INFORMATIVE PAPER

Why are prawns in the Sofala Bank declining?

by Gustavo Manez and Lucia Scodanibbio
for
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Background

Mozambican prawns are internationally renowned for their quality. Due to a variety of unique environmental conditions that come into play such as sea temperature, geographical position, sea currents and freshwater input they are considered the best in the world. Nevertheless, a decline in the total prawn catches has been experienced in the past two decades. This is a matter of concern for Mozambique, as the prawns' high prices contribute to an important part of national revenues. Different explanations have been given regarding the decline. These will be discussed in this paper, together with the need to do further research on the subject.

Influences on prawn production

Prawns develop at the interface of marine and freshwater environments, such as mangrove areas at river estuaries and deltas. Floods are critical to aid juvenile prawns to enter the sea, as the prawn's lifecycle below shows:

During the dry season adult prawns lay eggs into the sea. These develop into larvae that, with the aid of the sea, which in the dry season has a stronger push than the river, drift to mangrove areas along the coast. Here the larvae grow into juveniles, which during the wet season are pushed into the sea by the flooding rivers. At this point, adults will lay eggs once again to re-begin the cycle (see figure 1).

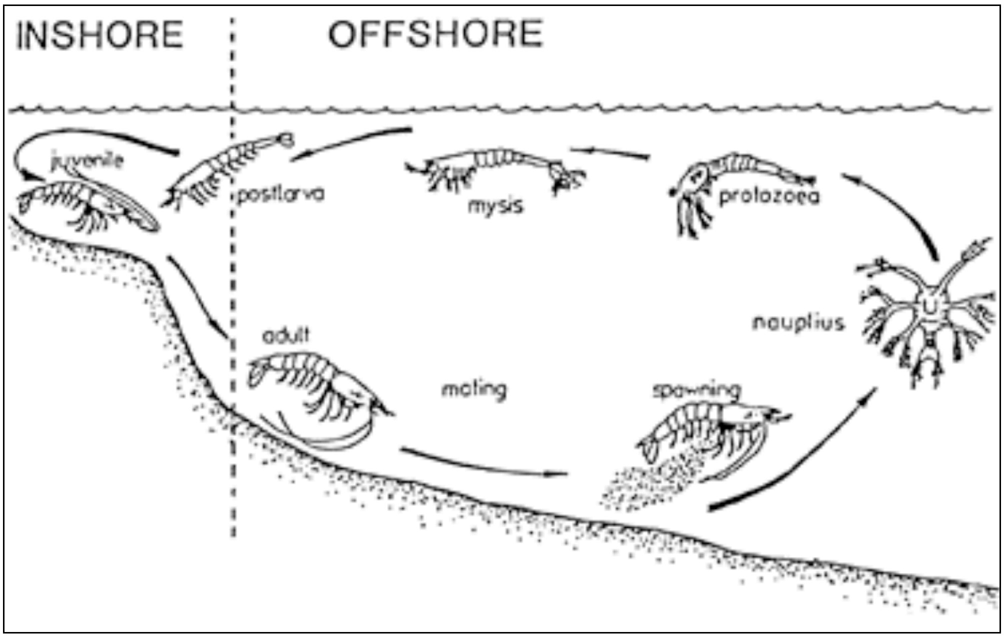

Figure 1: Diagram of a typical penaeid prawn life cycle
(source:http://thesis.library.adelaide.edu.au/adt-SUA/uploads/approved/adt-ADT20010213.232311/public/08chapter7.pdf, site visited 17th March 2004)

Floods are also important as floodwaters are carriers of sediments and dissolved nutrients which nourish the larvae. Fisheries in nutrient-poor seas, such as in the tropics, often have localized areas of higher productivity around the estuaries of rivers that carry large amounts of nutrients and sediments. For example the Nile River used to be responsible for large phytoplankton blooms in the eastern Mediterranean during its annual floods, which in turn supported a highly productive prawn and sardine industry. This changed dramatically after the Aswan Dam was built in 1965 (Nixon, 2003).

Sofala Bank also used to be at the receiving end of large annual floods (in the order of 8,000 to 14,000m^3s^{-1} (Davies et al., 2000)) by the Zambezi River, until the river's total runoff and seasonality was altered following Kariba's closure in 1959 and Cahora Bassa's in 1975. Between 1975 and 2000 two floods occurred (1978, ca. 14,000m^3s^{-1}; 1997, 16,000m^3s^{-1}) (Davies et al., 2000). Except for these, Cahora Bassa has caused floods to disappear from the system, with flood peaks during the mid-1990s of 1,700m^3s^{-1} (Beilfuss and dos Santos, 2001).

Trends in Mozambican prawn catches

From the late 1970s until the 1990s there was a drop in the catch per unit effort of prawns, with catches declining from 90kg/hr in 1978 to 30kg/hr in the early 1990s (see figure 2)

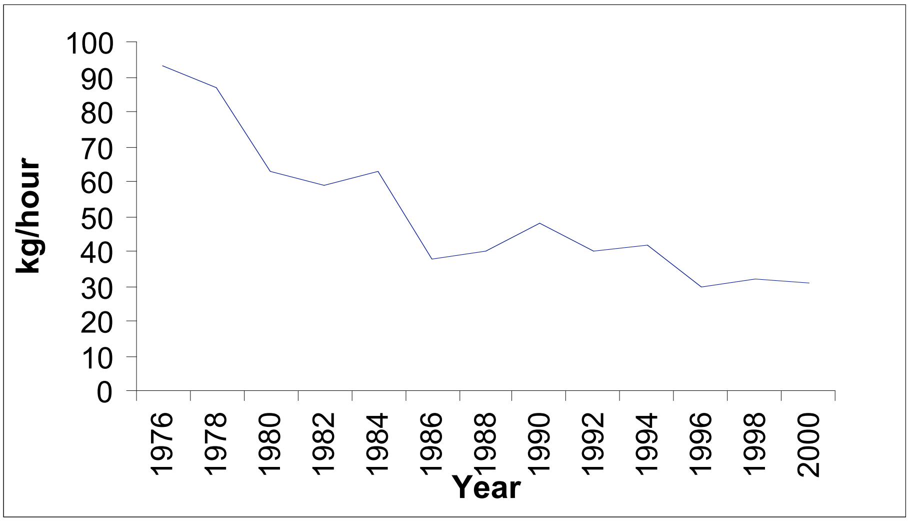

Figure 2: Prawn catches in Sofala Bank (source: Hoguane, in press)

Different explanations have been given to the above trend. Two are discussed.

1. "Effort" hypothesis (Palha de Sousa, 2001, Instituto de Investigação Pesqueira, IIP):

   Since large-scale fishing of prawns only began in the mid-1970s the initial drop was expected as the stock began to be exploited, often in an unsustainable manner. Beginning in the mid-1980s the first measures to control effort were put in place, including:

   - increase in mesh size (late 1980s)
   - increase in length of closed season (early 1990s)
   - decrease in Total Allowable Catch (TAC) (mid 1990s)

   These measures helped to stabilize catch per unit effort (CPUE) for a certain period, although catch values did not rise. This was explained in terms of the fact that industrial fishermen began finding alternative means to increase their catches, which included fishing at night time, fishing with more nets (four instead of two) and taking the quota of the semi-industrial fishing fleet, by reducing the sizes of their boats.

2. “Environmental” hypothesis (Gammelsrød, 1992; Hoguane, in press):

Since Cahora Bassa’s closure, flows in the Zambezi River have been dramatically altered. Both the extent of flooding (runoff decreased from 160 km^3 in 1978 – a flood year – to 40-70 km^3 in the 1990s) and its seasonality have undergone great changes. Today not only are the rainy season floods practically null, floods can also occur at any time of the year and during the peak of the dry season (August - September). Cahora Bassa releases water in preparation for the rainy season (Beilfuss and dos Santos, 2001). This, as one could expect, has dramatic consequences on the prawn’s lifecycle.

In an ongoing study, Hoguane (in press) considered both the role of runoff (only) and size of the spawning stock. He found that Zambezi runoff positively correlated to shrimp catches and was the determining variable, rather than stock size.

Criticisms

- Both hypotheses are likely to be in part right at explaining the decline in CPUE, although both can be subject to criticisms.

- It is clear that although many measures were applied to the fishing effort in the 1980s and 90s, the decline in catches that was being experienced continued. The closed season regulation in January and February greatly aided the production and performance of the prawn industry. The quota regulation however has shown to be of less help, given catch rates fall dramatically at the end of the year (Norwegian College of Fishery Science, 2002).

- Also, although since 2000 no new boats are allowed licenses to fish prawns on Sofala Bank, and effort has remained stable over the past three years, the negative trend in catches has continued. Even though the quota regulation seems to be less important than the closed season in the shallow water shrimp fishery, most attention has been put on the former (Norwegian College of Fishery Science, 2002) and today the Minister chooses the TAC according to minimum, maximum and average catch rates for the previous 5 years (Hoguane, in press), ignoring environmental conditions.

- Similarly, the environment hypothesis can be criticized on the basis that it lacks due consideration of effort (i.t.o. number of hours spent fishing), which should be included in a multiple regression with the data on runoff and parent stock size. In addition, the Sofala Bank is at the receiving end of many small rivers from Angoche to Save, which still flood in the rainy season. Lastly, the study was successful in explaining the trend until the 1990s, but afterwards the relationship between runoff and catches is not as strong anymore, and recent data (since 1999) is not included. Nevertheless communications with prawn fishermen have indicated that catches after the 2001 floods were the highest since the 1980s (Pescamar, pers. comm.).

What impacts could the proposed Mphanda Nkuwa dam have on the prawn fishery?

- Mphanda Nkuwa will further disrupt the seasonality and flooding patterns in the Zambezi Delta, by adding another barrier and reservoir along the Lower Zambezi.

- It will reduce the probability that environmental flows (see below) will be instituted, as the loss of revenue from electricity from two dams (Cahora Bassa and Mphanda Nkuwa) will be difficult to justify.

- It will block the sediments (and associated nutrients) accruing from the Luia River, one of the Zambezi's tributaries.

What do we suggest?

- A study which integrates all variables, environmental and those related to effort, in order to clearly determine which players need to be addressed to halt the dramatic decline in this lucrative industry.

- A study which analyses and integrates Mphanda Nkuwa's impacts downstream needs to be added to the environmental impact assessment (EIA), with due cognizance of the economic losses arising from the construction of the dam.

- Environmental flows:

  Beilfuss (2001) developed a number of scenarios which illustrate different timings and quantities of "artificial floods" that mimic the pre-Cahora Bassa flows that the Zambezi Delta used to receive. These environmental flows would benefit agriculture and subsistence fisheries along the Zambezi and in the Delta, as well as biodiversity, wildlife populations and prawns. The study shows that a middle point can be found, where the losses in electricity would be balanced by the gains in the rest of the uses.

  Hoguane (in press) predicts that if Cahora Bassa were to release 60 km^3 for four years and 150 km^3 in one year prawn catch rates could increase by 10-12kg/hr, equivalent to an increase in 9-11million $/yr with effort of 150,000 standardized hours and fixed price of 9$/kg.

What could you do?

- Request (and help finance) that due studies are carried out to analyse the determining variables in prawn catches and that these are addressed when implementing management and control measures for the industry.

- Request to the National Department of Waters and Hidroelectrica de Cahora Bassa that environmental flow releases are instituted from Cahora Bassa dam in order to maintain the ecology of the river and the shrimp industry.

- Take part in Mphanda Nkuwa's next environmental impact assessment consultation phase to ensure the consideration of the potential impacts of the proposed dam in the prawn industry and request that proper mitigation measures are put into place.

- Request to the authorities the implementation of World Commission on Dams recommendations in Mozambique, which set the best international practice for dam building and, among other things, state that all stakeholders who stand to be affected from a dam project are entitled to participate in the decision-making process.

The information provided in this brochure can be found in more detail in the following studies:

Beilfuss, R.D., 2001. Prescribed Flooding and Restoration Potential in the Zambezi Delta, Mozambique. Working Paper #3, Program for the Sustainable Management of Cahora Bassa Dam and the Lower Zambezi Valley

Beilfuss, R.D. & dos Santos, 2001. Patterns of hydrological change in the Zambezi Delta, Mozambique. Working Paper #2, Program for the Sustainable Management of Cahora Bassa Dam and the Lower Zambezi Valley

Davies, B.R., R.D. Beilfuss, and M.C. Thoms. 2000. Cahora Bassa retrospective, 1974-1997: effects of flow regulation on the Lower Zambezi River. *Verh. Internat. Verein. Limnol.* 27: 1-9.

Gammelsrød, T. 1992. Variation in shrimp abundance on the Sofala Bank, Mozambique, and its relation to the Zambezi runoff. *Estuarine and Coastal Shelf Science*, 35: 91-103.

Hoguane, A.M. In press. The role of Zambezi runoff in the shrimp abundance in Sofala Bank.

Nixon, S.W. 2003. Replacing the Nile: Are anthropogenic nutrients providing the fertility once brought to the Mediterranean by a great river? *Ambio*, 32: 30-39.

Norwegian College of Fishery Science. 2002. A Study of the Fisheries Sector in Mozambique. Report prepared for Norad.

Palha de Sousa, M.Z. 2001. Camarão do Banco de Sofala. Instituto Nacional de Investigação Pesqueira, Relatório Anual.

FOR MORE INFORMATION PLEASE CONTACT

Gustavo Manez – Justiça Ambiental– Mphanda Nkuwa capacity building project coordinator
(082) 257 607
araucano@ananzi.co.za
ja_ngo@yahoo.com

Dr. António Mubango Hoguane – Grupo de Trabalho Ambiental - Director
(01) 493102
(082) 315286
hoguane@hotmail.com

Dra. Maria Lizette Palha da Sousa – Instituto de Investigação Pesqueira - Researcher
(01) 490536 / 490307
lsousa@moziip.org

Prof. Tor Gammelsrød – University of Bergen, Norway - Professor
torg@gfi.uib.no