2. MARICULTURE

2.1 INTRODUCTION

Certain marine species can be successfully farmed, so producing valuable items for local or international markets. Broodstock of the species involved has to be collected from the wild in the first instance, but true mariculture involves development of captive breeding so that in the long term the operations can be run with virtually no collecting taking place. Although the farms generally take pressure off wild stocks, they need to be carefully designed and operated, in order to prevent environmental damage.

Currently, development of mariculture in Sabah is still in its initial phase (Komilus *et al* , 2000), consisting of (in order of importance), culture of tiger prawns (*Penaeus monodon*) in brackish water ponds, fish culture in cages, fish culture in brackish water ponds, seaweed culture and mollusc culture.

Extensive shallow areas of the proposed park are used for seaweed culture, and the area is also a source of juvenile and adult live fish for cage culture near Semporna town. A pearl farm was operating in the Bodgaya-Boheydulang lagoon between 1963 and 1993, and may be restarted. The Management Plan for the proposed Park also recommends establishment of a giant clam farm to produce these endangered species for sale and for re-introduction onto the reefs.

Figure 29. Seaweed farming provides jobs for many families in the proposed Park

Figure 30. Seaweed attached to strings for growth in the sea

Figure 31. Seaweed drying on a platform on the Sebangkat reef top.

Figure 32. Bagged seaweed ready for transport to Semporna

Figure 33. Giant clam culture is a feasible proposition for the proposed Park

Figure 34. A few pearl oysters are still maintained in the Bodgaya lagoon

Figure 35. Giant clams have been over-exploited and cultured clams could help to re-stock the reefs.

2.2. SEAWEED CULTIVATION

[Details from Komilus *et al.* 2000, unless otherwise credited].

Seaweed culture in Semporna has a long history since its inception in the late 1970s. In 1978, a US-based consulting company was appointed by the Department of Fisheries (DOF) Sabah to carry out Research and Development on the culture of *Euchema cottonii* in Semporna. Seaweed farming was given priority by DOF Sabah as a supplementary income-generating activity among the fishing community with the establishment of a demonstration farm within the SIP area in 1980. More people have gradually become involved in seaweed farming. For example, the residents of Pulau Selakan began seaweed farming in mid-1994, and since then it has grown and is flourishing as it provides a good income. Many of the Bajau here have switched from fishing to seaweed cultivation.

The main species cultured used to be *Euchema cottonii* and *Euchema spinosum*, but farmers have stopped culturing the latter as exporters prefer *E. cottonii* because it fetches better prices.

2.2.1. Location

Seaweed culture plots are found mostly on the extensive 'reef top platform' to the north of Sebangkat and Selakan, and also at various locations off Pu Bodgaya and Pu Boheydulang. There have been plots off Sibuan and Maiga but these are not currently operating. Komilus *et al.* (2000) report that Lembaga Kemajuan Ikan Malaysia (LKIM - The Malaysian Fish Development Board), through the Department of Fisheries Sabah is planning to take up seaweed farming at Sebangkat, where it has applied for a Temporary Occupation Licence (TOL) for 200 acres (80 ha).

2.2.2. Culture System

The culture system commonly used within the proposed Park is the long-line method, which is suited to the deeper water conditions of the islands (Komilus *et al.* 2000). Farmers stretch nylon monofilament long-lines (0.5 mm diameter) across the farming area, commonly around 200 yards (200m) long. One seedling of seaweed is tied to the line at 1-foot (30cm) intervals. A total seedling weight of 100-200g is tied, and the harvesting is every two months, by which time the plant is 1-3 kg in weight. Apart from the seeding and harvest, this culture system requires minimal maintenance. The main jobs are removal of foreign materials, attention to the long-line floats and moorings, removal of any dead or fungal affected plants, and some predator control.

2.2.3. Seaweed production and economic value

The harvested seaweeds are sun-dried after cleaning. In normal weather, it takes 4 days to sun-dry the seaweed to around 35% moisture content. Approximately 9 kg of wet seaweed produces around 1 kg of dry seaweed. Field surveys indicate an average yield of around 10-15 metric tons dry weight/ha. After drying, the seaweeds are sold to local buyers for export.

An average of RM600 to RM1,400 could be obtained from a good harvest, which is equivalent to between RM 300 to RM700 per month (Komilus *et al.* 2000). According to Baptist *et al* (1998) a seaweed cultivator can earn from RM600 – 800 per month. To add to their income, these farmers may fish on a part-time basis.

Seaweed culture requires low capital investment and has a fast turnover with good returns. Realising its value, the Department of Fisheries has encouraged seaweed culture around the islands in the proposed Park, and gives some assistance in terms of seedlings, mono-line rope (tie-tie) and floats. Fuel has to be purchased, but most of the costs are non-cash costs in the form of family labour.

2.2.4. Constraints

The Department of Fisheries Sabah has identified a number of constraints and problems which need to be addressed in order that the full potential of seaweed farming can be realised. The DOF stress that government support and guidelines are needed for example in infrastructure provision, marketing, setting up of local processing plants and regulation of the industry. The Department suggests that local Sabahans should be encouraged to get involved in seaweed cultivation, and also stresses the importance of diversification to include other forms of mariculture (see below).

2.3. LIVE FISH: CAGE CULTURE

The demand for live fish both in Sabah and for export has grown rapidly over the last few decades and high prices are paid. There are a small number of fish cages close to the Semporna mainland, but no hatcheries in the vicinity. None of the cages is located in the the proposed Park, but all the fish kept in cages are brought in from the wild (i.e. not true mariculture), with some being caught in the proposed Park.

2.3.1. Types of cage culture

Komilus *et al.* 2000 report that there are two types of cage culture in Semporna, one dealing with adults (holding cages), the other with individuals that have yet to reach marketable size (cultivating cages).

Holding cages: the fish are mainly for export and the average length of time the fish are held in cages is 2-10 days. The marketed size is commonly between 0.5 to 1.5 kg.

Cultivating cages: the fish are fed and grown over periods ranging from 3-12 months (occasionally more). The stocking size ranges from 0.1 to 1.0 kg while the marketed size is between 0.5-1.5 kg. Operators involved in culture may then sell fish to those involved in holding (particularly if the operators are small-scale farmers/fishermen).

The fish are fed with trash fish obtained from local trawlers, with feeding rate depending on the availability of trash fish and total body weight. Market size fishes are fed at 2 - 4% body weight/day.

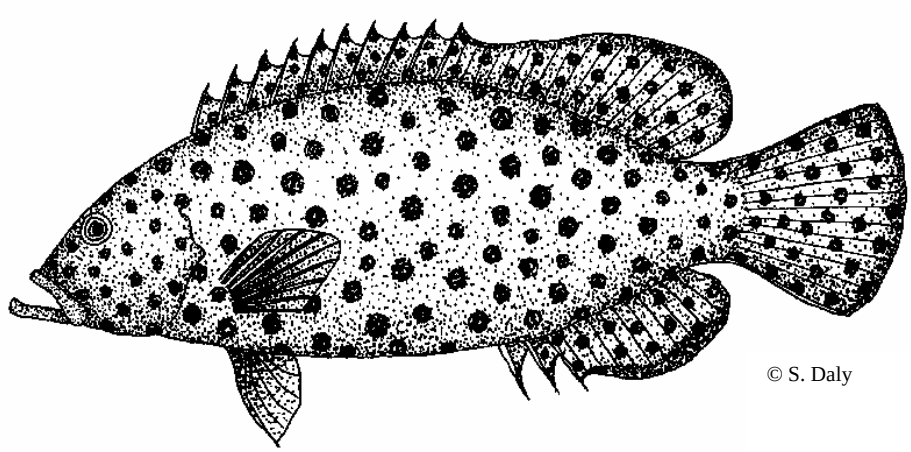
In 1999, there were at least 3 active marine cage culture operators based near Pulau Bum-Bum. In contrast, there were at least 8 operators in 1998 with 18 cages (8,200 m^3 total size) in full operation. Some of the operators were forced to close down in late 1988 due to unfavourable fingerling supply (Komilus *et al.* 2000).

2.3.2. Capture methods and target species

The target species are mainly groupers, wrasse and lobsters. Most of the fish are caught using portable or static traps (e.g. bubu; kelongs). There are also reports of illegal use of cyanide as an 'anaesthetic', but this is done covertly and is difficult to detect. The SIP diving team saw live fish being caught with a hookah system (compressed air supplied from a surface compressor), but it was not clear if cyanide was being used.

Common name	Scientific name
Greasy grouper	*Epinephelus coiodes*
Dusk tail grouper	*Epinephelus bleekeri*
Leopard coral trout	*Plectropomus leopardus*
Mouse grouper	*Cromileptes altivelis*
Vermillion grouper	*Cephalopholis miniatus*
Tomato rock cod	*Cromileptes sonneratti*
Green wrasse	*Choerodon schoeleinii*
Bigeye kingfish	*Caranx sexfasciatus*
Napoleon wrasse	*Cheilinus undulatus*

Table 15. Marine cage culture species in Semporna (from Komilus *et al.* 2000)



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2.3.3. Fish culture production and economic value

The annual yield from marine cage culture operations in Semporna ranged from 8 mt in 1994 to 7.19 mt in 1998, with a peak of 24.7 mt in 1997. The corresponding wholesale values were RM 0.32 million, 0.24 million and the peak of 1.15 million in 1997 (Komilus *et al.* 2000). Price of individual fish depends on size and species. The most expensive are the panther grouper *Chromileptes altivelis* and the bumphead wrasse, *Cheilinus undulates.*

Family/species	Price RM/Kg
SERRANIDAE	
Cephalopholis miniata	10.00
Cromileptes altivelis	50.00
Ephinephalus tauvina	28.00
Plectropomus areolatus	32.00
P. laevis	32.00
P. leopardus	20.00
P. maculatus	18.00
P. oligacanthus	20.00
Variola albimarginata	
LUTJANIDAE	
Lutjanus argentimaculatus	2.50
L. bohar	3.50
L. gibbus	2.50
L. rivulatus	32.00
L. sebae	3.50
Symphorus nematophorus	15.00
LABRIDAE	
Cheilinus undulatus	50.00
CARANGIDAE	
Alectis ciliaris	2.50
Carangoides gymnostethus	(only large size)
C. fulvoguttatus	

Table 16. Price list for some live fish marketed to Semporna. Source of information: Pulau Bodgaya (Kg Boheybual), Pulau Boheydulang (From Suliansa, 2000).

2.3.4. Constraints

Komilus *et al.* 2000 report that among the problems and constraints identified in marine cage culture operations in Semporna are the following:

Fish disease
Common disease occurrence mainly reddish skin, abdominal inflammation, red boil and others include fin rot involving *Myxobacter* sp. and *Vibrio* sp. and *Brooklynella* sp.

Social conflicts
Theft and poaching from marine cage culture operators is common in the SIP area. At present, all the farms had arranged for a night watch to resolve the problem.

Fry supply
Shortage of fingerlings is an acute problem with total reliance on the capture of wild fingerlings from offshore reefs, including those within the proposed park. SIP area.

2.4. THE POTENTIAL FOR ESTABLISHING A GIANT CLAM FARM WITHIN THE PROPOSED SEMPORNA ISLANDS PARK

This section is based mainly on a report produced for the Semporna Islands Project by Don Baker, a specialist in giant clam cultivation based in Kota Kinabalu, and with added information from Mark Wilson, Hatchery Manager at the Tropical Marine Centre, UK.

2.4.1. Summary

There have been no attempts as yet to carry out any farming of giant clams in the proposed Semporna Islands Park. However, a feasibility study has indicated that it would be a viable, low impact form of mariculture very suitable for the area. Like seaweed farming, this type of mariculture can easily be carried out by local communities, and would provide economic and conservation benefits.

Either Pulau Selakan or Pulau Maiga are recommended as suitable sites for the hatchery and nursery. Seed shells from here would then be provided to the giant clam farmers for grow-out in the wild. Apart from the use of the clams for food and shells, the scheme could also produce specimens for re-stocking the reefs. Another possibility would be to supply live juveniles for the aquatic trade, where there is a high demand for quality specimens which have been cultured rather than taken live from the reef.

2.4.2. Background and rationale

Giant clams (Family Tridacnidae) occur throughout the Indo-Pacific, and are valued for food and for their shell. Years of uncontrolled harvesting have severely depleted populations of giant clams in many parts of their range, and there have even been local extinctions as a result of this long-standing pressure. It is for this reason that they are listed in Appendix II of the Convention on International Trade in Endangered Species, which means that international trade can be carried out only under permit.

Stocks of giant clams in Sabah, and specifically in the proposed Semporna Islands Park, have declined as a result of heavy collecting over many years (further details are in *An Atlas of the Coral Reefs of the Semporna Islands*). The largest giant clam species (*Tridacna gigas*) has been so badly affected that only a few individuals are thought to remain around Sabah's coasts and offshore reefs (Baker, personal observations).

It has been recommended in the Management Plan that collection of giant clams from the wild should no longer be permitted within the Semporna Islands Park, but that it may be possible to establish a giant clam farm, the aims of which would be to provide specimens for food and sale and to re-stock the reefs. It would be the first giant clam farm for Sabah and could act as a flagship project, encouraging other ventures to start up elsewhere in the State. Such a project would also bring socio-economic benefits and has the added advantage that, unlike some other forms of mariculture, it would have minimal environmental impact. The fact that giant clam juveniles require no supplemental feeding makes this mollusc an ideal candidate for mariculture. No other cultured seafood is similar. They do very little filter feeding because the primary source for their sustenance comes from the photosynthetic by-products released by their symbiotic algal "partners."

Giant clam sea farming has been carried out in the Pacific and Indian Oceans for the past 25 years. Some success has been achieved in getting private sector business and village communities to adopt this type of sea farming as a form of alternative fisheries protein supplement. Giant clam farms that are currently operating are selling mostly cultured *Tridacna maxima*, *T. crocea*, and *T. squamosa* juveniles as high value marine aquarium trade specimens. Few active giant clam farms are concentrating on the larger species (*T. gigas* & *T. derasa*) for food, but this has good potential.

2.4.3. Site suitability

The essential ingredients for rearing of giant clams are clean, clear water, stable conditions, natural sunlight, and security against poaching and predators. The proposed Semporna Islands Park is one of the most appropriate of several possible, mainly offshore, sites in Sabah that meet these criteria.

The islands of Selakan or Maiga are seen as the most suitable locations for the holding tanks because they are already inhabited, so can provide a workforce and security. Also, this would leave the uninhabited islands of Sibuan and Mantabuan quiet and undisturbed, as recommended in the Management Plan.

2.4.4. Broodstock procurement, culturing and grow-out methods

Though the largest giant clam *T. gigas* has been targeted as the lead species for use in the development of small scale food fisheries enterprises for local fishermen, the second largest species and second fastest growing giant clam *T. derasa* is also a viable species to utilize. This is the main species cultured at the MMDC of the Republic of Belau in Micronesia. *T. squamosa* and *S. maxima* are most favoured for the ornamental trade because of their brightly coloured mantles. *T. gigas* is very rare in the proposed Park, but all the other species still occur in sufficient numbers to provide ample broodstock for culture.

Many years of research have been undertaken in giant clam farming by Australian institutions and by the MMDC [Micronesia Mariculture Demonstration Center] in the Republic of Palau [Belau], and the culturing techniques are well understood. Details are therefore not included here, but the essence of the operation is as follows:

The first step is to obtain eggs and sperm from wild stock. Traditionally, this is done by taking broodstock from the reefs and maintaining the animals in holding tanks until they spawn. A more direct method is to induce spawning *in situ* on the reef by injecting the animals with serotonin, which stimulates release of gametes. These can then be collected in plastic bags and taken to the farm where they are mixed so that fertilisation can occur (Wilson, pers. comm. 2001). This method would be especially relevant for the largest of the giant clams (*T. gigas*) because it is very rare and should be left on the reef.

Spawning giant clams can produce tens of millions of larvae at one session, but generally less that 10% survive for nursery grow-out operations. A 4000 litre concrete raceway can produce 50,000 to 100,000 / 3mm seed shells in 4 to 5 months.

Local communities on the islands within the Park would be supplied with ocean nursery cages about 12 months after the hatchery had begun, together with a supply of seedlings. Maintenance of each farm site would involve some 6 to 8 employees. The seedlings would be cared for until they reached marketable size (20cm average shell size) which would take about 3 years. Optimal harvest period for giant clam muscle and meat is 6 years from spawn to harvest.

Detailed costings, manpower requirements and profits have been calculated for a project in Bohol (Philippines) and show that giant clam farming can be a viable economic concern as well as bringing other benefits.

2.4.5. Budget

It is estimated that a fully operational giant clam hatchery & land based nursery [LBN] located on Pulau Selakan or P. Maiga will cost approximately $RM 700,000 to establish and run for two years. Two phases of installation are possible: if an eight raceway facility is chosen, then the overall costing will be reduced only from the stand point of man hour construction / labour and concrete. The difference in cost would probably be a reduction of $RM 50 to 60,000 only.

The $RM 700,000.00 figure estimate would include the following:

- An independent hatchery & land based nursery facility producing no less than 2,000,000 viable seed shell/year for both ocean nursery and land based nursery applications
- Living quarters for all staff
- Training in all hatchery & farming aspects
- Salaries for local staff for two years
- Operations & consumable items for two years
- Boats and motors
- Infrastructure and equipment depreciation contingencies
- Implementation of village-based ocean nursery programme

2.4.6. Marketing and reef replenishment

Clams can be used in a number of ways:

- Live for the ornamental trade
- Fresh meat - both mantle preparations & muscle
- Vacuum packed meat
- Dried mantle and muscle
- Valued added shell sculptures, lamps and other items

Juvenile clams about 9 months old can be used live for the ornamental trade and specimens to replenish the reefs could be one or two years old, provided they could be protected from poaching.

For food there would need to be a latent period of 3-4 years before production comes ‘on-stream’. Food sales can cater to Sabah and West Malaysia’s growing tourist industry, providing gourmet dishes in local restaurants, but exports would also provide important sources of revenue.

2.5. OTHER POTENTIAL SPECIES

Diversification of the present culture other than seaweed can enhance the income and profit of the people involved in seaweed culture. There are a few potential species found quite abundantly in the region which may be feasibly polycultured (Komilus *et al.* 2000):

Winged Oyster (*Pteria penguin*)

The winged oyster is quite abundant in the Semporna area. Its meat is not only tasty, but its shell can be used for ornaments and fetches a high price of RM 8 per kg locally. For white lipped oyster (MOP), its shell costs RM16 per kg locally, but it is sold at RM32 per kg in the Taiwan market. Research into their potential and growth performance in culture need to be closely looked into.

Sea Grapes *(Caulerpa racemosa)*

The wild sea grapes or locally known as "latok" in Bajau dialect are abundant in the islands of Madal and Karindingan. They are sold locally in Semporna at RM5 per basket. Some are sent to Kota Kinabalu every 2 days and the cost is RM30 per basket. They are very popular and eaten raw or processed.

Brown Mussel

The brown mussel known locally as "kalaput" is found growing usually in groups of 5 pieces are also found quite abundant around the Semporna islands. They are edible and can grow to the size of the green mussel (*Perna viridis*). More research needs to be conducted to examine their potential and growth performance in culture.

Donkey's Ear Abalone (*Haliotis asnina*)

The Semporna islands are one of the major source of wild abalone which are sold live or processed in markets in the State. They live in sheltered bays with good water movement and that are far from estuaries. Its meat is highly priced delicacy. It has a protein content of 20%. Though the culture of this species has not been fully established, it has a good potential in polyculture with other organisms. Thailand and the Philippines have both been very successful in propagating them in hatcheries.

Pearl oysters

A pearl farm used to operate in the area, and there are plans to begin cultivation again. Previously, the farm employed few if any of the local community. The new operation could be beneficial provided that it was built and operated to exacting standards, and fully involved local people. The application for a temporary occupation licence (TOL) is for 600 ha of the lagoon and a small amount of foreshore with the co-ordinates as follows: N4^{o} 35' 36 to 4^{o} 36' 36 and E 118^{o} 44' 24 to E118^{o} 46' 36.

3. USE OF ISLAND NATURAL RESOURCES

3.1. INTRODUCTION AND SOURCES OF INFORMATION

This section describes use of non-living resources (e.g. water, clay) as well as use of the wild plants and animals that are associated with the islands. Cultivation is described in Section 4.

Historical information comes from studies made by the Sabah Museum during surveys of the islands in 1980 (Piper, 1981). Several teams undertook surveys for the Semporna Islands Project, and their research has contributed to an up-to-date understanding of terrestrial resource use. This work was carried out by the Sabah Museum and Sabah Forestry Department with additional information coming from Sabah Parks and the project officers.

Figure 36. The high islands are a rich source of useful plants

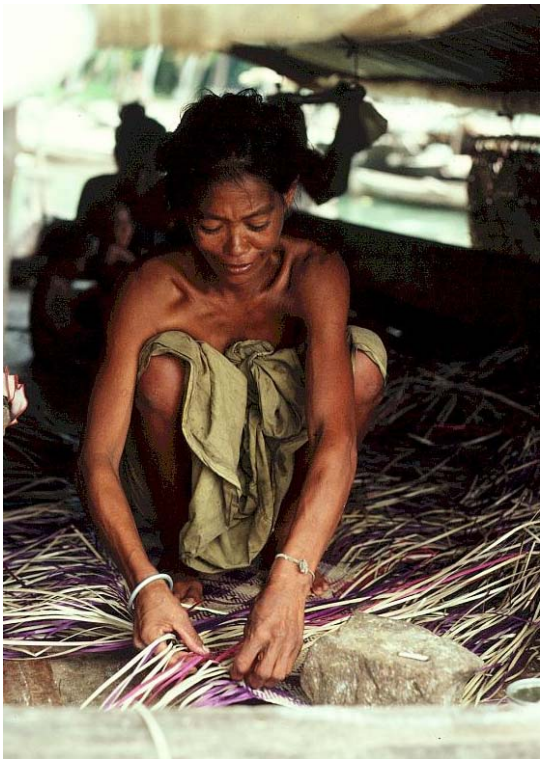

Figure 37. Mats woven out of pandan are still made on the islands

Figure 38. Pandan growing on Pulau Bodgaya

Figure 39. Temporary home of Bajau Laut on Maiga, made with mangrove and coconut posts and thatched with plaited coconut leaves

Figure 40. Mangrove wood being collected on Bodgaya

Figure 41. Cultivated area on Bodgaya

Figure 42. Boats are still made on the islands but most of the wood now comes from elsewhere.

Figure 43. Roots of *Derris eliptica* are crushed to release a poison used to catch fish.

Figure 44. Edible stems of sai, *Cymbopogon citrates*, grown on the islands.

Figure 45. *Gendarrusa vulgaris*: a plant used during ritualistic healings that brings good omens

3.2. WATER

Availability and use of water is as follows:

Boheydulang: There are a several streams on the island, and a series of pools on the east side. These are used as sources of water by people living on the island and may also be used by communities from other islands. A well has been dug at Kg Dasar (Baptist *et al.* 1998).

Bodgaya: There are a number of streams that provide water for people living on the island and may also be used by communities from other islands. Several wells have been dug adjacent to the kampongs.

Tetagan: Unknown

Sebangkat: There is no source of water on the island, so it has to be fetched from elsewhere. Rainwater is collected.

Selakan: There is a well on the island, but the water is salty and people either rely on rainwater or fetch water from Boheydulang (Piper, 1981).

Maiga: There is a well towards the southern end of the island. In 1980 there was one in the middle of the island which was reported to become salty in the dry season but otherwise to be drinkable (Piper, 1980).

Sibuan: There is no source of water on the island.

Mantabuan: In 1980, there was a well on the North side, opposite the moorage (Piper, 1981), but this is no longer in use. There is now a well in the centre of the island, behind the house. During the dry season, water has to be brought in from Semporna (Baptist *et al.* 1998).

3.3. CLAY

Some of the islands are a source of clay, which can be used for making earthenware pots and cooking places. The purest clay is found on Bodgaya (close to Kg Boheybual) and Tetagan, but there is also some on Selakan. The best clay is found at a depth of 2-4ft as there are fewer impurities at this level (Piper, 1981). Extraction of clay is much reduced now, with only a few women on Pulau Selakan continuing to make pots. However, the sturdy, flat-based cooking place is still in demand amongst the Bajau Laut because it is stable and well suited for use at sea (Piper, 1981).

3.4. ANIMALS

In 1980, the forests on Bodgaya and Boheydulang were a source of hornbills, ground-dwelling megapode birds and their eggs and other birds. These were hunted by Suluks and Bajau living on the islands. Sambar deer occurred on Bodgaya and were also hunted, using dogs and spears. The deer population is now reported to be extinct (Baptist *et al.*1998).

3.5. PLANTS

Plants are particularly widely used, especially on the central islands, where a total of 127 'useful' species were recorded in the survey conducted in 1998 by the Sabah Museum (Guntavid & Galaip, 1998). Their importance is as medicinal, edible, ritual and ceremonial plants, house and boat-building materials, fuel and for making baskets, mats, fish traps and other miscellaneous items.

These plant resources have been used at least since the time that the islands were first settled in the late 1880s. Many of the 'useful' species described by the Sabah Museum are part of the original natural flora of the islands, but others have been introduced from the Philippines or mainland Sabah. They are all included in the lists below, but cultivation is described separately in Section 4.

The ethnobotanical surveys were conducted by the Sabah Museum through a series of participatory interviews with various informants from a number of villages on the islands. All the informants were knowledgeable elders of the communities, including the *pandai* (village midwife), and *mengomboh* (renowned traditional healers). For each plant that was known to the informant, information was recorded in the local Samal, Sea Bajau and Tausug languages, including their uses, local knowledge and perceptions of the plants in terms of its habitat, commonness, rarity, folk tales or folklores related to each plant, and other related information.

Most of the ethnobotanical plants, especially the food and edible products, were introduced either from the Philippines or the Semporna mainland. Their existence became the basis of most of the customary rights claims by the communities on the islands.

The following descriptions and lists are taken from Guntavid and Galaip (1998).

3.5.1. Traditional Medicinal Plants

With the active and vigorous introduction of modern western health treatment especially in the surveyed localities, modern medicine is slowly taking the place of traditional herbal medicine known locally as *tambal.* The Suluk, Bajau and Bajau Laut communities are now more open and willing to accept this new trend. However, across these societies, there are elders who still practise what has been handed down to them for generations. Herbal medicine tends to be used especially by women after childbirth, and to treat the basic ailments of their children.

Traditional herbal medicines are used only in emergency cases while waiting for treatment from the local rural clinics. Where traditional herbal medicine is still personally and actively practised, most of the ingredients and methods of preparation and administration are kept secret for fear of misuse, competition and rivalry. The herbal preparations are usually passed down secretly by word of mouth and compensated with a small payment known as *pahookas* in the form of traditional paraphernalia consisting of small gifts.

According to the local communities, this traditional indigenous knowledge of herbal medicine was revealed either through physical or metaphysical methods. Initially it was revealed through dreams and it is said to be revealed by the God Almighty and other spirits of the forests. Trial and error is also used to help build up knowledge of useful herbal medicinal practices.

During the harvesting of plant materials for use in traditional medicine, strict rules and regulations need to be observed. God the Almightly, spirits and unseen forces of the jungle are consulted prior to the collections. Taboos and other do's and don't's also need to be fully observed and followed. The timing of collections is also vital. Common ailments treated with traditional herbal medicine include fevers, boils, skin diseases, cuts and wounds, diarrhoea to chronic dysentery and ailing mother after child labour.

Table 17. List of Medicinal Plants *Tambal* (Samal or Kubang Bajau) from Guntavid and Galaip, 1998.

Medicinal Plants of the Samal Bajau at Pulau Selakan

Species	**Vernacular Name**	**Medicinal Use**	***Parts Used***
Alpinia galanga	Langkuas	Post-parturition Treatment	Rhizomes
Ananas comosus	Nenas	Arbortifacient	Young Fruit
Andrographis paniculata	Pudu Bumi	Malaria /Hypotensive	Leaves
Anonna squamosa	Atis	Induce Appetite	Ripe Fruit
Caesalpinia sappans	Sibukau	Chest Pains	Stem
Carica papaya	Kapaya	Malaria/ Hypotensive	Leaves
Chromolaena odorata	Lahunai	Anticoagulant	Leaves
Curcuma domestica	Dulau	Post-parturition Treatment	Rhizomes
Cymbopogon citratus	Sai	Tonic and Stimulant	Stem
Euphorbia lactea	Pad-Pad	Bruises/Broken Bones	Leaves
Gendarussa vulgaris	Salimbangun	Stimulant/ Anti-depressant	Leaves
Hibiscus rosa-sinensis	Bunga Raya	Boils	Flower
Imperata cylinderica	Parang Suk	Induce Appetite	Stolons
Ipoemea pes-caprae	Tapak Kuda	Antidote	Sap
Jatropha curcas	Tangan-Tangan	Wounds & Cuts	Sap
Kalanchoe pinnata	Pad-Pad	Intermittent Fever & Headache	Leaves
Kalanchoe sp.	Pad-Pad	Intermittent Headache	Leaves
Lantana camara	Kejabat	Vomiting	Leaves
Lawsonia inermis	Pasal	Vomiting Blood	Roots
Musa acum. x balbisiana	Saing	Malaria	Young Shoots
Nypa fruiticans	Nipah	Sea Sickness/Sea lag	Young Leaves
Phyllantus niruri	Sogo-sogo	Intermittent Headache	Whole Plant
Pittosporum pentandrum	Mali-mali	Cancerous Swelling	Leaves
Psidium guajava	Biavas	Chronic Diarrhoea	Leaves
Urena lobata	Tambahalu	Stomach ache	Roots
Zingiber officinale	Luku	Post-Parturition Treatment Induce Appetite	Rhizomes

Medicinal Plants of the Kg. Bohey Bual Samal Bajau

Species	**Vernacular Name**	**Medicinal Use**	**Parts Used**
Ananas comosus	Nenas	Abortifacient	Young Plant
Andrographis paniculata	Pudu Bumi	Hypotensive	Leaves
Anonna squamosa	Atis	Diarrhoea	Leaves
Caesalpinia sappans	Sibukau	Tonic/Body Ache	Stems
Carica papaya	Kapaya	Malaria	Leaves
Cataranthus roseus	Saungga	Post-Parturition Treatment	Whole Plant
Coleus amboinicus	Bildu	Earache	Leaves
Commelina sp	Hauli	Constipation	Whole Plant
Curcuma domestica	Dulau	Stimulant/Emmenagogue	Rhizomes
Cymbopogon citratus	Sai	Carminative	Stems
Ervatamia divaricata	Tamang Kaun	Insect Bites	Sap
Euphorbia hirta	Patek-Patek	Post-Parturition Treatment Stomatitis	Whole Plant
Kaempferia galanga	Kisul	Swollen Tissues/Muscles	Rhizomes
Ipoemea pes-caprae	Tapak Kuda	Antidote	Sap
Portulaca grandiflora	Bisa-Bisa	Bruises	Whole Plant
Psidium guajava	Biavas	Diarrhoea	Young Leaves
Talinum triangulare	Istrapil	Vomiting Blood	Whole Plant
Vernonia cineraria	Tambal Sahup Sup	Bruises in the eye	Whole Plant
Zingiber officinale	Luku	Induce Appetite	Rhizomes

3.5.2. Food plants

Wild and introduced fruits and vegetables are used by all the local communities. Depending on the season, wild vegetables are often gathered. The most commonly gathered are the leaves and tubers of the *panggi kayu* (*Manihot esculenta*). The tubers are grated and made into a powdery, pasta-like *putu* which is a staple food for many islanders. Other emergency foods include corms of the *keladi* (*Colocasia esculenta*), fruit and young pithwood of the *saing* (*Musa acuminatum*), corms of the *deput-deput* (*Tacca leontopetaloides*) and the fruits and young shoots of the *labuh merah* (*Cucurbita pepo*).

There are a few trail plots of *kangkong* (*Ipomoea aquatica*) a popular leaf vegetable, *sai* (*Cymbopogon citratus*), which produces edible stems and *labu kundur* (*Benincasa hispida*) which has edible fruits. These grow mainly on the bare infertile sandy coastlines, especially on Pulau Maiga.

Some species with edible fruits such as *mengkuru* (*Morinda citrifolia*) and a few mangoes (*Mangifera odorata* and *M. indica*) have managed to naturalise and survive. During the fruiting season, desserts and traditional cocktails are easily prepared from the *atis* (*Annona squamosa*), *nanas* (*Ananas comosus*), *biavas* (*Pisidium guajava*), *belimbing* (*Averrhoea carambola*) or the *saing* (*Musa acuminatum*). These fruit plants are readily available as they are domesticated in home gardens and also grow well along the coastlines adjacent to the stilt houses. These products are shared and consumed among all the houses. However, excess production may sometimes be sold or bartered for during weekend excursions to Semporna town. Here, three *wani* and five *epal* mango fruits would cost RM10.00. So basically, a well harvested apple mango tree could bring in an estimated RM 300, while a wani mango tree harvest could be worth RM 3000.

Table 18 (opposite). Food plants from Selakan, Maiga, Tetagan, Bodgaya, Boheydulang and Mantabuan (Guntavid & Galaip, 1998)

Food plants include all edible flora which are consumed as actual staple food (ASF), vegetables (V), food flavours (FF), natural food preservatives (NFP), beverages (B), garnishes & sweetener (GS) and seasonings (S).

Species	Vernacular Name	Uses/Parts Used
Alpinia galanga	Luku	FF/S-Rhizomes
Ananas comosus	Nenas	V/FF/B/GS-Fruit
Anonna squamosa	Atis	GS-Fruits
Artocarpus heterophyllus	Nangkah	V/GS-Fruits
Artocarpus oddoratissimus	Marang	V/GS-Fruits
Averrhoea carambola	Belimbing	GS-Fruits
Benincasa hispida	Labu Kundur	ASF/V-Fruits
Capsicum frutescens	Lada	FF/S-Fruits
Carica papaya	Kapaya	V/FF/NFP/B/GS/S-Fruits/Leaves
Ceiba pentandra	Kapuk	V- Young Seeds
Citrus aurantifolia	Muntai Losoom	B/FF/S/NFP-Fruits
Citrus limon	Muntai Limon	B/FF/S/NFP-Fruits
Citrus maxima	Muntai Gajah	GS-Fruits
Citrus microcarpa	Muntai Kasturi	B/FF/S/NFP-Fruits
Citrus sinensis	Muntai Mamis	B/FF/S/NFP-Fruits
Cocos nucifera	Soka	B/V/FF-Fruits and Young Shoots
Colocasia escunlentum	Keladi	ASF/V-Corms
Cucurbita pepo	Labuh Merah	ASF/V-Fruits and Young Shoots
Curcuma domestica	Dulau	FF/S-Rhizomes
Cycas rumphii	Paku Laut	V- Young Shoots
Cymbopogon citratus	Sai	FF/S/NFP-Stems
Eucheuma spinosum	Agar-agar	B/GS-Whole Plant
Ipoemea aquatica	Kangkung	V-Leaves
Lagenaria siceraria	Labu Merah	V/Fruits
Mangifera indica	Mangga	GS-Fruits
Mangifera odorata	Mangga Wani	GS-Fruits
Manihot esculenta	Panggi Kayu	ASF/V/FF-Leaves and Tubers
Momordica charantia	Pelia	V/Fruits
Morinda elliptica	Mengkuru	V-Fruits
Moringa oliefera	-	V- Young Leaves
Musa acum. x balbisiana	Saing	ASF/V/GS-Fruit and Young Pithwood
	- Susu	ASF/V/GS-Fruit and Young Pithwood
	- Hinugun	ASF/V/GS-Fruit and Young Pithwood
	- Sabah	ASF/V/GS-Fruit and Young Pithwood
	- Mas	ASF/V/GS-Fruit and Young Pithwood
	- Tanduk	ASF/V/GS-Fruit and Young Pithwood
Nephelium lappaceum	Rambutan	GS-Fruits
Nephelium ramboutan-ake	Pulasan	GS-Fruits
Oryza sativa	Beras Padi	ASF-Cereals
Portulaca olearaca	Dapal-dapal	V-Whole Plant
Psidium guajava	Biavas	GS-Fruits
Punica granatum	Delima	GS-Fruits
Saccharum officinale	Tebuu	B/GS-Stems
Sauropus albicans	Cekup Manis	V-Leaves
Setcreasia sp	Laging Du	V-Leaves
Solanum melongena	Talum	V-Fruits
Tacca leontopetaloides	Deput-deput	SF-Corms
Talinum triangulare	Istrapil	V-Whole Plant
Tamarindus indica	Losoom Jawa	B/FF/GS-Fruits
Vigna unguiculata	Batung	V-Fruits and Leaves
Zea mays	Gandum	ASF-Fruits
Zingiber officinalis	Luku	FF/S-Rhizomes

3.5.3. Ritual, ceremonial and taboo plants

These plants are believed to posses special spirits of their own that were given by God that could bring good or bad cause to the users. Taboo plants normally comprise prohibited plant materials which are either poisonous, or cause disease or other physiological and psychological effects that finally bring negative impacts on every house dweller. Some examples under this category includes the *langas* (*Melanorrhoea wallichi*), *pelir kambing* (*Sarcolobus globosus*), *buto-buto* (*Exoecaria agallocho*) and the *tua* (*Derris elliptica*).

A pregnant mother is prohibited from consuming the *nanas* (*Ananas comosus*) for fear of aborting the foetus she bores. The *sireh* (*Piper betle*), *pola* (*Areca catechu*), *gambir* (*Uncaria gambier*), *sigup* (*Tobaccum herbaceum*) and the *dulau* (*Curcuma domesticum*) are the common ritual paraphernalias served to grace and venerate traditional ceremony receptions and ritual functions. During this ceremony, the *gabbang*, a traditional xylophone, made from the *gelam-gelam* is also played to accompany traditional dances and songs. A beautiful *tepoh* or plaited pandan mat made of *pandan duri* (*Pandanus odoratissimus*) or *buai saga* (*Calamus caesius*) is served to visitors as an act of respect and acceptance. During ritualistic healings, the *salimbangun* (*Gendarussa vulgaris*) is employed to call and expiate the healer spirit and at the same time to cool off a patient's spirit.

Campaka (*Plumeira obtusata*) is planted on graveyards to symbolise the same effects. The valuable *bulian* (*Photoxylon melangangai*) is used to make the well-sculptured *sunduk* or grave marker.

Species	**Vernacular Name**	**Uses/Remarks**
Ananas comosus	Nenas	T (Abortifacient)
Areca caetchu	Pinang	C
Carica papaya	Kapaya	C
Cocos nucifera	Soka	C
Coffea robusta	Kopi	C
Cyprus sp.	Tayum-Tayum	T (Causes Allergy)
Denis elliptica	Tua	T (Poisonous)
Euphorbia lactea	Pad-Pad	T (Poisonous)
Euphorbia pulcherima	Poinsettia	T (Poisonous)
Excoecaria agallocho	Buto-Buto	T (Poisonous)
Gendarussa vulgaris	Salimbangun	R (Good Omens)
Lawsonia inermis	Pasal	R (Good Omens)
Melanorrhoea wallichi	Langas	T (Poisonous)
Morinda citifolia	Mengkuru	C
Pandanus odorratissimus	Pandan duri	C
Pandanus textilis	Pandan	C
Piperbetle	Sireh	R & C (Good Omens)
Plumeria obtusa	Campaka	R & C (Planted only in graveyards)
Sacrolobus globosus	Pelir Kambing	T (Poisonous)
Tobaccum herbaceum	Tobako	R & C (Good Omens)
Uncaria gambier	Gambir	R & C (Good Omens)

Table 19. List of plants: C = Ceremonial Plant; R = Ritual Plant; T = Taboo Plant (from Guntavid and Galaip, 1998)

3.5.4. Building materials

Under this category, the majority of plants utilised include a wide range of light hardwood to heavy hardwood trees. These commonly grow on the fringes of villages and coastline habitats in the proposed Park.

The hardwood timbers used in house building cover a wide range of primary and old secondary forest species. Traditionally, timbers were obtained from Tetagan, Bodgaya and Boheydulang. However, nowadays, timbers are rare and therefore acquired from sawmills or timber shops on the Semporna mainland. Sometimes drift logs are collected for this purpose. The popular timbers are serayas and mangroves. Traditional houses, roofs and thatching are made from coconut leaves. The joists and posts for traditional houses, huts and shacks are made from the *bangkau* (*Rhizophora mucronata*) and the *tangol* tree (*Ceriops tagal*). Temporary moorage settlements use the coconut fibrous stem for their posts and roof thatching.

Sugau *et al* (1998) also mention the ranggu tree, *Koodersiodendron pinnatum*, which, although perhaps not advisably harvested here because of the steep slopes and overall low volumes, is of value to forestry as a seed source of special provenance. The *Mimusops elengi* (Sapotaceae) trees on the island have unusually good form, with straight, tall trunks and could have some forestry potential (Sugau *et al.*1998).

Species	**Vernacular Name**	**Parts Used**
Alstonia subspathalata	Gita	Wood
Bryobalanops beccari	Kapur Merah	Wood
Canarium littorallis	-	Wood
Ceriops tagal	Tangol	Wood
Cocos nucifera	Soka	Fibrous Stem & Leaves
Combretocarpus rotandus	Pahapat Paya	Wood
Cratoxylon formosum	Geronggang Biavas	Wood
Dryobalanops aromatica	Kapur	Wood
Hopea sangal	Gagil	Wood
Instia bijuga	Ipil Laut	Wood
Pongamia pinnata	Bohay	Wood
Rhizophora apicluata	Bangkau	Wood
Rhizophora mucronata	Bangkau	Wood
Shorea guiso	Selangan Batu Merah	Wood
Shorea pauciflora	Oba Suluk	Wood
Shorea sp.	Seraya	Wood
Terminalia catappa	Ketapang	Wood

Table 20. Trees used for wood by people of Selakan, Maiga, Bodgaya, Tetagan, Boheydulang, Sibuan and Mantabuan – these may now be sourced from outside the proposed Park. From Guntavid and Galaip, 1998.

3.5.5. Materials for boat building

Average small-size canoes known as *bogoh-bogoh* made locally are sold for about RM 200. A large lepa-lepa could sell from RM 2,000 – 4,000 depending on the materials used and the types and size of designs incorporated. Traditionally, timbers were obtained either through drift-logs or extracted from the forests on the Tetagan, Bodgaya or Boheydulang. However, most materials are now obtained from the Semporna mainland.

For boat building the *gagil* (*Hopea sangal*) and the *obah Suluk* (*Shorea pauciflora*) are preferred. A simple *bogoh-bogoh* needs only a single log, but a large *lepa-lepa* requires a considerable amount of plankwood. To strengthen the joints of the boat, rattan and belian wood pivots and nails are used. Natural caulking materials from the *golom* (*Osbornia octodonta*) in the form of a resinous substance are used along joints and cracks to erase leaks.

3.5.6. Miscellaneous uses

Fuelwood plants

Since time immemorial, wood has been the main source of fuel for local people, with wood fires used daily in preparation of food. However, not all species are suitable for fuelwood. Although certain plants may be readily flammable, there are others that are taboo. For example, the *langas* (*Melanhorrea wallichii*) is totally prohibited within the houses because it produces acrid and poisonous fumes.

The wood debris and drift logs that are washed ashore are preferred for fuelwood. It is believed that these burn more readily and efficiently than collected firewood. Cutting down trees is the last resort to get fuel wood. Fallen fronds of the *soka* (*Cocos nucifera*) are commonly used and also said to be an excellent fuel wood, Other commonly collected fuel wood comes from the *tangol* (*Ceriops tagal*), *geriting* (*lLumnitzera littorea*), the *pahapat laut* (*Sonneratia caseolaris*), *gapas-gapas* (*Colona serratifolia*), the *bintangor* (*Callophyllum inophyllum*) and the *ketapang* (*Terminalia catappa.*

Figure 46. Coconuts growing on Sibuan. The fruits, young shoots, fronds and stems are used for many purposes

Canes, rattans and fibres

Traditionally, fish were caught by means of bamboo spears (*serampang*), and the hook line (*rawai*) made from natural fibres. Nets were also plaited and shaped into trammel nets and cast nets by using a net plaiting apparatus made from the bulian wood (*Photooxylon melangangai*) Traditionally, fish caught were then tied together on strings or placed in a basket (*ambusa*) made from the rattans *buai vatu* (*Calamus iners*).

Although rattans and bamboos are the principal materials for making baskets they are seldom cultivated in the gardens, but are obtained from the wild. During the fruit harvesting seasons, various agricultural implements are prepared from a number of species of rattan (*Calamus* spp). Sugau *et al.* (1998) mention the presence of the large-cane rattan *Calamus subinermis*, and the importance of conserving wild seed stands. This is because progress is being made in forestry to use this species as a plantation subject, possibly yielding cane of quality comparable to the commercially valuable *C. manan* (the manau cane of the furniture industry, which is a dwindling resource).

Among the common agricultural and houshold implements are the *ambusa, balatak, lego, bakul* and *ambong* for threshing and winnowing rice and the *takung* – a coconut plate used by the Tausug. Household implements are coloured with natural red and yellow dyes obtained from leaves of the *mengkuru* (*Morinda citrifolia*) and rhizomes of the *dulau* (*Curcuma domestica*) respectively. The *tepoh,* a finely plaited mat, is made from leaf fibres of the *pandan duri* (*Pandanus odoratissimus*) or the rattan *buai saga* (*Calamus caesius*).

Ornamental value

A number of plants are of ornamental value, and the list from Guntavid and Galaip (1998) is in Table 21. Several are also mentioned by Sugau *et al.* (1998). These include *Thespesia populnea* (Malvaceae), *Pongamia pinnata, Mimusops elengi, Pisonia grandis, Cycas rumphii, Dracaena multiflora*, the climbers *Rhyssopteris timoriensis* and *Hoya* sp. indet. and the palm *Arenga undulatifolia* (Palmae).

Dracaena multiflora, as yet unused in ornamental horticulture, has a great potential. *Cycas rumphii* is already a well known ornamental plant but wild sources are increasingly scarce because of indiscriminate collection and destruction by ornamental-plant collectors. Thus, any protected wild source will always have value as a genetic bank for supporting the species in cultivation (Sugau *et al.* 1998).

Species	Vernacular Name	Parts Used/Uses
Areca caetchu	Pola	Fruits-Masticatory & Customary Rights Occurrence Shows Customary Rights
Asclepias currassavica	Dayang	Whole Plant - Ornamental
Bambusa cf stricta	Kayuan	Culms- Handicrafts & Weaponry
Barringtonia asiatica	Balak	Whole Plant - Ornamental
Calamus caesius	Buai sogo	Cane - Handicrafts, Basketry
Calamus cf. trachycoleus	Buai Alit	Cane - Handicrafts, Basketry
Calamus iners	Buai vatu	Cane - Handicrafts, Basketry
Callophullum inophyllum	Bintangor	Whole Plant - Fuelwood, ornamental & Building Materials
Canarium littorallis	Kayu Put	Stem - Resin
Ceiba pentandra	Kapuk	Fruit Fibres - Pillow Fibre
Cocos nucifera	Soka	Fruit Fibres - Fibre; Leaves-Thatchings, Ocurrence Shows Customary Rights, Building Materials, Plates and Cups
Colona serratifolia	Gapas-Gapas	Woody Stem - Fuelwood
Curcuma domestica	Dulau	Rhizomes - Natural Red Dye
Cycas rumphii	Paku Laut	Whole Plant -Ornamental
Derris elliptica	Tua	Roots-Fish poison
Dracaena marginata	-	Whole Plant-Ornamental
Drynaria cf. sparsisora	-	Whole Plant - Ornamental
Dryobalanops aromatica	Kapur	Wood-Boat Making, Building Materials
Erythrina indica	Balu-Balu	Whole Plant-Ornamental
Euphorbia pulcherima	Poinsettia	Whole Plant-Ornamental
Hopea sangal	Gagil	Wood-Boat Making
Khortalsia sp	Buai Malau	Cane- Handicrafts, Basketry
Lumnitzera littorea	Geriting	Wood-Fuelwood
Lycopodium flexeosum	Libu-libu	Fibre -Tying Materials
Macaranga sp.	Patau	Leaves - Food wrapper
Morinda citifolia	Mengkuru	Leaves - Natural Red Dye
Osbornia octodonta	Golom	Resinous Bark-Caulking Material
Pandanus odorratissimus	Pandan duri	Leaves - Mats
Pandanus textilis	Pandan	Leaves - Mats
Piper betle	Sireh	Leaves - Masticatory
Pittosporum pentandra	Kayu Puut	Whole Plant - Ornamental
Psidium guajava	Biavas	Wood - Traditional Tops
Sacrolobus globosus	Pelir Kambing	Fruit & Leaves - Poisonous
Scaevola sericea	Ambong	Whole Plant - Ornamental
Shorea pauciflora	Oba Suluk	Wood - Boat Making
Shorea sp.	Seraya	Wood - Boat Making
Sonneratia alba	Pahapat Laut	Wood - Fuelwood
Terminalia catappa	Ketapang	Whole Plant - Ornamental
Thespesia populnea	Baru Laut	Whole Plant - Ornamental
Uvaria purpurea	-	Whole Plant - Ornamental

Table 21. Plants with various miscellaneous uses. From Guntavid and Galaip, 1998.

4. CULTIVATION

Each of the eight islands in the proposed Park is used to some extent for cultivation, but some are more productive and important than others. Bodgaya, Boheydulang, Tetagan and Selakan all have pockets of rich soil on the lower slopes but the outlying islands are less fertile because they are either sandy (Sibuan, Maiga, Mantabuan) or rocky (Sebangkat).

Various crops are grown; also fruit trees and coconuts. Produce may be consumed locally by families living on the islands, traded with the Bajau Laut (who do not do any gardening), or sold in the market at Semporna.

Bodgaya

This large island has been important for cultivation for decades. Old aerial photographs show that in 1948, the north coast of Bodgaya was inhabited and there were cultivated clearings at the eastern end of the island, around Kg Tag Hawaian (Sugau *et al.* 1998). At this time, Bajaus were settled here. The cultivated areas increased in size after the arrival of Suluks in 1976, who typically have more extensive gardens (Piper, 1980).

Since about the mid-1970s, kampongs have appeared at the western end of the island (Piper, 1980), and the areas under cultivation have increased. There are now cultivated areas and clearings associated with each of the four villages on the island. Virtually all the gentler slopes along the North coast and at the tips of the island have been cultivated at some stage. In contrast, there are no cultivated areas along the South coast although there are some areas of secondary forest, particularly along the coastal fringe. (secondary forest occurs where the forest has been exploited for timber or cleared to provide space for cultivating crops and fruit trees).

Many types of fruit are grown, including mangoes, pineapple, local orange, guava, jackfruit, soursop, also maize, coconut and medicinal plants. Some of the produce is sold in Semporna, and one of the cultivators reported that he received between RM1000 – 3000 per year from the sale of fruits. Suluk families have received assistance in the form of seedlings, fertilisers and spray tanks from the Agriculture Department (Baptist *et al.* 1998). Hill paddy (rice) used to be grown in the 1960s and 1970s but is no longer.

Boheydulang

Parts of the island have been cultivated at least since the late1880s, when migration of Bajaus and Suluks from the southern Philippines intensified. A study of old aerial photographs (Sugau *et al.* 1998) showed that by 1948, nearly all the gentler slopes on the island (right up to the base of the rock outcrops) were either cultivated or consisted largely or completely of secondary vegetation. Signs of past disturbance were also noted by Piper (1981), who observed that, in addition to the gardens that existed in 1980, there was evidence of more widespread cultivation in the form of coconutes, fruit trees and bamboo.

Recent aerial photographs and surveys show significant cleared and cultivated areas, extending hundreds of metres up from the shoreline. However, some areas are reverting to natural vegetation. For example, the gardens at Penjuru Kenangan are no longer actively maintained due to the departure of the Bajaus from the village.

Elsewhere on the island, various fruits and vegetables are grown, both for personal consumption and sale. This includes mangoes, bananas, papayas, jackfruit, coconuts, sugar cane, maize and tapioca.

Tetagan

A significant amount of cultivation has certainly been carried out in the past but after the village was abandoned, the gardens were no longer maintained. Fruit trees remain, and previous settlers still return from the mainland or other islands to collect fruit.

Selakan

Gardening is still an important activity. The island is extensively planted with coconuts, fruit trees, vegetables and bamboo. Many mango trees have been planted, and the island is known for its supplies of quality mango which are sold on the mainland in Semporna (Baptist *et al*. 1998). The soil is reported to be very fertile, but at present apparently only 0.8 ha is under cultivation (Baptist *et al*. 1998).

Sebangkat

The island is stony, and the soil poor and dry. In 1980 it was reported only to support coconuts (owned by Bajaus living in Semporna) and papayas. Apparently no other crops survive (Piper, 1981), although a few small plots were seen on the north side during the Semporna Islands Project (see cover photograph).

Maiga

Coconuts are important. They are owned by Bajaus living in Semporna and used to be (and still are?) guarded by the Bajau Laut for a wage (Piper, 1981). A few crops are grown on a small scale, but these are not very successful due to the poor, sandy soil (Guntavid & Galaip, 1998).

Sibuan

At one time the economy of the island was based on the coconut plantation – an old copra production shed was seen in 1980 (Piper, 1981). The plantation is no longer actively managed, but there is some harvesting of coconuts judging by the piles of discarded husks. A small plot of maize was seen close to the huts in 1999, but otherwise there is no cultivation.

Mantabuan

Much of the island has been planted with coconuts at least since 1980 (Piper, 1981). There is no other cultivation.

5. MANAGEMENT OF RESOURCE USE IN THE PROPOSED SEMPORNA ISLANDS PARK

This section provides a brief summary of the conservation issues and the proposals for effective management. Further details of conservation issues are in Management Plan and . For more details please refer to the *Management Plan for the Semporna Islands Park*, section 5 (Conservation Issues) and section 8 (Managing Resource Use).

5.1. CONSERVATION ISSUES

Conservation issues are discussed in detail in other publications, and for this reason, only a brief summary is included here. For further details see the *Management Plan for the Semporna Islands Park*, section 5 (Conservation Issues) and the *Atlas of the Coral Reefs of the proposed Semporna Islands Park.*

The main conservation issues in relation to **resource use** in the proposed Park are as follows:

Direct use of marine resources

Over-exploitation of target species
Extractive, unmanaged, use of marine resources over many years has led to a serious decline in many fish and other edible species on the Semporna island reefs. This is causing hardship to fishermen and is threatening biodiversity.

Blast fishing
Fishermen in the area have used explosives for decades, even though this practice is illegal. When explosives are used over reef areas, the force of the blast shatters corals and kills both juvenile and non-commercial species of fish. The end result is habitat degradation, loss of biodiversity and waste of resources.

Other damaging fishing methods
There are a number of methods of fishing and collecting of marine life that are causing some damage in the proposed Park. Placing of traps on the reef and entanglement of lines and nets causes localised problems. Use of the poisons cyanide and tuba root (derris) are also of concern. Reef 'gleaning' for clams and other marine animals from the shallow reef top results in corals being broken and the habitat disturbed.

Crown-of-thorns-starfish outbreaks
A number of active and severe outbreaks of the large, coral-eating crown-of-thorns starfish were recorded on the Semporna reefs during the survey period. These plagues caused widespread coral mortality, particularly on the shallow reefs. There is, as yet, no hard evidence that over-fishing of starfish predators (e.g. triggerfish, pufferfish, humphead wrasse, giant triton shells) is causing the outbreaks, but it remains a distinct possibility.

Mariculture

If carried out carefully, seaweed farming should have minimal impact on the environment, although it may interfere with other uses of the area. The main concerns are damage to live coral heads due to the attachment of the ropes that hold the strings of weed; littering due to detached floats and strings and the 'escape' of pieces of weed on to the reef, where it may smother or out-compete the corals.

Cultivation of giant clams, pearl oysters and possibly other bivalves are potentially low-impact, but would have to be subjected to an impact assessment before they were allowed to start.

Whilst live fish are of high value, it would be inadvisable to start up farms in the proposed Park because of the risks of contaminating the reefs with waste food and faeces.

Cultivation and use of terrestrial resources

Extractive use of terrestrial resources has had various impacts and consequences. Some wild animals have been hunted to local extinction on the islands and there has been a decline in populations of timbers to the extent that nearly all now have to be acquired from the mainland. The extent of mangrove has also declined, almost certainly due to extraction over many years.

Land clearance for cultivation and houses has resulted in changes to the natural vegetation and loss of some important plant communities, particularly on the central, high islands.

Clearance for cultivation can lead to increased soil erosion and sediment run-off into the sea, with resulting pollution. The lagoon is particularly vulnerable due to the low rates of flushing.

There are dangers associated with cultivation, such as use of herbicides, pesticides and fertilisers, all of which can cause pollution and damage to natural systems and wildlife.

5.2. MANAGEMENT

A major objective for the Semporna Islands Park is to have a plan for sustainable use of the area and its resources that will benefit local communities and also help promote conservation. All sustainable use activities need to be integrated with each other and be compatible with the primary conservation objective for the park.

Recovery and sustainable use of resources will be achieved by regulating and monitoring harvesting in all zones, and by setting aside some areas where removal of living resources is prohibited (Sanctuary and Preservation Zones). Destructive methods of harvesting will be prohibited throughout the park. Designation of no-take zones could be a staged process. More crucial reef areas could be protected first, followed by other areas as acceptance of the concept among the community grows.

Resource use will be governed by Park regulations and allowed only under permit. These regulations will be drawn up in consultation with local communities and other interested parties and reviewed at regular intervals. Permits will be non-transferable, subject to annual renewal, and will stipulate conditions and regulations to be met.

Seaweed cultivation should continue in the park, but not be expanded further. The pearl farm is likely to re-open, in which case it should be carefully managed to benefit conservation and local communities. A pilot giant clam farm is recommended as a way of re-stocking the reefs and providing alternative incomes and other opportunities.

Cultivation and harvesting of fruits and coconuts provides employment and valuable products, and should continue in designated areas – the aim being to ensure maximum benefit to local people and minimum environmental impact.

Regulations on resource use recommended in the Management Plan

- Harvesting of natural resources will be allowed in the Pelagic Use/Buffer Zone (marine) and General Use (marine and terrestrial) Zones, but not in the Preservation and Sanctuary Zones (see Figure 47). Regulations will apply regarding the methods and type of gear that can be used in the permitted areas.

- Certain species will be protected throughout the park, and may not be used or disturbed in any zone.

- A permit will be required for all harvesting activities, and for marine resource use, boats will also require a permit.

- For marine resource use, hook and line will be permitted, with a permit, and consideration will be given to other traditional fishing gear such as lures, traps, and nets in very limited numbers at certain locations.

- Trawling and use of explosives or poisons will not be permitted in the park.

- Use of hookah or SCUBA gear for fishing or collecting marine organisms will not be permitted anywhere within the park.

- Records of the harvest of both marine and terrestrial species and use of other resources (e.g. water) will be collected for management purposes.

- There will be an option to introduce quotas on certain species if this is considered necessary.

- There will be an option to close certain areas (e.g. spawning aggregation sites) for specified periods (e.g. the breeding season).

- Visitors will not be permitted to take or disturb any natural resources (dead or alive) in any area of the park.

- Mariculture will be restricted to certain areas and species, and can be carried out only under permit, following an impact assessment.

- Cultivation and gathering of fruit will be allowed under permit in specified areas already used for this purpose, and will be subject to an impact assessment.

- A permit will be required for fishing, mariculture, cultivation and other activities in the park. Conditions will be applied to the permit, and it will be non-transferable and renewable annually.

Figure 47. Map of the proposed Park showing the Preservation and Sanctuary Zones where extractive use of natural resources would not be permitted. Use would be allowed in the rest of the Park, under permit.

REFERENCES

Baptist, J.J., R.F. Lojiwin & D. Kubud, 1998. Report on Human Settlements in Semporna Islands Proposed Park. Sabah Museum.

Baker, D. 1999. The potential for establishing a giant clam farm within the proposed Semporna Islands Park. Report for the Semporna Islands Project, July 1999.

Biusing, E.R. 1996. Status of the coastal fisheries resources of Sabah, Malaysia. Pp 31-80 in Development and Management of Fisheries in Malaysia. Proceedings of the Seminar on *Sustainable Development of Fisheries Resources in Malaysia*, 1995. Eds Chuan, TT, Othman, M and Fung, S.

Guntavid J. P. & J. Galaip, 1998. Ethnobotany of the proposed Semporna Islands Park. A report for Semporna Islands Project. Sabah Museum.

King, M, 1995. Fisheries biology; assessment and management. Fishing News Books, Blackwell Science Ltd.

Komilus, C.F., T. Hassan, W.C. Shing, I. Isnain, B. Martin, D. Laision, G. Gueh, R. Biusing & B. Jintony, 1999. The Semporna Islands Project: The Marine Fisheries Industry. A report for the Semporna Islands Project. Fisheries Research Centre, Sabah.

Soong, Y.K. 1996. Policies and strategies in managing fisheries resources in Sabah. Pp 111-124 in Development and Management of Fisheries in Malaysia. Proceedings of the Seminar on *Sustainable Development of Fisheries Resources in Malaysia*, 1995. Eds Chuan, TT, Othman, M and Fung, S.

Sugau J. B., R.C. Ong; J.T. Pereira; G.H. Petol; R. Nilus & K.M. Wong, 1998. The vegetation and botany of the proposed Semporna Islands Park. A report for the Semporna Islands Project. Forest Research Centre, Sabah Forestry Department.

Suliansa, M.S. 2000. Survey on the use of marine resources at the Semporna Islands. A report for the Semporna Islands Project. WWF Malaysia.

Ruddle, K. 1996. Geography and human ecology of reef fisheries. Ch 6 in Reef Fisheries: Ed N.V.C. Polunin and C.M. Roberts. Chapman and Hall.

Wood, E.M., F. Dipper, C. Wood, A. Angkaji, S. Daly, 2001. Atlas of the Coral Reefs of the Proposed Semporna Islands Park. Marine Conservation Society & Sabah Parks.

Wood, E.M., A. Angkaji, S. Daly, C. Davis, L. Goh, F. Dipper, R. Haynes, T. McKeown, C. Wood, 2001. Reef assessment and monitoring in the proposed Semporna Islands Park. Marine Conservation Society and Sabah Parks.