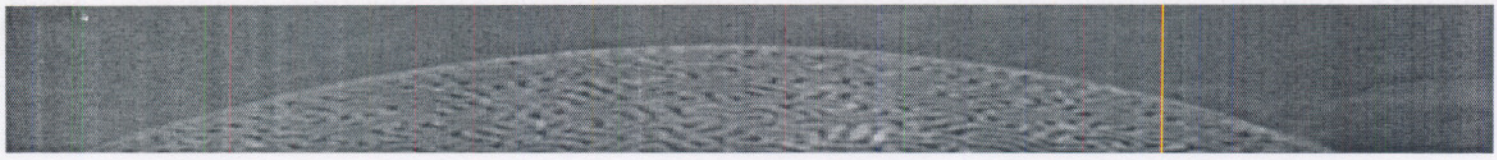

SPAWNING OBSERVATIONS OF CORALS AND OTHER INVERTEBRATES IN AMERICAN SAMOA

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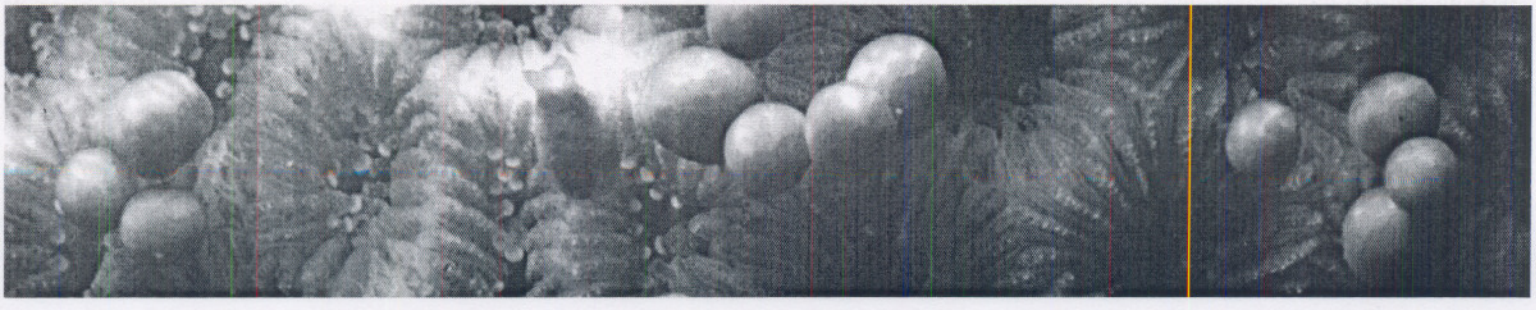
A REPORT PREPARED FOR

DEPARTMENT OF MARINE AND WILDLIFE RESOURCES

AMERICAN SAMOA GOVERNMENT

1999



INTRODUCTION

Sexual reproduction in tropical corals occurs through one of two main processes: Broadcast spawning involves the release of large numbers of gametes (eggs and sperm) into the water column over a short period of time (see Box 1 for a description of the spawning process). The egg-sperm bundles float to the surface where they form distinctive pink slinks that disperse or deteriorate over the next few days. In calm weather these slicks form a foamy brown slick with a distinctive odour. The fertilised eggs develop into planulae (=larvae) within 36 hours, and are capable of attaching to the reef and undergoing metamorphosis after 4 days in a process called settlement (Harrison & Wallace 1990). At this stage the planulae are very small and vary between 0.1mm and 0.7mm in length depending upon the species. Brooding involves internal fertilisation and the release of fully developed planulae.

Research over the past two decades indicates that the majority of corals reproduce by broadcast spawning (Babcock et al. 1986). Coral planulae, whether they are produced by broadcast spawning or brooding, drift at the ocean surface and are carried by tidal and ocean currents around and among coral reefs until they are ready to settle. The patterns of water movement around reefs, particularly isolated reefs, can be very important for the coral recruitment process.

Box 1.
Most broadcast spawning corals are simultaneous hermaphrodites (i.e. each polyp is both male and female). Before spawning, the eggs and sperm within each polyp are packaged into an egg-sperm bundle, which can often be seen inside the polyp (called "setting") just before spawning (Figure 1). Corals may "set" for only a few seconds or for as long as 60 minutes before spawning (Figure 2). Each egg-sperm bundle may contain between 30 and 100 eggs. The bundles float to the surface where they break apart, and the eggs are fertilized by sperm from different colonies of the same species.

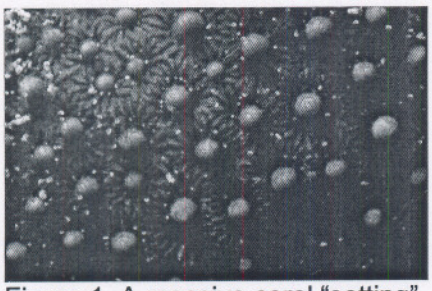


Figure 1. A massive coral "setting" prior to spawning.

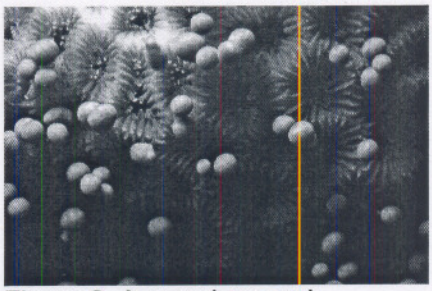


Figure 2. A massive coral releasing egg-sperm bundles (spawning).

Understanding the timing of coral spawning events is important for the management of coral reefs, since this represents a crucial stage in their life history. Of particular concern is the effect of sedimentation on coral recruitment, as planulae will not settle on substratum covered by sediment (Babcock and Davies 1991). Newly settled corals are also very small (Figures 3, 4) and are especially vulnerable to impacts from human activities. Therefore it is important to know when these events occur, so that human impacts which may effect coral settlement can be timed to avoid this period. This is especially important on small islands where coastal zone development is often located immediately adjacent to coral reefs.

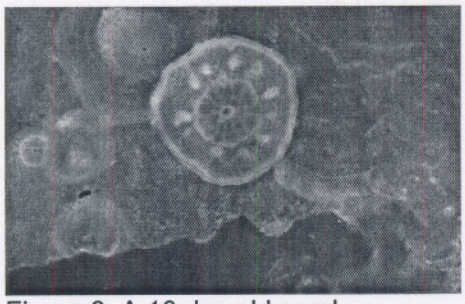


Figure 3. A 10 day old coral (*Montipora* sp)(diameter 0.4 mm)

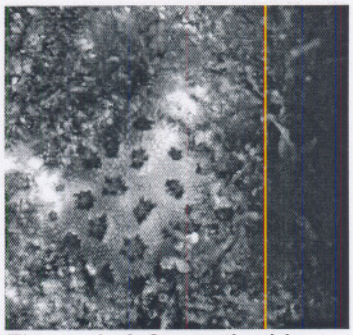


Figure 4. A 3 month old *Acropora spp* (diameter 5mm)

On the Great Barrier Reef and other reefs in the Indo-Pacific, coral spawning takes place once a year during the week following the full moon in late spring or early summer (Harrison et al. 1984). All colonies of each species usually spawn on a particular night during this week, and the timing is predictable from year to year (e.g. *Acropora* spp usually spawn on the 4th night after the full moon, *Platygyra* spp usually spawn on the 5th night etc.). On some reefs such as those in the Red Sea, spawning also occurs around the full or new moons, but is spread over several months rather than just a single month as on Pacific reefs.

Preliminary information suggests that coral spawning occurs in Samoa at the same time as in other locations in the Indo-Pacific ie in the week following the full moon in late spring or early summer. Samoan people have long been able to predict the mass spawning of the palolo worm (*Eunice viridis*) which spawns predictably on the 7th night after the full moon in October or November (Caspers 1984). The palolo "rising" is met with much enthusiasm by Samoan people who consider palolo a delicacy and the event is one of much cultural significance. Traditionally, Samoans used a number of natural signs to predict the palolo rising, including the occurrence of a strong salty odor coming from the ocean, and the

appearance of brown, foamy scum or slicks on the surface of the ocean a few days before the event (Itano and Buckley 1988). Preliminary observations by Itano and Buckley (1988) have confirmed that these slicks appear to be comprised of coral spawn, probably the result of broadcast spawning of several common coral families including Poritidae, Acroporidae and Faviidae. However, their observations were based primarily on circumstantial evidence (ie the appearance of eggs in the water, and the disappearance of eggs from coral tissues) with few direct observations of colonies actually spawning. The objective of this study was to expand our knowledge of coral spawning in American Samoan by obtaining direct observations of coral spawning for a range of common species.

METHODS

This study was done opportunistically while the authors were engaged in a survey of the coral assemblages of American Samoa (Mundy 1996). Coral spawning observations were made on five nights from November 9 to 13, 1995, which spanned three to seven days after the full moon.

On the first four nights, observations were made on the reef at Faga'alu at the entrance to Pago Pago Harbour on Tutuila Island (Figure 5). This site was chosen because of the high diversity of coral species in a small area, and because of its accessibility in the prevailing weather conditions. Corals at Faga'alu were examined for the presence of eggs in the week before the full moon, and again on each day of the predicted spawning period (3 to 7 days after the full moon). Developing eggs are normally opaque, but become coloured in the week prior to spawning. The presence of pigmented (coloured) eggs is a good indication that spawning will occur within a week or two. Based on published data from the Great Barrier Reef (Babcock et al. 1986) and the species present at Faga'alu, observations were made in the shallow lagoon (< 3m) on the first two nights (3rd and 4th nights after the full moon) and on the reef slope at 10m on the next two nights (5th and 6th nights after the full moon).

Each evening, we arrived at the study site just prior to dusk (1800 hrs). Species that were most likely to spawn on that evening were tagged and monitored by two to three divers for 3 - 4 hours after dusk. Most corals are very sensitive to light during spawning, and often they will not spawn if there is too much light (i.e. light from a bright torch). However, after a coral

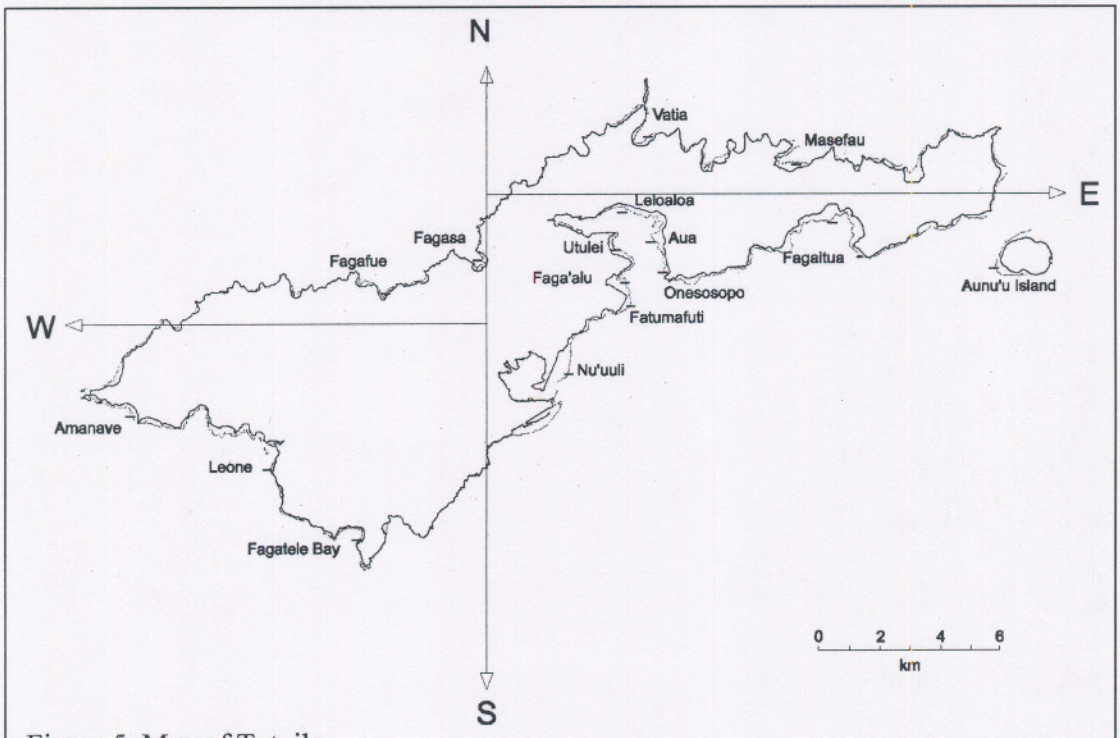


Figure 5. Map of Tutuila

starts to release egg-sperm bundles bright light has little effect on most corals. In addition to regular checks on the tagged corals using a weak light, the divers monitored other corals in the area for signs of spawning. When a spawning coral was observed, the coral was identified and the exact time and date noted onto underwater paper. Observations of spawning by any other animals were also recorded in the same manner as for corals.

RESULTS

Coral spawning observations

A total of seven coral species from five families were observed spawning at Faga'alu during the period from November 9 to 12, 1995 (Table 1). Only one species, *Porities cylindrica* was dioecious (separate male and female corals) which release clouds of eggs and sperm from different corals. The remaining six species were hermaphrodites (individuals are both male and female), and either released egg-sperm bundles, or eggs and sperm separately from the same polyp. Prior to their release, egg-sperm bundles could be clearly seen in the mouth of the polyp ("setting" – see Box 1 above). Details of spawning observations for each species are described below. No photographs were taken of coral spawning at Faga'alu, however the spawning was typical of coral spawning in the western pacific (Figure 6).

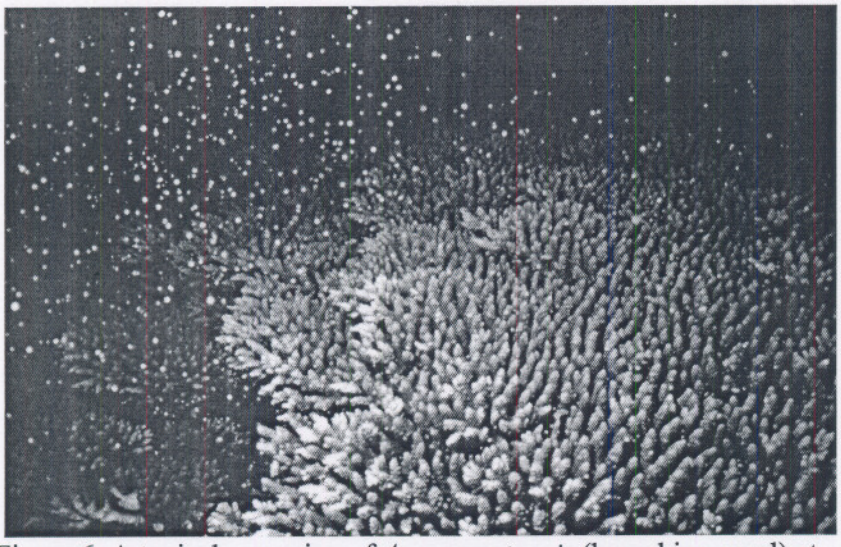


Figure 6. A typical spawning of *Acropora tenuis* (branching coral) at Magnetic Island, Townsville, Great Barrier Reef

Porites cylindrica (Family Poritidae)

Porites cylindrica is a branching coral with short, smooth finger-like branches, and often forms large dome shaped structures (2-10m in diameter). Fifteen to twenty *P. cylindrica* colonies were observed releasing milky clouds of sperm in the shallow lagoon site at Faga'alu on the third night after the full moon. At 2035 hrs (2:15 after sunset), most of the corals spawned simultaneously with a few spawning over the next 20 minutes. At times these clouds were so dense as to reduce water visibility in the vicinity of the corals. *P. cylindrica* is dioecious (separate male and female corals), although no female corals were seen releasing eggs.

Acropora formosa (Family Acroporidae)

This species is often called staghorn coral, and forms large thickets (each 4-5m in diameter) in the shallow lagoon at Faga'alu. *Acropora formosa* was observed spawning from 2020-2120 hrs (2 –3 hours after sunset) on the fourth night after the full moon. However, egg-sperm bundles were only released from small patches within each colony (approximately 25% of total colony area). This species is hermaphroditic, and egg-sperm bundles were clearly seen setting along the branches for approximately one hour prior to release. Egg-sperm bundles were orange and approximately 1 and 2mm in diameter. The remaining parts of the staghorn corals did not spawn, and no pigmented eggs were found in the polyps in this part of the coral.