Kuwait's Finfish Catch Three Times More Shrimp Than Its Trawlers

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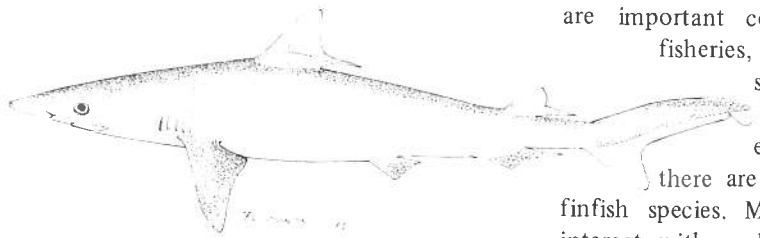
Shrimp landings in Kuwait are valued at US$10 million/year. They are the country's main export after oil, and form the largest single component of Kuwait's fisheries, currently around 8,000-10,000 t/year.

Fish caught in Kuwait waters are not exported and supply about 45% of the fish products eaten in Kuwait. Fish consumption in Kuwait is low. Only about 3% of animal protein consumed in Kuwait presently consists of fish, and this proportion has fallen from 5% in 1973. However, fish is a popular food and securing a steady supply of both fish and shrimp from Kuwait's own fisheries is an important objective for the country.

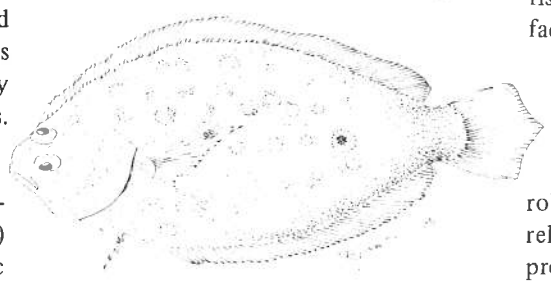


Finfish demand already exceeds current fish supply from Kuwait waters, while likely projections of shrimp demand suggest that, for a significant period, shrimp must be an export-oriented industry. The excess of demand over supply means that careful assessment and management of the fish stocks is necessary if increased prices are not to contribute to overfishing. This is particularly relevant because of the marked reduction in shrimp landings that has occurred since the 1970s. It is necessary to avoid a similar fall in finfish landings.

Single Species Assessments

Since its inception in 1967, the Mariculture and Fisheries Department (MFD) of the Kuwait Institute for Scientific Research has devoted much of its energy to assessing various stocks of shrimp (mainly *Penaeus semisulcatus*) and fish (several species of snapper, groupers, croakers, grunts and other percoids). This, however, was done for each species independently, without reference to yields and effort expended upon other species and without reference to species interactions. While this may be appropriate for the shrimp fishery which in Kuwait is based on three species, one of which largely dominates the catches, it is particularly inappropriate in a country where finfish may be landed in a variety of ways, e.g., by stake nets (hadra), fish traps (gargoor), trawling, hook and line, and gill nets. Many species are important components of several fisheries, and are also taken in several different habitats by the different gear. Furthermore, there are about 20 commercial finfish species. Many of these species interact with each other, e.g., through predation; and juveniles of some species are caught in some fisheries (trawls), while adults are caught in others (gill nets and traps).

The shrimp fisheries of Kuwait produce substantial amounts of bycatch, as do many other shrimp fisheries throughout the world. Giant sea catfish *(Arius thalassinus)*, which form an important component of the catches, are not often consumed in Kuwait and the bycatch, with an estimated maximum sustainable yield (MSY) of at least 15,000-17,000 t/year, is mostly underutilized. Unwanted fish are discarded at sea and at least 10,000-15,000 t/year have been discarded in this way during the last few years.



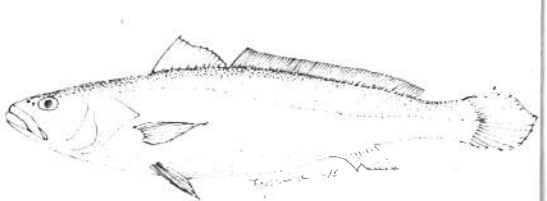
Technological and Biological Interactions

The technological interactions between the shrimp and the finfish bycatch in Kuwait have received little attention and no serious attempts have been made to utilize bycatch on a large scale, although increasing quantities of bycatch species are being sold in the markets. No attempt has been made to use any gear-which is selective for shrimp as is used in many shrimp fisheries elsewhere.

Another issue has recently become relevant in Kuwait and affects many management decisions concerned with interactions between fish and shrimp stocks: the biological interactions between fish and shrimp. While some small fish may compete with shrimp for food the major biological interaction between the fish and the shrimp is undoubtedly the fact that fish eat shrimp.

Estimating Shrimp Consumption by Fish

To obtain a more precise idea of the role that fish predation may play in relation to Kuwait's shrimp stocks, a preliminary study was conducted at MFD from April to November 1985 by a French volunteer, Mr. Olivier Euzen. The stomachs of various Kuwait fish were investigated to determine the proportion of penaeid shrimps in their diet. The proportion of shrimps in the diet of Kuwait fish was found to be highly



Some of Kuwait's shrimp-eating fish. *Top:* requiem sharks (*Carcharinus* spp.), 14.5% of their diet is shrimp. *Center:* large-toothed flounder *(Pseudorhombus arsius)*, 23.8%. *Bottom:* the croaker *(Otolithes argenteus)*, 20.2%.

variable, ranging from 0.5% in the ray *Himantura uarnak* to 23.8% in the large toothed flounder *Pseudorhombus arsius*. The mean percentage (weighted by the estimated biomass for each species) was 5.9%.

The data on consumption, finfish biomass and the proportion of shrimp in the diets of the fish can be combined as follows: (Mean annual biomass of fish) X (annual food consumption per unit biomass of fish) X (fraction by weight of shrimp in the diet) = (shrimp consumption by fish). Annual food consumption by fish was estimated using a method recently developed by one of us (D.P.), which is based on the detailed analysis of data on the growth and food conversion efficiency of fish.

Total shrimp consumption by finfish was estimated to be about 6,000 t/year. Current shrimp landings in Kuwait vary from 1,500 to 3,000 t/year with an estimated MSY of about 1,850 t/year. Therefore, finfish catch about three times more shrimp by weight than do trawlers in an average season in Kuwait.

It appeared that the mean length of shrimp eaten is about 4.1 cm total length, corresponding to a mean weight of about 0.55 g. Shrimp harvested by the trawlers average 4.5 cm with a mean weight of about 0.73 g. Thus, the number of shrimp eaten by fish is four times the number landed by the fishery.

Management Implications

The differences between the quantities of shrimp eaten by fish and landed are large. It is tempting, based on these numbers alone, to suggest some scheme of reducing the predatory biomass, for example by a trawl fishery aimed at fish which could reduce fish predation on shrimps. Technically, this would not be simple to achieve because trawl fishing is presently banned during the closed season for shrimp in Kuwait.

However, predation in nature does not occur in linear food chains but in intricate foodwebs in which several predators may feed on the same prey(s). A number of researchers, notably Erik Ursin at Charlottenlund, Denmark, have proposed that triangular subunits such as those depicted in Fig. 1 are the basic constituents of most foodwebs. In this instance,

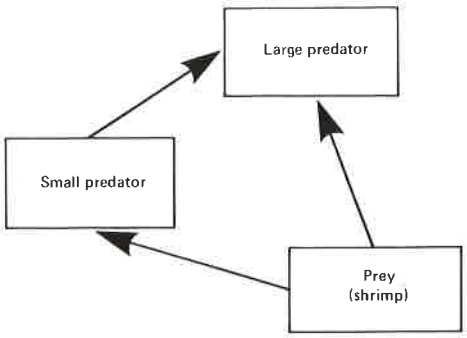


Fig. 1. Basic subunit of most of food webs, as suggested by a number of authors. Note that the large predator, when abundant, keeps both the small predator and the "prey" biomass down, and that reduction of the large predator biomass does not necessarily imply that the prey will increase.

reducing the biomass of a large predator would lead to a decrease of its intake of prey and small predators. Biomass of the small predators and their prey consumption would then increase.

In the case of fish predation on shrimp, it cannot be assumed that reducing fish biomass by 50% would lead to 50% more shrimp becoming available to the fishery. It is possible that numbers and biomass of some presently unimportant shrimp predator might increase, and in part at least replace the predatory impact of the large fish.

Research Implications

No clear management advice can be provided at present on these issues and more research has to be conducted before reasonable management options can be formulated.

The following research is needed:

- Examination of stomach contents of more species of finfish, particularly small fish species occurring on or near shrimp nursery grounds, and with seasonal changes in the proportion of shrimps in the diet.
- Refinement of estimates of fish biomass and the food consumption per unit biomass.

A research program covering these items is presently underway at MFD. Results of work on the conversion efficiency of several species of cultured fish are available while work is also being started on conversion efficiencies of major species of wild fish. The results of seven years of sea surveys are being analyzed so that long-term trends in biomass, size frequencies and distribution of bycatch fish will be available. Growth and mortality parameters are also being estimated. Further stomach content studies will be conducted and it is hoped that eventually the data obtained will allow more accurate estimates of the effects of trawl effort variations upon shrimp catch rates by taking into account the indirect effects of predation upon shrimp catch rates.

The results of the study should also throw light upon natural mortality rates of shrimp. The possibility that natural mortality varies with size can be investigated by studying the size frequencies and number of shrimp eaten. It may be possible to estimate the number of shrimp recruits in different years and to correlate such estimates with effort, predation levels and/or physical environmental variables presently being monitored by MFD's oceanography team.

Long-term Benefits

An economic study of Kuwait's shrimp fisheries is being completed which suggests that a major reduction in effort to a level of about 25% of the current level would optimize the profits and landings in the industry. However, reversal of the increases in effort which have taken place during the last seven years might not lead to the expected increase in shrimp catch rates (and so in economic benefits) if the decreased effort levels lead to higher populations of associated fish and hence a large increase in predation upon shrimps. Such an increase might be sufficient to offset significant economic benefits obtained by reducing effort. Indeed, it is possible that the resilience of many shrimp fisheries is the result of decreases in predation at higher levels of effort such that increased shrimp removal by the fishery coincides with decreased shrimp removal by fish.

Although the problems being tackled are complex, their timely solution is necessary both in respect of the immediate economic optimization of Kuwait's fisheries, and the longer-term possibility of manipulating the ecosystem so as to provide greater economic benefits. This will probably involve optimizing the landings of all edible species with shrimp being only one of a large number of species being utilized. •