ment Corporation, highlighted the importance of "knowing thy business" by thorough business planning. Bob stating that "Only then will proper business decisions be made, based on maximising profit and reducing loss." This was also a point highlighted by the economic model (version 1) presented by Bill Johnston and Peter Rawlinson who identified the three key cost centres of technicians, labour and capital depreciation, accounting for greater 65 per cent of the production costs (based on a 50 000 shell farm).

Overall, the two-day workshop was regarded as a success, aided by the conducive atmosphere of the Underwater World Function Centre and the sponsor's trade show. Day two's open session derived many key outcomes for the Amwing Association to pursue in 2000, particularly in the area of strategic branding and marketing.

Copies of workshop abstracts are available from: Simon Bennison, Executive Officer, Amwing Pearl Producers Association Inc., tel. 9244 2933 fax. 9244 2934 or Dan Machin, Fisheries WA, tel: 08 9482 7201 fax: 9482 7390.

Evaluation of success in the seeding of round nuclei in *Pteria sterna* (Gould 1851), a new species in pearl culture

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Introduction

The Mexican pearl fisheries of the rainbow-lipped pearl oyster (*Pteria sterna*) have existed since before the arrival of the Spaniards to the American continent. Evidence of the use of ornaments made from these shells was found deposited in an ancient burial site – probably belonging to the indigenous Seri Indian nation – in the coastal part of the State of Sonora. It is very common to find pieces of this shell in ancient shell hills (*concheros*) related to the presence of semi-nomadic groups that roamed most of the central coast of Sonora, before the arrival of Western civilisation. After this incipient use of pearl beds, much larger efforts were given to the pearl fisheries of the Sea of Cortez (*aka* Gulf of California), from the start of the Colonial period until 1940. These fisheries gave abundant supplies of naturally coloured pearls, from light-grey to dark-purple, with many intermediate tones of pink, gold and green.

The rainbow-lipped pearl oyster populations, as has been the case of all commercial species of pearl oyster, suffered severely from over-exhaustion. The Mexican Government was forced to decree in 1940 a permanent ban on its fishery that still holds to this day.

Historical background

Over the past few decades, several Asian-Pacific rim countries have used a species of the same genus (*Pteria penguin*) for the culture of half-pearls. The general belief of Japanese specialists is that round pearl production in pearl oysters of the genus *Pteria* is technically difficult. Shirai (1981a) mentions "most of the genus *Pteria* are too small. Also they have a wing-shaped shell, which makes the entire operation rather difficult". The same author states, referring to *Pteria penguin*: "the extraordinary luster of the shell's interior has invited many to try and produce round pearls but, at the moment, not any effort has been rewarded with success" (Shirai 1981b). Monteforte (1997) reports on the results of seeding both species of pearl oysters (*Pinctada mazatlanica* and *Pteria sterna*) and mentions that – when compared with *Pinctada mazatlanica* – "*Pteria sterna*, on the contrary, presents anatomical difficulties for round pearl production, because the pearl sac is very wide at its base and the graft moves freely…"

There is one commercial pearl farm in Mexico that utilises *Pteria sterna* as its main production species. The farm has been able to produce cultured half-pearls and loose pearls on a regular basis (McLaurin et al. 1997; McLaurin et al. 1999; http://www.perlas.com.mx).

The present article analyses the "seeding operation" costs and the number of pearl oysters needed for the implementation of the round pearl seeding technique on *Pteria sterna* at the commercial first modern Mexican pearl farm, ITESM/Perlas de Guaymas.

Materials and methodology

The implementation of the round pearl production technique was performed under the following circumstances:

a) The use of a species reported unsuitable for the production of cultured loose pearls, *Pteria sterna*.
b) No outside training or help was given to the seeding technicians.
c) An adaptation of the "Mise-Nishikawa" technique was developed locally.

Obtaining organisms

Pearl oysters 18 to 36 months old were used for this study. All of them were grown from wild spat at the pearl farm facilities of the Instituto Tecnológico y de Estudios Superiores de Monterrey, Guaymas Campus (ITESM-Guaymas), found at the central zone of the Gulf of California on the continental side (Figure 1). For details on the pearl oyster culture techniques used at the farm, please consult the information found at our website: http://www.perlas.com.mx.

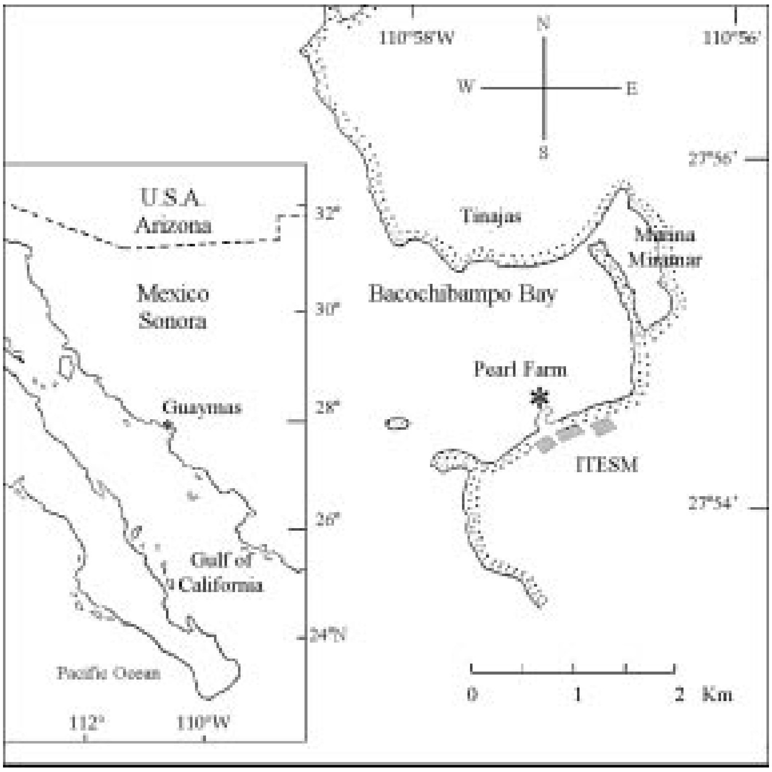

Figure 1. Location of the ITESM/Perlas de Guaymas pearl cultivation facilities in the Gulf of California, Mexico

Seeding operations took place during two seasons (between November 1997 and May 1999) and were performed by four different researchers/technicians. Commercial shell nuclei, in sizes between 5.5 to 10.0 mm, were employed. Nuclei size selection was decided on operation based on the overall condition and size of the organisms.

Each grafter's lots were kept separate and examined under X-ray after eight weeks, to identify those oysters that retained their nuclei, and reject those that had not. Mortality was also registered.

For comparison with available literature, data was analysed eight weeks after the operation took place.

Results and discussion

Figure 2 represents the accumulated nucleus retention percentage, based on the total number of operated organisms by each grafting technician. In the case of grafters 3 and 4, a significant descent, from modest to high, in the retention percentage was followed by a rapid increase up to a maximum level for each person.

Grafters 1 and 2 only show the second phase of grafters 3 and 4 curve, that is, from a slow to rapid increase up to a maximum retention.

This can be attributed to:

1) Individual differences in the "seeding skill" of each person.
2) Selection of pearl oysters. Initially, organisms for seeding were strictly selected and thus had the ideal condition for seeding. Later, as animals became more scarce, all available oysters were subject to operation, many of which did not have the best condition (physiological or size) for operation. This was due to negative influences of *El Niño* on the growth of oysters.

In the case of grafters 1 and 2 this is different because the majority of selected organisms did not belong to the lots that followed a strict selection process. In this case, the initial behaviour of the retention curve is more related to the second part of the curve from the other two grafters, where a steep increase can be observed. This can be attributed to the experience they were acquiring over time, as well as an improvement in the overall physiological and size condition of the organisms.

Another point to emphasise in Figure 2 is the fact that the tendency to improve the retention percentage is different for each grafter. In the case of grafters 2 and 3, the period of a slower increase in the retention percentage begins at about 4000 seeded organisms, while for grafters 1 and 4 this number can be found at around 6000–7000 seeded organisms. Grafter 1 has yet to reach this decrement after more than 7500 seeded oysters. According to many authors, some 10 to 15,000 pearl oysters are needed in order to produce a single trained seeding technician (Salomon and Roudnitska 1986; Lintilhac and Durand 1987).

This differs significantly from our results: each grafter arrived at a different time at its maximum retention value. Undoubtedly, as a grafter acquires more experience he can increase his retention rate. However, for three out of four of the grafters in the present study it can be seen that after 7000 seeded oysters this strong tendency to improve is lessened. This is highly significant because none of the grafters received any kind of training, and so it can be considered that when some form of technical training takes place, the number of organisms required to develop the maximum potential of a grafting technician can be lessened.

Haws et al. (1999) mention that the "success rates of trained technicians range from 60 to 80 per cent nucleus retention at 30–40 days post-implantation". This retention rate is for the *Pinctada margaritifera*, a species used for at least three decades now for the production of cultured pearls. In Figure 3, with the elimination of the two last months of operation (January and February, 1999) which had anomalous temperature conditions that made the retention rate of all four grafters go down (Figure 3), three of the four grafters had already attained a retention rate higher than 60 per cent, eight weeks after operation started (post-op). Thus, according to Haws et al. (1999) our group of grafters fall in the category of "trained technicians", if these results are applied to *Pinctada margaritifera*.

If we take into consideration the period prior to December 1998, three of the four grafters had attained values higher than 60 per cent of retention rate, and only one of them had operated over 7000 organisms. So, we can most certainly state that 7000 seeded organisms give the necessary training to consider a person as a "trained technician".

Figure 3 shows a similar behaviour for all four curves, representing the retention percentage of all four grafters, but slightly out of phase. This can be directly related to the individual skills of each person. On the other hand, the general behaviour of the curves – being very similar in all four cases – demonstrates the influence of external factors that directly affect the retention rate.

Total retention percentage of all four grafters shows marked variations on the short-term. This could be attributed to a series of external factors, some of which have been identified as influential: the variation in the proportion of seeded organisms in each lot by each grafter (remember that the retention rate is different for each person); the daily variation in the physiological condition of the organisms in each lot; the variation in the size of used nuclei; and, most importantly, the mean sea temperature variation.

Both our results (from unpublished grafting log book) and those published by Tamura (1966) show that the bigger the nucleus, the lesser the retention. In the two different seeding seasons, nuclei size increased. In the first season, nuclei size range was 5.6 to 6.5 mm with a mode of 5.6 mm. In the second year, the nucleus size range was 5.6 to 10.0 mm with a mode of 7.5 mm. Also, the overall condition and size of the organisms differed. This also resulted in erratic changes in the retention rate.

When examining temperature behaviour in Figure 4, the main tendency in the variation of the total retention rate has approximately the same curve variations as that of the temperature. Some parts of both curves show values that seem unrelated, but examining data on the daily log we found that for points "a", "b" and "d" of the curve, the operated organisms belonged to small lots of strictly selected organisms with very good size and gonadal development; on the contrary, in part "c" of the curve, the operated organisms had a prior operation (resulting in no retention), and posed some seeding difficulties. Another point of importance is related to water temperature. Bacochibampo Bay (where the farm is located) presents a minimum temperature of 16° C under normal environmental conditions, but due to the anomalous environmental conditions created by *La Niña*, the winter months of 1998 and those at the beginning of 1999 registered temperatures lower than 16° C (down to 15° C). This lower water temperature present for such a long period, could have been in part responsible for a lower retention rate, as seen on Figure 4, at points "e" and "f" of the curves.

Conclusions

The results of this study were obtained in the real operation conditions of a commercial pearl farm.

In the case of seeding round nuclei in *Pteria sterna*, a grafting technician can be considered as "technically trained" (having developed the best part of his potential) after seeding 7000 pearl oysters. This number could be reduced if there is a previous training effort.

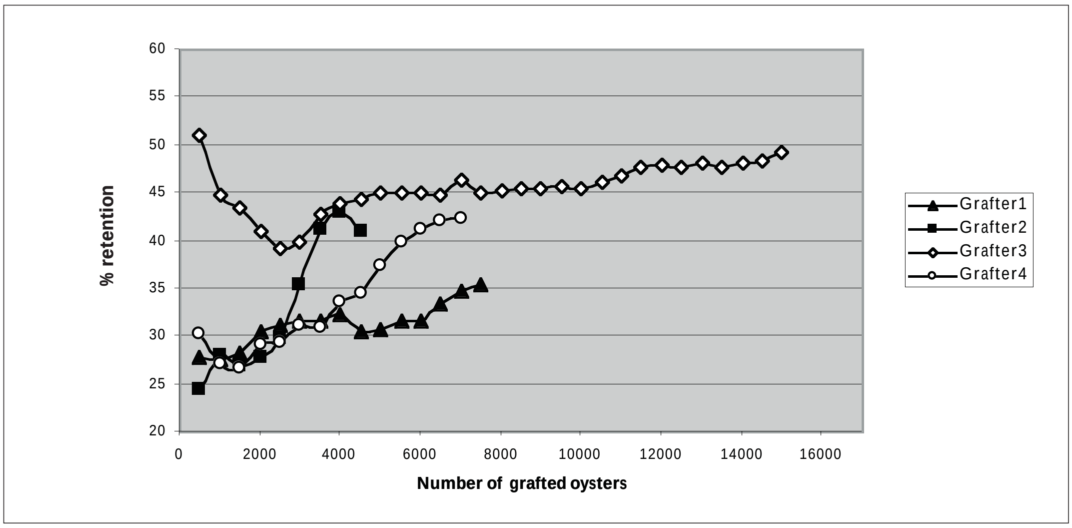

Figure 2. **Accumulated retention percentage, based on the total number of operated pearl oysters (*Pteria sterna*, Gould 1851), for four different grafters/technicians.**

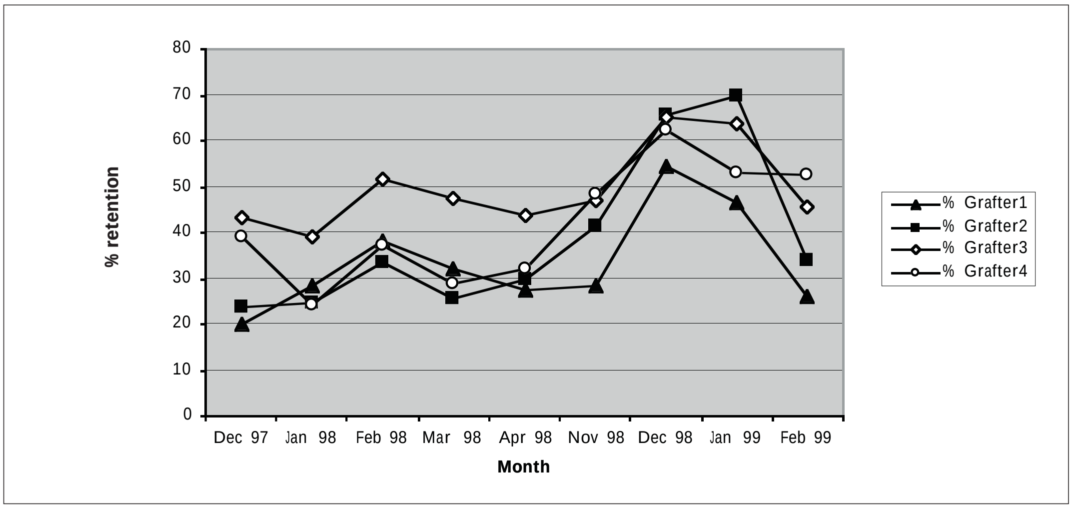

Figure 3. **Percentage of monthly retention for four different *Pteria sterna* grafters.**

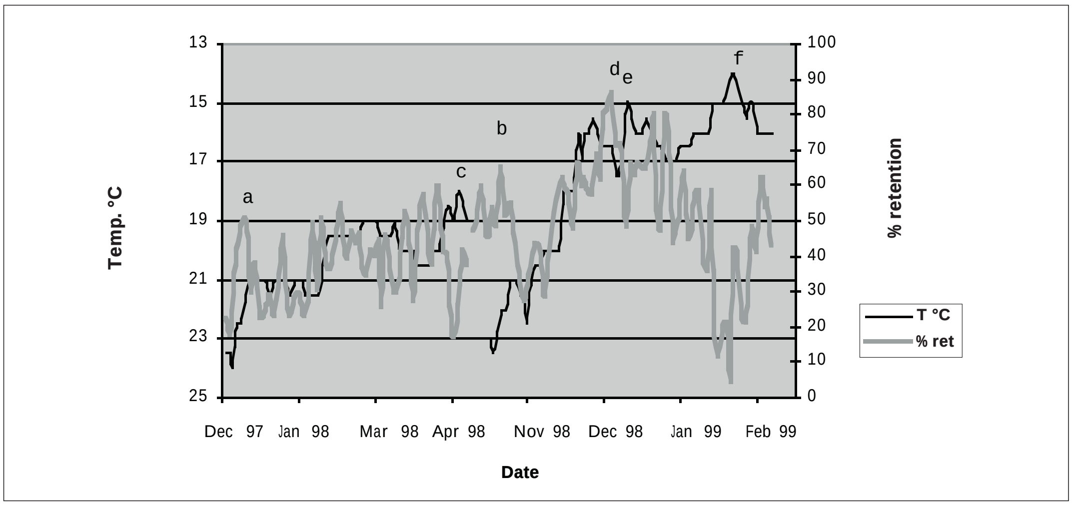

Figure 4. **Monthly retention rate in *Pteria sterna* (Gould 1851) for all four grafters, compared against seawater temperature at the time of operation. The letters in the graph are discussed within this article context.**

The most important factors influencing the retention rate of pearl oysters (*Pteria sterna*) are water temperature, nuclei size and the overall condition of the organisms.

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Pearl oyster training course at James Cook University

A five-week training course in pearl oyster propagation was recently held (4th to 5th November 1999) at James Cook University's Orpheus Island Research Station as part of the ACIAR project "Pearl Oyster Resource Development in the Pacific Islands." The trainees included three Fisheries Officers from Kiribati (Mr Beero Tioti, Mr Iannang Tealoro and Mr Iobi Arabua); two from the Solomon Islands (Mr Celtus Oengpepa, ICLARM and Mr Gideon Tiroba, Solomon Islands Fisheries); Mr Mataarora Masters (Marine Resources, Cook Islands); Mr Tevia Taumaipeau (Fiji Fisheries) and Mr Rajesh Prasad, a PhD student from University of South Pacific.

The Course covered aspects of the biology of the blacklip pearl oyster longline establishment, broodstock maintenance, spawning induction, larval rearing, microalgae culture, settlement, nursery and grow-out culture systems. While culture techniques developed at James Cook University formed the basis of the training course, trainees brought considerable and varied experiences to the course from their respective countries and sharing these experiences complemented to training course considerably.

During the course, trainees conducted a number of spawnings and reared 1.2 million *P. margaritifera* larvae through to settlement. These larvae were used in an experiment to assess different types of spat collectors and resulting spat will be used for subsequent nursery culture experiments.

To complement the course, trainees received a training manual outlining biology and general culture methods for blacklip pearl oysters. This will form the basis of a more comprehensive culture manual to be published by ACIAR in 2000. A second shorter training course should be conducted in Kiribati in the second half of 2000.

Source: Paul Southgate, Project Coordinator, ACIAR/JCU Blacklip Pearl Oyster Project, James Cook University