

Status, Prospects and Potentials of the Commercially Important Species of Sea Urchin, *Tripneustes gratilla* (Linnaeus 1758) in Malaysia

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Abstracts: The collector sea urchin, *Tripneustes gratilla* (Linnaeus 1758) is one of the sea possessions, which has been used as luxury food (i.e., prepared from the gonad) for certain countries. It is not only used as food but also as medicines. Sea urchin has become one of the most important products and fetches high price in international market and thus provide an important employment and income source to the coastal communities in many Pacific island countries including Malaysia due to having higher protein contents, and nutraceutical and pharmaceutical compounds. Nowadays, sea urchins have been harvested for trade with Asia and are perhaps one of the worthy exports from the Indo-Pacific islands. Unfortunately, due to increasing demand and prices, combined with the development of cash economies and growing coastal populations in many islands, it has led to extensive overfishing of the resource across much of this region especially in Pulau Bum Bum and adjacent areas near Semporna between Sabah and Philippines. Nevertheless, there is a high level of interest in adoption of aquaculture and stock enhancement techniques to restore production levels, but different capacity levels require execution of different procedures. Some Pacific island countries and territories have completed research trials of hatchery, nursery and culture techniques, but such types of research are still in the primitive stage in Malaysia. Issues that work in favor of successful aquaculture include pristine marine environments, long familiarity with sea urchins as a commodity, and traditional marine tenure systems that in some places can provide a basis for management of released sea urchins. Presently, the over-exploitation of sea urchin turns out to be excessive and disturbs its sustainability. Under such circumstances, aquaculture through the appropriate broodstock management, seed production and grow-out culture techniques in captive rearing system should be the best alternative to prevent this serious problem to a greater extent.

Keywords: Sea urchin, Roe, Potentials, Culture, Nutraceuticals, Pharmaceuticals

I. INTRODUCTION

It has been documented a lot of different benthic invertebrates in the marine ecosystem. The sea urchin is one of them that have calcareous tests and moveable spines.

Approximately there are 1,000 species of sea urchins that have been existed in different marine habitats as well as in the Arctic Sea and Antarctic Ocean [1]. Sea urchins are the important marine resources in Malaysia and also have long been regarded as an important part of Malaysia's marine heritage due to their rich biodiversity and commercial value. Several ecological studies have been conducted aimed at documenting the distribution and abundance of sea urchins in Malaysia. Until now, twelve species have been identified on Malaysian coral reef communities such as *Diadema setosum*, *Echinometra mathaei*, *Astropyga radiata*, *Toxopneustes pileolus*, *Echinothrix calamaris*, *Echinothrix diadema*, *Parasalenia gratiosa*, *Salmacis sphaeroides*, *Diadema savignyi*, *Pseudoboleia maculata*, *Tripneustes gratilla* and *Salmaciella dussumieri* [2–6].

Traditionally, three extant species of the genus *Tripneustes* (Agassiz 1841) have been documented. These are: *T. gratilla* (Linnaeus, 1758), *T. entricosus* (Lamarck, 1816), and *T. depressus* (Agassiz, 1863). Among them, the world's most commercial species, *T. gratilla* (Fig. 1.), occurs in Pulau Bum Bum (Fig. 2) and adjacent areas near Semporna between Sabah and Philippines [6]. It along with other sea urchin species have profound biological, ecological, aquacultural, conservational, nutritional and pharmaceutical importance, but yet to be completely explore and utilize in Malaysia [3–5, 7] Therefore, the purposes of this work were to investigate the status and potential of sea urchins, and to document the edible sea urchin species that have emerging importance for aquaculture production, species conservation as well as nutraceutical and pharmaceutical product development in Malaysia.

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Fig. 1. Adults of the commercially important tropical sea urchin, *Tripneustes gratilla*.



Fig. 2. Geographical location of Pulau Bum Bum, Sabah, the eastern Malaysia.

II. IMPORTANCE AND STATUS

Sea urchins are generally harvested by various countries such as Japan, France, Chile, the northeastern United States, the Canadian Maritime Provinces and the west coast of the North America from the California to British Colombia and are processed for marketing by eliminating the gonads, which are the most important constituent of the fleshy tissue. The processing gonad of sea urchins commonly referred to as "Sea urchin Roe" is used as raw material to produce foodstuff, and also is considered to be a prized delicacy in Asian, Mediterranean and Western Hemisphere countries [2–5, 7–9]. The sea urchin gonads, either fresh or in the form of processed food, have long been using as luxury foods in Japan [5, 7, 10, 11] and its roe can be retailed for as much as

AU\$450/kg thus making it one of the most valuable sea foods in the world [12]. The population of the Asian Pacific Region has also been using it for a long time as a remedy for improving general living tone, treatment for a number of diseases and strengthening of the sexual potency of men, especially the middle aged peoples [13, 14]. However, the higher levels of AA (arachidonic acid) and EPA (Eicosapentaenoic acid) recently detected in sea urchin gonads, supported the development of aquaculture of this urchins [15], since PUFAs are important for human nutrition [16].

The world sea urchin fishery industry is focused in Japan since a very long time ago. Japan is the world's largest importer and consumer of sea urchin "Roe" [17, 18]. The

United States has become the largest supplier of sea urchins and processed roe to Japan. The price of Sea urchins roe is especially high in Asia, Mediterranean and Caribbean countries [19]. Sea urchins are basically imported by Japan from the Southeast Asia, Indonesia, Philippines and also from Vietnam [1, 18].

In recent years, global Sea urchin fisheries have expanded so greatly that the natural population in Japan, France, Chile, the north-eastern United States, the Canadian Maritime Provinces, and the west coast of North America from California to British Columbia have been overfished to meet the great demand [4, 5, 7, 20, 21]. Most, if not all, sea urchin fisheries have followed the same pattern of rapid expansion to an unsustainable peak, followed by an equally rapid decline. World landings of sea urchin, having peaks at 120,000 mt in 1995, are now in the state of about 82,000 mt [22]. These decreasing patterns clearly reflect the overexploitation of most fishery grounds and highlight the need for conservation policies, fishery management and aquaculture development.

III. PROSPECT AND POTENTIALS

Tripneustes gratilla (Linnaeus, 1758) (Echinodermata: Echinoida: Tripneustidae) or collector sea urchin, one of the commercially important regular echinoids, has a circumtropical distribution extending into the subtropics. It occurs most abundantly throughout the Indo-West Pacific, where it can be found from east Africa (Red Sea to Natal), the South Sea Islands (from the Norfolk and Kermadec Islands to the Marquesas and Hawaii), and from Australia (to Port Jackson on the east coast and Sharks Bay on the west), to southern Japan (with the Bonin Islands) [23]. It can also be found in the warm tropical regions including Pulau Bum Bum near Sempurna, between Sabah and Philippines. It is most common in very shallow water on a variety of hard substrates and is found at the depths of 2 to 30 meters [23]. It grazes near the substrate, and their diet comprises of algae, periphyton, and seagrass. A maximum size of 160 mm TD is reported, which corresponds to an age of four to five years. It has long tube feet and is often seen carrying all kinds of things from shells to seaweeds to cover their presence from predator such as sea otters, sea gull, trigger fish and snails. The season of spawning by *T. gratilla* varies. It has been reported in the spring and fall at the Great Barrier Reef [24], the winter in the northern Red Sea [25–27], the summer off Japan, autumn in the Philippines and at Taiwan [28]. However, in the tropical area like Malaysia, it usually breeds throughout the year (Rahman unpub. data).

Sea urchin usually used to make traditional delicacy known as “Oku-Oku” or “Ketupat Tehe-Tehe” whereby glutinous rice is put into degutted urchin test and boiled with coconut milk or water, and after adding spices, the concoctions are steamed and then serve to the guests and customers [2, 3, 5, 7,

29]. This delicacy is usually prepared for special events such as Lepa-Lepa festival, wedding ceremony and other cultural events, and is being treated as valuable fishery resources, especially by Bajau people in the Sabah state of the eastern Malaysia [6]. However, the custom of consuming sea urchin gonad is thought to come from the influence of Filipino and Indonesian people that live in Sabah. Although sea urchins are always treated as the “enemy” especially by divers and snorkelers since their spines could cause serious injuries to them, Sabah citizens still treat sea urchins as a traditional delicacy and source of subsistence income.

IV. CONCLUSION

From the above discussions, it should be concluded that sea urchins can play an important role in providing subsistence income and health benefits to the coastal communities in Malaysia. However, very few systematic works have been done on the abundance, distribution, breeding, development and population growth patterns of some non-commercial species of echinoids (e.g., *D. setosum* and *S. sphaeroides*) in Peninsular Malaysia [3, 9] but no published information on the breeding, nursing, seed production and culture techniques are available in the high-valued sea urchin, *T. gratilla*. Due to the higher nutritional and pharmaceutical values of sea urchin gonads [30], it is very essential to develop the appropriate techniques for captive breeding, larval rearing, seed production and grow-out culture protocols of *T. gratilla* in Malaysia to a greater extent in commensurate with the national and international demands. In view of this a research project have been initiated from July 2015 and until now, we are successful in producing a good number of 3-month old juveniles (stocking size in grow-out culture) (Fig. 3) through the development of captive breeding, ontogenic development, larval rearing and metamorphosis. The resulting juveniles have successfully been cultured up to 1 year old adults (Fig. 4) at different stocking and feeding regimes to find out the most appropriate techniques for the maximum growth and sustainable aquaculture production.



Fig. 3. Three-month-old juveniles of *T. gratilla* for grow-out culture.



Fig. 4. One-year-old adults of *T. gratilla* produced under captive rearing condition.

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