

Marine finfish culture in Komodo, East Indonesia - building a triple bottom line industry

A nature conservation organisation sets up a pilot marine finfish culture project as part of an innovative initiative to protect coral reef environments. A more long term aim is to transform the live reef fish trade from an unsustainable capture-based activity to a sustainable culture-based one.

The 12th of June 2004 represented a milestone for the Komodo Fish Culture Project, based in East Indonesia. On that date, the sale of 500 kg of cultured estuary grouper *Epinephelus coioides* took place from grow-out cages operated by one of the village communities around the Komodo National Park.

These grouper represented the first

**by Trevor Meyer,
Sudaryanto, Jos Pet &
Peter Mous**

batch of fish produced by a pilot fish culture project which aims to demonstrate

the feasibility of introducing fish culture to local communities as an alternative livelihood to destructive fishing practices, such as the use of explosives and cyanide. This represents one of the few examples of aquaculture being used as a tool for conservation, in this case to protect the coral reef environment within the



Using water jets to clean nets at a cage installation at Warloka village.

Komodo National Park. This project also has a more general aim of contributing towards the transformation of the Hong Kong based live reef fish trade from unsustainable capture-based to sustainable culture-based activities.

The pilot project is scaled to produce a maximum of 25 mt of grouper and snapper per annum, from which a fully developed commercial fish culture industry of 250 mt per annum aims to be developed within the next few years. The product will be sold as live fish to the Hong Kong based live reef fish market.

The project is currently being funded by The Nature Conservancy, a US-based NGO active throughout Indonesia, known for its use of innovative techniques in environmental conservation. Now that the pilot project has demonstrated the potential of a viable fish culture industry in the Komodo area, The Nature Conservancy is actively looking for partners to help transform this project into a 'triple bottom line' business, namely a business that is profitable, environmentally sound, and with benefits to the local community.

The Komodo Fish Culture Project consists of a pilot marine fish hatchery which supplies fish juveniles to community-based grow-out cage units situated within the Komodo area. Six species of fish are maintained as broodstock by the project, and are held in cages situated just offshore from the hatchery facility.

Species cultured

All broodstock were obtained from the immediate surroundings of the hatchery, and thus representing endemic stock and reducing the chance of disease introduction from outside the area. The Komodo Fish Culture Project has pioneered the successful maintenance of broodstock and the collection of eggs directly from the cages, which avoids the need for relatively expensive land-based tanks. Egg yield and hatching rates have proven excellent, and most species spawn naturally, without the need for hormonal manipulation, which in itself maximises egg productivity.

A total of six species of fish are



The floating cage fish farm at Warloka.

maintained, namely tiger grouper (*Epinephelus fuscoguttatus*), estuary grouper (*E coioides*), mouse grouper (*Cromileptes altivelis*), mangrove jack (*Lutjanus argentimaculatus*), Asian seabass or barramundi (*Lates calcarifer*) and leopard coral grouper (*Plectropomus leopardus*).

This multi-species approach allows flexibility with respect to stocking, allowing different species to be reared according to prevailing market conditions, environmental characteristics of grow-out and ease of culture. All species have different culture characteristics. Tiger grouper, for example, are fast growing (reaching a market size of 500 - 700 g within 12 months of cage culture) and reach a high market price (around US\$12 per kg, ex farm), but require intensive and regular grading to avoid the excessive rates of cannibalism associated with this species. Estuary grouper are easier to culture in the hatchery, but fetch a lower market price of around US\$5 per kg. The mouse grouper (otherwise known as humpback grouper or barramundi cod) is by far the most valuable species, reaching an ex-farm price of US\$30 per kg, but requires up to 20 months of grow-out to reach market size. Hatchery rearing of this

species is also more demanding than other species of grouper, with a lower success rate. Mangrove jack reach a lower market value, but are extremely interesting in that they are amenable to large-scale culture at relatively high stocking rates (which is not possible with grouper). The cage farmer can therefore spread his risks by producing a combination of fast-growing, lower-value fish with slower-growing, higher-value species, for example.

The hatchery

The hatchery itself is based on a design developed by the Gondol Research Institute for Mariculture, Bali, which provides technical support for this project. This design allows the hatchery to be built from locally-available materials and at a relatively low cost, with minimal reliance on equipment which must be imported or which may require lengthy and regular maintenance and repair. It is thus ideal for such remote areas as Komodo. In addition, management methods in place reflect the necessity for robust, practical production methods. For example, algae and rotifers are produced in open systems - low-cost and low-tech systems, but which have



Some of the fish being cultured: mangrove jack, mouse grouper and tiger grouper juveniles.

been proven to work. Yields are lower than from the complex, intensive production methods in use in Europe and the US, but far more reliable.

The pilot hatchery is scaled to produce up to 100 000 juveniles per annum. In addition, it has a modular design, so that up-scaling and enlargement can be carried out efficiently without the need for alterations to the existing facility.

Both SS and S rotifers are produced by batch culture methods, supported by the production of algae, mostly *Nannochloropsis*, and supplemented with yeast. Master cultures of both algae and rotifers are readily available from Gondol. Algae and rotifers are successfully cultured in outdoor 9 mt concrete tanks, using natural sunlight and industrial fertiliser. Imported *Artemia* cysts, enrichment diets and larval diets are readily available in Indonesia.

Water supply to the hatchery is based on a flow-through system. All incoming seawater is passed through sand filters, and filtered to 5 microns where necessary. Water quality is excellent, and temperatures are consistently within the range 28-30°C. Effluent water passes through a series of settlement ponds, where any particulate materials are allowed to settle, and any organic nitrogenous material broken down naturally.

Fish larval rearing is carried out in 10 mt concrete tanks, with regulated photoperiod. All fish species produced are fully weaned by day 50, by which time they are transferred to nursery rearing tanks of a similar size until acclimated for transfer to grow-out cages.

Grow-out farms

The Komodo Fish Culture Project aims to involve local communities in the grow-out of the hatchery-reared juveniles. These communities are well-placed for this activity, since all are existing fishing villages, and many have experience in holding wild-caught live fish in small net pens until sale to market. Most have available labour, and have shown a strong interest in involvement in the project to date.

Cage platforms are constructed of locally-available materials, mostly wood and plastic drums as floats. This keeps construction costs to a minimum. Although the cages are relatively strong and flexible, their installation is limited to sheltered stretches of coastline. Each cage platform conforms to the standard Asian practice of incorporating a guardhouse, so allowing the 24 hour manning of the platform, ensuring security throughout the night.

Each of the existing cage facilities are scaled to a production capacity of 6 mt per annum. Each platform consists of groups of cages of 3 m, 4 m and 5 m diameter. Cages of this size are optimum for the production of regularly graded and thus small batches of grouper.

Each grow-out facility is encouraged to use pelleted feeds, as part of the project's aims to optimise efficiency and incorporate best practices. A number of suppliers of good quality pelleted feed designed specifically for grouper exist in Indonesia, and these feeds are readily available.

In addition to supplying juvenile fish to the grow-out units, the hatchery has an additional function in providing

technical support to the cage units, such as disease diagnosis and treatment.

The coastal areas of the Komodo area are well suited to small-scale cage culture, and many suitable locations have been identified for additional cage installation. However, it is recognised that limits exist with respect to the capacity of the marine environment of the Komodo area to support cage culture operations. All grow-out units include an environmental monitoring programme, the results of which will be used to determine a maximum carrying capacity allowing safe environmental limits to future fish farm development in the Komodo area.

Community involvement model

Each grow-out unit is operated by a group of villagers, consisting of junior 'trainees' who work full-time at the facility, and who are supervised by the 'senior members', who would normally include the village leaders. The trainees receive training at the hatchery facility, as well as on-site training at the grow-out facility itself. The training and continued technical support and back-up is provided by Komodo Fish Culture Project staff.

Since many of the coastal communities targeted for fish farm development have limited resources, the communities are allowed to enter into an arrangement whereby the hatchery provides certain inputs such as juveniles, feed and other support, with the participating grow-out units deferring payment until the first harvests are achieved. Continued development of this project with a business partner

will allow a range of avenues to be explored in the development of these 'contract farming' arrangements.

The market

Most fish produced by the Komodo Fish Culture Project are destined for the lucrative Hong Kong-based live reef fish market. Ex-farm prices for farmed grouper range from US\$5 to \$30 per kilo, depending upon species, thus allowing for the production of relatively small quantities of fish on a profitable basis. A pre-existing network of live fish buyers exist in the Komodo area, based on the wild capture fishery, who take delivery of the live fish product directly from the 'farm gate'. Consequently, no additional investments in fish packing, processing or delivery are necessary.

Although wild-caught fish do attract a premium price on the Hong Kong market, the trading of farmed fish offers many advantages to the live fish transporter, particularly the consistency of the product in terms of species and size, and low transport mortality rates. Furthermore, farmed product has advantages over wild-caught fish at the consumption end of the marketing chain, such as the absence of ciguatera poisoning and cyanide residues (from the illegal use of cyanide to capture wild reef fish).

The market for chilled fish on-ice and processed fish is currently being explored in an attempt to diversify possible markets for farmed fish product of the Komodo Fish Culture Project.

Results to date

The first 18 months of hatchery operation have seen the successful production of 40 000 juveniles of four species of grouper and snapper. In addition, the first production batch of fish has already been harvested, with the sale of 0.5 mt of live grouper during June 2004. Two community-based grow-out units have already been in operation for some months, and currently hold a combined stock of 2.5 mt of live fish, representing a marketable weight of approximately 10 mt of live fish by June 2005. Two additional grow-out units will be installed by the end of 2004.

The greatest challenge encountered to date has been the inconsistency in larval survival, primarily due to the occasional incidence of Viral Nervous Necrosis (VNN). This disease is ubiquitous throughout Asia and, although no treatment is currently available, a number of avoidance and management methods have been incorporated into the hatchery operations which have successfully

limited the incidence of this disease. In addition, first generation broodstock are being selected from hatchery production, in an attempt to incorporate some degree of resistance to this disease to future hatchery-reared generations of fish.

The future

The Komodo Fish Culture pilot

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Live food production at the hatchery

project has successfully overcome a number of major technical challenges, and has shown that an operation of this type is technically feasible. The project is now ready, therefore, to enter its

only in a supporting and catalytic role. The approach to this process is that The Conservancy will carry out a final feasibility study, which will support the formation of a business group that will

most critical and exciting phase: its transformation into a triple bottom line business that is not only profitable but that also benefits local people and that is environmentally sound. As a global non-governmental, non-profit organisation, The Nature Conservancy fully realises that this transformation must be driven by the private sector, with The Conservancy

take over and up-scale the fish culture facilities and that will operate as an independent business.

The site of the pilot hatchery is able to support up-scaling to a full-scale commercial hatchery of 2 million juveniles per annum capacity. This hatchery will be well sited to provide juveniles for on-growing, both within the Komodo area, and throughout the Nusa Tenggara and south Sulawesi area, and also for export by sea or air via ports in Flores, Sulawesi and Bali. There is currently a desperate shortage of commercial marine fish hatcheries in Indonesia, combined with a massive demand for hatchery-reared juveniles from potential cage farmers.

It is envisaged that this model of integrated marine fish culture may be replicated throughout Indonesia and other south-east Asian countries, and so provide sustainable livelihoods to coastal communities throughout the region whilst at the same time helping to preserve wild stocks of grouper and other reef fish, together with the coral reef environments on which they depend. ☺

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Trevor Meyer is currently managing the Komodo Fish Culture Project for The Nature Conservancy's Bali-based South East Asia Centre for Marine Protected Areas (SEACMPA) with Sudaryanto as mariculture coordinator. Dr Jos Pet is programme manager of the Centre while Dr Peter Mous is also with the Centre. The Komodo project is part of the SEACMPA.

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