

Did you say pislama, dairo, bislama, kereboki or bêche-de-mer?

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Sea cucumbers are named pislama in Papua New Guinea (PNG), dairo in Fiji, bislama in Vanuatu, kereboki in Kiribati and bêtes or bêche-de-mer in New Caledonia. During October and November 2017 participants from these five Pacific Island countries took part in activities in Papua New Guinea, Fiji and New Caledonia to further their knowledge of sandfish (*Holothuria scabra*) aquaculture for restocking by visiting their neighbouring counterparts. For this initiative, which was led by the Pacific Community's Fisheries, Aquaculture and Marine Ecosystems Division, we set ourselves a few criteria and targets. It had to be regional, technical and most importantly, it had to be about the people who work in this field. It was as much about 'how far we have come', as it was about 'how far we still have to go'. It was introspective and intended that way so that regional experts could meet and share their experiences in a setting that would foster networking among Pacific islanders.

The region has many national sandfish restocking programmes – some of which are carrying out ground breaking research and development in hatchery/nursery production, restocking/sea ranching and processing. All programmes have great stories to tell. They may be stories of success and sometimes failure but all have some precious lessons to share in creativity and in the way they have been able to adapt processes and technology to make things happen under challenging local conditions and contexts.

The group of participants that gathered represented sandfish programmes ranging from highly advanced where sandfish aquaculture and ranching are being tested at a large scale, down to countries that have fledgling programmes and are in the process of developing seed production capacity.

The regional participants included the following: Esther Leini (Hatchery Manager, National Fisheries Authority [NFA], Papua-New-Guinea [PNG]), Nicholas Daniels (Mariculture Research Technician, NFA, PNG), Shalendra Singh (Principal Fisheries Officer, Ministry of Fisheries [MOF], Fiji), Sheik Saheb (Fisheries Officer, MOF, Fiji), Ajay Arudere (Senior Fisheries Management and Fisheries Officer, Vanuatu Fisheries Department [VFD]), Rocky Kaku (Research Officer, VFD, Vanuatu), Derek French (Hatchery Operator, Aquaculture Solutions Vanuatu), Andrew Williams (Aquaculture Development Officer, VFD, Vanuatu), Joana Rabaua (Hatchery Manager, Ministry of Fisheries and Marine Resources Development [MFMRD], Kiribati), Kamarawa Tamton (Aquaculture Technician, MFMRD, Kiribati), Bernard Fao (Fisheries Division Manager, Southern Province, New

Caledonia), and Laurent Burgy (Hatchery and Farm Manager, Société d'élevage aquacole de la Ouenghi, New Caledonia).

The exchange programme was structured in three chapters for three different locations: PNG, Fiji and New Caledonia. In each chapter, participants were taken for one week to see and experience the way that sandfish research and development is being carried out in neighbouring countries. The Fiji chapter also included 2–4 week placements at the Galoa Fiji government hatchery for delegates from PNG, Kiribati and Vanuatu.

Pislama sea ranching in Kavieng, PNG

The exchange programme started in Kavieng at the Nago Island Mariculture Research Facility (NIMRF) where Esther Leini and Nicholas Daniels are based, and where we were welcomed by Facility Manager Peter Minimulu and ACIAR scientist Thane Miltz. PNG's National Fisheries Authority has made a significant investment in developing NIMRF into a state of the art research facility that is currently housing several mariculture initiatives that are supported by the Australian Centre for International Agricultural Research (ACIAR). One of those initiatives is the sandfish sea ranching project, which started in 2010. During the week we were chaperoned by Esther and Nicholas who took us through their work from hatchery production and nursery to sea ranching and the research being conducted in those areas. It was an action-packed week during which activities were organised for participants to experience production phases such as spawning, larvae culture, nursery, the release of juveniles and bio-physical survey of sea ranching sites. We learned about the challenges

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that Esther and Nicholas faced; for instance, with feeding live micro algae to larvae and with mortality during nursery stages. Importantly, we were able to see first-hand the solutions that had been developed through repeated research trials for the development of larvae culture protocol using 100% algal paste instead of live micro algae (Figure 1) and to increase juvenile survival in floating hapa net systems.

Hatchery placements and restocking of dairo in Fiji

During the PNG chapter, activities also started in Fiji with the placement of Derek French (Aquaculture Solutions Vanuatu) at the Ministry of Fisheries marine hatchery in Galoa. Derek was later joined by Esther Leini and Joana Rabaua (MFMRD, Kiribati).

Placements were overseen by Anand Prasad (Facility Manager) and Teari Tekebo (Sandfish Hatchery Manager). Sandfish production at the Galoa hatchery is, like at NIMRF, a story of adaptation to local conditions and the systems available to work with. In Galoa, Teari Tekebo was able to develop her unique blend of hatchery techniques to overcome early difficulties during larval stages caused by copepod infestations. With the presence of Teari and other sandfish hatchery managers, the Fiji chapter was a unique opportunity to hold a small workshop on hatchery techniques. We heard presentations from the perspective of PNG, Fiji, Kiribati and New Caledonia and from this workshop we were able to see some changes and evolution from the manual by Natacha Agudo (Agudo 2006), which is still considered as a benchmark in all four hatcheries:

- Spawning techniques: All hatcheries use dry and heat shock with spirulina bath as recommended in Agudo's manual;
- Feeding: There is an evolution toward using paste with all hatcheries, partly using paste and some like NIMRF using only paste. New Caledonia feeds mostly live algae with a little paste and Algamac Protein Plus supplement. Fiji feeds only 10% live algae, the rest being paste.
- First feeding and feeding rates: Some hatcheries feed at day 1 (Fiji and New Caledonia) and New Caledonia feeds a little more than what is prescribed by Agudo. Other hatcheries (PNG and Kiribati) follow Agudo's manual for both start of feeding and feeding rates.



Figure 1. Shalendra Singh (left, Fiji Ministry of Fisheries) and Ajay Arudere (right, Vanuatu Fisheries Department) feeding sandfish larvae under the watchful eye of Esther Leini (centre, PNG's National Fisheries Authority) (Image: Michel Bermudes, SPC).

- Water exchange: There are two methods being used, the first being for minimal water exchange with larvae staying in the same tank throughout the cycle and until 3–5 mm size and the second being for full regular water exchange every 2 to 4 days until settlement, complemented or not with partial exchange. The full water exchange method is favoured in hatcheries (Fiji and Kiribati) with limited capacity for UV water filtration to keep copepod infestations under control.
- Settlement: Spirulina and/or Algamac coated plates are used in all hatcheries except in New Caledonia where they have stopped using plates. New Caledonia has also developed an effective technique to induce settlement.

Additional details for each hatchery is provided in Table 1. The productivity to 5 mm relative to the volume of each hatchery is comparable across facilities in PNG, Fiji and New Caledonia. A range of systems is being used across all hatcheries with production statistics available – hapa nets in ponds being the most effective techniques used in New Caledonia and Fiji.

The Fiji chapter concluded with the release of sandfish juveniles at Vitawa village (Figure 2), which was followed by a customary ceremony during which the village chief, the village head and elders, and our group of regional experts engaged in a question and answer session on sandfish restocking and the management of community-based marine protected areas.

Beche-de-mer farming in New Caledonia, a broader regional perspective

With a large-scale hatchery capable of producing in excess of 1 million sandfish juveniles per year, tens of hectares of ponds that are potentially available for stocking and sea ranching are still being investigated, and New Caledonia has the most advanced sandfish programme in the region. Participants were able to see all this during a series of visits to the hatchery, farms and beche-de-mer processing plant. This level of development is still a long way off for other countries in the region. The gap is not necessarily due to the production technology being applied – sandfish hatchery and grow-out technology is still fairly low tech and apart for some local variations, similar techniques are being used across all countries represented. What sets New Caledonia apart is the investment in a public-private partnership venture, the scale of the operations and the opportunities that exist for large-scale production using shrimp ponds and applying state-of-the-art processing techniques to craft a premium product that is able to demand higher prices. It helped for the participants to see this state of advancement and completed the picture of what is being done and what is possible in the region.

These last field visits set the backdrop for the first Regional Workshop on Sandfish Aquaculture for Restocking held in Noumea (22–23 November 2017) to conclude the exchange. The goal of the meeting was to identify gaps and potential solutions going forward.

Two main constraints were highlighted during the workshop:

1. Insufficient seed supply; and
2. Lack of effective model for sea ranching and restocking.



Figure 2. Releasing sandfish at the Vitawa village marine protected area, Fiji (Image: Michel Bermudes, SPC).



Figure 3. Workshopping a regional approach to common constraints to sandfish aquaculture (Image: Melinda Morris, SPC).

To address insufficient seed supply, participants suggested the creation of a working group to facilitate exchange, increase transfer of technology between countries and raise the pace of hatchery development in the region. Regarding the lack of an effective model for sea ranching and restocking, it is important to note that participants did not perceive this to be a technical issue but rather a challenge to address (at a governance level) the involvement of private operators, governments, NGOs and communities for developing integrated and harmonious models. Again, participants voiced the need for greater regional exchange on

Table 1. Information on the mode of operation and productivity of sandfish hatcheries in four countries of the Pacific region.

	Fiji	PNG	Kiribati	New Caledonia
No. of successful production cycles using current techniques	2/2	17/17	2/5	17/18
Broodstock	Wild from destination	Wild from destination	Wild from Fiji	4 th generation
Production per cycle	30,000 @ 5 mm and 5000–10000 @ 5–10 g juveniles	50000 @ 5 mm juveniles	1000–5000 2 g juveniles	100,000 to 400,000 @ 5 mm (with ~70% survival to 2 g)
Hatchery size (volume of larval tanks)	8000 L	10,000 L	6000 L for larvae + 22,000 L of settlement raceways	Up to 90,000 L
Settlement	Plates in larvae tanks	Plates in larvae tanks	Plates in settlement raceways	No plates
Nursery to 5 mm	In larvae tanks	In larvae tanks	In settlement raceways	In larval tanks
Nursery to 1 g	Hapa nets in ponds	Raceways, nursery tanks, floating bag-nets	In settlement raceways	Hapa nets in ponds
Nursery to release	Hapa nets in ponds	Sand bag nets in pond and ocean	In settlement raceways	Hapa nets in ponds to 2 g and pond to 20 g
Release size	5–10 g	3 g	2 g	1.5 g for ponds, 15–20 g for sea ranching

this topic so that countries can learn from each other's experience.

Overall the regional exchange was full of lessons for the participants and for SPC as the organiser and facilitator of this event. For a start, this is a great model for technical and leadership capacity building, and for professional networking in the region. All participants came in with a positive attitude and were able to show case their country's experience in an environment that was conducive of sharing and learning from each other. Aquaculture is challenging and sea cucumber aquaculture probably even more so given the place and impact of sea cucumbers in the culture and politics of Pacific Island countries. In such an environment, for regional experts to continue working together will provide the necessary perspective for the development of sound and sustainable mariculture and sandfish sea ranching and restocking models.

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Reference

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