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Notes on Aquarium Plant Production in Peruvian Amazonia

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Abstract

Two *Echinodorus* species were produced in masses in Peruvian Amazonia for international aquarium plant trade from the 1950s to 1990s. In the beginning of this time period production was large-scale including field cultivation, but to the end of the period production faded rapidly. Decline in production was a consequence of rapid development of aquarium plant cultivation in Asia, U.S.A. and Europe. Nowadays aquarium plant production involves in vitro propagation and other highly sophisticated methods, and thus re-establishing large-scale aquarium plant production in Amazonian countries may not be economically viable. However, due to high biodiversity in Amazonia, the area may have a significant role in new aquarium cultivar prospecting.

Introduction

Due to the magnificent diversity of aquatic environments, South America has been an important source of aquatic ornamentals for the aquarium industry (Chao & Prang 1997). Both ornamental fish and ornamental aquatic plant exportation began in Brazil by the 1930s (Goulding *et al*. 1995, Rataj 1978). Decline in aquarium plant production began in South America after development of mass production in the late 1950s in Southeast Asia (Rataj 1975), and a few decades later cultivation in South America had practically ended. In this article we present information of the ornamental aquarium plant production under semi-natural conditions in Peruvian Amazonia. We discuss the magnitude of aquarium plant production in Amazonia, the importance of production to rural people, reasons for the end of the production, and the possibilities to re-establish production in South America.

Materials and Methods

Three different groups of stakeholders were interviewed in order to gather information about aquarium plant production. Local rural people who were responsible for plant cultivation were interviewed close to Iquitos in Peruvian Amazonia. Personnel from all of the operational companies and from one already closed aquarium company in Iquitos were interviewed. Besides the Peruvian producers and traders international aquarium plant companies were also interviewed in order to get a better understanding of the development of aquarium plant industry. The interviews were made during August 2003 - February 2004.

Unfortunately we were able to find only two households who had been involved in aquarium plant production around Iquitos, both of them located in Moena Caño, along the Itaya River. They were asked about the dates of cultivation of plants, and the amount and type of labour involved in these practices. We were especially interested in the number and species of produced plants, area of the fields, methods used in cultivation and transportation of plants and economical importance of aquarium plant

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cultivation for locals. The people were asked to compare present and past situations in each question.

A total of 27 aquarium entrepreneurs were interviewed in Iquitos. Questions included basic information about the company, e.g. year of foundation, entrepreneur's previous experience in the aquarium business, number of employees and information about the international and national contacts and economical activities. More detailed questions were asked concerning aquarium plant trade and cultivation.

Six European companies responded to our questionnaire, among them were three wholesalers and three aquarium plant producers. We asked about the market development, innovations made in plant cultivation, companies' opinions of the reasons for the shift of cultivation from South America and expectations for the future development of the aquarium trade.

Results

Local growers

According to questionnaires the production of living aquarium plants in Peru has concentrated along river margins close to Iquitos (Figure 1). Methods of production have included intensive cultivation on fields and less intensive collections from natural populations. Only two aquatic plant species have been produced for trade by rural people, *Echinodorus grisebachii* Small and *E. horizontalis* Rataj (Alismataceae).

Echinodorus cultivation by local people took place only in one locality, Moena Caño, along the Itaya River. Moena Caño is situated next to Iquitos, so that the transportation time of the plants from field to town is less than half an hour. According to local growers the plantations have been situated on inundated riverbanks and cultivation has taken place during low-water period from August to February (Figure 2). Sizes of the plantations in the 1970-1980s were mostly 5(-10)x10m, and each household had four to five plantations (total area 200-500m^2). However, before the 1970s cultivation was more intensive and plantations were not only larger but also more numerous. Sizes of the fields have reached 10x100m and each household may have had more than 10 such fields. Thus, the total area of *Echinodorus* cultivations may have surpassed 1 ha per household.

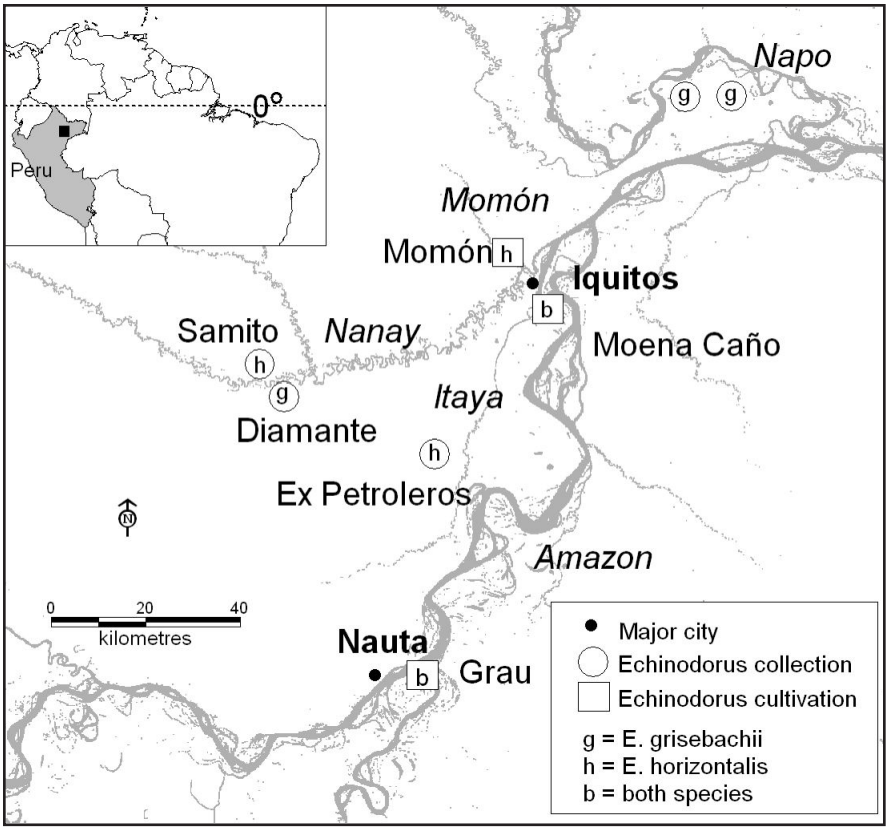

Figure 1. Locations of *Echinodorus* production in Peruvian Amazonia. Note that exact locations for two sites (Yuracuyacy and Baradero) along Napo river are not known. One production site (Cocha Cedro, *E. grisebachii*) along Putumayo River is not shown, but the site is situated NE of represented map.

The cultivations have produced a large number of plants. A cultivated area of 200-500 m^2 has yielded 10,000-30,000 plants monthly and about 160,000 plants per seven months growing season (about 300-800 plants/m^2/year). Based on these numbers given by the locals we may assume that during the era of most intensive cultivation households may have reached annual production numbers of 3,000,000 plants. Plants were harvested for sale 1-3 times per month and the growth time of an individual plant was more or less one month. Other tasks on the

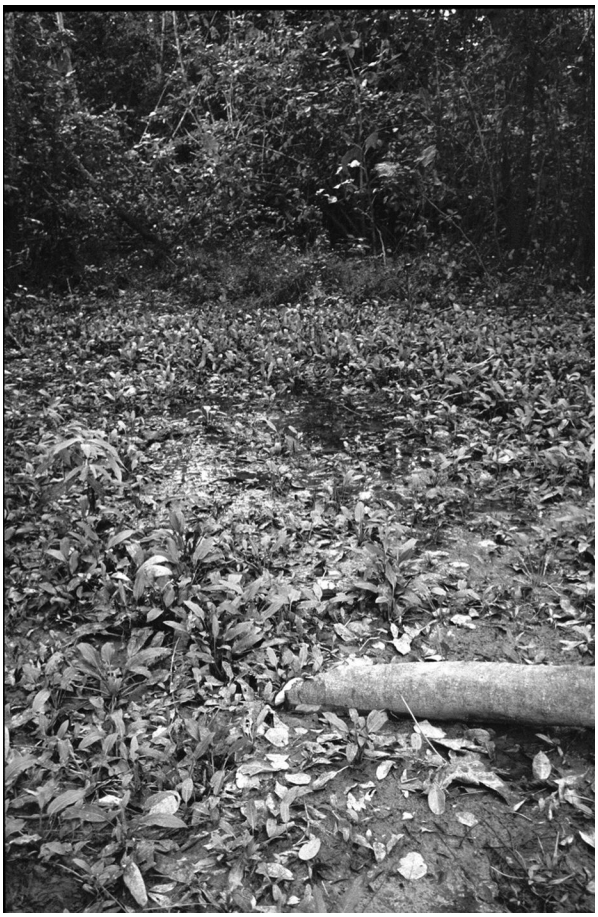

Figure 2. Old *Echinodorus grisebachii* field in Moena Caño, Peru.

fields besides harvesting have included weed removing and pesticide spraying.

The growers have earned US$ 2-10 per 1,000 plants (Table 1); *E. horizontalis* was more valuable (about US$10/1,000 plants) than smaller *E. grisebachii* (about US$7/1,000 plants). For the grower with 160,000 produced plants this means an annual income of about US$320-1,600 from aquarium plant cultivation alone. However, even during the era of most intensive production *Echinodorus* cultivation was not the only source of income but also other forms of agriculture and hunting were practised.

Table 1. Development of value of 1,000 *Echinodorus* plants in marketing chain. Values according to interviewed growers and traders, representing prices in mid-1990s to 2003.

	Mean	Range	N
Producer	US$ 7.6	US$ 2.3-10	11
Exporter	US$ 26	US$ 14.5-50	8
Importer	US$ 700	US$ 700	1
Retailer	US$ 6,000	US$ 5,000-7,700	5

Aquarium companies in Iquitos

The 26 interviewed aquarium companies in Iquitos had been operating from a few months to 28 years, average age was four years and median age was only two years. The closed company was founded in 1957, thus it represents the era of mass production of aquarium plants in Peru. The turnover rate of companies seems to be high, since the number of aquarium companies in Iquitos was already 26 in 1989 (Barthem *et al*. 1995), but only two of these companies are still operational. The number of employees varied from two to 10 (average and median five), which is considerably less than the 1950-1970s, when the companies had up to 40 employees. Currently (2003) the aquarium companies in Iquitos offer jobs for 125 persons altogether. Interviewed personnel (N=27) had an average experience of 5.5 years in the aquarium business with maximum experience being 30 years and median experience only one year.

The aquarium trade in Peru is export oriented, only two companies out of 26 had no international contacts. Despite the fact that most of the companies were founded much after the decline in aquarium plant production in Peru, 19 % of the operational companies have had aquarium plant trade, and three companies out of 26 (11.5%) still have. However, aquarium plant trade is nowadays economically unimportant for the companies, since plants are sold only infrequently in local markets without export.

Companies have gathered plant material for trade by three different methods: buying plants from local producers, collecting plants from nature or by cultivating plants. The majority of the traded plants were bought from the local producers. The number of traded plants was at its highest in the 1950s. In that era an individual company bought and exported a total of 960,000 plants into USA annually, including species *E. horizontalis* and *E. grisebachii*. Even in the 1970s the number of annually exported plants rose up to 320,000 by one company. Plants were bought mostly from Itaya River (Moena Caño), while other areas of production were Napo River (Yuracuyacy and Baradero) and Amazon River (Grau). The duration of transportation varied from less than half an hour from Moena Caño to about 24 hours from the Napo river.

Nowadays three companies are still buying plants of *E. horizontalis* and *E. grisebachii* from local producers, either from the Itaya River or Nanay River areas (Diamante & Samito). However, the number of traded plants is only a fraction compared to the earlier times. Currently the three companies are buying annually no more than 1,800-5,000 plants altogether, and all of them are sold in Iquitos.

Only one company has collected plant material directly from nature without any intermediary. Both species *E. horizontalis* and *E. grisebachii* were regularly collected in the 1990s. According to the company, 24,000 individuals of *E. grisebachii* were collected from the Cocha Cedros (Putumayo River) and 96,000 individuals of *E. horizontalis* from Ex Petroleros (along Iquitos-Nauta road) annually. *Elodea horizontalis* were collected all year round whereas *E. grisebachii* were collected only from January to February. Collected plants were exported into Germany and Chile. However, collection ended because of lack of markets for the plants, and the company is not going to continue collection in the future.

One company has experimentally cultivated aquatic plants of the genera *Elodea* Michaux and *Anubias* Schott in concrete tanks. *Elodea* is a native genus in South America but *Anubias* is imported from Africa. The company has also tried cultivation of *E. horizontalis* along the Momón River.

Even though the aquarium plant trade is a minor activity compared to fish trade among the Peruvian aquarium companies, most of the companies are still interested or very interested in the plant trade. Those companies still involved in plant trade are willing to continue, and the extra income from plant trade interests also those companies currently involved only in fish trade.

International companies

Information about modern aquarium plant production and trade is based on interviews of three wholesalers and three plant producers in Europe. Large producers of aquarium plants exist also in Southeast Asia and Florida, U.S.A. In Asia and Florida plants are cultivated in outdoor pools, unlike in Europe where greenhouses are used (Figure 3). Aquarium plant nurseries in these countries have introduced many new innovations into production since the beginning of the cultivation, including cultivation of plants in mineral wool in plastic pots, breeding of new variations by crossing and tissue propagation in test tubes. Prospecting wild material plays a crucial role in the breeding, but companies said that due to tightening permission policies it is becoming more difficult.

Poor quality of naturally produced plants was the most commonly mentioned reason for the end of natural production. Another problem related to plant exportation from South America is that transportation of plants alone is not economic, for example plants produced in Asia are transported together with ornamental fish. Also, new cultivars have replaced many natural species.

The largest aquarium markets are in the U.S.A, central Europe and Japan. All of the companies believed that the

Figure 3. Modern aquarium plant nursery in Germany.

aquarium market is still growing and also spreading to new countries like China and Mexico.

Discussion

Aquarium plant exportation has been one source of secondary income beside ornamental fish trade for aquarium companies in Peruvian Amazonia. The total impact of aquarium plant trade for local economy during 1950s to 1970s is very difficult to estimate, but today the trade is economically unimportant in Peru. In the international economy *Echinodorus* trade may be worth of over US$10 million annually (Dierk Wanke, personal communication) and the value of aquarium plant trade altogether is much higher. However, this trade no longer benefits the original producers or countries where cultivated plants come from.

The magnitude of the previous aquarium plant production in Peruvian Amazonia is not well known. Our results are based only on few scattered interviews given that the aquarium industry statistics of Iquitos region kept by DIREPE – Loreto (Dirección Regional de Pesquería – Loreto) were destroyed in a fire in 1989. We do know however, that the number of annually exported plants by an individual company was almost one million in the 1950s, over 300,000 plants in the 1970s and still over 100,000 plants in the 1990s, and that aquarium companies had many more employees before the 1980s than nowadays. The number of aquarium companies has varied between 12 and 26 in Iquitos during the 1980s (Barthem *et al*. 1995), but the exact number of companies in 1950-1980 is not known. Also, it is not known how many companies were involved in plant trade, but in any case it is reasonable to believe that the number of annually exported plants has been millions from 1950s to 1970s. Discussions with the growers support these numbers.

The annual income of rural households in Peruvian Amazonia is estimated to be US$500-5,000 per household (Padoch *et al*. 1985). Our results suggest that *Echinodorus* growers in Moena Caño may have earned comparable income from aquarium plant production alone. Thus, it seems that aquarium plant production has been an important, though not the only source of income for rural people in Moena Caño. However, this income has benefited only a small number of households nearby Iquitos.

Nevertheless, Amazonia has great diversity of aquatic life and many fish and plant species are suitable for aquariums, for example 35 aquatic vascular plant species (Kasselmann 2003) out of 177 species present in Peruvian Amazonia (León & Young 1996) are used as ornamentals in aquaria. Thereby one could imagine that Amazonia could have a larger part of the ornamental aquatic industry than it has at the moment. Still a large number of ornamental fish are exported from Amazonia (Chao & Prang 1997) and plants could be transported with the fish shipments. Production numbers could be very high in Amazonia: according to our study the cultivation in semi-natural fields may yield better crops per square meter than modern cultivation yields in greenhouses. However, problems with the quality and irregular production should be solved.

Aquarium industry has developed rapidly, and artificial hybrids have already replaced many natural species in markets (Kasselmann 2003). Tissue propagation provides many advantages compared to traditional reproduction methods: rapid reproduction even from very sparse material, cloning and maintaining decorative mutants and hybrids, and production of virus-free plants (Kane *et al*. 1999, Kasselmann 2003). On the other hand, tissue propagation requires both laboratories and biological knowledge of the species in question, and for these reasons only the wealthiest companies can rely on it.

High biodiversity in the tropical countries includes potential species for commercialization, and prospecting new species for cultivation is part of the aquarium trade. It should be guaranteed however, that all the benefits do not flow to foreign companies. Also, nature conservation has to be incorporated into development by creating sustainable rainforest economies. In this progress, ornamental aquatics with existing markets and high value (Chao & Prang 1997, Wijesekara & Yakupitiyage 2001) surpass many other non-timber forest products (NTFP). In order to achieve mutual benefits from bioprospecting, close cooperation and contracts are needed between national and international operators, regulated in the basis of Convention on Biological Diversity (CBD 1992).

Conclusion

Aquarium companies in Iquitos claimed that there is no market for the plants, but in reality markets not only exist but also are large and growing. Perhaps this misunderstanding is caused by the young age of the companies and the entrepreneurs' short experience in the aquarium business. Companies in Peru have international contacts, but contacts should be improved in order to enhance companies' knowledge of international markets.

To overcome these problems more co-operation is needed. Current research institutes in Amazonia (e.g. Institute of Investigations in Peruvian Amazonia (IIAP) in Peru and National Institute of Amazon Research (INPA) in Brazil) could be involved in developing cultivation methods and prospect new species for trade. There is already an ongoing project in Rio Negro basin to develop ornamental fish production (Chao & Prang 1997) and ornamental plants could be included in similar projects. Contacts between exporters and importers should be stronger and more active to guarantee the markets for the products. South American aquarium plant production was already once re-

placed with more efficient production elsewhere and thus, instead of direct competition with the existing producers the Amazonian companies perhaps should focus their business differently. They could concentrate on prospecting new species or variations for trade and on cultivation of pure natural species instead of hybrids. One possibility is to focus on species that are too expensive to produce in greenhouses, for example *E. horizontalis* has almost disappeared from the markets because of high production costs due to its large size and slow growth.

Aquarium trade may reduce poverty in developing countries, but conservation questions should be remembered. Market-oriented conservation cannot guarantee the preservation of biodiversity alone, but can result in over-exploitation of natural resources (Crook & Clapp 1998). Habitat losses together with overexploitation of natural populations for aquarium trade have resulted in serious problems in Asia, where several species of genus *Cryptocoryne* Fischer (Araceae) are now threatened by extinction (Jacobsen 1985, Mansor & Masnadi 1994). Thus, possible re-establishment of the production in South American countries should be done cautiously. In any case, native plants should have priority over potentially invasive exotic species in the development of the aquarium plant industry.

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