An Indo-Pacific coral spawning database

Supplementary material

Data entry

Data may be entered into the three primary tables (tblSitesForSpawningObservations, tblSpawningObservations and tblReferencesForSpawningObservations) in Access via a data entry form (Fig. S1) or appended from Excel spreadsheets in an appropriate template (CoralSpawningDatabaseTemplate.xlsx). Details of fields are provided in the main text.

Figure S1. Data entry form for entering site information and details of each spawning observation at a site.

Before entering data one should check whether data for the Site (or Subsite) already exists, in which case the spawning observations can be added to existing ones for that Site (or Subsite) without any need to re-enter site information. If the Site (or Subsite) is new, then clicking on the Add New Site button brings up a blank Site information form with a blank Spawning Observations subform. The Ecoregion_ID can be looked up in tblEcoregionsVeron2015 and added at time of data entry or later (this is only used to group sites for analysis).

Veron et al. (2015) shows the boundaries of the 150 marine ecoregions (see their Supplementary Material 1: reproduced as Fig. S2 below). Note that although the database currently contains only Indo-Pacific data, it is designed to also accept Atlantic coral spawning data.
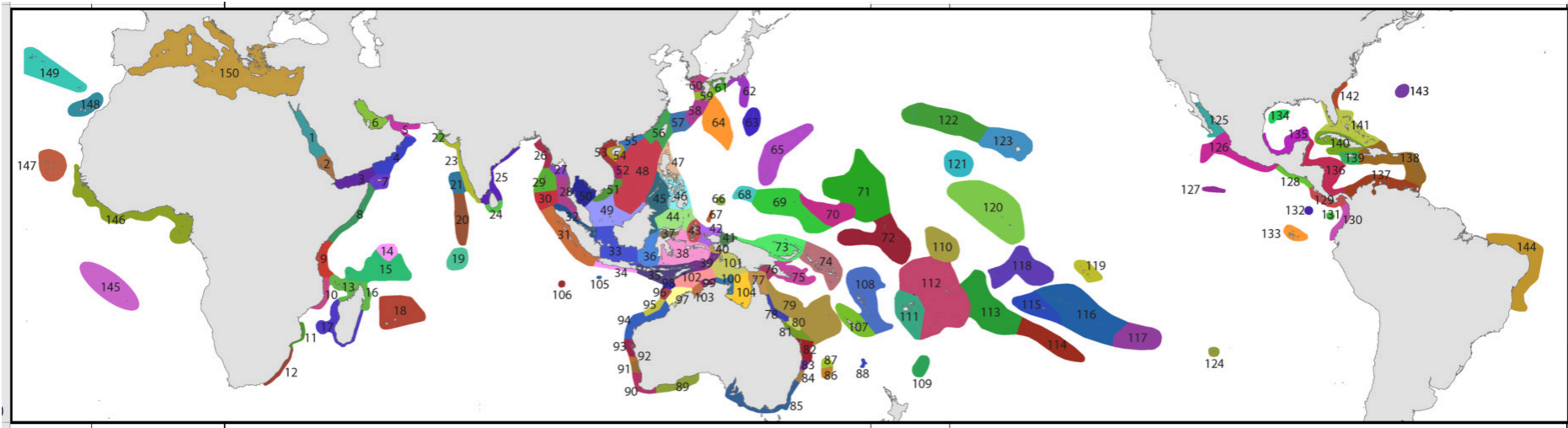

Figure S2. Ecoregion boundaries from Veron et al. (2015). [https://www.frontiersin.org/articles/file/downloadfile/116213_supplementary-materials_datasheets_1_xlsx/octet-stream/Data%20Sheet%201.XLSX/1/116213]

Where spawning observations from several localities within a relatively small geographical area such as Magnetic Island, Moorea, Heron Island, Kaneohe Bay (each reported with different latitude and longitude coordinates) have been recorded, these localities are treated as Subsites within the distinct location (archipelago, island, bay). In cases where spawning has been observed in colonies collected from several localities spread across a Site (e.g. Kaneohe Bay), "na" (not applicable) is assigned as the Subsite name.

Notes on fields:

Subsite_ID   This is assigned automatically and provides a unique identifier for different locality where spawning was recorded.

Obs_ID   This is assigned automatically and provides a unique identifier for every observation.

Genus	Type in first letters of the genus name (e.g. "Por", "Acr") to bring up a drop-down menu of generic names. This avoids spelling mistakes and is linked to Current_Genus field in tblCoralSpecies. (In unlikely event that required genus name does not appear then tblCoralSpecies may need to be updated later.)
O_n	If an open nomenclature qualifier is required, a drop down menu offers "aff" or "cf" options.
Species	Type in first letters of the species name (e.g. "dig", "ver") to bring up a drop-down menu of species names. This avoids spelling mistakes and is linked to Current_Species field in tblCoralSpecies. (In unlikely event that required species name does not appear then tblCoralSpecies may need to be updated later.)
Coral_ID	This field does not appear in the data entry form as purely involved in the internal workings of the database but is used to link tblSpawningObservations to tblCoralSpecies and thence to tblSystematics so that species can be grouped into higher taxa and future genus and species name changes readily incorporated. This field is updated with a query after data entry.
Date	Date of the spawning observation (dd/mm/yyyy). Input mask 00/00/0000 is used.
Start_time	Time when spawning first noted in hh:mm (24 h clock). Input mask 00:00 is used.
No_start	Drop down menu allows: True (start time not noted) or False (start time noted) to be entered.
Quality_start	Drop down menu allows: Approx or Exact to be entered.
End_time	Time when spawning first noted in hh:mm (24 h clock). Input mask 00:00 is used.
No_end	Drop down menu allows: True (end time not noted) or False (end time noted) to be entered.
Quality_end	Drop down menu allows: Approx or Exact to be entered.
Gamete_release	Drop down menu allows: Bundles, Eggs, Sperm, Both separately or Not recorded to be entered.
Situation	Drop down menu allows: In situ or Ex situ to be entered.
Timezone	Knowing the local time zone on the spawning date allows 4 benchmarks: date of the nearest full moon (DoNFM) and thus date of spawning relative to nearest full moon (DoSRtNFM), and time of Sunrise and Sunset to be calculated automatically within the database. This is done by a macro (mcrUpdate_DoNFM_Sunset) which searches for records without DoNFM data entered and uses a VBA function to search a table of full moon dates for timezones -12 to +12 from 1970 to 2030 (tblDoNFM1970_2030) for the date of the nearest full moon to the spawning date in the relevant time zone (date can vary by a day across time zones). A second VBA function uses the date of spawning, timezone, latitude and longitude to calculate the times of Sunrise and Sunset at the site on the spawning date. This uses the algorithm described in NOAA solar calculations day spreadsheet at https://www.esrl.noaa.gov/gmd/grad/solcalc/calcdetails.html. The table of full moon dates for all timezones and a spreadsheet version of the sunset and sunrise calculator are provided as Sunrise_Sunset_DoNFM_Calculations.xlsx for those not wishing to use Access. NOAA indicate that the spreadsheet

calculator should theoretically be accurate to within a minute for sites within the tropics. The database VBA function produces results on average within 6 seconds of the spreadsheet generated times (differences probably due to internal rounding errors when calculating intermediate variables). Thus calculated times appear accurate enough for purpose of benchmarking spawning timing.

Ref_ID   This is assigned automatically in tblReferencesForSpawningObservations and provides a link to the full reference and short reference (for inclusion in tblSpawningObservations) for each group of observations from a published paper or each source of unpublished data. This can be entered at the time of data entry if the reference information has already been entered in tblReferencesForSpawningObservations or added later. The Reference field in tblSpawningObservations uses the Short_ref field as its source once linked by Ref_ID.

Figure S3. Right hand side of the data entry form showing the 4 benchmark fields (DoNFM, DoSRtNFM, Sunrise, Sunset) that can be calculated automatically. Calculating automatically reduces chance of human error.

Fields DoNFM (Date of Nearest Full Moon), DoSRtNFM (Date of Spawning Relative to Nearest Full Moon – days before (-ve) or after (+ve) FM), Sunset and Sunrise can all be calculated automatically in the database using a macro called mcrUpdate_DoNFM_Sunset which runs two Visual Basic for Applications (VBA) functions [AddDoNFM_SpawningObs() and CalcSunset_Sunrise()] stored in the Module SpawningFunctions. These need the Site and Spawning observation data to have been entered in the database correctly (e.g. using the data entry form) to work correctly. The VBA code uses the latitude, longitude, date and time zone to calculate the times of sunset and sunrise on the date of spawning, and the date and time zone to work out the DoNFM and DoSRtNFM using the database table tblDoFM1970_2030 to look up the nearest full moon. The latter table has dates of the Full Moon from 1970 to 2030 for time zones -12 to +12.

For the VBA code to work your version of Access may need to have its "Available References:" updated. To check these click on Create > Visual Basic to open the Visual Basic editor. Then click on Tools > References to check which Available References are checked and thus available.

These should include:

- Visual Basic For Applications
- Microsoft Access 16.0 Object Library
- OLE Automation
- Microsoft Active X Data Objects 2.1 Library (or later)
- Microsoft Visual Basic for Applications Extensibility 5.3
- Microsoft Jet and Replication Objects 2.6 Library

Check any that are missing before attempting to run VBA code in the module SpawningFunctions.

Occasionally spawning times are reported by lunar day – days after the New Moon. To check such dates a database table tblDoNM1970_2030 is included with dates of New Moon from 1970 to 2030 for time zones -12 to +12.

Also included in the database is a macro called mcrSpawningObsAnalysis which uses a query (qryMaketblTmpSpawningObsForAnalysis) and a VBA function (Calc_SpawningTimesRelativeToSunsetOrSunrise) to generate a table called tblTmpSpawningObsForAnalysis (included in the Excel workbook CoralSpawningDatabaseTables.xlsx) where data is reformatted to be easier to analyse. Firstly, the Genus, O_n (open nomenclature) and Species fields are concatenated into a single Taxon field. Secondly, times of start and end of spawning and sunset and sunrise are converted to decimal hours (on a 24h clock). Thirdly, times of start and end of spawning are also benchmarked against either sunset (if spawning starts after 15:00h) or sunrise (if spawning starts after 03:00h), and expressed in decimal hours before (-ve values) or after (+ve values) sunset/sunrise respectively.