

Working Group on Aquaculture  
RECOFI Meeting  
Oman, 13-15<sup>th</sup> May 2002

WGA/05-02/Bahrain

---

## **A REVIEW OF MARICULTURE IN BAHRAIN**

Abdulredha J. Shams Ph.D.

Directorate of Fisheries & Marine Resources  
Ministry of Housing and Agriculture  
P.O. Box 20071  
Kingdom of Bahrain  
May 2002

## INTRODUCTION:

The Kingdom of Bahrain Comprises an archipelago of 36 low lying islands with a total land area of 706 km<sup>2</sup>. The total land area of Bahrain has increased by about 33 km<sup>2</sup> between 1976 and 1995, largely due to reclamation activities. The land is made up primarily of sand covering limestone bedrock and supporting sparse vegetation, with only a narrow fertile strip along the North and North Western coast. It is situated off Saudi Arabia between Kuwait and Qatar peninsula in the middle of the Gulf between latitude 25°32'N to 26°20'N and longitude 50°20'E to 50°50'E (**Directorate of Statistics, 2000**).

Bahrain's climate is warm and dry with a little rain, the average rainfall is 74mm per year with relatively high humidity and the most dominant wind is the northern (Shamal) wind which brings moist air, while summer brings warm and dry wind from the southwest (Kauws). Wind speed rarely exceeds 30 knots. The atmospheric temperatures range from 12-46°C. The relative humidity ranges between 29-90% (**Directorate of Statistics, 2000**).

The sea around Bahrain is generally clear and is characterized by a relatively high salinity ranging from 40-60 parts per thousand (high readings on the Western side), a high water temperature ranging between 8 °C and 37 °C, and an average pH value of around 7.9. Daily water temperature can also fluctuate widely. Changes of 3.5°C have been recorded within a 24-h period. The seabed substrate is mostly silt, sand, limestone pavement and rocks, with extensive remains of coral beds fringing the islands, but few live coral reefs. The inter-tidal zone, particularly in the northern parts of the island, is very extensive and may extend 3-5 km. from the shore. Major habitats include: sea-grass areas, algal areas, oyster beds, coral reefs, and mangrove areas. These habitats face increasing environmental stress from man made activities that include: improper land reclamation, dredging for sand, and increased industrial discharges to the marine environment.

The population of the Kingdom of Bahrain is 650,604.00, of which 37.6% are non-Bahrainis. Population growth declined from 3.6 for the period from 1981-1991, to 2.7 in 1991-2001 (**Central Statistics Organization, 2001**).

Fishing is an ancient profession in Bahrain, this profession gradually declined in recent years giving ground to more secure land based industries. Fishing in Bahrain was divided into two sectors, the artisanal

and the industrial, but since 1995 there was a ban on industrial steel trawlers. The per capita consumption of marine products fluctuates between 18-27 kg per year, which reflects the importance of fish in Bahrain. The gross value of fisheries output in 1998 was BD. 9.2 million (**Fisheries Statistical Service, 1999**). This only represents about 0.4% of GDP. The fisheries sector employs about 4,770 people directly (**Radhi et al, 1999**) and about 700 indirectly (**Uwate, 2000a**).

Bahrain, once thriving with freshwater springs both on land and in the sea, now has very meager fresh water resources. Out of the  $25,663 \times 10^6$  gallons of water that was consumed in 1999, more than half (52.5%) was from desalinization plants (**Directorate of Statistics, 2000**).

#### Status of Mariculture in Bahrain:

##### The National Mariculture Center (NaMaC):

The center is ideally located on the northern side of Manama and the total construction area occupies 5600 m<sup>2</sup> and remaining area is kept for future development programs.

In 1979 aquaculture development started as a joint project with the Food and Agriculture Organization of the United Nations. A feasibility study of mariculture development was planned in three phases. The three phases mainly included expanding the center by adding new infrastructure, during which research studies on aquaculture techniques for suitable culture species were carried out on small scale to facilitate its implementation on larger semi-commercial scale once all the facilities were completed.

##### Objectives of NaMaC:

- to create a technical and scientific base for mariculture in Bahrain
- To conduct appropriate research and development work on mariculture of living marine resources
- To develop culture systems suitable for local conditions
- To assist and encourage private sector investments in the field of fish farming
- To produce seed of cultured species for use in fish farming
- To produce juveniles of cultured and endangered species for release into the sea to enhance natural stock
- To produce cultured marine products for the local market

### Present Facilities at NaMaC:

- Laboratories; Offices; Stores; Work shop.
- Indoor hatchery unit that includes 22 concrete tanks of capacities ranging from 16-50 m<sup>3</sup> used for larval rearing.  
Out-door hatchery unit that includes 21 concrete tanks of capacities ranging from 30 to 160 m<sup>3</sup> used for spawning and nursery operations.
- Microorganism production facility with 99 m<sup>2</sup> for continuous rotifer production set up, and a 66 m<sup>2</sup> controlled temperature laboratory for high density algae production, in addition to offices, laboratory and store
- Feed nutrition unit with a laboratory fully equipped for proximate analysis and a feed preparation area with necessary equipments, and set up with tanks and water re-circulating system for feeding experiments
- Green house, 480 m<sup>2</sup> – covering 24 fiberglass tanks of capacities ranging from 6 to 14 tons
- Ten 600m<sup>3</sup> concrete tanks for nursery and grow-out operations.
- Four 300m<sup>3</sup> raceways for grow-out operations.
- Ten floating cages of various sizes.
- One 600 m<sup>2</sup> PVC lined earthen ponds for grow-out culture
- Indoor hatchery unit, 1000 m<sup>2</sup> with 22 concrete tanks of capacities from 10 to 72 tons. The unit also includes a laboratory, office, equipment room and a store
- A 3.5 hectare lagoon which acts as a water source and for other purposes
- 600 m<sup>3</sup> per hour sea water supply system
- 40 m<sup>3</sup> per hour well water supply system with a constant temperature range of 22-26 °C
- 600 m<sup>3</sup> pressure filtration system
- 1200 m<sup>3</sup> per hour main drain canal
- One 35KV emergency electric generator
- A fully equipped workshop

### Planned Additional Facilities:

1. 1100 M2 formulated feed preparation and testing unit.
2. 4 X 100 tons concrete spawning tanks.
4. Multi-purpose hall and library.
5. Pathology laboratory.
6. Floating net cage units and work shed.

## State of Development of the Mariculture Sector:

Management of mariculture in Bahrain is under the Directorate of Fisheries and Marine Resources represented by the National Mariculture Center. A detailed history of aquaculture in Bahrain has been documented in **Shams & Uwate (1996)**.

At this time, there is no private sector mariculture industry in Bahrain. All research and production efforts are focused on development and refinement of appropriate economically-efficient technology.

A review of the biology of local fish species resulted in a list of seven promising candidates for mariculture. All are important commercial fishes with good market value. Priority species are as follows (local names are provided in parenthesis):

1. Rabbitfish, *Siganus canaliculatus*, (safee);
2. Sobaity bream, *Sparidentex hasta*, (sobaity);
3. Brown-spotted grouper, *Epinephelus coioides*, (hamoor);
4. Black bream, *Acanthopagrus latus*, (shaem);
5. Golden trevally, *Gnathanodon speciosus*, (rebeeb);
6. Diamond mullet, *Liza spp.*, (byah); and
7. Red tiger shrimp, *Penaeus semisulcatus*, (rubian).

Recently, production trials of the first three species are being carried out (see **Aradi et al 1985; Chang and Al-Hendi 1994; Chang et al 1992; Directorate of Fisheries 1994, 1995, and 1996; Kawahara, Al-Bosta et al 1995; Kawahara, Shams et al 1995; and Lu et al 1996, Kawahara et al, 1997, Alansari et al, 1998 & 1999**). Previously, work on shrimp was carried out (see **Chang et al 1994**), and then stopped for technical purposes. A recent addition to the candidate list is the mangrove snapper *Lutjanus argentimaculatus*. Breeding trials for this species are already underway.

Despite having no freshwater resources, in 1986 juveniles of fresh water *Tilapia nilotica* were imported from Thailand and grown to adult size. The fish were bred and reared in fresh water but grow-out was done in sea water. Market acceptability for tilapia was not good and the work was discontinued. Tilapia was also stocked in public garden ponds for weed and algae control and in the wild-life sanctuary for use as food for aquatic birds.

Given the state of freshwater resources in Bahrain, all efforts now target marine species.

There are no commercial operations at this time. Most of the activity at NaMaC is now aimed at producing fish juveniles for sale and for release programs and for use in a limited grow-out activity in concrete ponds and floating cages.

At the hatchery level, NaMaC fish production has increased steadily since 1993 (Table 1).

Table 1: Fish Fry Production at NaMaC, 1993-2002				
Year	Species	Fry Produced (>1 g)	Fish Released to Sea	Fish Harvest (MT)
1993	Grouper	6,500	-	-
1994	Rabbitfish	4,000		0.5
	Grouper	19,000	10,000	1.0
	Sea bream	17,000	7,000	1.5
		40,000	17,000	
1995	Rabbitfish	59,000	300	3
	Grouper	11,000	10,000	0.7
	Shaem	7,400	3,000	0.3
		77,400	13,300	4.0
1996	Rabbitfish	59,000		2.4
	Grouper	12,000		
	Shaem	120,000	124,250	
		191,000		
1997	Sobaity bream	650,000	150,000	-
1998	Sobaity bream	142,000	-	1.1
1999	Sobaity bream	659,000	7,500	2.5
2000	Sobaity bream	525,000	-	11.5
2001	Sobaity bream	395,000	100,000	-
2002	Sobaity bream	Mid-year	Mid year	Mid year

The National Mariculture Center is currently the leader in the region in the production of marine fish seed. Production is tuned to market demand. Even with the existing ineffective organization structure and shortage in manpower and resources, NaMaC's hatchery production capacity can exceed one million (1.4 million this year) fish fry per year. This figure may still not be economically viable and would certainly not

satisfy the needs of a mariculture industry. Increase in production should be preceded by remedial measures in organization and resources. The market size fish sales figures can not keep up with the hatchery production because of in-sufficient grow-out facilities.

### **Economic Aspects:**

Despite recommendations by **Coche et al.**, in 1979 that economic aspect of aquaculture in Bahrain is investigated. There was no follow up on this recommendation until 1994 when the first financial assessment of aquaculture in Bahrain was completed (see **Uwate et al., 1994**). In this study, the financial feasibility of rabbitfish and grouper seed production and grow-out trials were assessed at different production levels. In the same year, the economics of a private investment venture in large-scale grouper cage culture was investigated (**Uwate, 1994**). In 1999, the economics of hatchery and grow-out production of the sobaity bream, rabbitfish, and grouper was assessed (**Uwate, 1999**). Other cost studies included a survey on global feed suppliers to identify less-costly feed sources (**Uwate & Shams, 1995**).

### **Future Considerations:**

Resources for aquaculture development are usually limited. Bahrain government has taken a long-term perspective on aquaculture development. This, added to the fact that private investor interest in aquaculture has been almost lacking, has resulted in a very slow but steady growth of mariculture in the country. Despite these limitations, the National Mariculture Center has had various successes such as large scale seed production, development and refinement of large scale fish release technology, and development of large scale fingerling transport technology throughout the region. Such experiences make conditions suitable for a commercial hatchery and a commercial floating cage culture industry aimed at stimulating private sector mariculture operations. These are the plans for mariculture to be hopefully implemented in the not too far future.

## **References:**

- Al-Ansari, A.A., **A.J. Shams**, A.A. Albosta, A.H. Alshaikh, and A.A. Alshawoosh. (1999). Fry production of sobaity beam, *Sparidentex hasta*, at Bahrain's National mariculture Center during the 1999 hatchery season. National Mariculture Center, Directorate of Fisheries, Ministry of Works & Agriculture, State of Bahrain. 19pp.
- Alansari, A.A., A.A. Al-Bosta, A.H. Al-Shaikh, and A.A. Al-Shawoosh. (1998). Production of sobaity breem, *Sparidentex hasta*, larvae and fry at the National Mariculture Center (NaMaC), Bahrain: 1998. National Mariculture Center, Directorate of Fisheries, Ministry of Works & Agriculture, State of Bahrain. 19p.
- Al-Aradi, J., W. Al-Baharna, and Zahra Al-Alawi. (1985). Feasibility of rearing *Siganus oramin* (*Siganus canaliculatus*) in closed system in the State of Bahrain. Pages 933-940 in Proceedings of the Symposium on Coastal Aquaculture held in Cochin. 12-18 January 1980. Part 3: Finfish culture. Ser. Mar. Biol. Associ. India No. 6.
- Chang, R.M., and H.J. Al-Hindi. (1994). Grow-out trials of the grouper, *Epinephelus coioides*, in floating cages and concrete tank in Bahrain. National Mariculture Center, Ministry of Commerce & Agriculture, State of Bahrain. 7pp.
- Chang, R.M., H. Jaffer, M. Hassan, and K.R. Uwate. (1994). Results of pond grow-out trials of the shrimp, *Penaeus semisulcatus*. National Mariculture Center, Ministry of Commerce & Agriculture, State of Bahrain. 8pp.
- Chang, R.M., A.J. Shams, J. Al-Aradi, and A.A. Al-Ansari. (1992). The spawning and larval rearing of the haffara breem (*Rhabdosargus haffara*) (Forsskal 1775) under high salinity conditions. Symposium on Mariculture Technology and Investment Opportunities. Bahrain Center for Studies & Research. Manama, Bahrain. 9-10 May 1992.
- Coche, A.G., Cuzon, G., & Lichatowich, T. (1979). Mariculture Development in Bahrain. Report of a feasibility mission. FAO/UNDP/ Regional Fishery Survey & Development PROJECT, Rome (Italy).
- \_\_\_\_\_. (1996). Directorate of Fisheries Annual Report of Activities for 1996. Ministry of Works & Agriculture, State of Bahrain. 28pp.
- \_\_\_\_\_. (1995). Directorate of Fisheries Annual Report of Activities for 1995. Ministry of Works & Agriculture, State of Bahrain. 31pp.
- \_\_\_\_\_. (1994). Directorate of Fisheries Annual Report of Activities for 1994. Ministry of Works & Agriculture, State of Bahrain. 34pp.

- Directorate of Statistics (2002). Basic Results. Population, Housing, Buildings & Establishment's Census Part One. Ministry of Cabinet Affairs, Central Statistics Organization, State of Bahrain. 199pp.
- Directorate of Statistics (2000). The Statistical Year Book 1999. Directorate of Statistics, Central Statistics Organization, State of Bahrain. 409pp.
- Fisheries Statistical Section (1999). Annual Statistics Report 1998. Directorate of Fisheries, Ministry of Works & Agriculture, State of Bahrain. Technical Circular No. 75.
- Kawahara, S., A.A. Al-Bosta, F.A. Al-Murbati, and A.J. Shams. (1995). Hatchery production of the grouper, *Epinephelus coioides*, at the National Mariculture Center (NaMaC), Bahrain: 1993-1994. National Mariculture Center, Directorate of Fisheries, Ministry of Works & Agriculture, State of Bahrain. 22p.
- Kawahara, S., A.A. Al-Bosta, A.H. Al-Shaikh, A.A. Al-Shawoosh, and **A.J. Shams**. (1997). Fry production of sobaity bream, *Sparidentex hasta*, at the National Mariculture Center, Bahrain: 1997. National Mariculture Center, Directorate of Fisheries, Ministry of Works & Agriculture, State of Bahrain. 27pp.
- Kawahara, S., **A.J. Shams**, A.A. Al-Bosta, M.H. Mansoor, and A.A. Al-Baqqal. 1995. Effects of water temperature and salinity on egg development of the grouper, *Epinephelus coioides*. National Mariculture Center, Directorate of Fisheries, Ministry of Works & Agriculture, State of Bahrain. 14pp.
- Lu, J.Y., H.J. Al-Hindi, and M.H. Mansoor. (1996). Grow-out trials of the rabbitfish, *Siganus canaliculatus*, in Bahrain. Directorate of Fisheries, Ministry of Works & Agriculture, State of Bahrain. 20pp.
- Radhi, A.K., N. Al-Saffar, F. Mirza, A. Abdulla, and N. Hermis, (1999). Fisheries Census-1998 (boats & fishermen census). Fisheries Statistical Section. Directorate of Fisheries, Ministry of Works & Agriculture, State of Bahrain. 39pp.
- Shams, A.J., and Al-Hendi, H., and Lu, J.Y. (1996). Plan for establishing a floating cage system for fish culture. National Mariculture Center, Directorate of Fisheries, Ministry of Works & Agriculture, State of Bahrain.
- Shams, A.J., and Uwate, K.R. (1996). A review of mariculture development in Bahrain. National Mariculture Center, Directorate of Fisheries, Ministry of Works & Agriculture, State of Bahrain.
- Uwate, K.R. (2000a). Fishery country profile Bahrain. FAO. 6pp.

- Uwate, K.R. (1999). Possible private investment for hamoor (grouper) cage culture. Internal paper submitted to the Director of Fisheries. Bahrain.
- Uwate, K.R., and Shams, A.J. (1995). A comparative cost study of importing fish feeds to Bahrain based on a world survey of feed suppliers. Directorate of Fisheries, Ministry of Commerce & Agriculture, State of Bahrain.
- Uwate, K.R., Chang, R.M., & Kawahara, S. (1994). Aquaculture development in Bahrain: preliminary economic assessment. Directorate of Fisheries, Ministry of Commerce & Agriculture, State of Bahrain.
- Uwate, K.R., Al-Ansari, A.A., & Al-Hendi, H. (1999). Hatchery and grow-out economic considerations of sobaity bream, *Sparidentex hasta*, pearl-spot rabbitfish, *Siganus canaliculatus*, and orange-spotted grouper, *Epinephelus coioides* mariculture in Bahrain. National Mariculture Center, Directorate of Fisheries, Ministry of Works & Agriculture, State of Bahrain.