A low cost, appropriate technology method for estimating the productivity of a traditional, multi-species fishery in Papua New Guinea and implications for management

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UNE MÉTHODOLOGIE PEU ONÉREUSE POUR ESTIMER LA PRODUCTION D'UNE PÊCHERIE TRADITIONNELLE MULTISPÉCIFIQUE EN PAPOUASIE-NOUVELLE-GUINÉERESUME

L'information sur les pêcheries traditionnelles dans les pays du Pacifique sud est essentielle pour planifier le développement mais fait encore défaut. Ceci est largement dû à l'incapacité des scientifiques occidentaux d'adapter leurs méthodologies. Par la mise en place de techniques d'enregistrements appropriées et grâce à la formation de personnes sélectionnées sur place («biologistes aux pieds nus»), on peut obtenir des données utiles pour un prix raisonnable. En utilisant cette méthode, la pêcherie plurispécifique du village de Labu Butu en Papouasie Nouvelle-Guinée (PNG) a été étudiée pendant une période de deux ans. L'activité de cette pêcherie est plus élevée que pour toute autre région de PNG.

1. INTRODUCTION

In coastal regions of Papua New Guinea, animal protein requirements for the traditional inhabitants are primarily met by fishing. Planners in Papua New Guinea (PNG) have begun to recognize and act on the conflict between coastal resource development and the traditional utilization of these resources (WRIGHT, 1985).

In other areas of the world the economics and politics associated with the introduction of commercial fishing technologies has frequently led to the decline of artisanal fisheries and subsequent impoverishment of many traditional subsistence fishermen (FORMAN, 1970 ; NIETZCHMANN, 1973 ; CORDELL, 1973 ; ANON., 1978 ; JOHANNES, 1978, 1981). Rather than supporting research on traditional subsistence fisheries, governments have ignored the

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activity (JOHANNES, 1981). This decision is based largely on economics. Most developing countries can count very few fisheries scientists among their inhabitants. The cost of employing a foreigner to live in an artisanal fishing community, learn the local language and gather catch data is hard to justify economically as it is commonly believed that village based fisheries are not very productive. Consequently, there is very limited published information about many coastal subsistence fisheries in the Pacific and in particular PNG.

Such information is necessary for planned development and management of national fisheries. SMITH (1979) states: «the statistics and other preliminary analytic studies to permit evaluations in a convincing empirical manner are generally not yet available in Southeast Asia or the Southwest Pacific. For example, stock assessment and estimates of sustainable yields require time series data even for a single species fishery. The task is seriously complicated by the multispecies stocks exploited by traditional fishermen in the tropics where catch and effort data are generally not available.»

JOHANNES (1981) asserts that this requires a modification of typical western scientific fisheries approaches as problems at the village level in the tropics present both unique opportunities and difficulties.

To some extent the lack of information is a function of scientists' inability to adapt their methods to a village situation and possibly take a less rigorous sampling approach. We suggest that by developing appropriate recording tools and guiding selected people from within a fishing village, useful fisheries data can be obtained with limited training and at a reasonable cost. This approach is similar to that taken by fisheries departments today when they ask skippers of commercial fishing boats to record catch data.

This study was part of an environmental impact study of the effect of the development of the Lae Harbour on the fisheries resources of the Labu Butu people. Harbour expansion was to include removal of vegetation from the north bank of the river, excavation of a large harbour area and dumping of spoil from this excavation just up-river from the mouth over a six month period.

The purpose of the study was to : 1) document the fishery prior to harbour construction ; 2) determine if harbour construction had any adverse affects on the fishery and if so ; 3) determine after construction was completed, if the fishery recovered. This was important to the national government not only because it was legally necessary, but also because compensation claims would need to be paid to the village for any adverse affects to the fishery. The harbour was never built, so only the first stage of the study was completed.

This paper discusses a method for obtaining multi-species fisheries information used in a traditional village fishery in Papua New Guinea.

2. VILLAGE LOCATION

Labu Butu village, with a population of approximately 750 people, lies on the south bank of the Markham River (7°S. ; 147°E.) surrounded by forested swamp and ocean. Lae (population 60000), the second largest town in PNG, lies on the other side of the Markham River.

Despite the proximity of Labu Butu to Lae, it is a traditional village relying on its own garden areas for growing taro and other vegetables and local ownership of the sea, river and swamps for catching fish, crabs, prawns, and shells. The villagers sell excess marine and agricultural products in Lae and buy small amounts of tools, fishing gear, food, clothing and building materials. There is no electricity, running water or other conveniences associated with urban life. Canned meats, fish and other imported sources of protein are still luxury items.

This subsistence fishery is representative of many PNG village fisheries as they exist today. These fisheries have experienced much less socio-economic impact than the traditional fisheries of Hawaii, Guam, and most other Pacific island urban centres. The Labu Butu fishery is an example of the direction taken by PNG subsistence

fishermen as they adapt traditional fishing techniques to new tools and materials and adopt market economies. Further information about traditional fishing practices in PNG can be found in QUINN *et al.* (1984).

3. SURVEY METHODS

3.1. Setting Up the Survey

We were aware of the necessity of adequately establishing rapport with the villagers. From June to November 1980, we visited the village to discuss traditional fishing knowledge, learn what fish were being caught and identify both the scientific and vernacular names of fish. To identify fish species we initially asked village fisherman to look at illustrated fish field guides, indicate which fish they caught and give us their name for the fish. We verified this information by obtaining specimens of all the fish caught.

Many informal discussions were held to explain the purpose of the survey and to answer any questions. When the villagers understood our interest in their fishing activities and the importance of an accurate record of the fishery, they readily answered our questions.

During this initial period a villager in his early twenties showed particular interest in the project. He had been educated to grade ten, but had no previous scientific training. His years of education absented him from the village when he would have learned traditional attitudes and skills. Being an average student he was denied access to the limited places in the advanced levels in a high school. Like many other educated Papua New Guineans he was unable to find work that met his skills and expectations and returned to his village.

A survey form was drawn up which included information about the fish caught, location fished and fisherman himself. To estimate the annual fish catch in kilograms of wet weight, the fin fish catch for 38 species was recorded in seven size classes of 5 cm each and the catch of larval fish and prawns weighed to the nearest 500 g.

By using vernacular names, it was easy for the interviewer to fill out the form. Forms, fish measuring board, spring scale, pencils, formalin and jars for fixing new species were supplied. Several days were spent establishing the interviewing procedure and sorting out difficulties. After that, the interviewer was largely on his own. Each two weeks we visited the village in conjunction with another research project and checked on progress and once a month the interviewer came into the university to drop off forms, pick up his pay, bring in any new fish species and discuss anything interesting about the fishery. He came in at special times when anything interesting was happening, such as large catches of larval fish.

3.2. Data Collection

The interviewer met with each fisherman on the beach or in the village as he returned from fishing. Because a local villager was conducting the interview many of the questions such as age, did not have to be asked and could simply be recorded. As most of the fishermen did not own watches, fishermen were asked to estimate time spent fishing to the nearest two hours. They were then asked where they fished and what equipment they used. All of the possible responses were listed on the form in the local language. The interviewer only had to circle the appropriate response. Payment was 10 t (12c U.S.) per completed form. This encouraged the interviewer to obtain as many interviews as he could.

Checks were made periodically to assure the accuracy the data by staying in the village ourselves to help with interviews and by asking friends who were spending a couple of days in the village to see if there were any problems

developing. It became apparent that many village fishermen would report to the interviewer or have one of their children report to the interviewer, often bringing the fish catch to his door.

Support of the village elders for the project was very important in keeping the interviews coming in and the reports accurate. It was also important in protecting the interviewer from jealousies that were precipitated by the income and importance he received from his job. Because few people in the village had jobs in Lae and no other villager was employed in the village, jealousy arose and the interviewer was attacked one night by other members of his village. After the attack, the elders in the village had a meeting to discuss the importance of the survey to the village and resolved the conflict.

The survey period extends from 8 December 1980 to 16 January 1983 with 12399 fishing trips recorded. Lengths and catch numbers for fish, crabs and crocodiles were recorded for each fishing group as they returned from fishing. Total weights of larval fish and prawn catches were also recorded.

The initial few months represented a testing and training period. More fishermen were interviewed in later months as the program had become established. An estimate of the number of people fishing, but not interviewed, was made in consultation with village people and was recorded for each day when interviews were taken. This estimate was considered to be accurate +/-10% given the high degree of village social interactions.

Weight estimates for each size class were determined by weighing median size fish of various common species in each recorded size class and using the mean weight. The number of fish were then multiplied by the weight estimate for each size class. Fish greater than 30 cm were weighed to the nearest 0,5 kg. Estimates for the value of the fish were obtained by asking both fisherman and market seller the price.

3.3. Inadequacies in Data Collection

In a subset of 2948 interviews collected during the first thirteen months, 350 different fishermen and women were interviewed. Cultural restrictions resulted in a bias towards interviewing males (>99 % of all interviewed). Social mores prohibited the interviewer, a young, single male from talking with women about their activities. Consequently, this study under sampled the women's fishing effort. One result of this was a gross underestimate of the number of crabs caught. The habitat and fishery for crabs is largely set aside for women. To accurately sample the women's fishing efforts it would have been necessary to employ a female interviewer.

4. RESULTS AND DISCUSSION

This survey represents approximately 82000 hours of fishing. The form provides the following data: 14 demographic variables, numbers caught and size range of 38 species of fish, numbers of one species of crab, counts of crocodile catches and weights of prawn and larval fish catches. This information was entered into a computer and analyzed using SPSS.

Combining demographic information with fisheries data allows calculation of fisheries statistics such as seasonality of catch, productivity of specific areas and catch per unit effort. The demographic data also allows comparisons between groups defined as to: 1) age of fisherman ; 2) month of fishing ; 3) site fished ; 4) equipment used ; and 5) species caught. Changes in village fishing patterns will doubtlessly alter catches. For example, traditional fishing activities pre World War II relied heavily upon the coordinated efforts of large groups. Before the introduction of steel axes, the construction of the typical 4-7 man canoe required the efforts of many men. Today with steel axes most men make their own 1-2 man canoe and go fishing alone or with a single companion.

Several crude estimates have been made of the total subsistence fish catch in PNG. Without data, SCHUSTER (1951) assumed 3700 tonnes of fish were caught annually. About twenty years later the catch estimates had increased to 10000 to 30000 tonnes per annum (FILEWOOD, 1972). Another «reasonable hypothetical quantity» of 18000 tonnes per annum for all of PNG (ANON, 1976) was based on estimates from subsistence production from the Sepik flood plain. The only published estimate based on scientific data was collected by university students (HAINES, 1979) for the Purari delta. He estimated a catch of 1 000 tonnes per annum of fish and crabs for 20000 people based on observations of 250 people over 25 days.

The Labu Butu villagers were skilled fishermen and knowledgeable about the biology of many of the target species. This knowledge, combined with use of a variety of fishing equipment and access to a diversity of habitats resulted in total catches of 85-105 tonnes per annum for a population of 750 people. The fishery was very productive compared with the 38 tonnes per 750 people for Kikori-Baimuru area (HAINES, 1979) and the estimate of 70 tonnes per 750 people for the population in the Sepik (ANON, 1976). The Labu fish and prawn catches are 1,2 to 1,5 times greater than the Sepik catches and 2,3 to 2,8 times that of the Kikori-Baimuru fishery. As both latter estimates were made from far fewer observations, it is likely that there was not enough data to make accurate estimates.

Considering specific equipment the Labu fishery was very productive in comparison with the limited data from other tropical subsistence fisheries. The gill net mean weight catch per unit effort was 40,6 g m^{-2} day^{-1} compared with 5,2 and 12,6 g m^{-2} day^{-1} in two freshwater locations in Sarawak (WATSON, 1981, 1982), over 3,2 times more productive. Attempts to alter the existing exploitation by increasing incentives for either particular sizes or particular species should be preceded by further studies of fish population dynamics, community structure and their natural variability.

This is the most comprehensive documentation of an artisanal fishery in PNG. It provides a data base from which future developments of the fishery or man induced modifications to the local environment can be assessed. It was done inexpensively and reasonably accurately with the assistance of a trained villager and with the co-operation of the village inhabitants. For K1240 (U.S.$1700 in 1983) over half of the fishing effort of the male sector of a village was monitored for two years. With reasonable cooperation a fisheries biologist could expect to coordinate up to five interviewers in separate villages.

5. CONCLUSION

By modifying fisheries science techniques so that they can be used by selected and trained locals, affordable time series fisheries data can be collected. There are numerous underemployed people, living in coastal villages throughout Asia and the Pacific that have the skills and interest to collect valuable fisheries data with the proper guidance and appropriate training. These people can become the "bare foot biologists" of the fisheries profession. Fisheries biologists and social planners must be willing to accept long term, structured observations by these "bare-foot biologists" as being more valuable than complete guesses made by highly qualified people who have never or only briefly visited an area.

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REFERENCES

ANON., 1976. Report No PNG AP-4 Appraisal of the East Sepik Rural Development Project in Papua New Guinea Vol II. Detailed report on subprojects. Nov. 1976. Asian Development Bank. Manila : pp. 56.

ANON., 1978. The long struggle to build up Sri Lanka's fishing industry. Ship and Boat Internat., 31 : 59-61.

CORDELL J.C., 1973. Modernization and Marginality. Oceanus, 17 : 28-33.

FORMAN S., 1970. The raft fishermen: Tradition and change in a Brazilian peasant economy. Indiana University Press, Bloomington : pp 158.

FILEWOOD L.W.C., 1972. Fishing Industry. In: Encyclopedia of Papua and New Guinea, Melbourne University Press, Vol 1 : 427-429.

HAINES A.K., 1979. The subsistence fishery of the Purari delta. Science in New Guinea, 6 : 80-95.

JOHANNES R.E., 1978. Traditional marine conservation methods in Oceania and their demise. Ann. Rev. Ecol. Syst., 9 : 349-364.

JOHANNES R.E., 1981. Working with fishermen to improve coastal tropical fisheries and resource management. Bull. Mar. Sci., 31 : 373-680.

NIETZCHMANN B., 1973. Between land and water. Seminar Press, New York : pp. 279.

QUINN N.J. KOJIS B.J., WARPEHA P., 1984 (eds.). Traditional fishing practices of Papua New Guinea. Appropriate Technology Development Institute, Traditional Technology Series : pp. 135.

SCHUSTER W.H., 1951. A survey of the inland fisheries of the Territory of New Guinea and Papua. Aust. J. Mar. Freshw. Res., 2 : 226-236.

SMITH I.R., 1979. A research framework for traditional fisheries. ICLARM Studies and Review, No.2 ICLARM, Manila : pp. 40.

WATSON D.J., 1981/1982. Subsistence fish exploitation and implications for management in the Baram River system, Sarawak, Malaysia. Fisheries Res., 1 : 299-310.

WRIGHT A., 1985. Marine resource use in Papua New Guinea: Can traditional concepts and contemporary development be integrated? *In* : The Traditional Knowledge and Management of Coastal Systems in Asia and the Pacific. (Ruddle K & R.E. Johannes ed.), UNESCO, Indonesia : pp. 79-99.