SPC/Inshore Fish. Mgmt./BP 33
1 June 1995

ORIGINAL : ENGLISH

SOUTH PACIFIC COMMISSION

JOINT FFA/SPC WORKSHOP ON THE MANAGEMENT OF SOUTH PACIFIC INSHORE FISHERIES
(Noumea, New Caledonia, 26 June - 7 July 1995)

FISHERIES MANAGEMENT IN THE TURKS AND CAICOS ISLANDS

BY

P. Medley & C. Nines
Dept. Of the Environment and Coastal Resources
Turks & Caicos Islands

Fisheries Management in the Turks and Caicos Islands

Paul Medley and Christopher Ninnes
Department of Environment and Coastal Resources
Grand Turk
Turks and Caicos Islands

Introduction

The Turks and Caicos Islands are at the southern end of the Bahamas chain in the Atlantic Ocean. The fishery is largely based on the larger of three areas of shallow water, the Caicos Bank. The fisheries resource is important to the Turks and Caicos Islands, second only to tourism in monetary value. The catch is dominated by lobster *(Panulirus argus)* and conch *(Strombus gigas)* which are exported to the United States and Europe. Lobster is exported mainly as frozen tails, conch as frozen 100% cleaned meat. Other finfish species are caught, but in comparatively small amounts for local consumption or as part of the sports fishery.

Since 1989 when an ODA (UK) funded project was put in place, management has been dedicated to improving the income from the fishery taking into account social constraints within the fishing community. The science programme, which is used to generate and test current management practices and to guide policy, forms an integral part of management. This approach has led to a relatively stable and productive fishery. Some of the methods employed may be of value to other tropical island states outside the Caribbean region. Although the social structures are clearly different, the biological systems have many similarities. However the fishery in the Turks and Caicos is relatively simple, and techniques and controls used may need a number of adaptations before being applied elsewhere.

The Fishery

Catches for both lobster and conch are recorded as pounds landed at the end of each days fishing at one of the fish processing plants, of which there are currently five. Conch are removed from their shells at sea (knocked), but landed whole, where the meat is processed and frozen for export. Lobster are landed whole, although only their tails are exported. Fishers generally leave between 0700-0800 and return to land their catch by 1600. The length of a fishing day is variable and will depend, among other things, on weather conditions. Each boat carries a boat driver (keep-up) and 1-2 divers. Most boats are now made of fibreglass and have 55-70 hp outboard engines. Conch are collected by free diving (only mask, fins and snorkel) in waters usually less than 10 metres deep. Fishers do not work in greater depths because the weight of the shells make it difficult to bring several conch at a time to the surface. Using the same method lobster can be dived from up to 20 metres depth depending on the capability of the fisherman. There is also a small trap fishery for lobster of 1-2 boats generally operating at depths unavailable to divers.

Conch fishing for export has been taking place for much of this century. Before freezing technology allowed the export of frozen conch, it was largely exported dried to nearby Caribbean islands. The lobster fishery only began in earnest with the arrival of appropriate freezing technology in 1966. Both fisheries expanded, with some fluctuations, to 1979. However the fishery subsequently went into decline and by 1985 lobster catches had fallen to less than 400,000 pounds (Figure 1). As fishers switched to conch, the conch catch also began to decline

(Figure 2) as did income from the fishery. By 1989 the fishery was in the worse state it had ever been. However, there has been a dramatic recovery between 1990 and 1994, with 1992 having the highest lobster catch on record. Similarly, there has also been a dramatic increase in conch stock and current catch rates for conch are very high. The main aim of the science programme has been to understand why this recovery took place, and to ensure that the industry does not experience a repeat of the low catches seen during 1985-89.

Current Management Controls

Currently there is a minimum size limit for lobster of 3¼ inch carapace length or 5 ounce tail. There is also a closed season for lobster running from April to July each year. The control was put in place to protect females carrying eggs which have been found to become more frequent during this period. It is also illegal to land female lobsters with eggs. For conch there is also a minimum size of 7 inch shell length, although this is difficult to enforce as only the meat is landed. There is also a closed area immediately around the main fishing town which acts as an effective reservoir for small conch. Scuba and hookah equipment are illegal.

Science Programme Results

The science programme was designed to investigate the effectiveness of current management controls and study potential benefits from a variety of new controls and fisheries enhancement. The programme started in 1989 when lobster and conch catches were very poor, so that initially the aim was to identify new fisheries resources which could attract fishing effort away from the over-exploited lobster and conch. With the results of fisheries surveys of pelagic and demersal fin-fish populations, and the improvements in the traditional fisheries, scientific assessments were redirected to lobster and conch to ensure gains made in these fisheries were sustainable.

Near-shore Pelagic and Demersal Fin-fish Surveys

A dedicated research vessel was used to survey three banks which form the Turks and Caicos Islands. Catch rates were low for the near shore pelagic resource, and it is unlikely they would support a commercial fishing operation. Therefore this resource has been allocated to the growing sports fishery for which the catch rates appear adequate, if not exciting. The demersal resource is not large, but would support a small artisanal fishery mainly supplying local hotels. This will require some help to interested fishers in the form of equipment.

Catch and Effort Data

Accurate daily lobster and conch catch and effort data for individual vessels has been analyzed for the period 1977-1993, although 1984-1985 are missing fishing effort. Daily data exists going back to 1966 and is currently being entered onto computer. These data have been obtained through upgrading from paper records to a computer data management system, which has allowed the reassessment of daily landings records reported from the processing plants. Significant errors have been eliminated from official government records by going back to original data.

The data was used to carry out a stock assessment and provide models of stock population dynamics for use in the assessment of management controls. The conch data was well explained by a fitted Schaefer model ($R^2 = 0.957$ with 12df). The non-equilibrium model was fitted using the CEDA package (ODA 1992), which supports analysis of residuals, and estimates standard errors through a bootstrap technique. The results suggest the maximum sustainable yield (MSY) to be 1.62 million pounds, although optimum economic yield is obtained before this point, with 4450 boat days as opposed to 5850 required to reach MSY.

The lobster stock assessment required a more complex model to explain past changes in catches and catch-per-unit-effort (cpue). A recruitment index was generated from daily catch and effort data from the beginning of the season when catches consist primarily of the lobster recently recruited to the fishery (Caputi and Brown 1986; Phillips 1986). The recruitment index was then used in a second model to explain yearly catch and cpue. The model fitted the data well ($R^2 = 0.987$, 11df), although it is only able to predict catches to the end of the season. However the recruitment index was found to be correlated with adult stock size from four years ago ($R^2 = 0.618$, 13df). If this correlation proves a reliable predictor of future recruitment, catches may be predicted up to four years into the future and the possibility exists to optimize the fishery.

The results suggest the conch and lobster stock sizes are now about the same as they were during the period 1975-79. The decline in lobster stocks was most likely due to recruitment failure, as overfishing depleted the mature egg-producing lobsters. This was probably made worse by the hurricane which hit the Caicos Bank in 1985 (which may well have killed many of the smallest lobsters), illegal fishing by foreign vessels and the capture of undersized lobsters. As fishermen stopped catching lobster and found alternative employment, the mature lobster population increased in size. At the same time, in 1989, tighter management controls were implemented. In particular fewer undersize lobsters (below 3¼ carapace length) were caught and many foreign vessels were arrested using patrol vessels acquired in 1990. The decrease in fishing activity and tighter controls probably led directly to the recovery.

Socioeconomic Research

Socioeconomic studies provided basic cost information for running fishing boats and historical price data for landings and exports for lobster and conch. This information has been used to develop simple bioeconomic models from the stock assessment and a cost-benefit analysis of the national fishing industry. Through surveys the socioeconomic programme has also collected detailed data on the social lives of the majority of fishers. These data have been used to classify fishers into social groups which has simplified the assessment of management controls. Analysis of the communication network within the fishing community has identified key individuals who can provide an important link between management and the fishing community. This link has improved compliance with regulations and allowed increased feedback between management and the community.

Management Implications

The relatively poor results from the demersal and near-shore pelagic surveys indicates that lobster and conch represent the largest fisheries resource in the Turks and Caicos Islands. Results

also indicate that relatively high yields are sustainable (in the region of 1,400,000 lbs conch and 800,000 lbs lobster) with effective management. The stock models suggest optimum yields could be obtained through effort control and export taxation.

Increasing export taxation lowers the landings price which in turn reduces fishing effort. Taxation will also raise revenue for the management authority, although it will not benefit the fishers directly. The first step has already been taken to increase export taxation for both lobster and conch. a low price seems to have been effective in protecting the conch population, so taxation may be an adequate control for conch as long as lobster catch rates are high. Maintenance of the lobster stock is a priority in management of the fisheries.

Unfortunately directly controlling fishing effort is not currently possible. Reducing fishing effort would increase income from the fishery as a whole and to those fishermen remaining in the industry. However the socio-economic study indicates the fishery acts as major employer largely replacing a national welfare system. The large number of part-time fishers derive a small but significant income from fishing, and it would be difficult at this stage of development to introduce limited entry, although this would remain the long-term plan.

Instead of direct effort control, the proposal is to alter the lobster closed season to ensure a minimum escapement from the fishery. The season's fishing effort for different season lengths can be estimated from the price and recruitment index at the beginning of the season. The stock-recruitment relationship is then used to guide the season length. For a high price with poor recruitment, the season will tend to close earlier, ensuring a minimum number of adults join the spawning stock found in deeper water. a properly enforced minimum size and the closed season control should protect future recruitment to the fishery.

The Current Science Programme

Catch and effort data analysis has a number of problems associated with it. Most obviously the models used may be a poor description of the real population dynamics. The most obvious weakness in using catch and effort data is the assumption that the catch-per-unit-effort is proportional to the abundance of the stock (Hilborn and Walters 1992). This assumption is being checked using detailed time budget of fishing boats activities, and relating this to the current cpue index, catch-per-boat-day. However, even assuming that the analysis of catch and effort data is valid, very often it will not answer all the questions management has concerning the fishery.

For instance, the current minimum size regulation, while excellent in theory, has many problems in ensuring compliance. The socio-economic study identified a large group of fishers who, through most of the season, are forced to catch lobsters below the minimum size because they are unable to dive deeper to target larger lobster. Minimum size, closed season and effort controls by themselves appear to be relatively unrefined in social terms. There are alternative measures which could be applied more sensitively and still achieve conservation and economic objectives. For the Turks and Caicos Islands there are two alternatives, closed areas and fishing gear controls. Closed areas can be designed to protect particular parts of the lobster and conch stocks while having an equitable impact on the different fisher groups in the community. However to

achieve this aim, an understanding of the spatial distribution of fishing and the lobster and stocks is required.

Geographical Information Systems, Habitat Mapping and the SAM System

Geographical Information Systems (GIS) provide an efficient way to organize and analyze spatial data. a GIS is being developed in the Turks and Caicos Islands which will hold information not only on fisheries and ecology of the islands, but also on land management for use by the lands and planning departments. The fisheries application is building a detailed and accurate habitat map of the main fishing areas, concentrating on a map of the patch reefs where lobsters are caught. The methodology makes use of remote sensing data (Landsat TM image), aerial photographs and field data, including a bathymetric survey, obtained using a differential Global Positioning System (GPS). These data are being used to make a series of detailed GIS layers on the biology and geography of the fishing grounds and surrounding areas. This information is being linked to actual fishing activity through a semi-automated monitoring (SAM) system using a differential GPS unit placed on the fishing boats with fishers' co-operation. The unit allows detailed monitoring of fishing activity without an observer on board the vessel. This is achieved by matching the vessel's track to the underlying habitat map (Figure 3). The search pattern and time spent in different activities (fishing and traveling) can be obtained, and with the (manual) measurement of the catch at the end of the trip, the catch can be estimated for each reef visited. Hence the SAM system provides information on which areas each fisher uses, and the abundance, size, sex, and maturity of the catch for those areas. The science programme is currently at the stage of developing GIS applications to make use of these data to improve the stock models and propose appropriate closed areas for enhancement of the fishery.

Casitas

Casitas are artificial lobster habitats in which lobsters hide to escape predators during the day are similar to artificial reef, but their design is specifically aimed to attract and catch lobster. In the TCI they have wooden walls (15 cm high), with openings to allow lobsters access, and a floor and ceiling made of corrugated iron. For trap casitas the openings can be closed and the whole casita hauled onto a fishing vessel.

Casitas will allow fishers who are not capable of deep diving to target larger sized lobster and make it easier to return lobster which are below the minimum size. It has been found that the geographical location, rather than the immediate environment, influences the success of a particular casita It is hoped the GIS will be able to help in the efficient placement of casitas. Perhaps of greatest interest is the use of casitas in attempting to increase the size of the lobster stock. If areas can be found where the limiting factor on the numbers of lobsters is shelter rather than food or other effects, casitas may be used to enhance the lobster fishery productivity.

Wider applications of the Turks and Caicos Islands Science Programme

The Turks and Caicos Islands fishery is relatively simple with only two major species and has historical data records which are found only rarely in developing countries. This makes it ideal to develop new methodologies which can be compared with traditional approaches to stock

assessment. a GIS / habitat mapping / SAM system programme may achieve the same or improved results as those using historical data in the assessment of some management alternatives. In essence such a programme should obtain abundance of fish species by location even if there is no historical data. However the GIS data would not replace the need for total catches, although it may help in obtaining this information. Neither would it be possible to predict changes in stock size without a population dynamics model, which would require historical time series data. However perhaps the approach is appropriate to the assessment of artisanal and subsistence fisheries in many developing countries, particularly where the fisheries operate in shallow water and spatial distribution and fishing effort plays an important role in determining catch size and species composition, as for instance on coral reef.

Acknowledgments

We are grateful for the support provided by the Turks and Caicos Islands Government, particularly the Department of the Environment and Coastal Resources. The project was funded by the Overseas Development Administration, UK.

References

Caputi, N and Brown, R S. 1986. The relationship between indices of juvenile abundance and recruitment in the western rock lobster *(Panulirus cygnus)* fishery. Canadian Journal of Fisheries and Aquatic Sciences 43 2131-9.

Hilborn, R and Walters C J. 1992. Quantitative Fisheries Stock Assessment. Chapman and Hall, New York.

ODA. 1992. Catch and Effort Data Analysis. Ver. 1.0. MRAG, 27 Campden Street, London W8 7EP, UK.

Phillips, B F. 1986. Prediction of commercial catches of the western rock lobster *Panulirus cygnus.* Canadian Journal of Fisheries and Aquatic Sciences 43 2126-30.

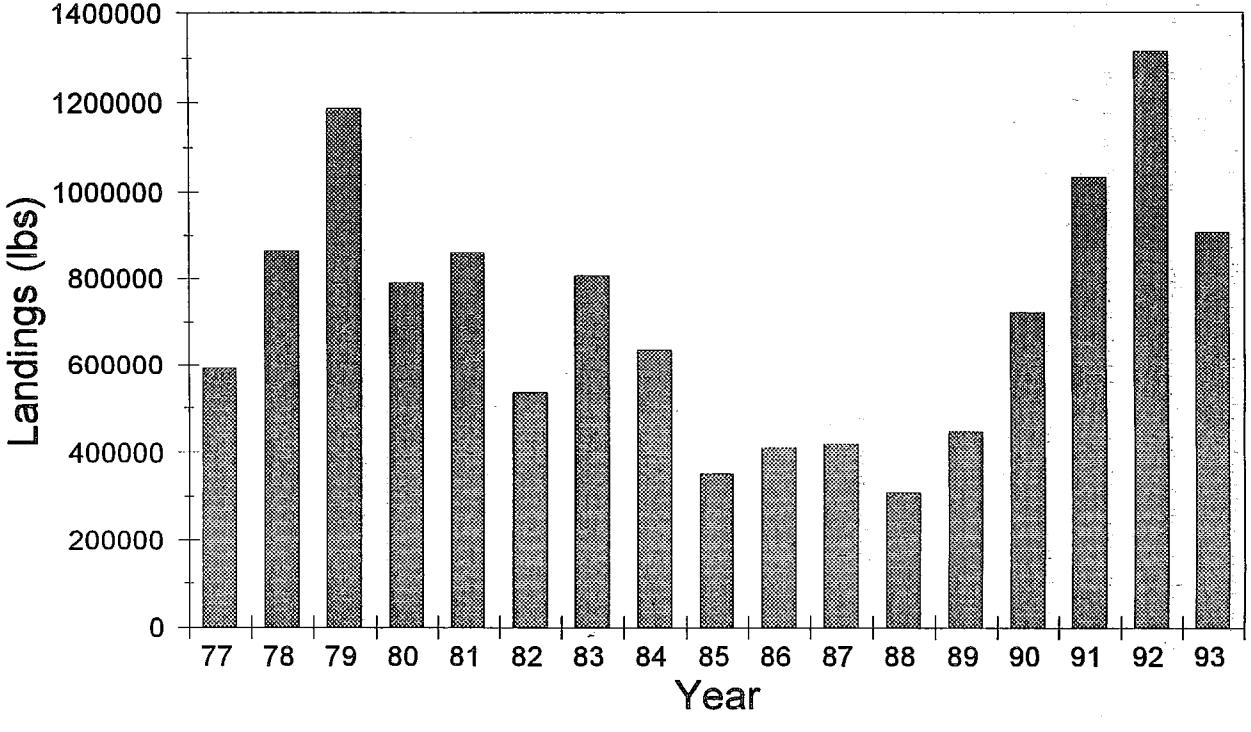

Figure 2. Total landings of whole lobster for the seasons, 1977-1993

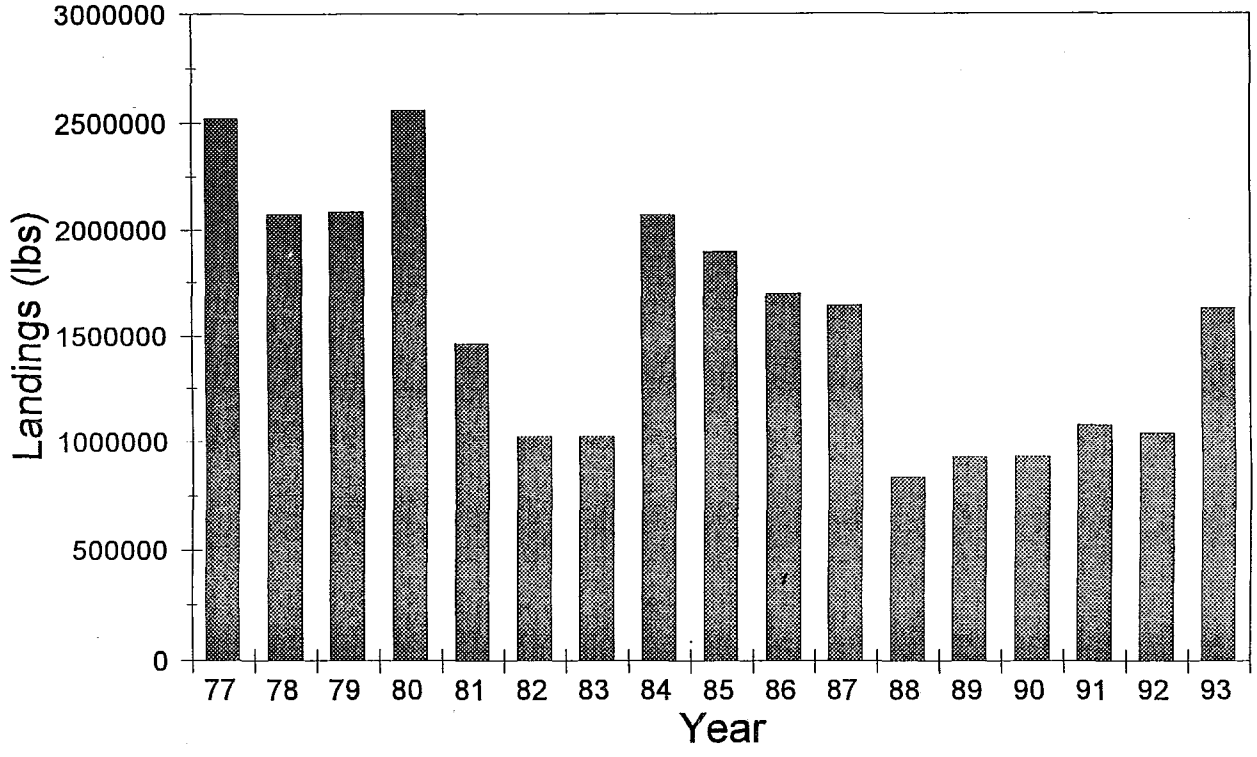

Figure 1. Total landings of conch for each season, 1977-1993. The fishing season lasts from April to July the following year

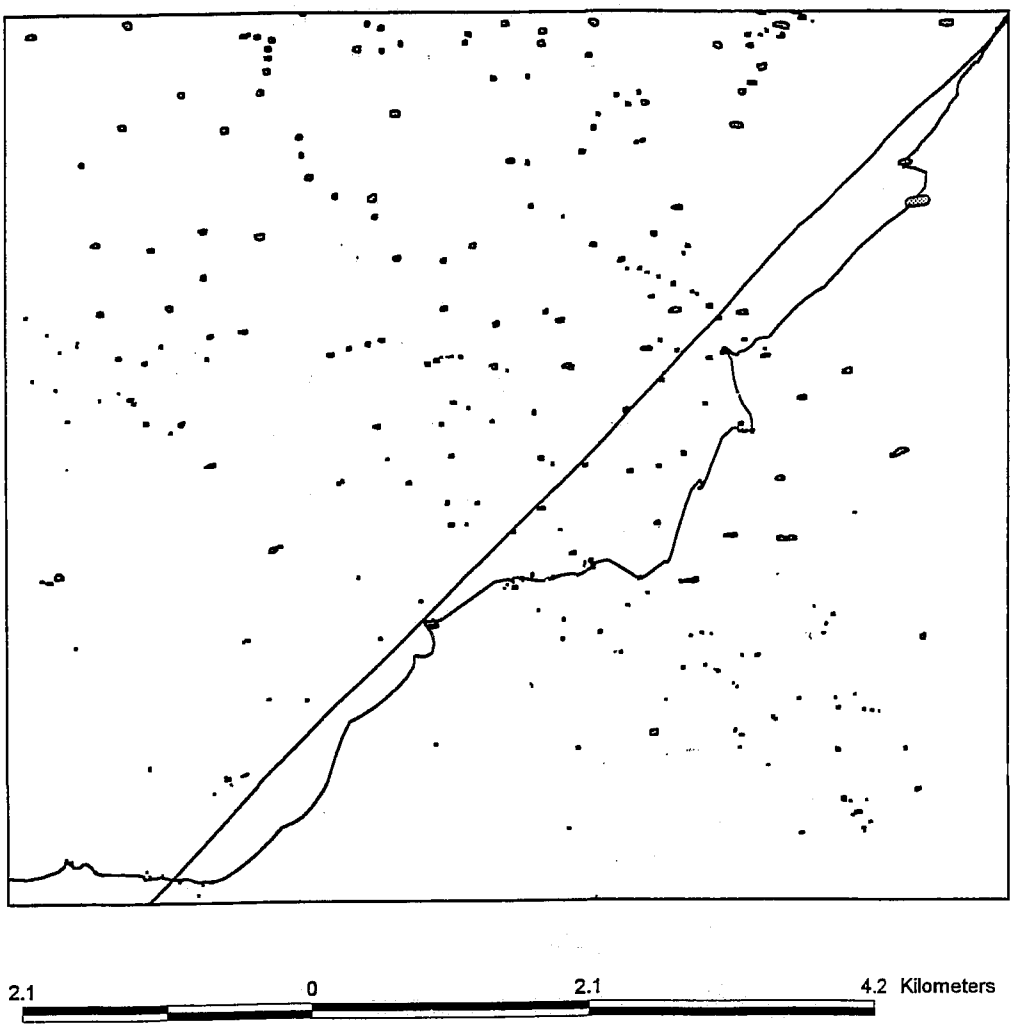

Figure 3. An example track of a fishing vessel using the SAM system. The outward bound search pattern can be seen as the vessel visits the coral patch reefs, which have been digitized from aerial photographs. The return to port can easily be distinguished by the straight track with no searching