Incubation period and indicators of the faunal assemblage

Joe K Kizhakudan, Shoba Joe Kizhakudan and Remya L.

The ARs act as source of food, shelter, refugia, stopover, attachment surface or substratum and proximity to the ecosystem community and food web. However, the actual cues which lead the multitude of species towards the AR structures are still under investigation. Many attribute it to the visual cues, the height of the structures, the assembly of the structures, acoustic signals, light and fluorescence, chemical cues and the community structures and assembly itself. The age of the reef can determine the type of communities in an AR site. The initial communities rapidly change during colonization and succession.

Three phases of colonization can be identified in an AR –

i. Pioneer settlement phase
ii. Barnacle/mussel dominant phase
iii. Regressive phase.

During these phases the substrates shift, soft sediments add on, and species diversity increases. The initial rise in colonization and a number of species later declines and stabilizes at an equilibrium, after which only cyclic changes take place in the composition.

Once the AR modules are deployed, in 30-45 days, **primary settlement** of epibionts like periphyton, larval stages of molluscans, barnacles and echinoderms and nematodes takes place. The settling sediments, particles and organic matter give a perfect substratum to support bacterial colonies along with protists, sponges and ascidians, and algal spores to build upon them. The primary settlers include –

A. Sediments, bacteria, and microbes.
B. Diatoms and periphytons - *Amphora* sp., *Bacillaria* sp., *Cocconeis* sp., *Navicula* sp., *Nitzschia sigma*, *Paralia* sp., *Rhoicosphenia* sp., *Synedra ulna, Thalassiosira* sp., blue green algae, cyanobacteria, heterotrophic microbes, and detritus.
C. Protozoans, foraminiferans and ciliates.
D. Invertebrate larvae - trochophore, tornaria, veliger, glochidium, planaria, auricularia, bipinnaria, zoea, megalopa etc.
E. Post larva, spats, seed, crablets, etc.

The planktonic stages of planktotrophic species swim and float for sufficient time till they identify a suitable substratum and settle down in the competent phase (which can be delayed)

which gives them a long survival life in the larval phase. Truly demersal larvae metamorphose quickly and settle down and start consuming the detritus, fungi, and algae.

These assemblages happen quickly in our waters and hence the secondary consumers and small predatory fishes and plankton feeders assemble in rapid succession.

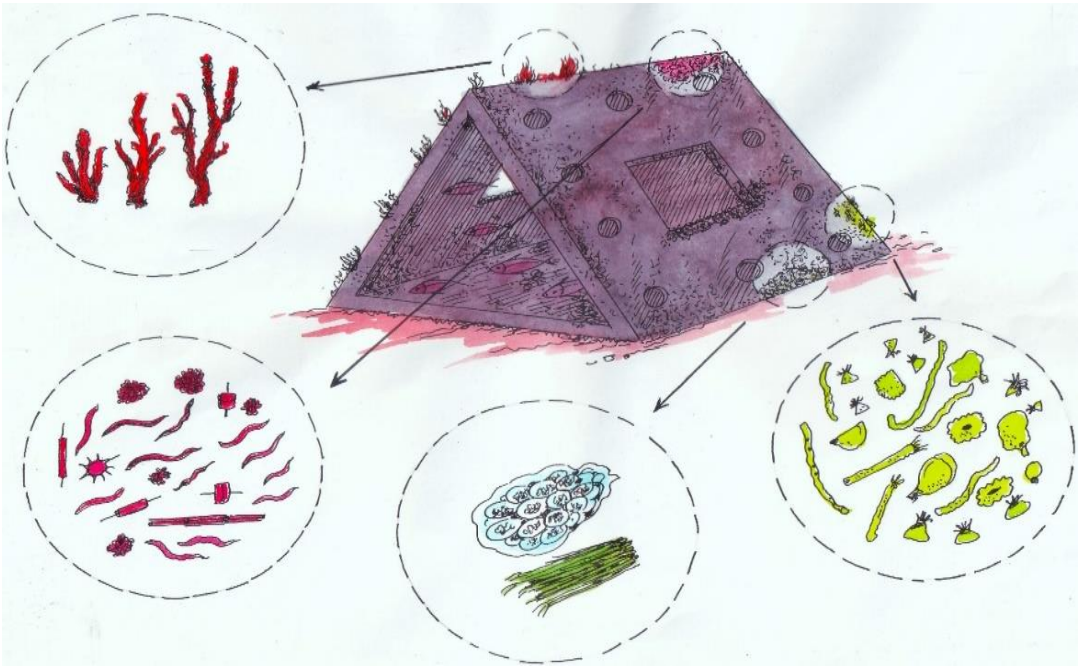

Fig. 43. Fauna assemblage indicators

The secondary succession (45-90 days post-deployment) follows with the growth of molluscans, polychaetes and nematodes converting the detritus, and the diatoms and bacteria creating the nutrient availability for more food and space for the primary settlers.

1. Nematodes and polychaetes dominate the recycling assemblers
2. Molluscans and barnacles and algal mats grow out
3. Sponges, ascidians, bryozoans, amphipods, ostracods, mysids, copepods, harpacticoids, hydroids and macro alga, coralline alga expand
4. Echinoderms, tardigrades, chaetognaths, caridean shrimps and crabs
5. Fish larvae and fry, zoea, nauplii, salps, doliolids and ctenophores create the ambience.
6. Gobiids, porcellanids, gammarids, galatheids, sea lilies, and brittle stars multiply and flourish on the surfaces.

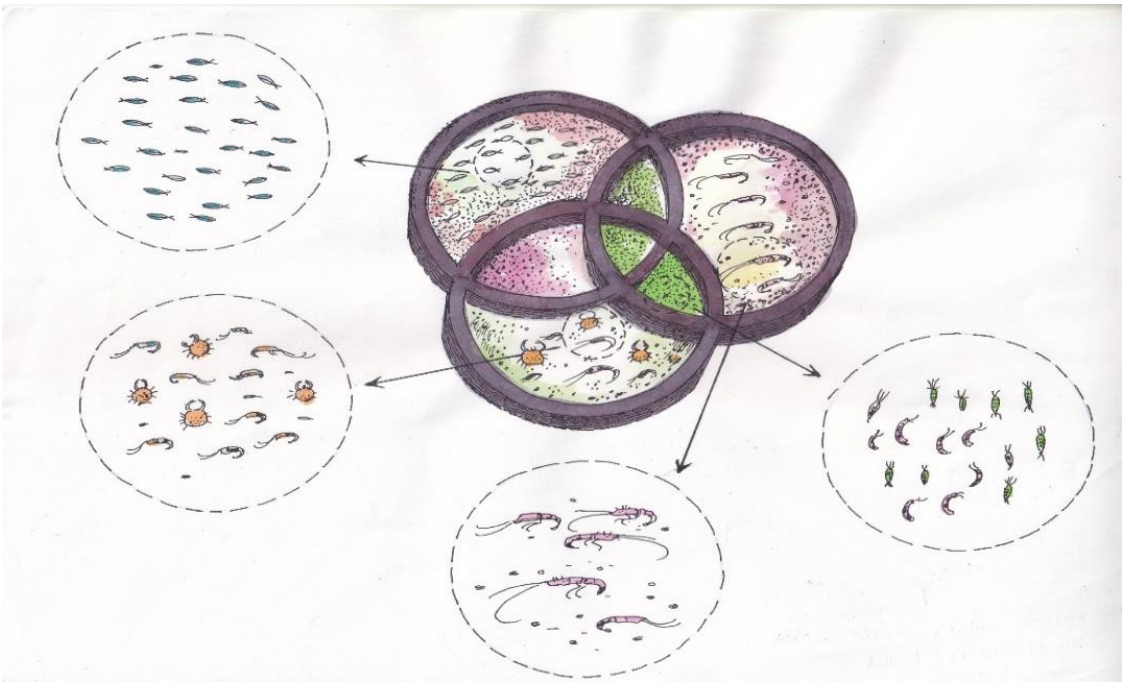

Fig.44. Fauna assemblage indicators

The tertiary settlers (3-6 months post-deployment) are mostly the permanent residents, refuge-seeking tenants and hiding populations, and include rays, *Amphioxus* sp, camel shrimps, spiny lobsters, larger crabs and crustaceans, serranids and lion fishes, scorpaenids, goat fishes, breams, zanclids, pomacanthids, sea horses and sea lilies, butterfly and squirrel fishes, sergeants and trigger fishes, wrasses and parrot fishes, puffer fishes, eels, starfishes, cardinals, damsels, perches, carangids and siganids.

Fig.45. Electric ray in an artificial reef site

The quarternary successors (4-8 months post-deployment) are the forage community (mackerel, scads, trevallies, barracudas, small tunnies, perches, breams, silver bellies, biddies) and benthic feeders. Many are residents, while others are temporary migrants frequenting the reefs for nursing, feeding and shelter during their grow-out phases. The small tunas and barracudas move out after a particular size, the seer fish move out after feeding, bigger perches move out as a thinning of the population over the reef, gobiids move out as they multiply, octopuses and spiny lobsters settle down while breams, surgeons, siganids and sergeants remain resident, around the reef but not necessarily in contact with the reef.

Fig. 46. Juveniles of the golden trevally, *Gnathodon* sp. and snappers and breams seen in artificial reef sites

Fig 47. Giant snappers and groupers resident to the reef fish and pipe modules and crustaceans and echinoderms in the well ring modules

Fig. 48. Recruitment of cardinals, snappers, damsels, pempherids, breams, squirrels, siganids and surgeons

The penultimate entrants are the giant groupers, perches, giant trevallies, grunters, sharks, cobia, seer fish and barracudas which are top predators; very few remain residents like the groupers, grunters and snappers while the others stop over only for feeding and hunting and move on.

Fig. 49. Larger snappers, trevallies and groupers in artificial reef site as bottom dwellers and settlers

The final groups are the visitors and long-distance migrants like whale sharks, hammer head sharks, dolphin fishes, bigger barracudas, tunas and cobias.

Fig.50. Whale shark spotted in an artificial reef site in Tamil Nadu

Fig.51. Faunal assemblage in an artificial reef site

The first and second years will show a very sharp rise in foraging pelagic fishes and barracudas; subsequently, the predator settlements in the reef bring about a balance in the reef populations, which remain more or less in equilibrium unless there is some serious impact or exploitation of certain communities. During the third to the seventh year of a well-developed and managed reef, the fishery output remains more or less steady and unaltered, unless there are damages or sinking of reef structures or increased exploitation in the reef site. Therefore, more expanded areas under AR will be beneficial.

The good health indicators of a reef in its developmental stages are -

1. Good fish catches in drift gillnets in the surrounding in the first six months of deployment.
2. The improving catch rates of scads and horse mackerel and mackerel in hook and lines fishing
3. The improving collection of perches and breams
4. The improving catch rates of the goatfishes, sciaenids and siganids in the set gill nets in the surroundings of the reefs
5. The tertiary and fourth succession are indicated by the catches of small groupers and perches in baited hooks and the capture of bigger trevallies
6. The capture of fresh live baits every season is an indication of the population underneath.
7. The shoaling of sharks and barracudas and cobias over reefs indicates good forage assemblages
8. The visits of whale sharks and small tunnies indicate the abundance of small forage fishes and plankton, and physical cues released from the reefs to distant water (sight/light/acoustic)
9. The surface shoaling of the bat fishes with their dorsal fins emerging out of the water shows a good healthy reef community underneath.