditic coral. It spawns from late spring to early fall. Three aspects of its life history were investigated in Kaneohe Bay, Hawaii - the survivorship and growth of newly settled individuals and 'visible' recruitment. To follow recently settled larvae in the field, plates at study sites were either seeded with larvae ('seeded plates'), or natural settlement occurred to plates ('field plates'). *Montipora capitata* cumulatively made up approximately