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**CULTURE OF FRESHWATER PRAWN
Macrobrachium rosenbergii
IN THE STATE OF RIO DE JANEIRO, BRAZIL,
FROM 1981 TO 1990**

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Abstract : In 1981, PESAGRO (FIPERJ today), the institute for fisheries and aquaculture research of the state of Rio, Brazil, decided to start the culture of freshwater prawn *Macrobrachium rosenbergii* as a source of diversification in the traditional production of this State. 1000 post-larvae were imported from Miami in 1982. PESAGRO built first a small hatchery to ensure a reliable supply of PL. The interest of investors for this new activity appeared since the production of the first "brazilian" PL in 1984. PESAGRO started experiments in grow-out on the station of Guaratiba and provided technical assistance to the first farms.

The market showed to be excellent : 5.5 to 12 USD / kilo to the restaurants and supermarkets of Rio city. Most of farms are located in the region of Silva Jardim 100 km north-east of Rio. Up to now, yields remain low (0.5 to 1.5 T / ha / year) in relation with the lack of skilled technicians and poor pond management.

Development is slow but regular : 65 farms, 120 ha of ponds, 120 m.t of production in 1990. Since 1988, a technical cooperation with French Guiana has been developed with several missions and workshops in both countries.

INTRODUCTION

The state of Rio de Janeiro is located in the south-east of Brazil, South America. Its area is about 43 000 square kilometers for a population of 14 millions habitants, which represents 10% of Brazil total population. Freshwater prawn *Macrobrachium carcinus* was already studied for several years in the state of Rio (Thomas and Martino, 1979) when the government decided in 1981 to try to promote the development of a freshwater crustacean. Indeed, the State of Rio has several favourable characteristics in order to develop this culture : warm climate all year round, large flat lands and numerous rivers, cheap labour available and proximity of the big market of Rio city.

The first objective was to test this new culture in cooperation with some private farmers before any large development. In case of success, the second objective was to develop this new activity in order to diversify the traditional agriculture and increase the farmers income with a high value product.

Two effects were expected :

- The extension of cultivated areas,
- The settlement of farmers and workers in the rural areas , far from urban zones.

Then, this demonstration should interest industrial groups to invest in this new activity at a larger scale.

1.THE STARTING PHASE

By the end of the seventies, the State of Rio created a scientific institute, called PESAGRO-Rio, in order to develop research on several animal and vegetal productions and especially on shrimp aquaculture. The budget was mainly provided by the state of Rio (75%) and the rest, 25%, by the federal government.

1.1.The research station

PESAGRO-Rio constructed the experimental station of Guaratiba close to the bay of Sepetiba, 50 Km South of Rio. Facilities include all buildings and equipments required for experiments on Peneids and *Macrobrachium* as well: a polyvalent hatchery and various laboratories for micro-algae production, chemical analyses, microscopic observation, feed processing, etc.

The hatchery is equipped with rectangular and cylindro-conical tanks in fiberglass or asbestos cement. Volumes vary from 1 to 2 cubic meters. Marine water comes from a 4 Km channel and requires decantation, chlorination and sand filtration before use. Freshwater comes from a deep well. Water circulation system is open and designed for 80 % renewal per day. Several 5 cubic meters concrete tanks are available outdoor.

1.2.Import of the first post-larvae

Although many observations and experience had been gained on *Macrobrachium carcinus* since 1977 (Thomas et al, 1981; Costa et al,1982) it was obvious that this species was not suitable for rearing : long larval phase, excessive cannibalism and low yield in grow-out.

Thus, in 1981, PESAGRO-Rio decided to import one thousand post-larvae of *Macrobrachium rosenbergii* from a private farm in Florida. The animals were stocked in concrete tanks for 60 days and were fed with pellets specially produced at the station. Few animals survived but they were enough to start the first broodstock.

1.3.Control of the hatchery phase

The first trials of larval rearing in the hatchery of Guaratiba gave bad results : 3 % survival after 40 days (Thomas et al, 1983). Progressively, biologists learned how to improve all the parameters of rearing. The main problem concerned feed given in complement with Artemia: composition, size, quantity and feeding frequency. The use of rotifers has also been studied to diversify feed and limit requirements of Artemia (Seixas et al, 1984, 1985).

From 1983 to 1986, larval density increased from 30 to 100 larvae per liter, the survival rate was stabilized at 60 %, and the duration of cycles was reduced from 45 days to an average of 30 days (Thomas et al, 1986). Today, this hatchery has a capacity of 10 millions PL per year, with a better reliability than most private hatcheries of the State.

1.4. Control of the nursery phase

Several nursery experiments had been tried in 6 ponds of 2700 square meters each. Initial densities varied from 30 to 250 PL per m² for 60 days experiments. 35 % protein feed came from the station and was distributed twice a day at 5 % of biomass. Results were good with 85 to 95 % survival and a final average weight of 1 g. Then, juveniles were given to private farms to test grow-out.

1.5. Test of the grow-out phase

The five first farms totalized 11 ponds and 5,5 ha. The grow-out system was discontinuous with seeding of PL or juveniles and drain-down harvest after 8 months. Initial densities ranged from 5 to 10 PL /m². Feed was pelletized by PESAGRO from soybean, corn and fish meal as main ingredients. Feeding ratio varied from 5 to 2 % of estimated biomass, decreasing regularly with time. Biologists of PESAGRO provided technical assistance and collected data in order to analyse the feasibility of grow-out phase.

The first results were poor : 0,4 T/ ha/ year average yield (Seixas et al, 1984). A better control of water quality parameters, especially dissolved oxygen and pH, the increase of the initial density and introduction of selective harvesting with large mesh seines (22 to 24 mm) before drain-down allowed to improve yields up to 1T/ha/year. Thanks to the low level of investment (bamboo pipe for water distribution for example), and reduced working costs (family labor, use of local by-products to minimize artificial feed, etc), this yield appeared to be far beyond the break-even point. A very attractive market allowed excellent prices equivalent to "jumbo" shrimp (10 to 15 USD/kg).

1.6. Transfer of technology

After 5 years of experiments in cooperation with farmers (1982-1986), PESAGRO informed the government of Rio that the technology, including hatchery and grow-out was ready to be transferred to the private sector at a large scale since economic data showed clearly the profitability of this new activity.

Thus, the government asked PESAGRO to coordinate this development program and to provide various services: selection of suitable areas, feasibility studies, staff training, technical assistance including co-management of farms, supply of broodstock, post-larvae and feeds for larval rearing and grow-out, organization of technical workshops with other development agencies involved in this culture like IPA of Pernambuco, EMCAPA of Espiritu Santo or IFREMER (French Guiana).

2.THE DEVELOPMENT OF PONDS AND PRODUCTION

2.1.Evolution of development

First results of farmers were good which helped the diffusion of information to potential investors and cooperatives. PESAGRO kept the responsibility of technical assistance and PL supply. The success of this new culture conducted PESAGRO to create a separate structure in charge of all the aspects of aquaculture development : the FIPERJ institute.

Figure 1 shows the regular increase of ponds surfaces from 15 ha in 1985 to 120 ha in 1990. This activity represented 65 farmers, 144 employments, 120 ha of ponds, 120 tons of production and a gross income of about 2 millions USD in 1990 which ranks the State of Rio as the second producer of freshwater prawn in Brazil after Alagoas. In 1990, Brazil produced about 450 Tons from 565 Ha of ponds.

The increase in PL demand led the three main industrial farms to construct their own hatchery. The excess of PL is sold to small farms. Hence, the experimental hatchery of FIPERJ is now able to come back to research instead of PL commercial production.

Most of farms are located in the regions of Silva Jardim and Rio Bonito about 100 Km East of Rio City as shown on figure 2. Farms areas vary from 0,5 to 14 ha. Most of farmers use a discontinuous system for grow-out : a nursery phase at 150-200 PL/ m² during 2 months and a production phase which lasts 4 to 8 months according to density, fishig efficiency, market sizes, etc. Selection of juveniles (1 g av. weight) in nursery ponds is done regularly with a selective seine mesh of 10 mm. Harvesting starts after the third month of grow-out phase with selective mesh seining (20 to 22 mm). Yields are heterogeneous and range from 0,5 to 1,5 Ton/ Ha/ year.

2.2.Description of a typical farm

The farm of Santa Helena (FSH) is located in the region of Silva Jardim, first "município" (county) of Rio state for prawn production. After 6 years evolution, the farm is now stabilized with 10 ha of ponds.

The hatchery has a total volume of 20 m³ and a capacity of 12 millions PL per year. Water is recirculated through a big biological filter (36 m³) after decantation. Marine water comes by truck every 2 months. Larval rearing is divided in two phases : first, a larval nursery at high density (300 L/l) in fiberglass tanks (2 m³) during 12 days and then, a second phase at 100 L/l in rectangular cement tanks (1 m³) until the end of metamorphosis. Final yield averages 70 PL/l in one month. Larval feed requires Artemia (8 to 10 nauplii/ml at 4 p.m) and artificial mix - which main elements are squid and mussel- given every 3 hours all day long.

For grow-out, a discontinuous system in two phases is used : nursery during 2 months then final grow-out during 6 months with selective harvests before drain (22 mm). Feed is prepared every day on the farm. Ingredients are grinded, then mixed and pressed without steam through a 3 mm screen. Pellets

are then sun-dried outdoor on trays. Table 1 shows the usual composition of feed. Feed is given once a day, at 2 to 6 % of estimated biomass, 6 days a week. The average yield is about 1,3 Ton per hectare and per year.

The farm produces PL and feed for several small farmers around. These bring their production to FSH for processing and commercialization. The vicinity of an important road allows a direct sale of 40 % of the production. The rest is sold in restaurants, hotels and supermarkets of Rio city.

2.3.The market

The demand is much higher than supply especially since the recent start of an information campaign which drew up the specific qualities of this prawn : fresh, sweet and original.

Table 2 shows the different size classes and corresponding prices. The main part of the production is sold in medium and large classes (7,5 to 9,5 USD/kg).

Ingredients

Fish meal	30 %
Corn	30
Soybean	20
Wheat	18
Premix (minerals and vitamins)	2

Analysis

Crude protein	30 to 33 %
Fat	4 to 6
Minerals	8 to 10

Table 1 : Usual composition of feed used on freshwater prawn farms of the State of Rio, Brazil

Size class	Individuals per kilo	Price per kilo (USD)
Small	51-70	5.4
Medium	41-50	7.5
Large	31-40	9.5
Export	21-30	12
Special	10-20	15

Table 2 : Size classes and retail prices for freshwater prawn sold on the market of Rio city, Brazil

2.4.Cooperation with IFREMER

Since 1988, the FIPERJ institute developed a technical cooperation with the French research institute IFREMER, which was working in R and D on the same species in French Guiana. Several missions of biologists and technicians were organized in both regions with an important workshop in Rio in november 1990. The main sectors of cooperation concerned the use of recirculation system in hatchery (Griessinger et al, 1986), the conditions of efficiency in technical assistance (Lacroix and Griessinger, 1988), and the adaptation of feed formulation to local available ingredients. FIPERJ prepares also the translation in portuguese of the french handbook on freshwater prawn culture.

2.5.Bottlenecks

Bottlenecks are numerous and can be summarized as follows :

- Poor scientific information** : there is no federal center in Brazil which could collect scientific papers and specialized reviews on aquaculture and dispatch information to the main regional centers.
- Lack of skilled people** : very few biologists and experienced technicians are available for farms or for research centers as well. Foreign training courses are far too expensive for Brazilian scientific institutes.
- Lack of funds for research and development** : aquaculture is still considered by the government as a high risk activity even if the potential is excellent.

CONCLUSION

After 10 years of direct responsibility in the development of freshwater prawn culture, the FIPERJ foundation has demonstrated the technical feasibility of its culture. All this work had been achieved within a limited budget of 1,35 million dollars which is low compared to results. The demonstration of its profitability has been done by private farmers without special grants which is the best way to convince new investors.

The state of Rio de Janeiro has now many assets to improve the development of freshwater prawn aquaculture :

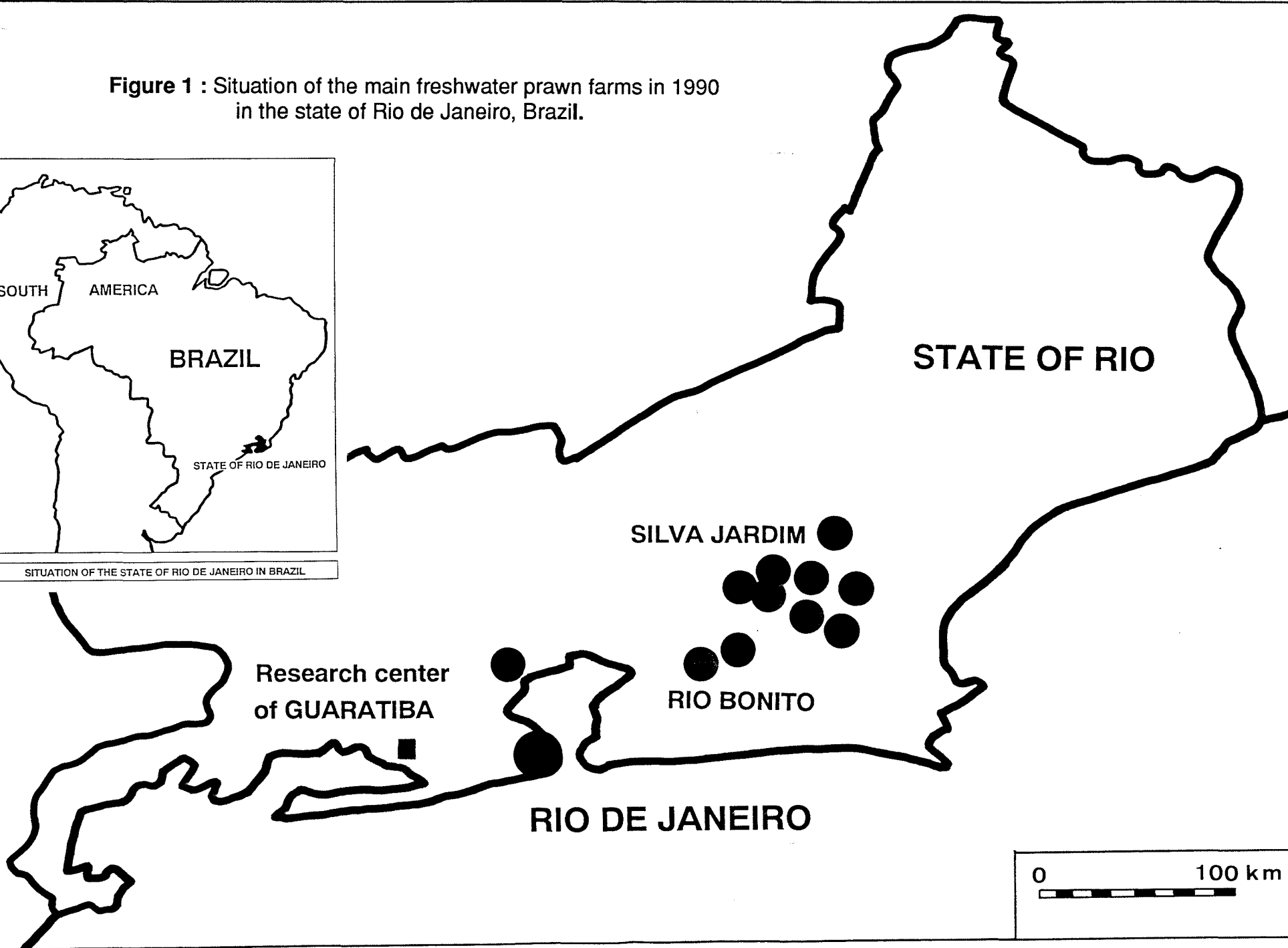
- excellent and large local market**, including the first tourism place in Brazil: Rio City (440 000 foreign tourists in 1990). There is also a good potential export market to Europe and USA.
- good research and development structure** with the station of Guaratiba.
- 10 years of experience** in technical assistance and training of farmers and technicians.
- efficient cooperation with France** since 1988.

This ambition of development is logical : today, aquaculture production in Brazil reaches only 20 % of the total aquaculture production in South America although Brazil represents about 50% in surface and in population. For all these reasons, the state of Rio could become a pilot-region for Brazil and a training and information center for freshwater prawn technology and research.

Figure 1 : Situation of the main freshwater prawn farms in 1990 in the state of Rio de Janeiro, Brazil.



SITUATION OF THE STATE OF RIO DE JANEIRO IN BRAZIL



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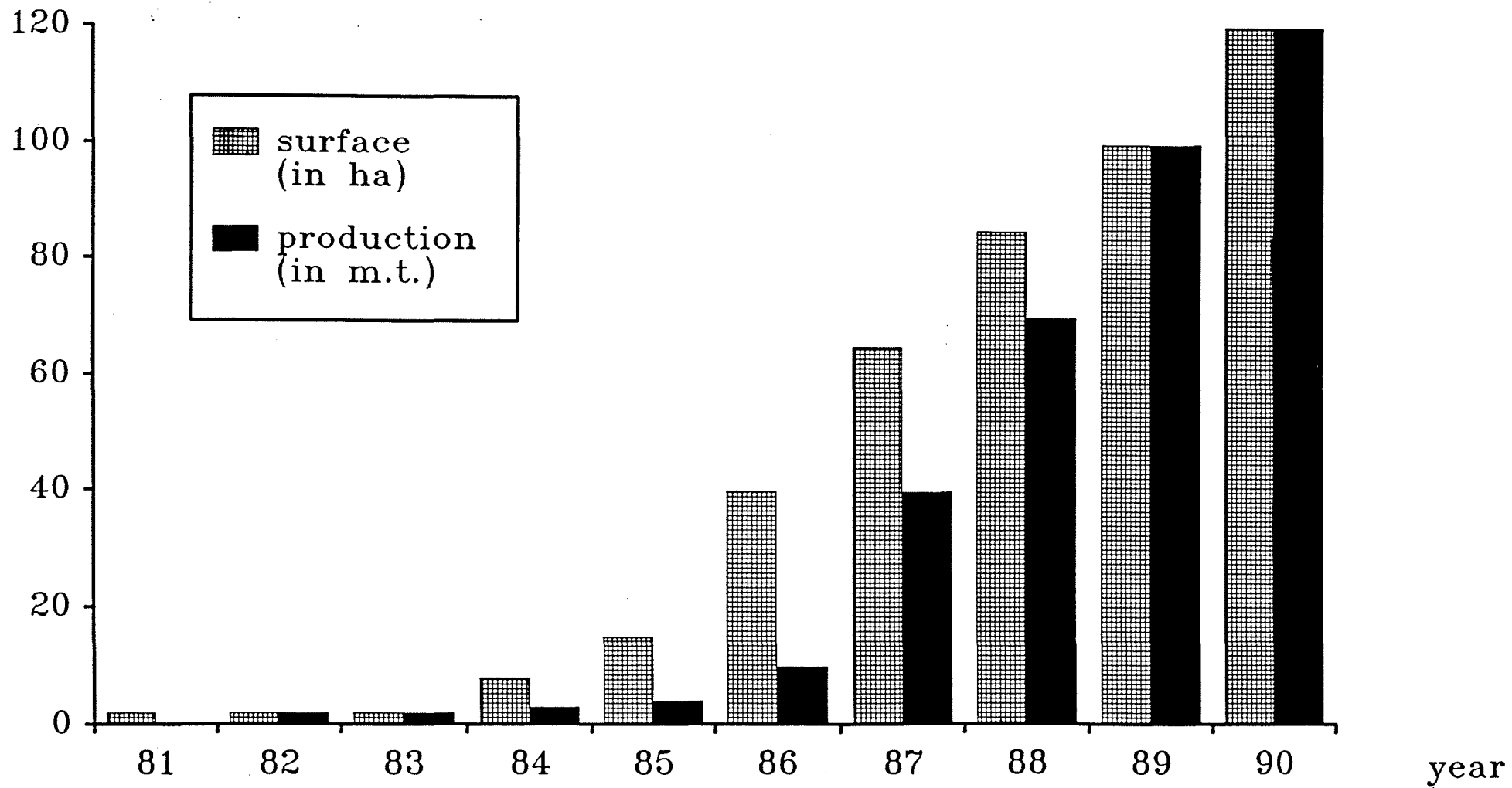


Figure 2 : Evolution of ponds surface and production in freshwater prawn culture in the State of Rio de Janeiro, Brazil.