

**Fishery of Shared Stock of the Silver Pomfret, *Pampus argenteus*,
in the Northern Gulf; A Case Study**

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Summary

Zobaidy (or silver pomfret, *Pampus argenteus*) is a prime, valuable and shared fish stock in the northern Gulf (Persian, Arabian) between Kuwait and Iran. Its catches constitute from 30 to 40% of the total value of Kuwait's capture fin-fish fisheries, but Kuwait catches have declined from 1100 t in 1994 to 120 t in 2000. The catches and catch rates of by Iranian fleet have also decreased substantially from 1142 t in 1996 to only 114 t in 2000. Now it is believed that the northern Gulf's fishery stocks are under environmental stress due to high fishing capacity of fleet, and to ecological changes due to the decrease of the rivers discharges.

The available data indicate that zobaidy in the northern Gulf is comprised of one stock unit and its migration is confined to the sea area between Kuwait, Iraq and the Khuozestan Province of Iran. It is believed that the major spawning and nursery areas are located in estuaries in Iran (Shatt Al-Arab) while feeding and wintering areas are within Kuwait's waters.

A cooperative research proposal was formulated by the Kuwait Institute for Scientific Research and the Iranian Fisheries Research Organization to study jointly the status of the severely depleted zobaidy stock. The main objectives of the proposed project are to determine the standing biomass, seasonal abundance, migration patterns and other basic biological parameters necessary for management. The structure and impact of the operational fishery in the region will be investigated. The output of the project will provide baseline knowledge for the establishment of a regional cooperative management system based, as proposed, on total allowable catch (TAC) and Individual Quota system within each country. The success of any management and stock conservation plan in the region will depend entirely on effective enforcement and surveillance powers, cooperative decision-making, and accurate stock monitoring.

Introduction

Kuwait's fin-fish fishery is a multigear and multispecies fishery, operating almost year-round. A total of 3378 fishermen land an of 5,916 t valued at KD 9.011X10⁶ per annum (1992-1998). The major sectors include gill netting with various mesh sizes targeting different demersal and pelagic species, trawling for penaeid shrimp species and demersal fish by-catch, and hemispherical wire traps (gargoor) targeting demersal species. The fin-fish landings are mostly derived from 11 fish species, among which are silver pomfret (*Pampus argenteus* locally known as zobaidy), orange-spotted grouper (*Epinephelus coioides*), grunt (*Pomadasys kaakan*), Hilsa shad (*Tenulosa ilisha*, locally known as suboor), tigertooth croaker (*Otolithes ruber*), yellowfin seabream (*Acanthopagrus latus*) and mullet (*Liza klunzingeri*). The fin-fish catches are landed by 732 fibre-glass speedboats (707 gill net and 25 gargoor), 84 wooden dhows (20 gill net and 64 gargoor), and as by-catch from 27 dhow and 35 steel shrimp trawlers. The actual number of operating dhow boats and speedboats, however, would be much lower than these numbers and would vary seasonally.

Two main migratory fish stocks, zobaidy and suboor, in the northern area of the Gulf are shared among Kuwait, Iraq and Iran. Both species are considered economically valuable and important for the fisheries in the region. Both life cycles, i.e. reproduction and nursery grounds, are associated with the river systems of the northern Gulf. Other shared fish stocks might exist, like grunt (*Pomadasys kaakan*), but are less defined, although it is believed that their distribution is also closely associated with estuaries.

Zobaidy (family Stromateidae), widely spread throughout the Indo-Western Pacific region, supports valuable fisheries along the coast of India (Kagwade, 1988; Pati, 1982), the eastern part of China, the western and south western Korean Peninsula (Cho et al., 1989) and western Asia all the way to the Gulf. The value of the local zobaidy landed in Kuwait's fish markets in 1993 was US \$9,477,000 out of the total fish value of US\$ 19,410,000 of Kuwait's fish production. The catch of the Kuwaiti gillnet fleet has declined to less than 88%, from 1112 tons in 1994 to 120 tons (US \$1,570 10³) in 2000 (CSO, 2001).

Along the coast of western Bengal in India, zobaidy undertake spawning migrations to their breeding and nursery grounds in the north during the onset of the spawning season, and migrate to the south in the post-spawning period (Pati, 1982). Most catches of zobaidy in the East China Sea and Yellow Sea come from areas where oceanic fronts occur due to mixing of warm and cold currents (Cho et al., 1989). Zobaidy migrates northward or southward according to the distribution of warm water currents thus, they migrate to the north in summer and to the south in winter.

Studies from other regions indicate that a muddy-sandy substratum is important for providing adequate habitat for foraging (Kuthalingam, 1967), while large numbers of ripe zobaidy and post-larvae are found in shallow coastal waters (Pati, 1982). Gonadal maturation indicates that zobaidy has a prolonged spawning season. The spawning season in Kuwait starts in March to April (Abu-Hakima et al., 1983; Hussain and Abdullah, 1977) or peaked in May (Dadzie et al., 2000a) and ends in August to September. In the Bay of Bengal, two peaks were observed: February to

April and July to August (Pati, 1982), while in the eastern China Sea, the spawning peak was from May to July (Lee and Jin, 1989).

The probable distribution may be due to five important factors: water temperature, salinity, dissolved oxygen levels, currents, water clarity, and zooplankton abundance. Ichthyoplankton surveys by Dames and Moore (1983) of the northern and western part of Kuwait's waters indicate that zobaidy eggs and larvae were found throughout the year in Kuwait Bay. Larvae abundance was highest in Khor Al-Sabyiah and the northern flats of Failaka Island during the summer months between May and August. Judging from larvae concentrations around Khor Sabyiah, zobaidy appeared to reproduce mostly in late spring and summer. Few larva or eggs were collected in any other months or at other sites (Dames and Moore, 1983).

Zobaidy is a herbivore during the pelagic post-larval period. After metamorphosis, it becomes a benthopelagic carnivore (Pati, 1983) and a column feeder as it feed on copepods, which undergo diurnal vertical migrations (Pati, 1980). The main bulk of the diet of the young zobaidy is small copepods and small crustaceans, while adults feed mainly on small crustaceans at shallow depths, and polychaetes and foraminifera in deeper areas (Kuthalingam, 1967). Pati (1980) studied the stomach contents of zobaidy in the Bay of Bengal showed that copepods are the main dietary component throughout the year. Other major food items are decapod larvae, polychaetes and ctenophores. Dadzie et al. (2000b) study reported that copepods were dominant (39%) food item in zobaidy's stomach from Kuwait's waters. Bacillariophyta (21%), Mollusca (11%), fish scales (10%), and fish eggs and larvae were other major groups. Pati (1983) found that growth changes in the zobaidy are directly correlated with the changes in the trophic levels of the marine habitat.

Most fish species of Kuwait's fishery are prolific breeders, but any environmental changes together with heavy fishing pressure could result in a population collapse. The goals of the fisheries management program in Kuwait is to prevent this from occurring in order to provide the nation with food security.

The required stock assessment advice depends on the phase of development of a fishery and its characteristic problems and degree of complexity. Nearly 15 years ago, Kuwait's fin-fish fisheries were over developed (KISR, 1988). This situation is still characterized by over-capacity (excessive fleet size or effort), declining catch rates and total catches, and economic losses. Thus, corrective advice is needed for specific measures such as mesh size, catch quota, length of fishing season, and protection of spawning biomass or juveniles.

The United Nations Conference on Environment and Development highlighted the poor performance of existing international fisheries management organizations and increasing conflicts among nations regarding the harvesting of migratory species. Conference attendees agreed to carry out negotiations to develop more effective management regimes for these fisheries. The United Nation Conference on Straddling and Highly Migratory Fish Stocks started meeting in 1993 to establish the best measures for sustainable management regimes for the most economically and environmentally valuable species (Doulman, 1995, see also Barston, 1995, Hayashi, 1994, Hayashi, 1995). According to the Food and Agriculture Organization (FAO) report, the world is facing a global fishing crisis at the beginning of this century. The

catches are declining from their peaks during late 1980s, and most of the world's major marine fisheries are overexploited or have reached the edge of extinction, which present new challenges to fisheries management institutions around the world.

With extension of national jurisdictions and the declaration of exclusive economic zones (EEZ) of 200 miles in late 1970s, the fishing areas were limited for some large oceanic fishing fleets and conflicts about fish resources increased. Meanwhile, stock abundance and biomass decreased. Most of these fish stocks are highly migratory species dwelling across different EEZs or the territorial boundaries of adjacent countries. Hongskul (1985) classified these shared stocks into two main categories:

- Stocks occurring in two or more national jurisdictions with movement across boundaries but no clear migratory patterns.
- Stocks occurring in two or more national jurisdictions with a clear pattern of movement between one zone and another.

The latter stock type is the most important group and includes many significant demersal and pelagic fish species, the migration of which occurs seasonally between spawning and feeding grounds. Usually, migratory fish species exhibit seasonal cycles of migration, which take place through different national jurisdictions. Feeding and growth take place in one area while spawning occurs in another area, or possibly, development and growth occur in a third area (a nursery area). In a given area, fishing or other ecological activities including changes in ecosystem components related to the fish stock will definitely affect fisheries in other areas.

Ecology of the Northern Gulf

The Gulf (also known as the Persian or Arabian Gulf) is semi-closed shallow sea, bounded by arid tropical and semi-tropical coastal area. The main source of freshwater, nutrients and fluvial inputs into the northern Gulf is from the Shatt al-Arab River (mean flow = 1,456 m³/s) that discharges in north and formed by the confluence of Euphrates, Tigris (in Iraq) and Karun (in Iran) Rivers (see Fig. 4). The Shatt al-Arab plays a very important role in the sustenance of the economically important shrimp and finfish fisheries of the northern Gulf, with average of total annual production of 72.7X10³ tons (Kuwait, Iraq and Iran). The average primary productivity of the northwest Gulf was 152.89 mg C l⁻³ d⁻¹ with a minimum of 11 and maximum of 610 using C-14 methodology (Al-Yamani et al., 1997a). Phytoplankton and zooplankton productivity blooms during spring and summer in the northern Gulf, the biodiversity and biomass were the highest in the Gulf (Jones et al., 2002). Significant correlations have been documented in the Gulf between the zooplankton abundance (copepods and meroplankton), which provide food for larval fish species, and eggs and larvae (Houde et al., 1986).

Recent changes in the ecology and hydrobiology of the northwestern Gulf result from the destruction of vast areas of marshes in southern Mesopotamia and decrease of freshwater flow (Maltby, 1994). The marshes were formed by the

confluence of the Euphrates and Tigris Rivers formally encompassing an area of 15,000 to 20,000 km². Massive channelization of the marshes and the upstream damming in Turkey, Syria and Iraq (Maltby, 1994) has put the associated fish stocks of the riverine and estuarine systems in jeopardy. Dams constructions will almost eliminate flooding, the main driving force for physical and biological riverine processes, and will alter the quality and quantity of water received downstream. Satellite images show that about 90% of wetlands have been drained, leaving only 1,500 to 2,000 km² remaining. Completion of all planned development in Turkey and Iraq by 2003 will reduce the Shatt Al-Arab flow to 70% (Maltby, 1994).

It is almost certain that annual fish migration and breeding will be disrupted due to changes in the hydrological regime and marine environment that are associated with the freshwater flow system. Consequently, this will have an impact on fish spawning activity, recruitment, and hence, stock productivity.

Furthermore, the recent construction of the Third River in Iraq has ecologically impacted the water quality of Kuwait's northern waters. This river discharges into Khor Al-Zubair, which is immediately north of Warbah and Bubyian Islands and Khor Al-Sabyiah. The impacted area exhibited lower salinity (from 38.19 to 35.04 ppt), higher nutrient levels (nitrates, phosphates, and silicates), and higher turbidity levels in 1995 to 1998 than in the period from 1985 to 1993 (Al-Yamani et al., 1997b). River discharge decreased in 2000 and 2001, and the salinity increased to 40.3-43.4 ppt and 43.5-44.1 ppt, respectively. Sources of nitrates in the lower reaches of Tigris and Euphrates, as well as from the upper reaches of Shatt al-Arab, have been attributed to agricultural runoffs, discharge of sewage wastes, and increased decomposition of organic matter and release of the adsorbed nitrate (Saad, 1982).

Fishery

Locally, zobaiddy are considered the most dominant and commercially important species. This species constituted on average 25% of the 1991 to 1994 fish catches landed at Kuwait's fish markets (Fisheries Statistics of Central Statistical Office, Ministry of Planning, Kuwait), while most of the supply came from imports in 1985 to 1989 during the Iran-Iraq war (KISR, 1988). It accounted for only 4.3% of the total landings from Kuwait's catches in these years (Lee et al., 1990, Mathews et al., 1989).

The main operating sector inshore and offshore for zobaiddy in both Kuwait and Iran is the artisanal fleet consisting of dhow boats and speedboats using drift gillnets. The mesh size of the gill nets in use is about 140 mm. The fleet size of Khuzestan Province in Iran consists of 826 dhows (artisanal wooden vessels) and 1495 speedboats, while Kuwait's drift and gillnet fleet consists of 15 dhows and 720 speedboats. However, the actual operating boats involved in zobaiddy fishery are not known in both countries. The fishery characteristically operates in shallow waters of 3 to 10 m on muddy-sandy bottoms. The main fishing grounds for zobaiddy in Kuwait are north and east of Failaka Island, southeast of Bubyian Island and in Khor Abdullah. Other sectors like shrimp trawlers and coastal stake nets (hadrah) contribute small quantities to the zobaiddy landings.

The main fishing seasons in Kuwait are in April to May and September to October, although small quantities of zobaidy are landed during November to March either by drift gill net or shrimp trawling fisheries. In Iran, the fishing season starts in May and continues to September. Some zobaidy are landed as shrimp by-catch during the shrimp season during the autumn and winter. The extensive fishing grounds for the shrimp *Metapenaeus affinis* are known to also overlap with the main nursery area of zobaidy in Iran, but no data are available except fishermen's reports indicating the severe impact of this fishery on juvenile zobaidy populations.

From 1972 to 1979, Kuwaiti landings of zobaidy averaged 715 t/yr, where as from 1982 to 1988, landings averaged only 300 t/yr (Fig. 1). This reduction was a result of the closing of fishing areas in northern Kuwaiti waters and in Iranian waters during the Iran-Iraq war. The catches increased to an average of over 1000 t/yr after 1991, when the restrictions on fishing grounds were lifted; however, these catches started to decline in 1996, dropping to 120 t in 2001.

No fishery statistics were collected prior 1993 in Khuzestan Province, Iran. Actual research started with the establishment of a data collection system in 1993 to estimate catch and effort as well as surveys and sampling of length measurements at landing places. As a result of these preliminary studies, a 45-d ban period has been implemented to protect spawning in the presumptive spawning areas.

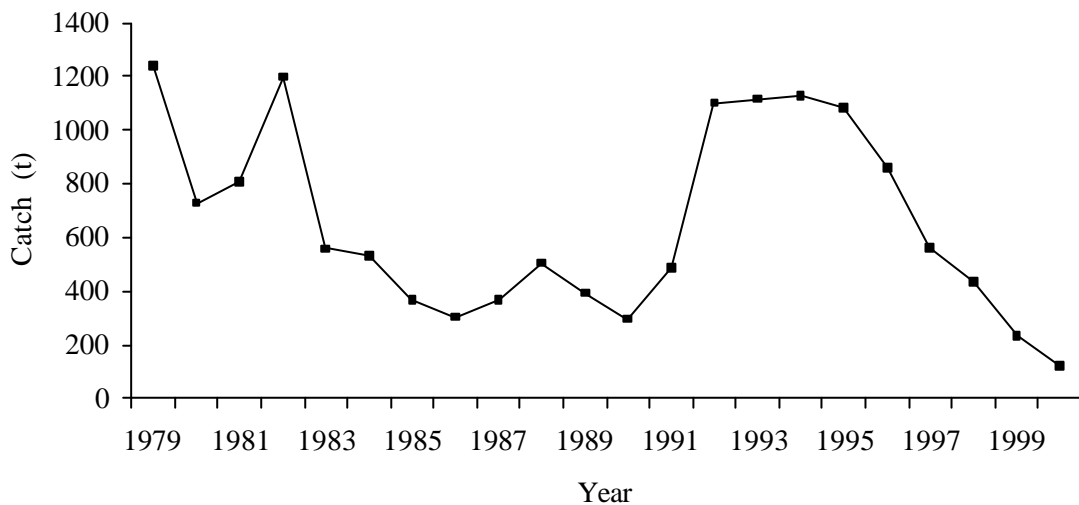


Fig. 1. Total zobaidy catch of Kuwait's fisheries, 1979 to 2000.

The landings by the dhow fleet of Iran average about 591 t in recent years (1998-2000), which comprises about 6% of Khuzestan's total catch. The recorded statistics for zobaidy landings in this province are given in Table 1. A significant fraction of the catch was not landed because it was sold illegally at sea and landed in countries (mainly Kuwait) in the Gulf (Parsamanesh et al., 1996).

Table 1. Yearly Total Catch of Zobaidy Landed and Number of Speedboats and Dhows in Khouzestan Province (Iran) for the Period 1993-2000

Year	1993	1994	1995	1996	1997	1998	1999	2000
Total Catch	738.2	721.5	895.5	1142.4	1688.7	875.3	782.8	114.8
Number of Boats	1612	1872	1935	2009	2011	2052	2133	2332

The catch statistics show that the catches of the Iranian fleet more than doubled from 1993 to 1997 (Fig. 3). Concomitantly with the increased landings was an increased in the total number of boats from 1612 in 1993 to 2332 in 2000 (Fig. 2). Iranian catches of zobaidy landed at Kuwait's fish markets, however, are not reported in Iran's catch statistics. The Kuwaiti catches declined from 1112 t in 1994 to 120 t in 2000. Consequently, economic loss was high due to low catch rates, and hence, the number of fishermen leaving the sector increased. Parsamanesh et al. (2001) reported that the catch rate of zobaidy in Khouzestan fleet is also decreased from 4.0 kg/panel (or 32 kg/day) in 1993 to 0.9 kg/panel (or 8.5 kg/day) in 1999.

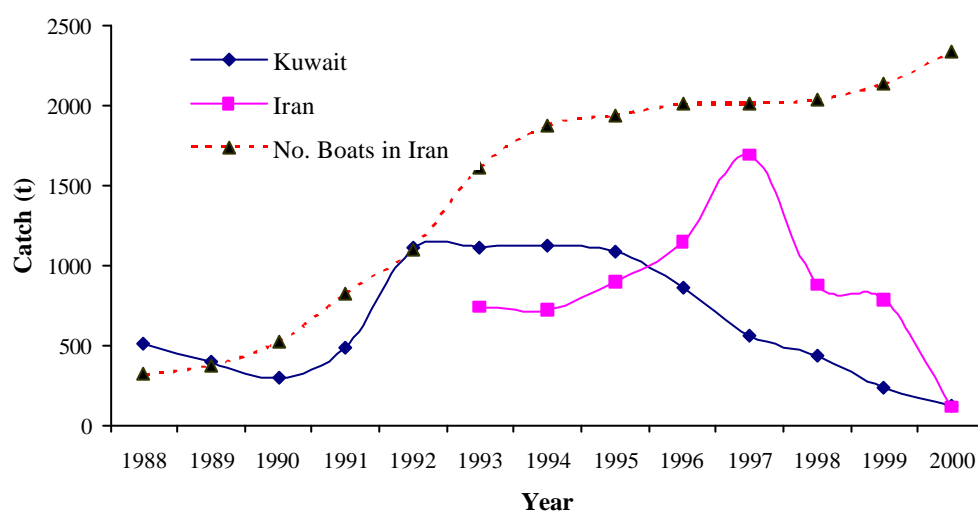


Fig. 2. Zobaidy catches landed by Kuwait's and Iran's fleets, and size of the Iranian fleet in Khouzestan Province from 1988 to 2000.

Stock Assessment

Both Kuwait and Iran exploit the zobaidy stock when it migrates to waters in the northern Gulf from March to October for spawning. During the cooler months from November to March, the stock is believed to migrate southward to deeper waters (see Fig 4). As waters warm from March to May, zobaidy adults return to spawn in estuaries at the head of the Gulf through Kuwait's waters. These areas might be also considered the main nursery area. Mature and ripe to spent zobaidy and small juveniles are also found in Kuwait's waters, but their contribution to the total spawning biomass is not known.

The nature and extent of specific nursery and spawning grounds in the northern Gulf is not fully known; however, it is believed that spawning occurs in the vicinity of the estuaries. A sub-spawning stock occurs in Kuwait's waters as indicated from sea surveys in a limited area of Kuwait Bay (Almatar, S., KISR, personal communication), while Iranian scientists confirm that spawners are found in Iranian estuaries in the northern areas of the Gulf. In addition, migration patterns and the location of feeding grounds and wintering grounds are also not fully documented. Monthly landings at Kuwait's fish markets (Fig. 3) indicate that zobaidy catches by the gillnet fishery increase during April and May in the areas of Khor Abdullah, south east of Bubyian Island, east of Failaka Island and in the eastern areas of Kuwait Bay. This distribution continues up to September and then gradually decreases. On the other hand, the catches by shrimp trawlers operating in deeper areas from south Auha Island to north of Umm Al-Maradem Island increase from October to December.

Assessment of the zobaidy stock indicated that the maximum sustainable yield (MSY) was around 500 t (Mathews et al, 1989). This estimate, however, was based on the 1982-87 historical catches by Kuwait's fleet when the Iran-Iraq war had limited access to fishing grounds, while average annual catches were near the MSY (422 t) during the same period. Parsamanesh et al. (1998) indicated that zobaidy was fished (1993 to 1995) at or near its MSY in the Khouzestan Province of Iran. All previous assessments at the Mariculture and Fisheries Department of the Kuwait Institute for Scientific Research were covered only the adults and the of the zobaidy stock in Kuwait's waters.

The results of the MSY should be applied with caution since this stock is migratory and is harvested by two countries. Recently, Iran initiated data collection on catch and effort, and, thus the actual sustainable yield may be determined collectively for the stock using data of the two countries. Presently, neither standing biomass (stock size) nor whether this stock consists of one unit or several sub-unit stocks is known.

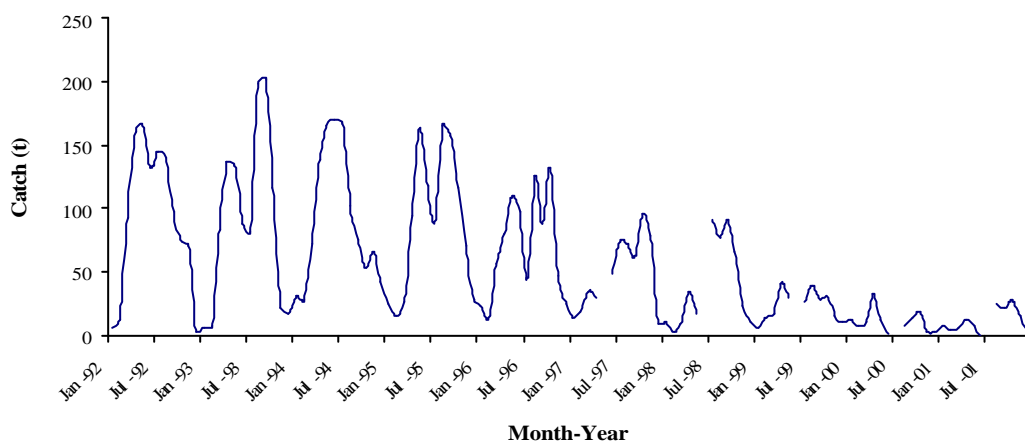


Fig. 3. Monthly zobaidy catches landed at Kuwait's fish markets from January 1992 to December 2001.

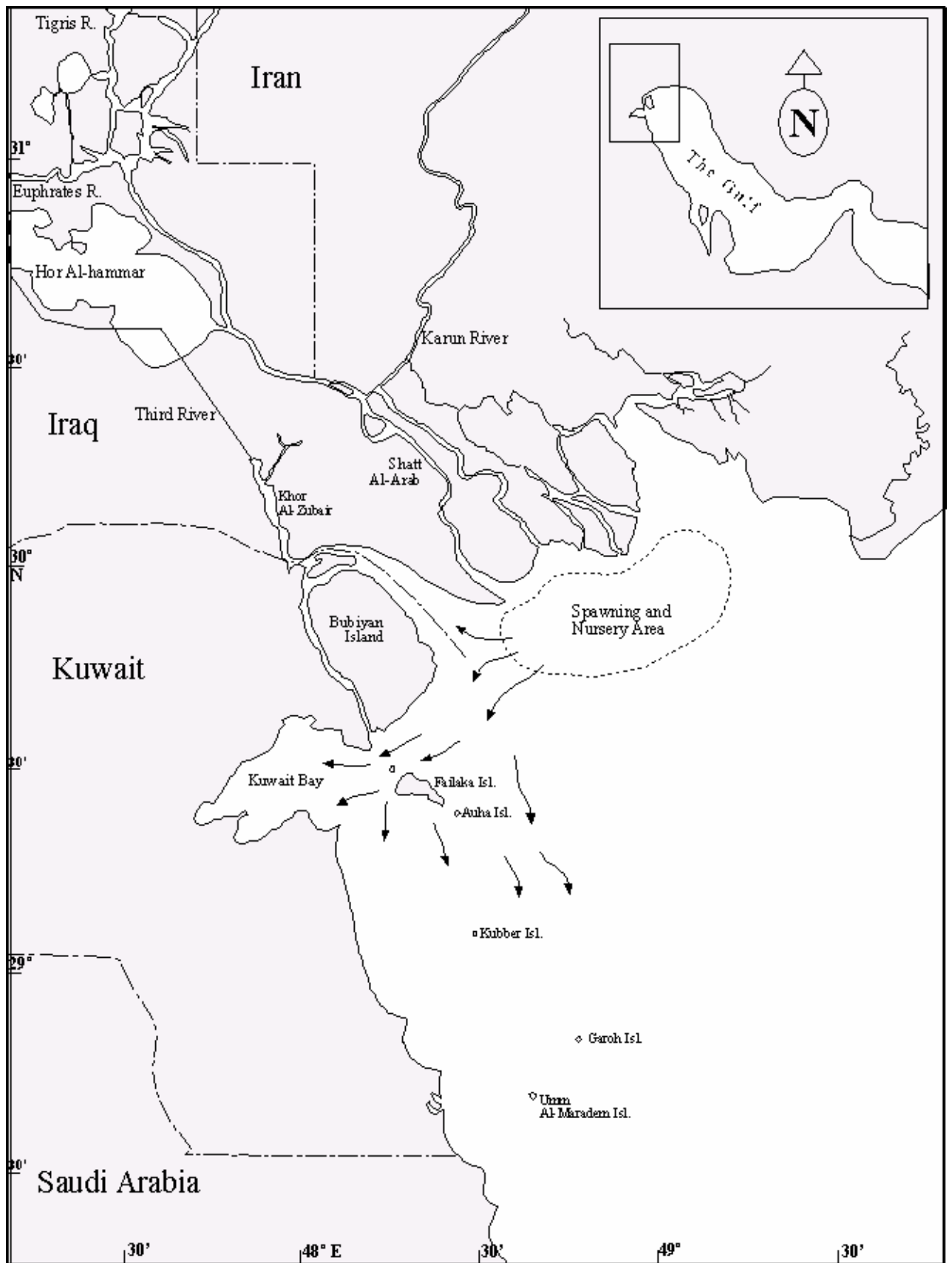


Fig. 4. Map of the Northern Gulf area showing the riverine system, zobaidy's presumed spawning and nursery area in Iran waters and migration routes (indicated as arrows) to feeding areas in Kuwait's waters during September.

All previous assessment work on zobaiddy stock used length-based methods (Al-Hossaini, 1994; Lee et al., 1990; Mathews et al., 1989; Morgan, 1985; Parsamanesh et al., 1998). Estimated von Bertalanffy growth parameters for L_{∞} (asymptotic maximum length) ranged from 32 to 44.5 cm forked length and for k (growth rate) from 0.49 to 1.0 per annum. Total mortality (Z) estimates using catch-curve methods were 1.5 (Lee et al., 1990), 1.62 (Morgan, 1985) and 2.4 (Al-Hossaini, 1994). Natural mortality (M) estimates varied from 0.5 to 1.05, and estimated age at first capture was one year (Lee et al., 1990). The results from Khoozestan Province on length distribution analysis for 1993 to 1995 (Parsamanesh et al., 1998) indicate that L_{∞} varies from 35 to 42, k from 0.85 to 1.12, Z from 2.6 to 5.36 and M from 1.4 to 1.6.

Both countries now imposed a 45-day ban during May to June to protect spawning biomass, however, there is extensive fishing by the Iranian fleet after this closure in the nursery areas, and any overexploitation will affect the yield of the Kuwait fishery. Thus, cooperative research and management of this stock is recommended for future sustainable harvesting.

It is not possible to determine zobaiddy age from counts of annual marks in whole otoliths or by the grinding and burning method, or by applying modal progression analysis of length-frequency samples. The results of previous assessments of the zobaiddy stock in the vicinity of Kuwait were based on extensive length-frequency data analysis (Morgan, 1985).

Although ageing of another species of pomfrets, *Pampus echinogaster*, using vertebrae was successful (Kang et al., 1989), attempts of using this technique with zobaiddy have been unsuccessful. Microstructural analysis of zobaiddy otoliths revealed that otolith ageing is difficult because of the otolith structure is very complex and the daily increments are highly irregular, making them difficult to observe and interpret (Brothers and Mathews, 1987). The only promising ageing technique is that of annual marks with a robust validation study using thin sectioning and staining.

Yield-per-recruit analysis (Morgan, 1985) indicated that optimal fork length at first capture is about 20 cm while the actual fishery figure is less than 16 cm. The same analysis with the exploitation rate showed that the stock is not heavily exploited according to data on fishing effort for 1981 to 1984.

Research Plans

The available information on zobaiddy stock indicates that the two countries, Kuwait and Iran, share the stock and any damage to the stocks in one country will affect the catches in the other country. Thus, it would be highly beneficial for the two countries to formulate a mutual agreement and practice joint management of the shared stock.

Fisheries scientists initiated a research proposal for a cooperative project between the Aquaculture, Fisheries & Marine Environmental Department (MFD) of Kuwait Institute for Scientific Research, and the Khoozestan Fisheries Research Centre of the Iranian Fisheries Research Organization (IFRO). A proposal was developed over several regional meetings between the two groups of scientists, and a

Memorandum of Understanding was signed by the General Directors of the two institutes for implementing cooperative research between the two departments. The Public Authority for Agriculture and Fisheries (PAAF) of Kuwait and the Iranian Shilat Fisheries Company will also sign an agreement for cooperative fisheries management.

Identification of shared stocks is the main task for the fisheries organizations in the northern Gulf region. Properly organized management schemes and measures for these stocks require a clear understanding of baseline information including their bio-geographical and temporal distributions, migration patterns, stock biomass and unity, and occurrence of transboundary movement. Management-wise, allocation of shares (total allowable catch, TAC) for each country through negotiation requires biomass estimates, and an explicit understanding of the biological characteristics and effort trends of fishing fleets (Caddy, 1982) as well as a clear understanding of operational characteristics of the fishery (Morgan, 1997). Various legal measures may be adopted, such as size-limit regulations, catch quotas, minimum mesh size, and restrictions on fishing effort, to ensure proper sustainability of the stock.

Implementation of stock harvesting strategies and a quota system for zobaidy stocks require basic information on the biomass, seasonal abundance, migration and spawning. Abundance can be estimated by different methods. The most reliable methods are mark-recapture experiments or cohort analysis (or virtual population analysis, VPA). Mark-recapture experimentation is an excellent method to estimate population size, survival rate and migration pattern. Tagging of zobaidy is not possible because this species is handling-sensitive once caught by fishing gear, and as a result, mass mortality is inevitable. VPA is a powerful tool for estimating population size, mortality rate and recruitment, but it is very data-intensive. The minimum data required for VPA are a catch-at-age matrix and estimates of natural mortality. Total catch, size distributions and age-length keys are the main components for constructing age composition of the catches. Age data are lacking for both countries while total catches and size distributions are lacking for Iran. Hence, these basic data need to be collected during the cooperative research project.

Sea surveys allow estimation the average fish density over a spatial range, and then the spatial distribution of the density can be mapped. Incorporation of a temporal scale (i.e. a monthly or quarterly time scale) with the spatial distributions of the relative densities can be used to ascertain the migration patterns of zobaidy.

Zobaidy is considered difficult to age by means of hard tissues such as otoliths using whole otolith reading method or grinding and burning method. Attempts were carried out at MFD to age zobaidy by microstructure analysis of otoliths (Brothers and Mathews, 1987), but the pattern of accretion of the daily increments is irregular, and therefore, increment counts are uncertain. Thin sectioning with polishing and staining will be conducted to discern the presumptive annual marks but validation of these marks needs to be conducted.

The Cooperative Project

The PAAF, KISR and the Kuwait Foundation for Advancement of Science financially support Kuwait's involvement in the project (KFAS) while IFRO will support the Iranian sector of the project.

The project will start in September 2002, and last 37 months. During the seven-month mobilization period, setting of standard procedures for data collection and sampling will be established. The proposed project consists of three operational research tasks in each country and one management task in MFD. The duration of these tasks is two years. These operational tasks are:

1. *Fishery data collection*: the basic data on catch, fishing effort, and fisheries biology (length distributions, sex ratio, maturation, length-at-age, weight).
2. *Sea Surveys*: determine monthly abundance, biomass and length frequency for each proposed sampling station at sea
3. *Data analysis*: estimate monthly catch and effort, length frequency, growth and mortality estimates, biomass and seasonal distributions, migration pattern, maturity, recruitment, and yield forecast.

The final six months will be spent analyzing data and writing the final report.

Management Prospect for Zobaidy Stock

The success of implementation of the management plan, which will be based on project results, depends on the developmental stage and powered enforcement of the fisheries institutions in the two countries. The sharp decline of catches of zobaidy in the region is a worrying indication of diminishing stock abundance and all concerned parties should implement the resulting management program immediately to protect stock from further reduction or collapse. The project will encourage the two countries in the region in the following aspects:

1. Improve the political will for management organizations in the region for cooperative management.
2. Strengthen institutional research in terms of scientific advice to the management organizations and decision-making authorities.
3. Improve effective enforcement and surveillance power by the two management authorities (PAAF and Shilat) to ensure prevention of illegal fishing and catch transfer through marine borders.
4. Establish a joint stock monitoring system if the data show year-to-year variation of spawning biomass and migration pattern.
5. Establish biological reference points for the zobaidy to prevent further over-fishing and initiate recovery measures.
6. Establish a management system to ensure equitable distribution between the countries and to ensure long-term maintenance of the stock.
7. Establish a management system within the countries based on Individual Transferable Quota (ITQ).

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