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## The reproductive season of Acropora in Socotra, Yemen

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OBSERVATION ARTICLE

**REVISED** The reproductive season of *Acropora* in Socotra, Yemen  
[version 2; peer review: 2 approved]

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**Abstract**

Determining when corals reproduce has clear management and economic implications. Here we document the reproductive condition of corals in the genus *Acropora* on the island of Socotra in Yemen during February 2014. Twenty percent of colonies (n = 143) contained mature gametes and 28% had immature gametes indicating that spawning will occur in both February and March in 2014, confirming previous anecdotal reports of coral spawning at this time in Socotra. *Acropora* typically reproduce in synchrony with many other broadcast spawning scleractinian corals, and we therefore predict that many other species are reproductively active at this time of year.

**Open Peer Review**

Reviewer Status

|                          | Invited Reviewers |        |
|--------------------------|-------------------|--------|
|                          | 1                 | 2      |
| <b>REVISED</b>           |                   |        |
| <b>version 2</b>         | report            | report |
| published<br>09 Apr 2014 |                   |        |
| <b>version 1</b>         |                   |        |
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- 1 **Jean Kenyon**, US Fish and Wildlife Service, Honolulu, HI, USA
- 2 **Bert W. Hoeksema**, Naturalis Biodiversity Center, Leiden, The Netherlands

Any reports and responses or comments on the article can be found at the end of the article.

**Corresponding author:** Andrew H. Baird ([andrew.baird@jcu.edu.au](mailto:andrew.baird@jcu.edu.au))

**Competing interests:** No competing interests were disclosed.

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**REVISED Amendments from Version 1**

The following changes have been made to the text following the suggestions of the reviewers. In response to a comment by Bert Hoeksema we have removed the final sentence of the manuscript. In response to the comments by Jean Kenyon we have included the number of *Acropora* species reported to occur in Socotra from Devantier *et al.* 2004 and we changed the title of the manuscript.

**See referee reports**

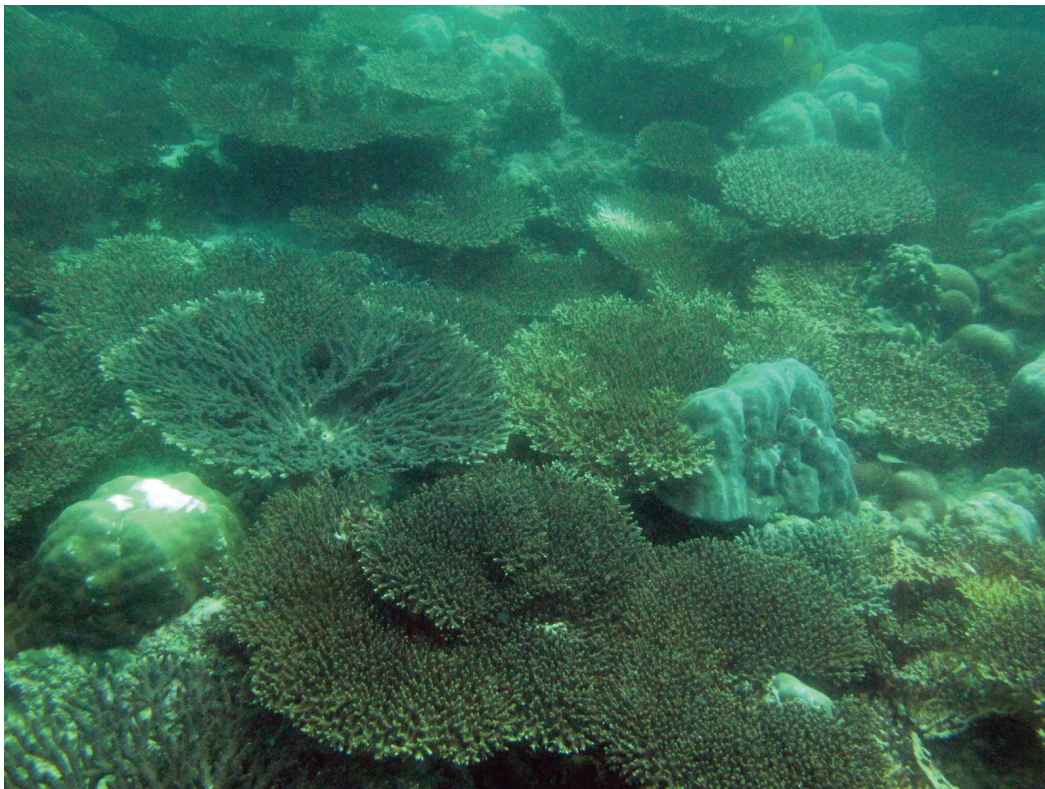
**Observation**

Most hermatypic scleractinian corals have an annual gametogenic cycle that culminates in the broadcast spawning of gametes once per year<sup>1</sup>. In most reef regions, numerous species spawn in synchrony following full moons when sea surface temperature is either rising or falling<sup>2,3</sup>. Determining exactly when spawning takes place has important implications for reef management and clear economic benefits<sup>4</sup>. For example, activities that are likely to limit fertilization success, such as dredging, can be prohibited during these often brief spawning periods<sup>5</sup>. In addition, the diving industry can benefit from public interest in coral spawning.

Here, we document the reproductive condition of *Acropora* corals on the island of Socotra, Republic of Yemen. The island, located 240 km east of the Horn of Africa and 380 km south of the Arabian Peninsula, supports a diverse scleractinian fauna of over 250 species (including 20 *Acropora* species)<sup>6</sup>, and includes sites with a high cover of *Acropora* (Figure 1). *Acropora* colonies were

sampled before the full moon on 15 February 2014 to determine their reproductive condition. Three reproductive conditions were defined based on the appearance of the oocytes as observed with the naked eye in the field<sup>7</sup> (1) mature - oocytes pigmented and therefore likely to spawn within a month (2) immature - oocytes pale but visible indicating that they are close to maturity and likely to spawn within two to three months (3) empty - oocytes too small to see or absent indicating either that the colony has recently spawned, or is unlikely to do so for at least three months.

A total of 143 *Acropora* colonies from approximately 14 species were sampled at four sites on the north of Socotra (Samerhur 12°41'40.96"N, 53°29'3.69"E; Qaiso 12°39'58.91"N, 53°24'33.86"E; Dihamri 12°40'20.35"N, 54°11'39.96"E; Hadibo 12°40'0.77"N, 54°3'7.74"E) between the 31 January and 8 February 2014 (Table 1). Twenty percent of colonies contained mature oocytes (Figure 2), 28% contained immature oocytes and no oocytes were visible in the remaining 52% of colonies (Table 1). Colonies with mature oocytes are highly likely to spawn at some time around the full moon in February 2014, whereas colonies with immature oocytes are likely to spawn in March 2014. The remaining colonies have either spawned recently, or alternatively, there could be a second reproductive season later in the year, similar to Western Australia<sup>8</sup>, Singapore<sup>9</sup> and some locations in Indonesia<sup>1</sup>. Ten species had at least one colony with mature gametes (Table 1) suggesting a multi-species spawning event is likely in February 2014. The *Acropora* typically reproduce at much the same time as most other broadcast spawning scleractinian corals<sup>10,11</sup> and therefore we predict that many other species will be spawning in February and March in Socotra. Our results



**Figure 1.** The island of Socotra supports diverse assemblages of *Acropora* species.

**Table 1.** The percentage of *Acropora* colonies with mature-, immature- or no oocytes, sampled between 31 January and 8 February 2014 on Socotra Yemen. n = number of sampled colonies.

| Species                          | Percentage mature | Percentage immature | Percentage empty | n   |
|----------------------------------|-------------------|---------------------|------------------|-----|
| <i>Acropora appressa</i>         | 100               | 0                   | 0                | 1   |
| <i>Acropora dendrum</i>          | 100               | 0                   | 0                | 2   |
| <i>Acropora downingi</i>         | 0                 | 7                   | 93               | 14  |
| <i>Acropora cf humilis</i>       | 8                 | 46                  | 46               | 13  |
| <i>Acropora lamarki</i>          | 33                | 33                  | 33               | 3   |
| <i>Acropora cf lutkeni</i>       | 33                | 33                  | 33               | 12  |
| <i>Acropora microphthalma</i>    | 0                 | 0                   | 100              | 2   |
| <i>Acropora formosa</i>          | 0                 | 11                  | 89               | 18  |
| <i>Acropora nasuta</i>           | 100               | 0                   | 0                | 1   |
| <i>Acropora roseni</i>           | 0                 | 27                  | 73               | 11  |
| <i>Acropora cf solitaryensis</i> | 67                | 33                  | 0                | 3   |
| <i>Acropora cf spicifera</i>     | 21                | 38                  | 42               | 48  |
| <i>Acropora valida</i>           | 44                | 33                  | 22               | 9   |
| <i>Acropora verweyi</i>          | 50                | 17                  | 33               | 6   |
| Total                            | 20                | 28                  | 52               | 143 |



**Figure 2.** Mature (colored) oocytes are clearly visible in the branches of *Acropora* colonies.



confirm previous anecdotal reports of coral spawning on Socotra in February and March<sup>6</sup>.

### Author contributions

All authors conceived the study, collected the data and wrote the manuscript.

### Competing interests

No competing interests were disclosed.

### Grant information

Funding was provided by the Australian Research Council Centre of Excellence for Coral Reef Studies COE561432 (AHB).

*The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.*

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Current Peer Review Status:  

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## Version 2

Reviewer Report 17 April 2014

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**Bert W. Hoeksema**

Taxonomy and Systematics Group, Naturalis Biodiversity Center, Leiden, The Netherlands

The authors followed up on my only recommendation. I have nothing more to add.

**Competing Interests:** No competing interests were disclosed.

**I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

Reviewer Report 17 April 2014

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**Jean Kenyon**

Hawaiian and Pacific Islands National Wildlife Refuge Complex, U.S. Fish and Wildlife Service, Oahu, HI, USA

The authors have responded appropriately to my review comments, and to those of [Bert Hoeksema](#). I am satisfied with this version of the article.

**Competing Interests:** No competing interests were disclosed.

**I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

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## Version 1

Reviewer Report 01 April 2014

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**Bert W. Hoeksema**

Taxonomy and Systematics Group, Naturalis Biodiversity Center, Leiden, The Netherlands

This short publication presents clear results and is well written. I have one comment. The conclusive sentence seems redundant, and may need rephrasing or some additional explanation if the authors want to maintain it. *“In addition, these data add to a growing body of evidence indicating that multi-specific spawning synchrony is a feature of all speciose coral assemblages.”*

The present results concern a selection of *Acropora* species. I wonder whether this would be sufficiently representative for a speciose coral assemblage. In theory any assemblage of two coral species can be considered multi-specific. With many *Acropora* species in a speciose coral assemblage, some degree of spawning synchrony is not surprising. So, in the present context I wonder if there is a minimum number of species for what counts as speciose and if the authors have a minimum number or percentage in mind for what exactly counts as multi-species spawning. If the authors cannot clarify their remark or cannot give more supportive information to this statement, I suggest that this sentence should be removed.

**Competing Interests:** No competing interests were disclosed.

**I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

Author Response ( F1000Research Advisory Board Member ) 08 Apr 2014

**Andrew Baird**, James Cook University, Townsville, Australia

We have removed the sentence as suggested.

**Competing Interests:** No competing interests were disclosed.

Reviewer Report 28 March 2014

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**Jean Kenyon**

Hawaiian and Pacific Islands National Wildlife Refuge Complex, U.S. Fish and Wildlife Service, Oahu, HI, USA

Background information, purpose of study, data, and interpretation are all clearly and concisely presented. Documentation of coral sexual reproductive status at Socotra, Yemen in 14 species of *Acropora* provides a useful first contribution to improved understanding of global patterns of this reef maintenance and renewal process. Given that more than 250 species of scleractinian corals are supported at the island, it would be interesting and useful to extend these initial studies to additional species at other times of the year, and to confirm inferred spawning period and synchrony with field observations.

That said, I would suggest that the article title, "*The reproductive season of scleractinian corals in Socotra, Yemen*" is too broad, given that only ~5% of the scleractinian fauna was sampled. A more focused title should indicate that the observations are confined to the genus *Acropora*. Within the article, it would also be informative to provide the number of species of *Acropora* reported among the scleractinian fauna, so as to give some perspective on the proportion of *Acropora* species sampled.

**Competing Interests:** No competing interests were disclosed.

**I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

Author Response ( F1000Research Advisory Board Member ) 08 Apr 2014

**Andrew Baird**, James Cook University, Townsville, Australia

We have changed the title to "*The reproductive season of Acropora in Socotra, Yemen*".

We have also provided the number of *Acropora* species reported to occur in Socotra as listed by [Devantier et al., 2004](#).

**Competing Interests:** No competing interests were disclosed.



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