STRATEGY AND ACTION PLAN FOR THE TNC KOMODO FISH CULTURE PROJECT

A pilot project to establish a multi-species reef fish hatchery in Loh Mbongi, and village based grow-out farms in communities surrounding Komodo National Park, Manggarai, West Flores

WORKING TEAM

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1. INTRODUCTION

1.1 Vision

The Komodo fish culture project is aiming to provide sustainable fish culture as an alternative livelihood to non-sustainable fishing practices in and around Komodo National Park, Indonesia. The fish culture project will also contribute to the market transformation of the live reef fish trade from unsustainable, capture-based to sustainable, culture-based.

1.2 Strategy

The fish culture project strives to offer alternative livelihoods for fishermen who presently use unsustainable fishing methods, such as blast fishing, reef gleaning ('meting') and cyanide fishing. These destructive fishing practices are major threats to the natural richness of Komodo National Park. The fish culture project aims to involve local communities in the grow-out of estuary grouper *Epinephelus coioides*, mouse grouper *Cromileptes altivelis*, tiger grouper *Epinephelus fuscoguttatus*, sea bass *Lates calcarifer* and mangrove jack *Lutjanus argentimaculatus*, which can be marketed as a high quality live food product to the Hong Kong - based live reef fish trade. Fingerlings will be produced from captive broodstock in a hatchery situated in Loh Mbongi (ca. 6 km North of Labuan Bajo).

The project hatchery will be constructed in 2001 and fingerling production will start in February 2002. The pilot hatchery will be supplying fingerlings to 4 village-based grow-out farms by July 2002. These grow-out farms will be developed sequentially and should all be fully functional by June 2003. The total capacity of this pilot project is 25 tons per annum but only 50% of this potential is estimated to be achievable during the start-up of the grow-out farms in FY03 (July 2002 – June 2003). At the end of FY03 the pilot project will be evaluated and a revised business plan will be produced for up-scaling to a 200 tons operation, on the basis of experience gained during the pilot project. This up-scaling to a 200 tons operation will be necessary to achieve economy of scale and economic viability. From July 2003 onwards, the pilot project will be producing an estimated 25 tons of live food fish annually. A business partner will need to be identified to invest in the up-scaling of the pilot project on the basis of the FY03 evaluation and the revised business plan. It is hoped that the project can be transferred to a business partner and privatized between July 2003 and June 2004.

2. PRODUCTION PLAN

The pilot project aims to develop the capacity to produce 25 tons of live fish annualy, to be realized over 3-4 harvests per year per grow-out unit. The produced volume will consist of a mix of the five species whereof broodstock is presently secured. This multi-species approach reduces risks related to species-specific vulnerability to disease and to fluctuation in consumer preference and price. The species composition of the first batch of fingerlings will depend on hatchery practicalities, as this batch will be used for training in grow-out in village-based fish farms rather than for the generation of revenue. Grow-out farms are planned to start operating in FY03, when 50% of potential capacity will be achieved, and will be producing at 100% of their potential capacity in FY04.

The project is based on full-cycle culture, meaning that impacts on wild stocks are minimal. A full cycle comprises spawning of captive broodstock, collection of fertilized eggs, larvae rearing, fingerling production, grow-out in sea cages, and marketing. A full cycle takes 11 to 22 months, depending on the species. The individual body weight of marketable fish varies between 0.4 and 1.2 kg, depending on the current market preference and on the species. The project aims to grow out fish to an individual body weight of 0.5 kg. Production plans, including the duration of production phases and survival rates between production stages, are summarized in Fig. 1a-e, using a production of 25 tons per harvest as an example. These production plans follow the development of a batch of eggs through the various production phases (spawning, larvae culture, nursery, grow-out). It takes ca. 1-2 years, depending on the species, to produce a batch of marketable fish from fertilized eggs. For the pilot project, the *yearly* production will amount to 25 tons. This yearly production will be attained by 3-4 harvests per year for each grow-out unit.

Broodstock will be kept in sea cages. Fertilized eggs are collected from the cages and transferred into tanks in the larvae culture unit for hatching. The larvae are fed with live feed (rotifers, copepods and artemia) initially and at an age of 20 days, artificial feed (granules) is added in increasing proportion up to an age of 40-45 days. Thereafter the fish are transferred to the nursery tank where they are fed with formulated feed or minced trash fish until they have reached a total length of 5-10 cm. The fingerlings of 5-10 cm TL are then ready for stocking in sea cages.

PRODUCTION PLAN
mouse grouper

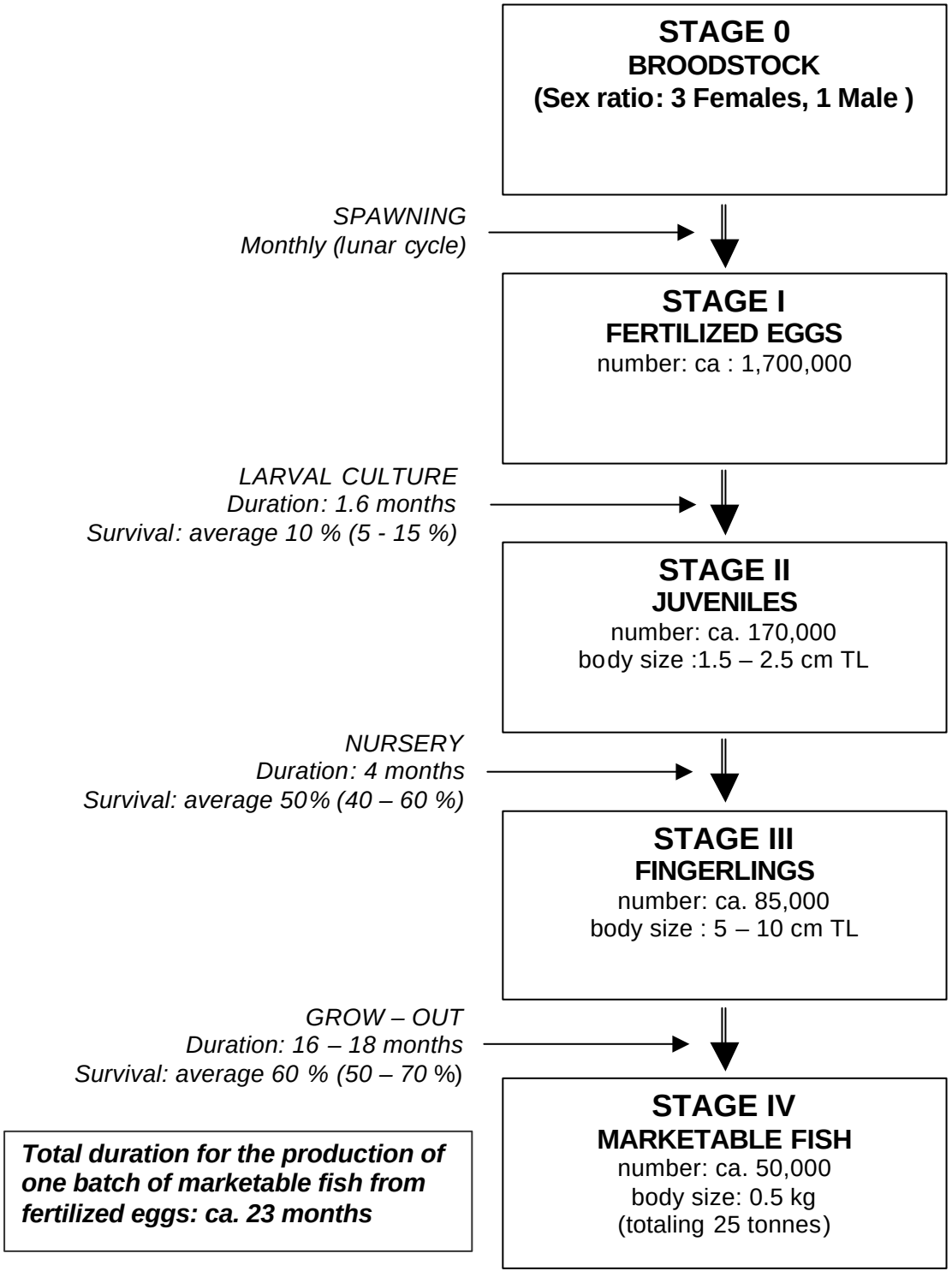


Figure 1a. *Production plan of mouse grouper* Cromileptes altivelis.

PRODUCTION PLAN
estuary grouper

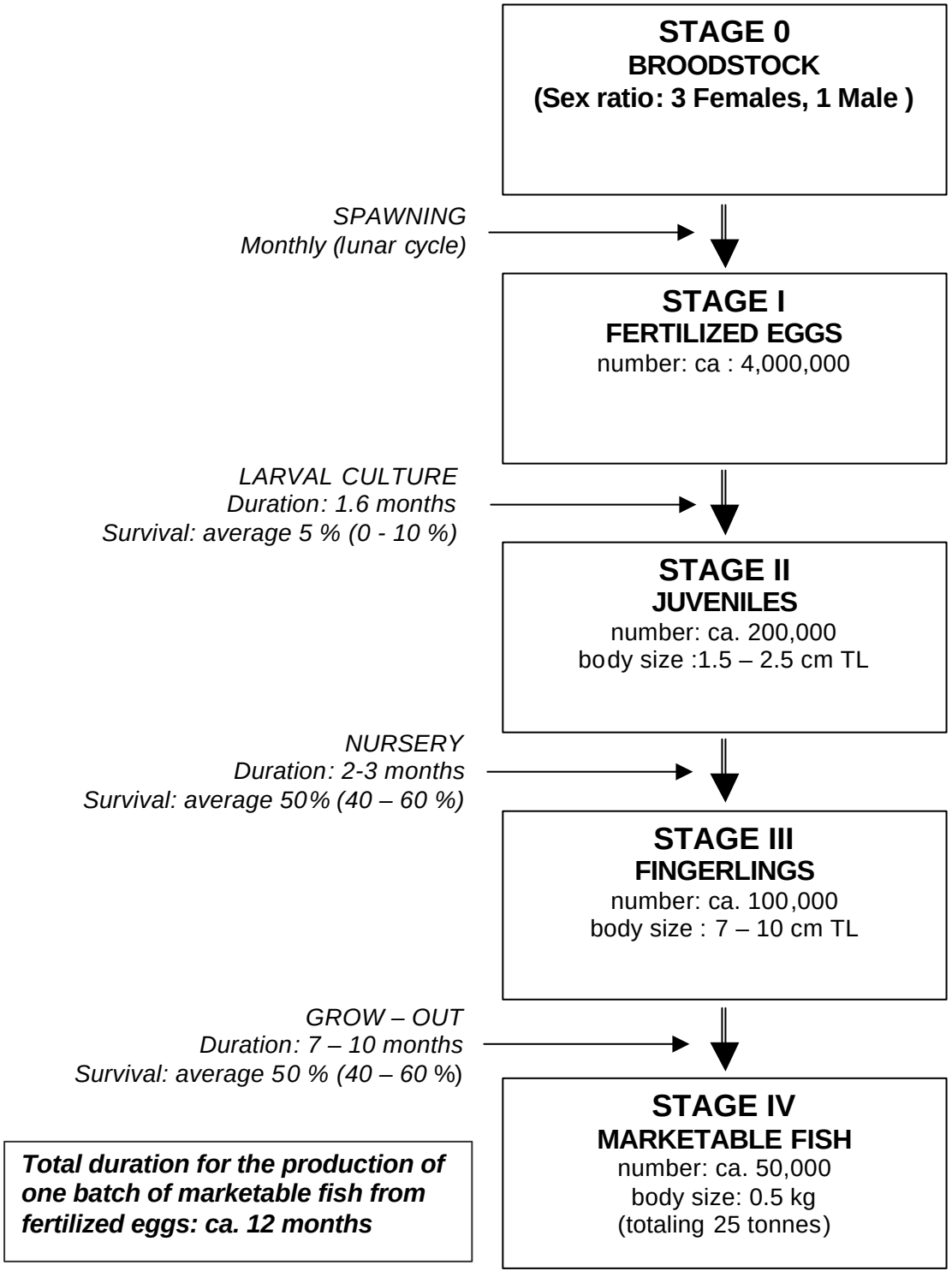


Figure 1b. *Production plan of estuary grouper* Epinephelus coioides.

PRODUCTION PLAN
tiger grouper

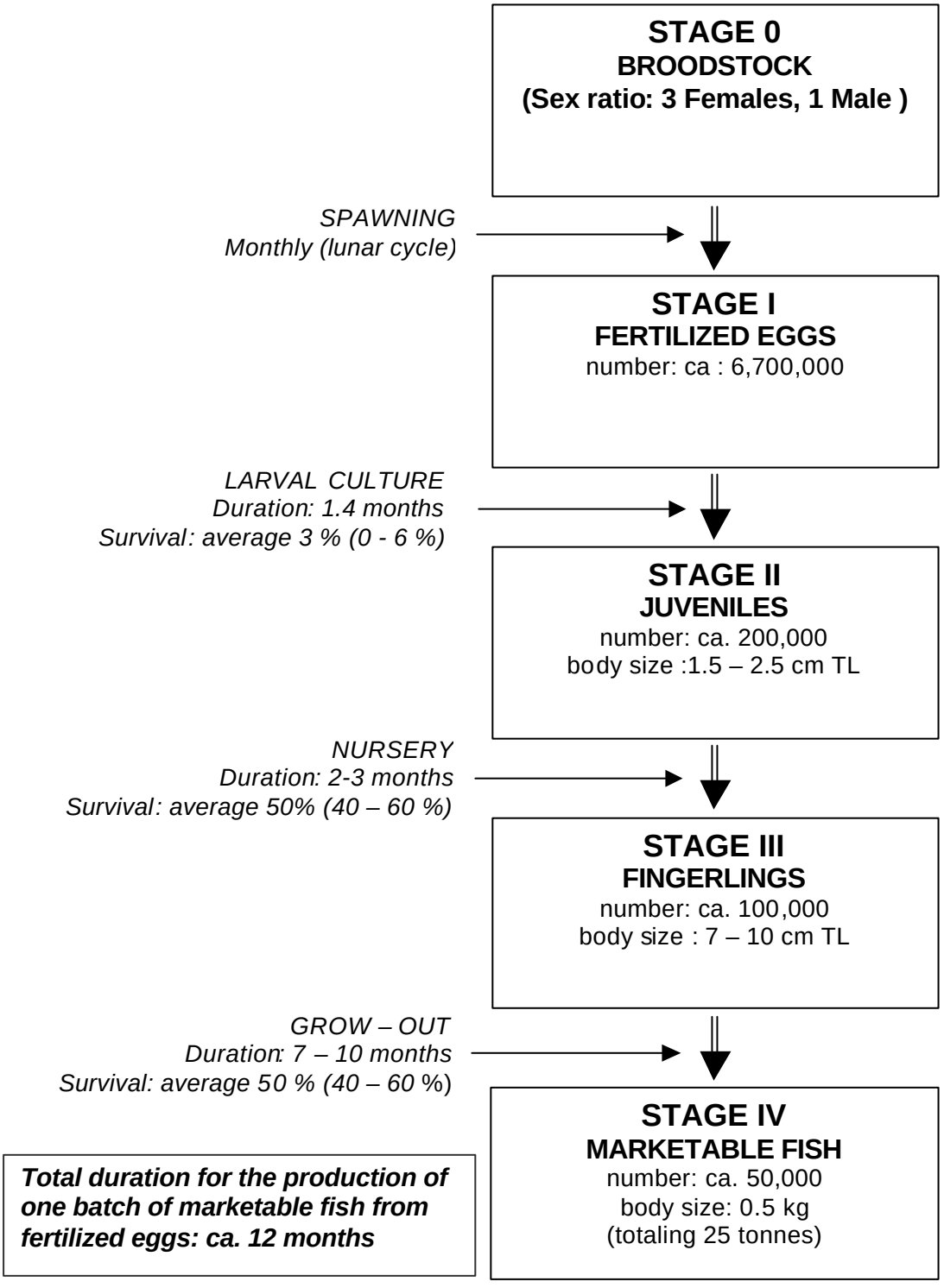


Figure 1c. *Production plan of tiger grouper* Epinephelus fuscoguttatus.

PRODUCTION PLAN
sea bass

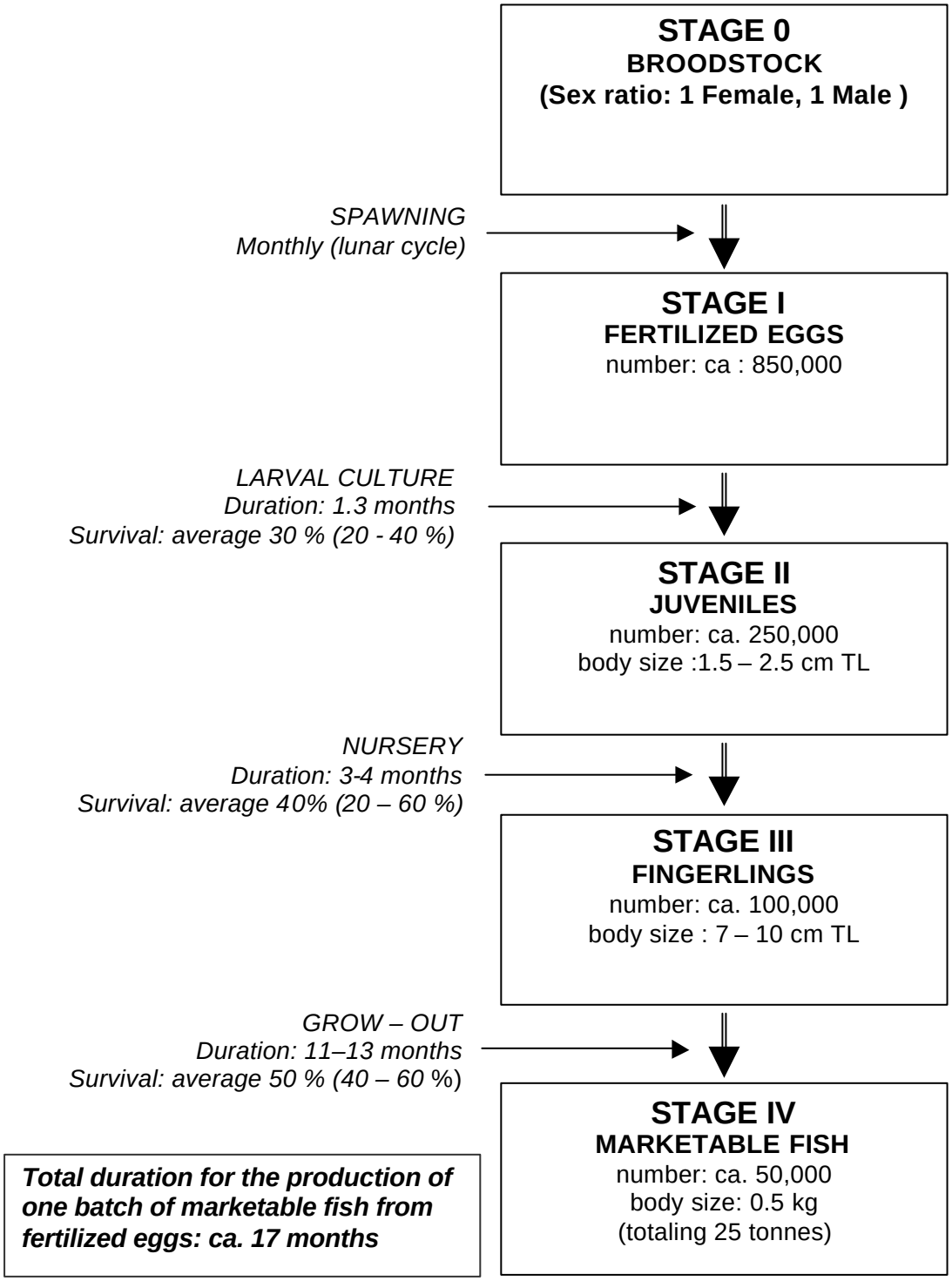


Figure 1d. *Production plan of sea bass* Lates calcarifer. *Note that growth rates pertain to grow-out in sea water.*

PRODUCTION PLAN
mangrove jack

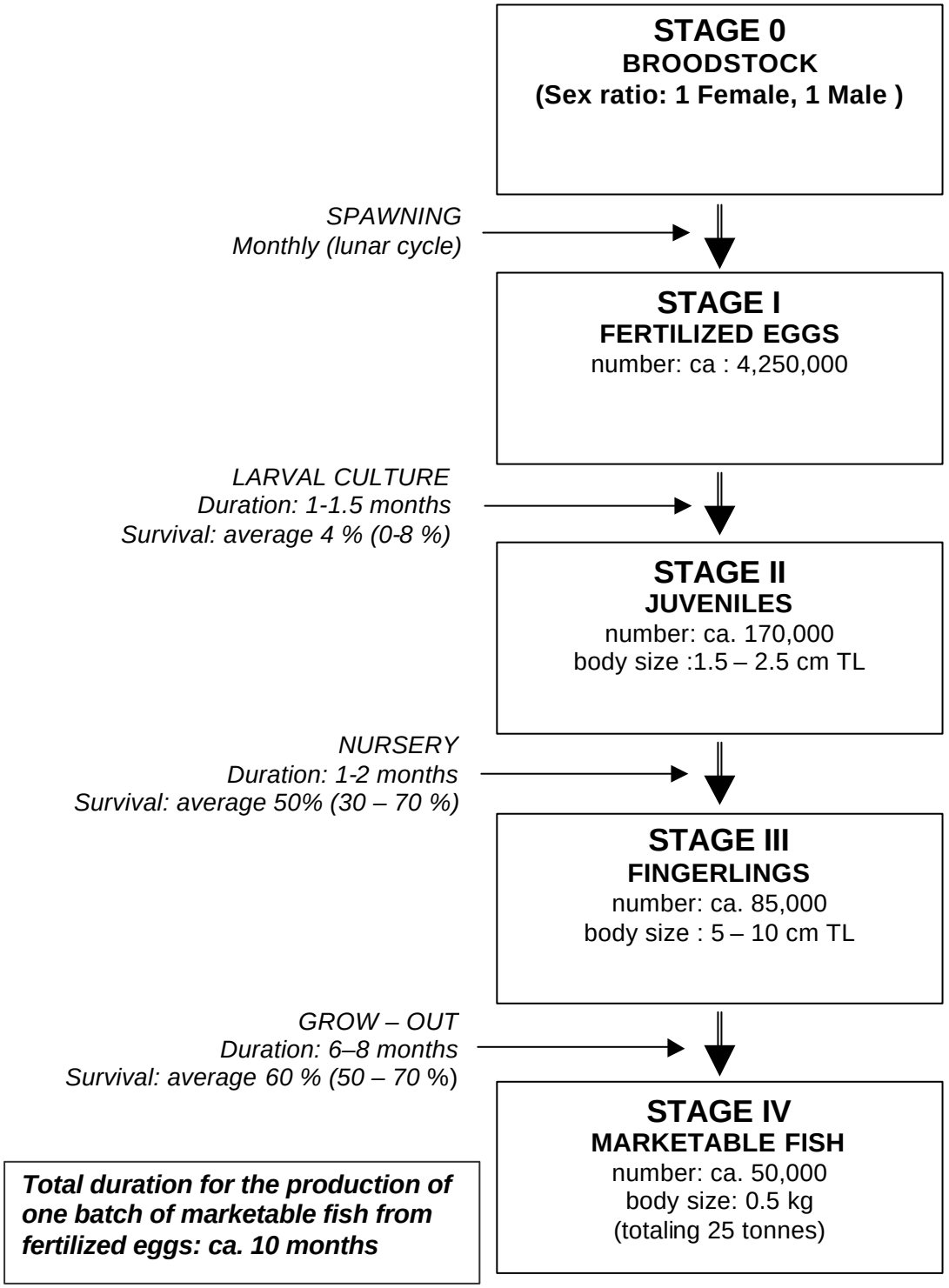


Figure 1e. *Production plan of mangrove jack* Lutjanus argentimaculatus.

3. BROODSTOCK

The mariculture project owns a collection of 2.4 tons of broodstock, which is kept in fish cages (Table 1) near the hatchery site in Loh Mbongi. Broodstock were purchased from local fishermen or they were caught during an earlier, discontinued mariculture project that focused on capturing juveniles from the wild for grow-out. The broodstock facility comprises 6 units of each 4 cages measuring 4 by 4 m, and 5 units of each 4 cages measuring 3 by 3 m. The depth of the cages is 5-6 m. The broodstock facility also includes a working deck, a storage shed and a guard house. All species have already spawned in captivity. The quality of the eggs produced by the captive broodstock was excellent, with a fertilization rate of 70% and a hatching rate that was also 70%. The broodstock is fed every second day with ca. 80 kg of fresh squid or small fish. Mortality has been low so far, amounting to only a couple of individuals.

Its high quality makes the broodstock an important asset to this project. All of the species that are kept change sex as they grow, implicating that broodstock has to comprise both small and large adults. Large adults are often difficult to get because they are rare in the wild, especially if the wild stocks are over-exploited. Sadly, the status of most wild stocks in Southeast Asia is even worse than that, as the profitable trade in live food fish has resulted in local extinction of most high-value grouper species. This means that most fish culture enterprises in Southeast Asia have to import their broodstock from remote areas in the Asia-Pacific, increasing the risk of importing diseases and of escaped fish genetically polluting local wild stocks. The broodstock kept in the fish culture project was collected from the Komodo area, so there is no risk of disease import and no risk of genetic pollution.

To produce 25 tons of fish, 2-7 million fertilized eggs are needed. As few as 2-4 females can produce this number of eggs yearly. The reason that the Komodo project maintains far more females (about 500) is to reduce the risk of inbreeding and to have enough reproducing females left in case of mortality or disease. Furthermore, the present broodstock will allow for up-scaling of the project.

Mouse grouper spawns monthly at night around new moon. Tiger grouper also spawns at night around new moon in the cages, during the rainy season (September / October - May). Note that the monitoring program of spawning aggregation sites in Komodo National Park indicates that tiger grouper in the wild spawn at full moon. Estuary grouper, sea bass and mangrove jack spawn at night about one week after full moon, during the rainy season (September / October - May).

Table 1. *Broodstock composition and size characteristics*

species	number		total weight (kg)	average length (cm)
	females	males		
estuary grouper	163	15	924.7	69.8
mouse grouper	36	8	77.1	49.5
tiger grouper	35	20	496.2	81.1
mangrove jack	228	40	720	57.8
sea bass	49	18	220.3	65.7
total	**511**	**101**	**2438.3**	

4. HATCHERY DEVELOPMENT

4.1 Hatchery site

A team of fish culture experts identified Loh Mbongi as a suitable location for development of a hatchery. Loh Mbongi (8º25'S; 119º52'E) is located on the Flores mainland, ca. 6 km North of Labuan Bajo. The Tahija Foundation owns the property and made it available to the fish culture project.

The property is situated in a sheltered cove with a sandy beach, bordered by undeveloped properties. The property is only accessible from the sea, there is no road connecting the property to the hinterland.

Extending about 80 m from the beach the sea bottom gently slopes to 3-5 m depth, featuring a sandy bottom with a seagrass community. The fringing coral reef beyond the shallows drops of to a depth of 15-25 m over a horizontal distance of ca. 3 m. The reef is damaged by blast fishing. Offshore, ca. 5 km from the beach is a string of patch reefs that protect the property from oceanic waves.

The total area of the property is 14 hectares, whereof the Western part comprises the fairly steep slopes of the hills that surround the cove (Fig. 2). The bottom of the Eastern flat part comprises 1-50 cm of sand on top of a layer with a black sand-clay mixture. The water table is 0 to 0.5 meters below the surface. The southern part of the property is a lowland area with some mangrove trees that floods after heavy rains. A well is constructed on the Southwestern section of the property. The hill slopes, consisting of clayey soils and rocky outcrops, are stabilized by shrubs and cannot be used for construction. Construction in the lower, wetter areas can only be done after landfill with sand. The hatchery, toilets, kitchen and living quarters have to be located about 100 m inland for organic waste and wastewater management.

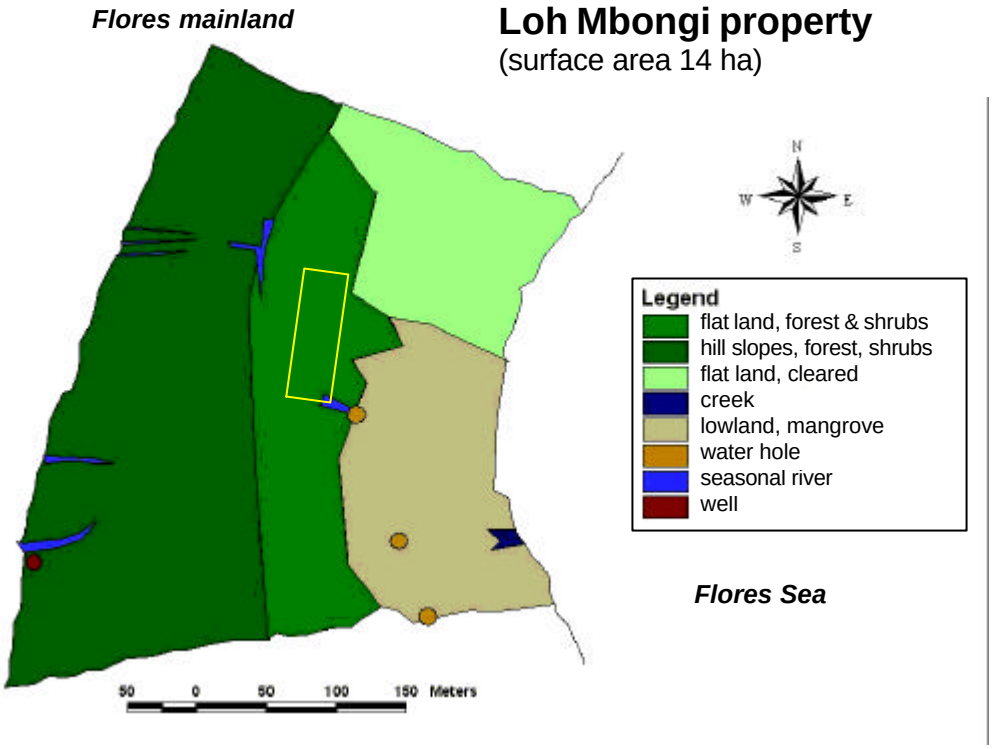


***Figure 2**. Loh Mbongi. The yellow rectangle depicts the proposed construction site for the hatchery complex (see Fig. 3a). Note that rivers are not completely mapped.*

4.2 Hatchery design

A modular system is designed for easy replication when scaling up the capacity of the system and to ensure safety features for the workers and fish health considerations. An aquacultural wastewater treatment system is installed to reduce loading of organic waste and nutrient prior to discharge. The treated water can possibly be re-used for the hatchery operation and for by-product production. Rain water will be channeled to storage tanks near each building (not shown yet in the plans). The roof of a unit is made of polycarbonate when sunlight is essential. Polycarbonate is very durable and transparent for day / night cycle. When necessary, shade cloth will be used to obtain a desired light transmission. Concrete tile roofing is recommended for other buildings. Zinc roofing will not be used for rain water collection because zinc is toxic. Asbestos as a building material will not be used because it is hazardous to humans.

Flooring is of concrete. A water proof sealant (non-toxic) will be used for the floor. Where appropriate, higher strength reinforced concrete will be used for better support of heavy weight on the floor (e.g. large tanks in the nursery). Appropriate reinforced footings and piling may be required for some buildings. The topography map indicates that buildings can be constructed in certain areas and topography will

determine the lay-out of the hatchery infrastructure and preference of materials. This is an engineering question.

Ground plan of the hatchery complex (Fig. 3a)

The wastewater treatment system is more than 100 m from the beach and the treated water discharges into the lowland mangrove area. A ring road runs along the periphery of the hatchery. A perimeter fence is built as security. The proposed construction site is depicted in Fig. 2.

Algae / Rotifer culture (Fig. 3b)

Presently, 9 algae / rotifer culture tanks are planned. For up-scaling, more algae / rotifer tanks can be added. There is no roofing. All the preparations will be done in the algae laboratory (cf. Fig. 3c).

Algae laboratory/storage/workshop/feed processing (Fig. 3c)

The multiple-purpose facility is an enclosed building with concrete flooring, walls and roof tiles. Algae, rotifer and other live feed stocks are kept and maintained in the lab. An algae reservoir stores algae prior to transfer to rotifer tanks. The feed storage room is air-conditioned for storage of dry formulated feeds and raw ingredients. The feed processing room consists of freezers and feed processing equipment. Wet feeds, trash fish and other moist ingredients are kept in freezers. The workshop functions as a handyman workshop. It stores all the equipment and tools for handywork and servicing and maintenance of equipment.

Larval & nursery culture (Fig. 3d)

The design consists of 2 separate units, each with a similar set of tanks and layout. A common roof of polycarbonate covers both units. The larval tank is enclosed by walls while the nursery unit is not serviced by a common facility.

Wastewater treatment (Fig. 3e)

The wastewater concept uses a zig-zag water flow system. Some of the heavy particles can be mechanically removed and processed as organic fertilizer prior to discharge into the treatment system. The concept includes the production of a by-product(s). Some of the water can also be channelled for seaweed production as a technique to remove nutrients prior to discharge into the sea. When the quality of the treated water is good enough, it can be reused.

Reservoir (freshwater) (Fig. 3f)

A tank of 6 sections is used for storage of rain water and well water. It has a capacity of 24 tonnes of water. A pressure pump will supply water on demand. This design can be easily replicated for location at strategic positions and for seawater storage.

Generator house (Fig. 3g)

A 24-hour supply of electricity is required for the premises. A set of two generators, alternating on a 12-hour shift, will be dedicated to supply electricity for the pumps and blowers. There is also a stand-by generator. Smaller capacity generators will be used for the housing facility and general lighting. The housing should address heat displacement and noise issues. Any oil spills will enter a sump and is trapped in the sump.

Seawater pump shed (Fig. 3h)

The pump shed houses 3 pumps. Two pumps will alternate with each other. One pump is on standby. The seawater is filtered through a pressure sand filter prior to supplying the hatchery. Presently, a seawater reservoir is not needed. The housing should address heat displacement and noise issues. Any oil spills will enter a sump and is trapped in the sump.

Sedimentation trap

The sedimentation trap functions as a means to trap run-off water. The main source of this water will be rain. The sedimentation trap is a ditch that runs parallel with the beach, about 2 meters inland from the spring tide water level and the periphery of the lake. The ditch is 1 meter wide and 0.5 meter deep.

Perimeter fence

A perimeter fence encloses the seawater pump shed, the well, and the freshwater reservoir. Metal mesh is used as fencing material.

Jetty

A wooden jetty will be constructed to facilitate loading and unloading of cargo vessels.

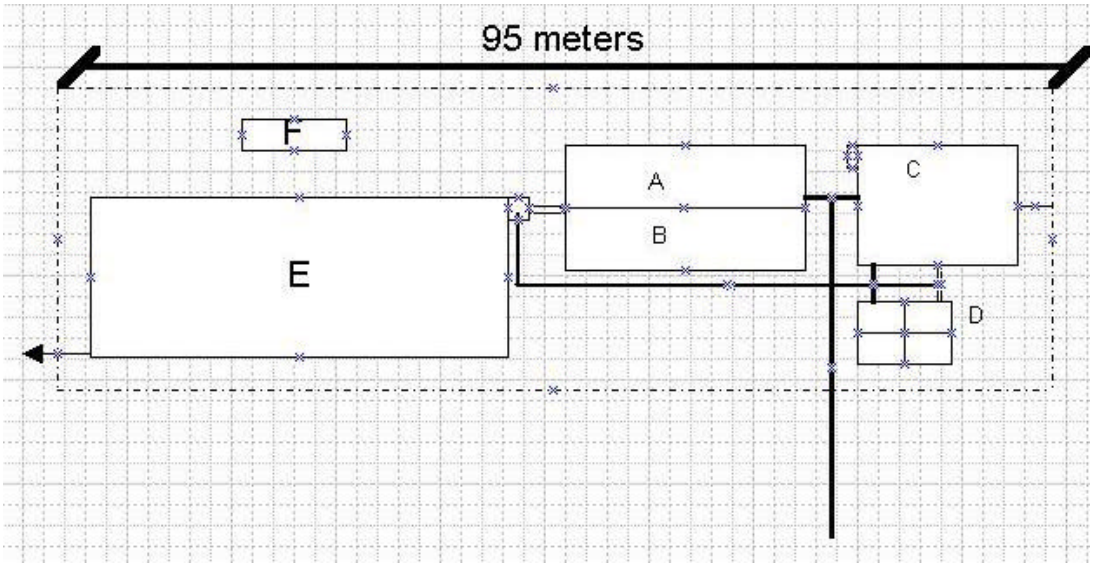


Figure 3a. *Diagrammatic plan for hatchery complex, Loh Mbongi (A=larvae culture; B=nursery; c=algae/rotifer tank; D=laboratory/storage/workshop/feed processing; E=wastewater treatment; F=generator plant)*

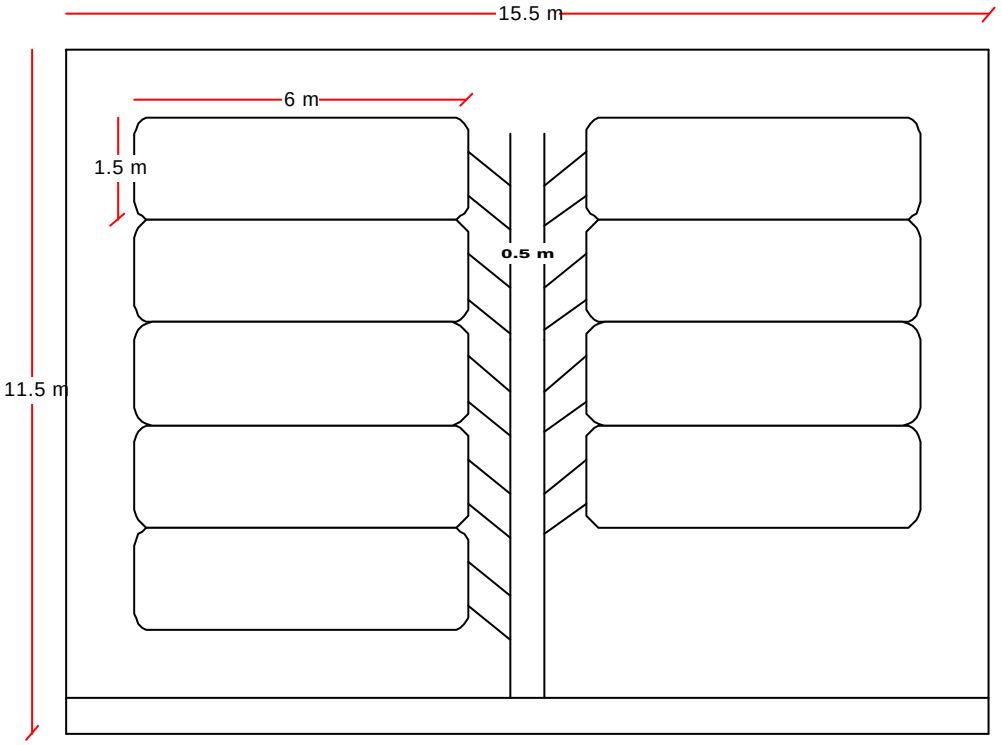


Figure 3b*. Algae and rotifer culture complex.*

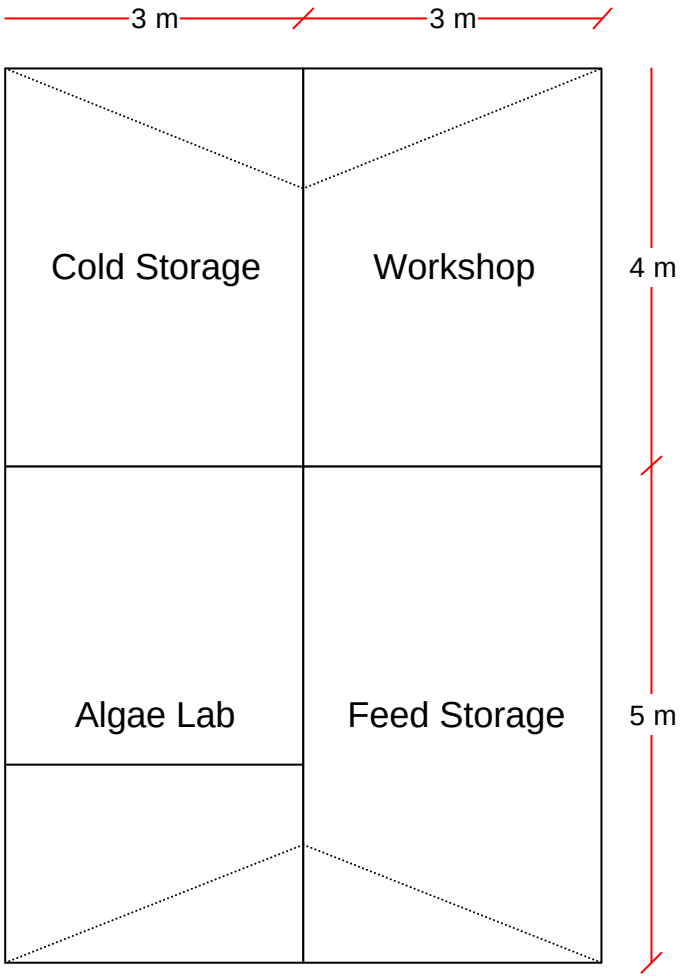


Figure 3c. *Algae laboratory/storage/workshop/feed processing*

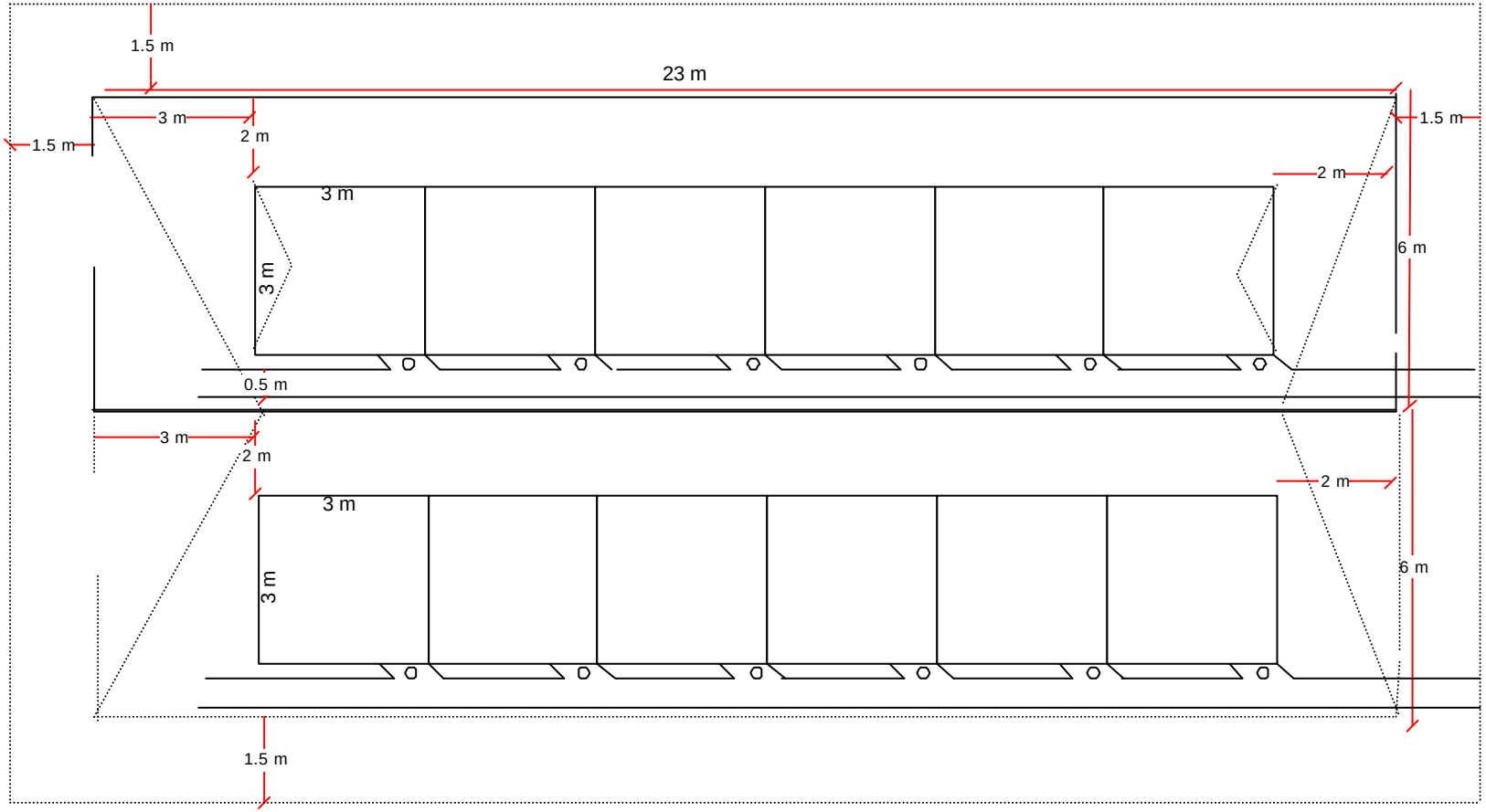


***Figure 3d**. Larvae & nursery culture.*

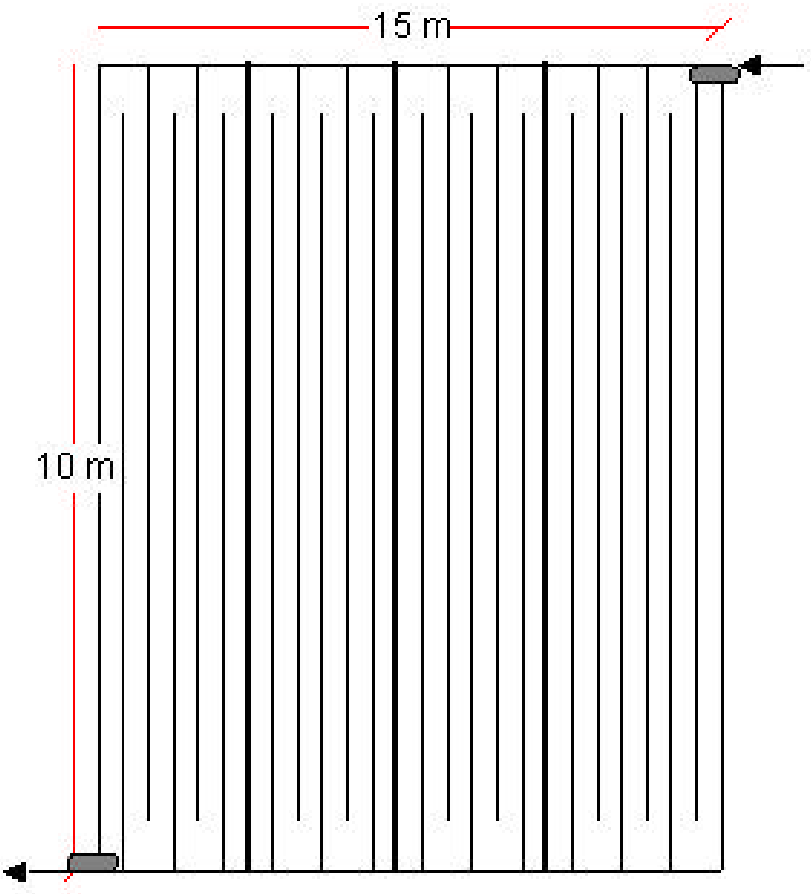


***Figure 3e**. Wastewater treatment.*

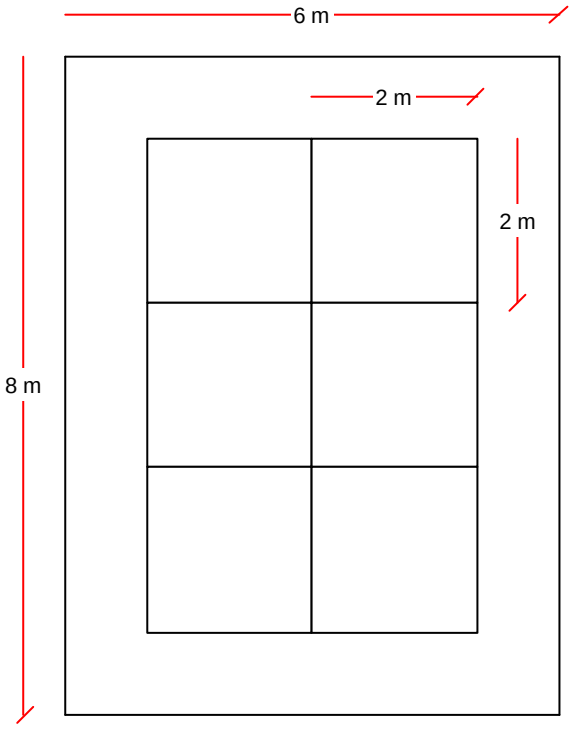


***Figure 3f**. Freshwater reservoir.*

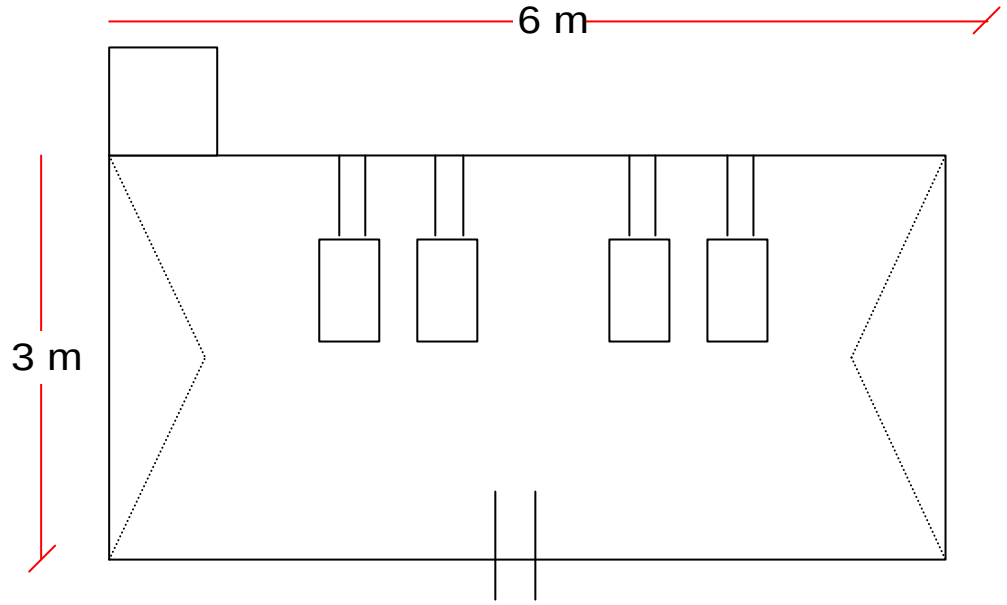


***Figure 3g**. Generator house.*

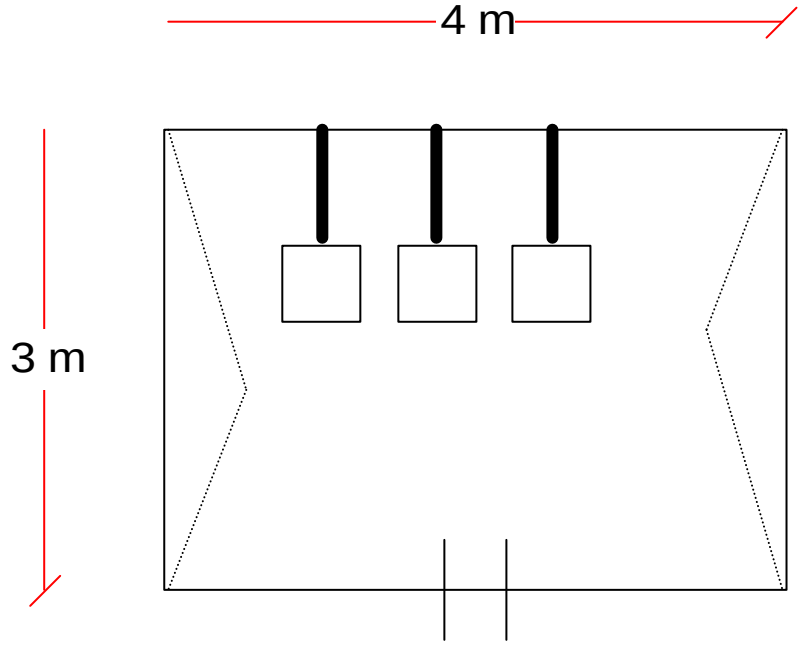


***Figure 3h**. Seawater pump shed.*

4.4 Housing facilities

The housing facilities consist of an office building, mess, dormitory and a bungalow. The presentation of these buildings will be reminiscent of the style of the region Manggarai. However, the roofing will consists of tiling for collection of rain water. Buildings will be raised from the ground when applicable. These buildings will be separated from the hatchery complex. The office building and mess are situated between the hatchery complex and the personnel living quarters. Meals will be provided for the personnel on duty in the mess.

Office (Fig. 4a)

The office has an area of 10 m x 6 m, built of concrete with tile roofing. The floor is concrete. The office will house all the administrative functions. It has a meeting room, functioning as a multipurpose room. The meeting room contains basic furniture, chairs and tables, white boards and electrical points for audio-visual aids. It has a room with a computer. The other space represents the general operations area.

Mess (Fig. 4b)

The mess has an area of 10 x 8 m, built of wood with tile roofing. The floor is concrete. It consists of a kitchen and a dining hall. The Kitchen will have an enclosed area with wooden walls, representing a store for food and kitchen utensils. The cooking area is an airy area with a wall of semi-clad zinc sheets only. The dining hall will have a semi-clad plywood board on one wall only while all the other walls will be exposed to capture the scenic view of the bay. All the meals are served in the dining hall. The dining area consists of long tables and long benches only.

Public convenience

The public convenience is situated in a central position between the hatchery complex and the office and mess buildings. It will consist of separate conveniences for men and ladies.

Bungalow (Fig. 4c)

The bungalow has an area of 9 x 8.5 m, built of concrete with tile roofing. The floor is concrete. There will be one unit, for the manager of the project. This bungalow consists of 2 bedrooms, lounge, dining, kitchen and bathroom/toilet. There will be a backyard of 8.5 x 15 m.

Dormitory (Fig. 4d)

The dormitory has an area of 18 x 7.5 m, built of wood with tile roofing. It has a wooden floor. The building is raised on stilts about 2 m above the ground level, providing space below for storage and a sheltered games area. The building will have features reminiscent of the region. The dormitory is a long house consisting of 4 attached units with a common verandah and utilities (toilets, bathrooms, laundry). Each unit consists of 2 double-decker beds, wash basin, cupboards, study desk and

chairs. There is a common backyard for drying clothes. Men and ladies will have separate toilets and bathrooms. The dormitory will house stay-in personnel, students and guests. Dormitory residents are expected to take all their meals at the mess.

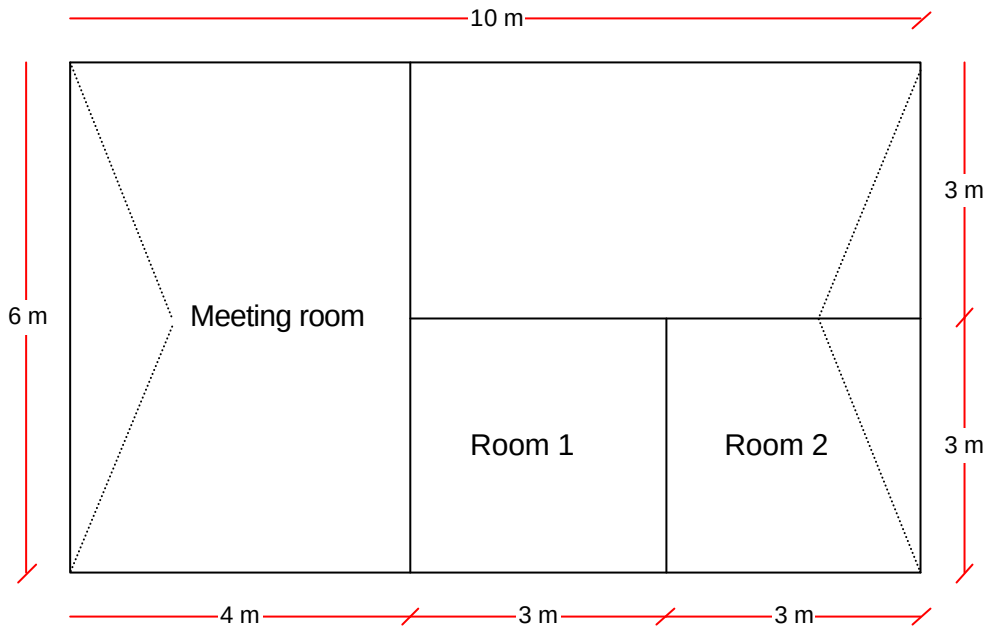


***Figure 4a**. Office building.*

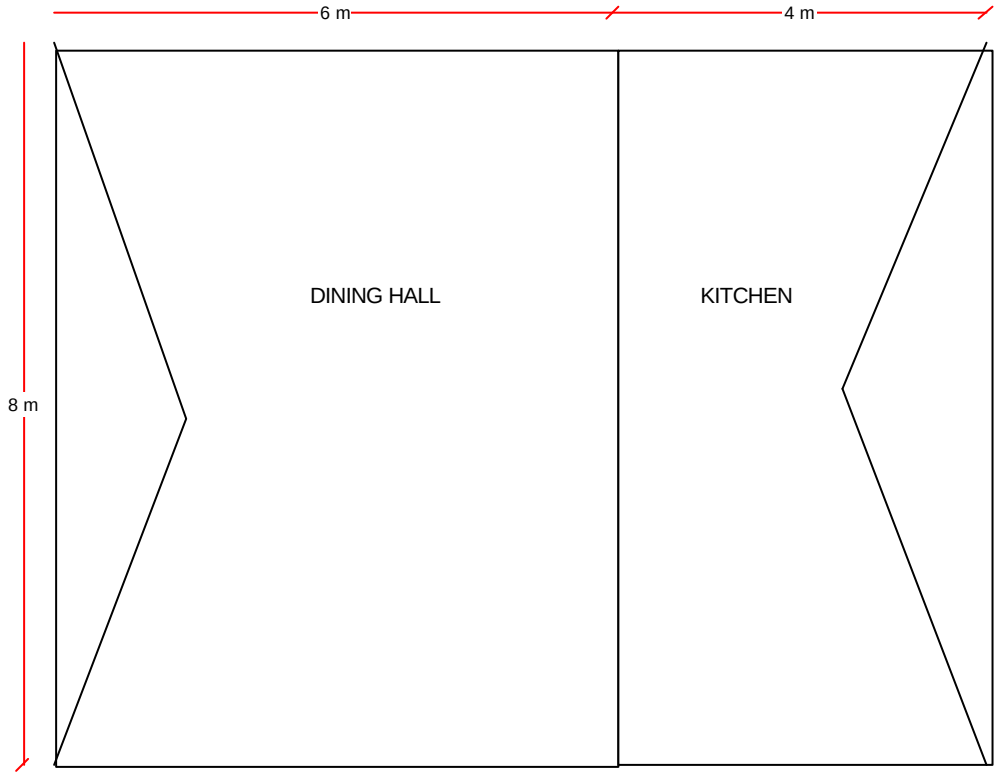
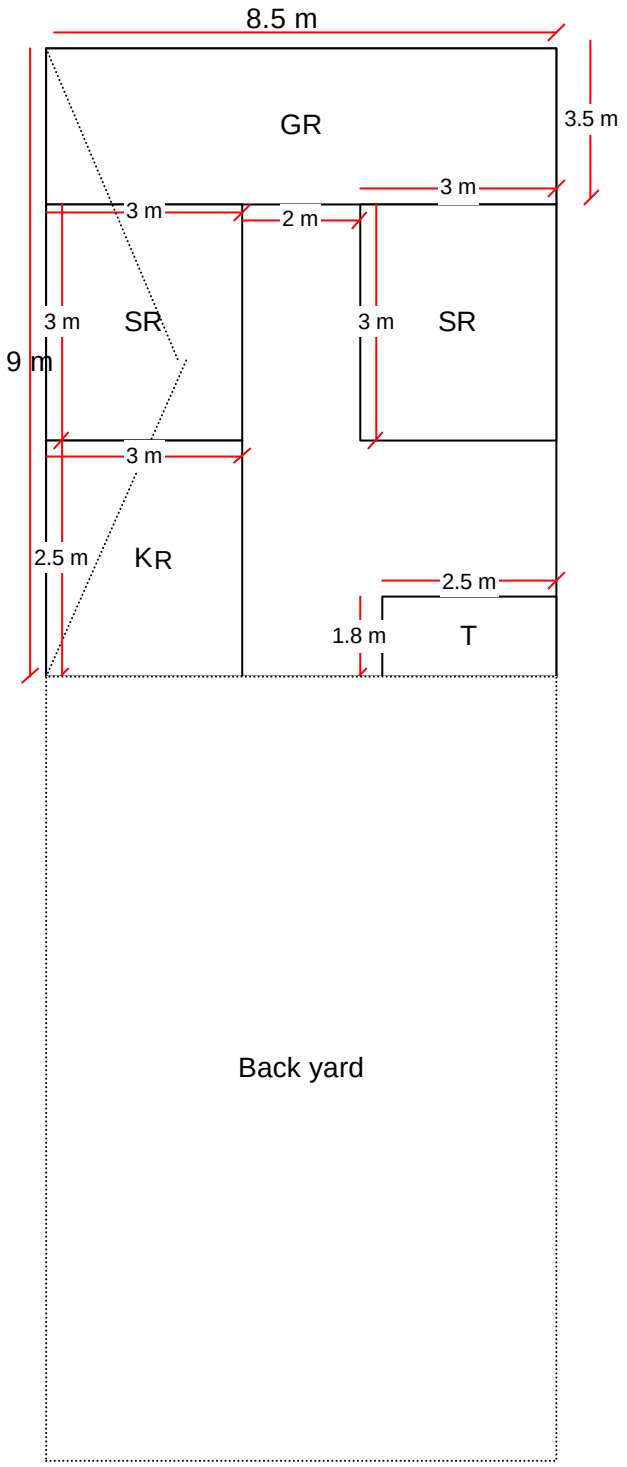


***Figure 4b**. Mess.*



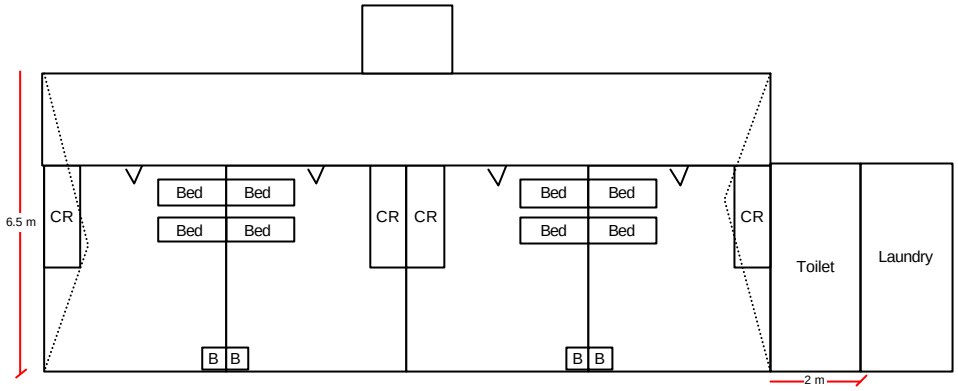
GR Lounge

SR Sleeping Room

KR Kitchen

T Toilet/Bathroom

***Figure 4c**. Bungalow*



Note:

CR : Cupboard

B : Basin

***Figure 4d**. Dormitory*

5. GROW-OUT

Grow-out scenarios, together with stocking densities are summarized in Fig. 5a-d. These scenarios provide more detail on the development from the fingerlings to marketable fish (cf. stages III and IV in Fig. 3). The fish have to be constantly graded according to size to prevent aggressive behavior of larger fish to smaller fish in the same cage. Furthermore, fish have to be shifted from smaller cages to larger cages as they grow. The grow-out plans are examples only, and they assume a production of 25 tons *per species* per year, to be realized by 4 grow-out units (Fig. 6). In reality, production of *all species combined* will be 25 tons per year. This implicates that in practice *for each species* less than three batches of fingerlings per year, or less than 28,000 fingerlings per batch will be forwarded to the grow-out farms. This lesser amount will be compensated by grow-out of more species during one year. The exact species mix will depend on hatchery practicalities, needs for training in grow-out practices, and market forces. Note that the grow-out phase for a single batch of fish may take less or more than one year; the annual production of 25 tons is attained by putting in more batches and by setting the number of fingerlings per batch at an appropriate level.

The grow-out units are staffed with each 6 persons for day-to-day activities (feeding, net cleaning, grading of fish, maintenance, etc.). Each unit will produce 3-4 harvests per year. Stocking densities, especially for the faster growing species, are planned to be fairly conservative, to minimize the risk of disease and to minimize usage of fish pharmaceuticals.

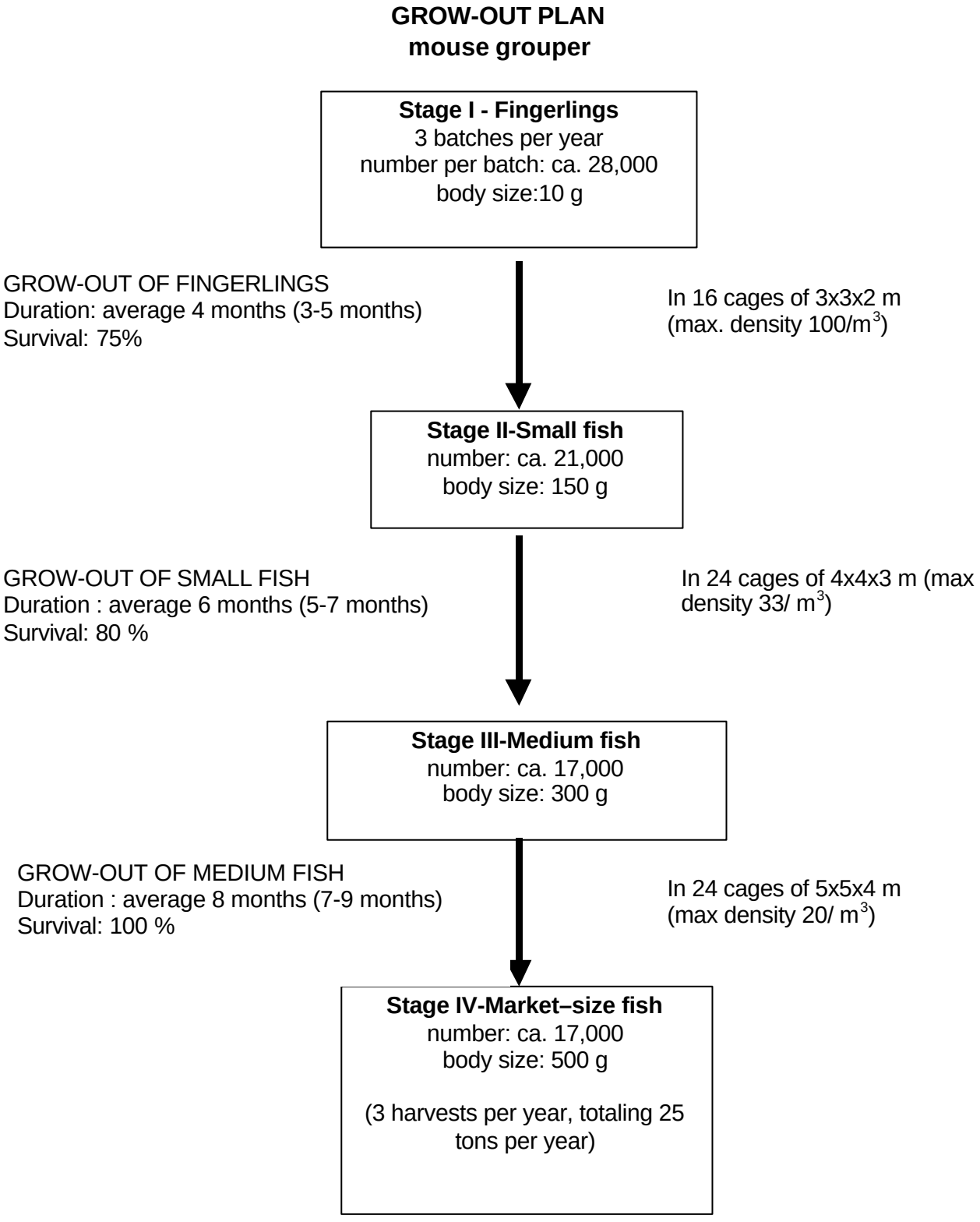


Figure 5a. *Grow-out plan for mouse grouper (*Cromileptes altivelis*).*

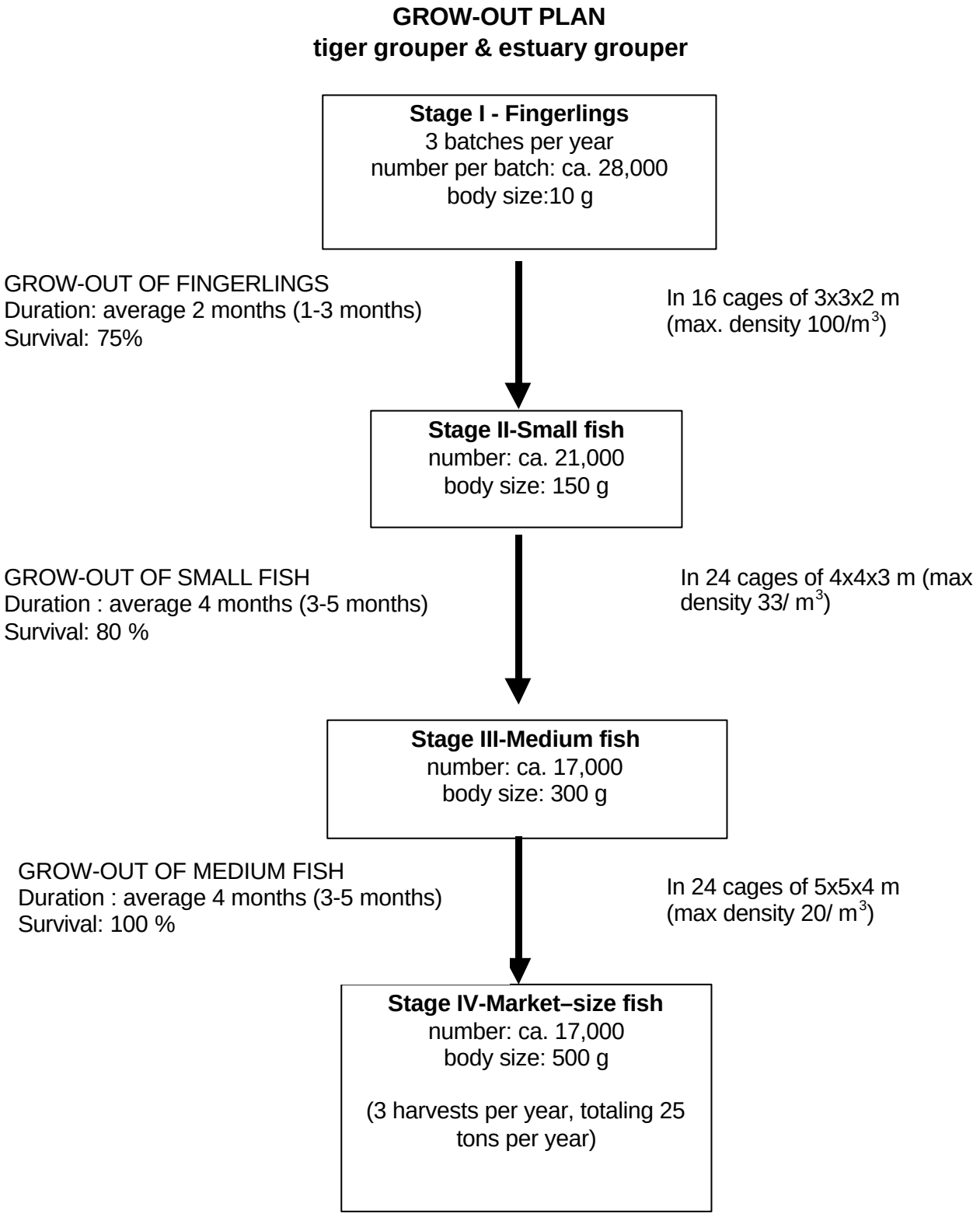


Figure 5b. *Grow-out plan for tiger grouper* Epinephelus fuscoguttatus *and estuary grouper* E. coioides

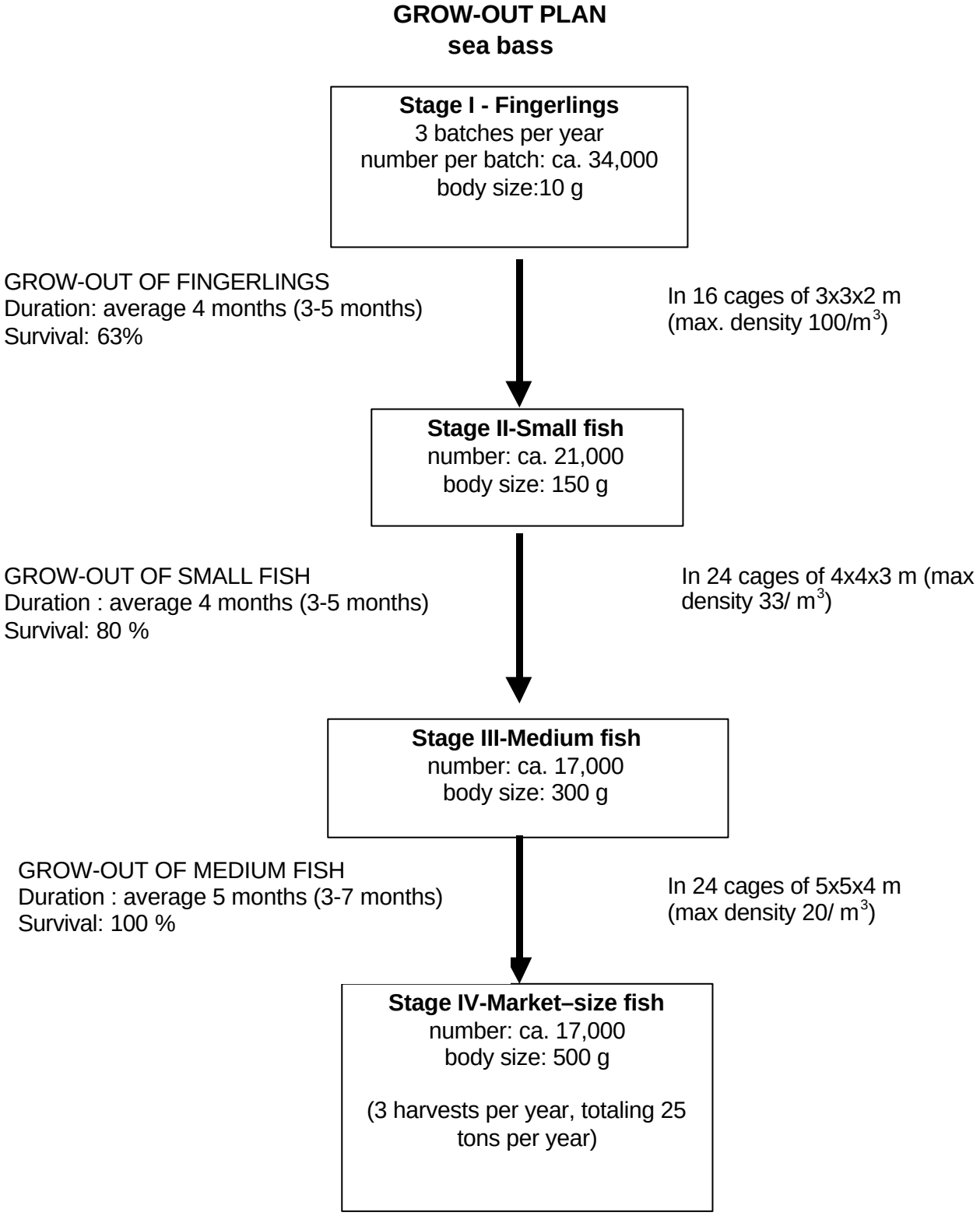


Figure 5c. *Grow-out plan for sea bass (*Lates calcarifer*).*

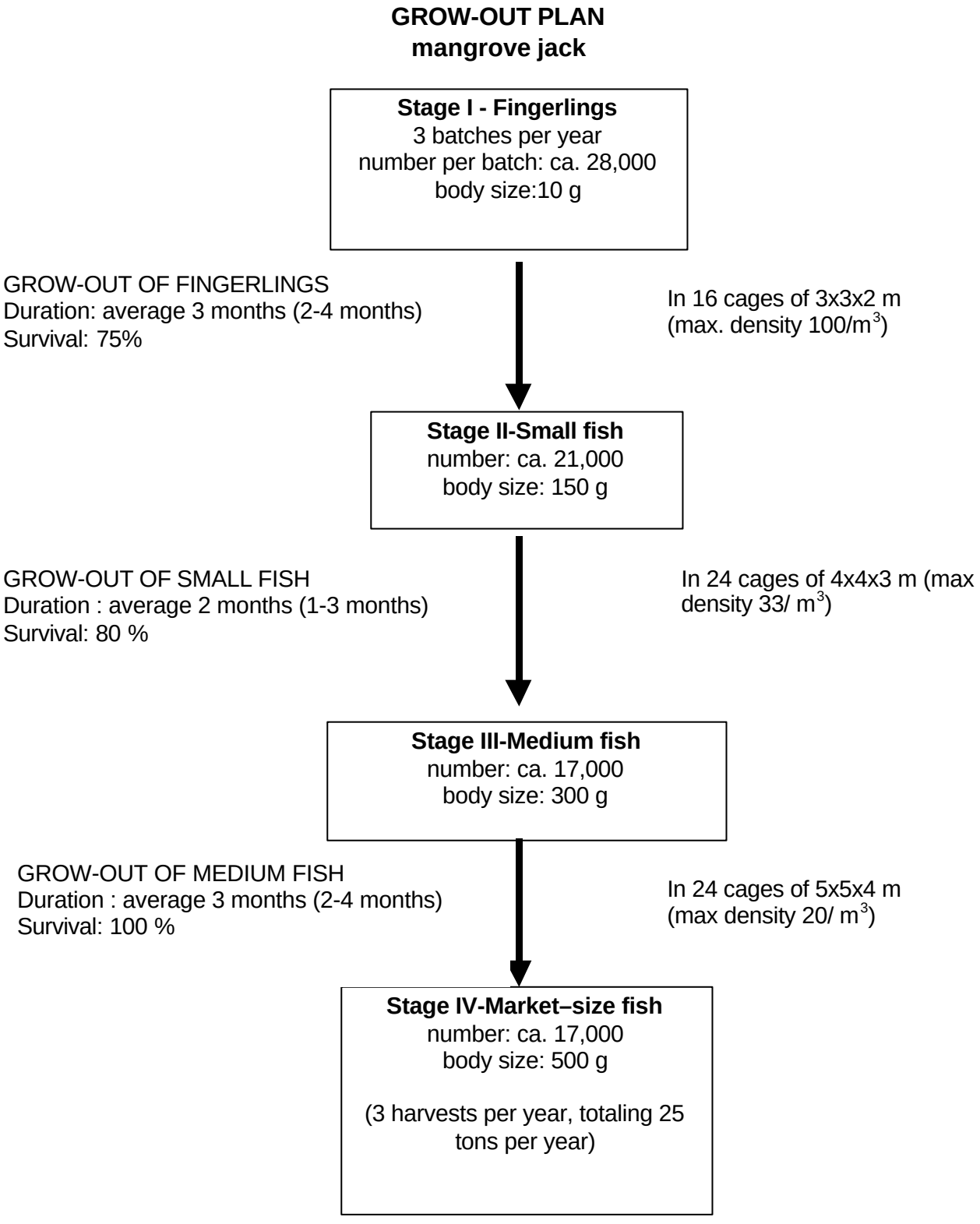


Figure 5d. *Grow-out plan for mangrove jack (*Lutjanus argentimaculatus*).*

GROW-OUT CAGES

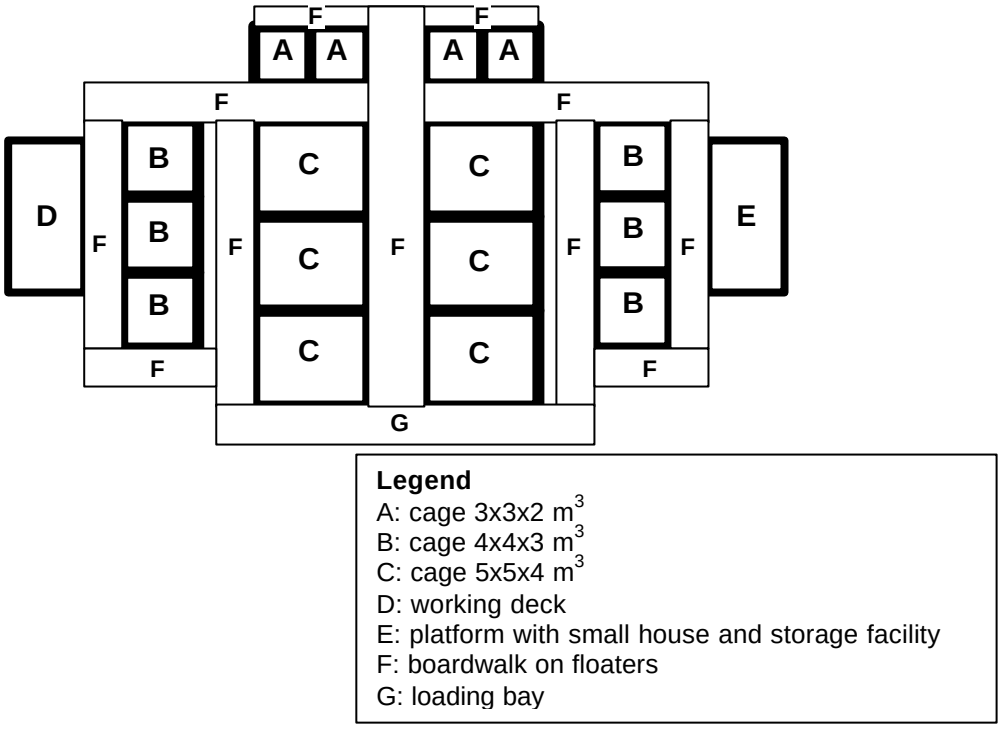


***Figure 6**. One unit of grow-out cages, top view. Surface area: 34 * 24 meters.*

6. ENVIRONMENTAL IMPACT ASSESSMENT

Two types of Environmental Impact Assessments (EIA) are required for the fish culture project: (1) an EIA for the hatchery and adjacent waters and (2) an EIA for grow-out in waters around Komodo National Park and possibly for grow-out in multiple use zones adjacent to selected villages inside Komodo National Park.

6.1 EIA for the hatchery complex in Loh Mbongi

The EIA (in Indonesia known as Analisis Mengenai Dampak Lingkungan Hidup or AMDAL) for the hatchery complex is required under the authority of Bapedalda of the kabupaten Manggarai (Manggarai regency) and the Bupati of Manggarai Regency. For the AMDAL, a report known as UKL/UPL (Upaya Kelayakan Lingkungan, Environmental Feasibility Report / Upaya Pengendalian Lingkungan, Environmental Assessment Report) will be prepared. The EIA will actually assess two aspects of the hatchery complex separately: land/water use and the jetty. The EIA encompasses air quality, noise, water quality, terrestrial and marine biology, social-economics, and social-cultural-health issues. The agency implementing the EIA is Universitas Nusa Cendana, Pusat Penelitian Lingkungan Hidup dan Sumberdaya Alam; leading consultant is Ir. I.W. Mudita MSc. The total cost of the EIA is Rp 50,800,000, and the final report of the EIA will be completed on August 28 2001.

6.2 EIA for grow-out

Inside the Park, a thorough EIA is required as is stipulated in Book 1 of the 25 Year Master Plan for Management of Komodo National Park:

> *p. 47*: 'Mariculture or keeping of live fish may be allowed for inhabitants of the Traditional Settlement Zones of the Park, dependent upon the favorable outcome of an environmental impact and carrying capacity assessment and approval from the Head of the Park.'
>
> *p. 66*: 'Environmental impact assessments (EIA) should be carried out before the establishment of any mariculture operation. Any type of mariculture should be developed slowly and the effects on the environment should be monitored carefully. Any licenses for mariculture should be withdrawn if the effects of the culture system prove to be harmful to the environment. The grow-out of wild-caught juvenile fish should not be allowed in Komodo National Park or its buffer-zone since this will lead to increased pressure on the sedentary resources. Only the grow-out of hatchery reared juvenile animals should be permitted in the Traditional Use Zones and Buffer Zones of the Park'.

Currently, only a license from the fisheries department (Dinas Perikanan) is required for grow-out in fish cages outside Komodo National Park. However, EIA requirements may be imposed if a coastal zone development program, currently being studied by the kabupaten Manggarai comes into effect. See also the following excerpt from Book 1 of the 25 Year Master Plan for Management of Komodo National Park:

> *p. 69*. 'Recommendations to incorporate Park management in the development of surrounding areas: … Develop sustainable fisheries by creating alternative harvest centers outside the park for pelagic fisheries, actively supporting mariculture initiatives when recommended by proper EIA, and establishing community training programs on fisheries post harvest techniques.'

It is envisioned that most of the grow-out will take place in the buffer zones and the waters surrounding the Park. The hatchery enterprise will impose restrictions for fish farms that want to obtain fingerlings for grow-out. The restrictions will be based on EIA and carrying capacity studies, to be implemented by the pilot project. These studies will show which production levels can be sustained in dependency of the physical and ecological characteristics of the area where the cages will be deployed.

Under authority of the Komodo National Park management body, carrying capacity studies for various uses (incl. fish culture) inside the Park will be initiated in 2001. Based on carrying capacity studies, requirements for EIAs will be compiled by the management body, and the fish culture project will then conduct an EIA according to these requirements. The EIA will take place before implementation of the grow-out phase. Other institutions or companies that plan to develop fish culture will have to adhere to the same EIA requirements.

Carrying capacity studies may be carried out together with the following institutions: University of Rhode Island, Queensland Dept. of Primary Industries, Gondol Research Station for Coastal Fisheries, the Network of Aquaculture Centers in Asia, the South Australian Research & Development Institute.

A rough estimate of the carrying capacity for fish culture in the traditional use zones *inside* the Park can be derived from the surface area of the suitable waters and of the grow-out units. The surface area of the Marine Traditional Use Zone is ca. 16,000 ha, whereof an estimated 5% is suitable for deployment of fish cages. The surface area of a 25 ton per year grow-out unit is 0.082 ha. Obviously, the suitable area cannot be carpeted with grow-out units as this would create problems with organic waste, even if fish densities in the cages are kept low. (The value for the percentage of available area that can but used sustainably will actually be the object of carrying capacity studies). Taking a precautionary approach and setting this value low, at say 1%, still a considerable carrying capacity would result: ca. 2,500 tons of fish per year (or about 10% of the total volume of the live reef fish trade in the nineties). Because of the larger surface area, the carrying capacity of the waters *around* the Park, where most of the grow-out will take place, is obviously up to orders of magnitude higher.

7. PROJECT STAFFING

Within the confines of each level in the staffing structure of the fish culture project (manager, coordinator, officer, assistants and support staff), personnel will become multi-skilled and knowledgeable in fish culture as required. Personnel is encouraged to develop capabilities as required for a higher level too. This approach makes movements of personnel more feasible and facilitates support for tasks requiring extra assistance at any particular time. When operating portfolios are documented and easily accessible, each personnel present will be able to carry out a specified job function professionally.

7.1 Organizational structure

The organization of the fish culture personnel is shown in Fig. 7. The existing fish culture personnel consist of a manager, 2 coordinators, 3 officers, 4 assistants and 2 support staff (boat drivers). Vacant positions exist for 6 fish culture assistants and 5 support staff for the fiscal year 2002 (Table 2). The assistants and support staff will be employed from participating villages for training in grow-out culture and related activities. The fish culture assistants will be trained to be multi-skilled personnel for independent operation of a grow-out farm as a livelihood. They will be operating the sea cage culture experiment in Loh Mbongi and work on the broodstock cages as part of their itinerary. The goal for this group of assistants is to become the operators of the first village based grow-out farm by July 2003.

A total of 24 assistants will need to be trained to run the 4 village-based grow-out farms, which need 6 operators each, and which will be established between July 2002 and June 2003. For the fiscal year 2003, there is a vacancy for 1 officer and 18 mariculture assistants, which will be recruited as again as trainees. These new recruits will again be sourced from participating with the objective to become operators of the remaining 3 grow-out farms. A mariculture assistant will initially work and study “hands-on” as trainee in the program for 6 months.

For all trainees, board and lodging will be provided “on-site” at Loh Mbongi. During the internship period as trainees, he/she should not be paid at the same rate as the presently employed mariculture assistants. Preferably, a trainee should get a token allowance for incidentals. A trainee will be allowed to go back to his/her village once a month with free passage and goodwill money. Going back for weekends once a month is part of acclimatization towards a very different livelihood. The goodwill money is a local custom and a display of achievement when he goes back to his/her village. The goodwill money would act as an incentive for future participants. When the internship is completed, the trainee will become a multi-skilled mariculture assistant. The salary will then be that of a mariculture assistant, depending on seniority. These mariculture assistants will become sea cage operators when cages become operational and as the sea cage culture program expands.

The support personnel consist of transport staff, security-caretaker-gardener and cook. Support personnel vacancies exist for 2 security-caretaker-gardener and 2 cooks. The transport staff will drive the boats and carry out maintenance and engine service for the boat. There is a vacancy for 1 boat crew when management acquires another boat. The transport staff is expected to do maintenance and general service works for the pumps, blowers and generators too. A security personnel is required to carry out security vigilance of the property and carry out care taking and gardening duties. The security position is described as security-caretaker-gardener. Two cooks will prepare meals for all the personnel 'on-site' All personnel will carry out administrative duties like inventory management, purchasing procedures and take charge of a particular infrastructure like workshop and laboratory. All personnel will maintain daily written records of biodata in log books.

Current Terms of References (TOR) of mariculture staff presently employed by The Conservancy are included in Annex 1, whereas proposed TOR are included in Annex 2. Proposed TORs are amended from the current TOR, and still need to be approved by the human resources department of The Nature Conservancy. Once approved, the proposed TOR will come in effect upon extension of contracts and follow-up by the mariculture manager and his supervisor with TNC's HR units.

7.2 Supplementary skills & qualifications, training

All mariculture personnel is required to develop and acquire skills that are basic to mariculture operations. These skills cover feeding schedules, fish health, biodata monitoring, water management procedures plus skills for operation and maintenance of scientific equipment, pumps, motors, wood/metal/glass/fiberglass work, general operation of relay systems for generators, pumps & blowers. Duties include general maintenance of cleanliness of the infrastructure environment and procedures pertinent to occupational health and safety (Human) and fish health guidelines.

These skills will be acquired predominantly through "hands-on" experience and in-house training. When necessary, trainers (e.g. generator mechanic) will be contracted to train personnel in the premises. When exchange schemes become available for short courses, personnel can be sent on an exchange scheme. The first exchange program to take effect will be the AUSAID funded exchange between staff of the Komodo Mariculture Project, the Queensland Dept. of Primary Industries (QDPI) and the Gondol Research Institute, as part of the Australia – Indonesia Government Sector Linkages Program.

7.3 Contractors for short-term technical support

The following contractors can be classified under this category:

a. Electrical / Civil / mechanical Engineer
b. Certified Plumber

c. Metal / Wood / Plastic / Cement fabricator
d. Computer equipment, include internet
e. Communications Equipment

The complex will be run on back-up systems, spare parts stock and duplication. Personnel training for maintenance will be part of the purchase contract for a particular equipment. For major equipment, a 3-year warranty is required to cover all faults e.g. generator. Mariculture personnel will service and maintain the equipment. For all major problems, it will be covered under the warranty. On expiry of the warranty, a qualified mechanic will be called for repairs. Alternatively, an extended warranty is made with the dealer or a contract established with a service provider.

As an illustration, there will be 2 sets of generators. One set will be operated on a daily basis. When there is a mechanical failure, the 2nd set will operate. Mariculture personnel will solve the problem or make arrangements to repair the failed generator. This mode of operation removes the need to hire 2 mechanics on a full time basis.

7.4. Liaison and cooperation with principal partners and local bodies

The mariculture project is commited to work in close collaboration with its principal partners (Taman National Komodo, QDPI Fisheries, Gondol Research Centre) and local bodies (NGOs, local government, fisheries, associations) and as an integrated R&D program within the alternative livelihoods module implemented by TNC's Komodo Field Office. The project will therefore assign a coordinator and one officer to liaise with intended parties. The manager will coordinate the assigned personnel and attend such meetings as deemed applicable. The duties of the 2 assigned personnel are as follows:

Coordinator

The coordinator will attend the meetings and express the views of the Komodo Mariculture Project (KMP) and report to KMP management on all outcomes.

Officer

The officer will function as a secretary taking notes and maintenance of a file of all outcomes. The officer will assist the coordinator to prepare a summary of outcomes and file the reports.

7.5 Salary budget

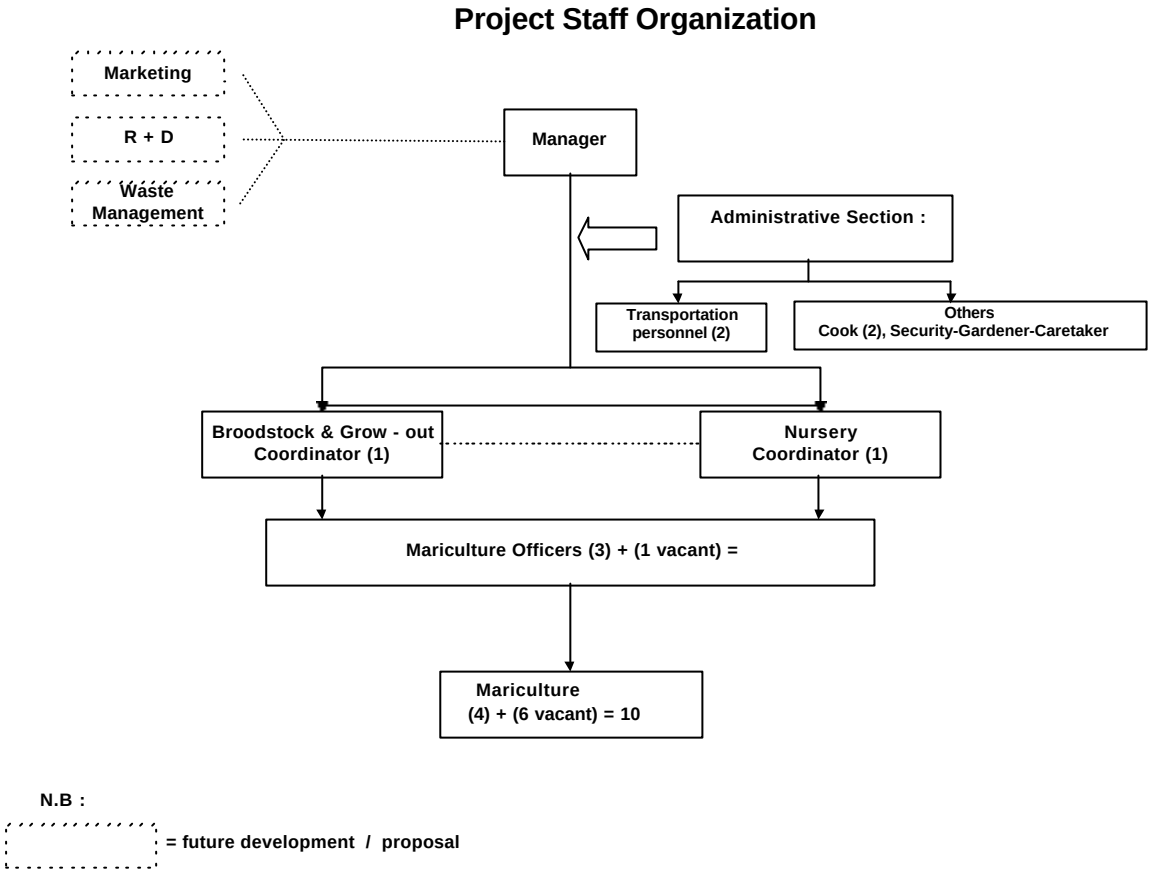


Figure 7. *Staffing plan fish culture project*

8. PROJECT IMPLEMENTATION SCHEDULE

Table 3 shows the scheme of events and time duration for each event. The planning is based on the fiscal year, FY02 (1st July 2001 to 30 June 2002) and FY03 (1st July 2002 to 30 June 2003).

Table 3. *Starting dates, completion dates of activities for the fiscal years 02 and 03.*

SPECIFICATIONS	**START DATE**	**COMPLETION DATE**
FISCAL YEAR 2002 (1st July 2001 to 30 June 2002)		
Jetty	May 2001	Early August 2001
GPS mapping (KFO personnel)	May 2001	May 2001
EIA (Universitas Nusa Cendana)	June 2001	Late August 2001
Engineering report	July 2001	July 2001
Construction of Buildings	July 2001	January 2002
Fingerling production of fish	February 2002	-
FISCAL YEAR 2003 (1st July 2002 to 30 June 2003)		
Grow-out in village-based fish cages	July 2002	-
Sales of marketable fish	April 2003	-
Review of Pilot Project and Business Plan for Privatization and Up-Scaling of Pilot to 200 tons Enterprise	April 2003	June 2003

9. UPSCALING PLAN

9.1 Capacity, Up-scaling and Carrying capacity

The premises where the hatchery is being constructed, Loh Mbongi, will allow for up-scaling of the fingerling production to a level where it can support a 200 ton per year grow-out enterprise. Unless landfill is applied, the Loh Mbongi hatchery cannot expand beyond a capacity that can support a 200-ton per year grow-out enterprise. The land area presently suitable for construction is the 'flat lands' depicted in Fig. 2. With landfills applied in the lowland area, it is expected that the capacity of the Loh Mbangi site could be further increased to a hatchery supporting grow-out farms with a combained capacity of around 300 tons. For further increases it would be advisable to look at other locations (land) in the areas of West Flores or East Sumbawa.

Presently, the hatchery is dimensioned to support a 25 ton per year grow-out enterprise. It is expected that up-scaling to 200 tons capacity will be needed to achieve economy of scale and business profitability. Up-scaling will only take place after evaluation of the 25-ton pilot project, only after control systems have been designed that ensure environmental sustainability, and only if a business partner can be found who is willing to invest in the up-scaling of the fish culture enterprise.

The investments needed for up-scaling to 200 tons will be beyond the budget of this project and a suitable business partner / private investor will therefore be attracted. Between April and July 2003 the pilot project will be evaluated and a revised mariculture business plan will be developed for upscaling to a 200 ton enterprise. These evaluation and revised business plan documents will be used in discussions with potential business partners. The business plan has to address the question whether upscaling should be done from 25 to 200 tons at once or that an intermediate step of a 100 tons enterprise would be more strategic.

A hatchery producing ca. 1 million fingerlings of 10 g body weight each can support a grow-out enterprise with a yearly production of 200 tons. The expected amount of organic waste from such a hatchery is less than 10,000 kg per year. Possibly, about 50% can be mechanically removed and re-used as particulate organic fertilizer, leaving an organic waste concentration of 5 mg/L assuming that the effluent will amount to 1 million m^3. Assuming that a major part of the 5 mg/L will comprise of suspended solids, this concentration can be compared to published standards.

Table 4 shows the standards as developed by the Aquaculture and Aquatic Resources Management Program, Asian Institute of Technology. The standards are based on the assumption that the effluent flow will be diluted at least 8 times in the receiving water. The published 'not-to-exceed' value for suspended solids in coastal waters 100 mg / L. This is well above the estimated concentration of the effluent of the upscaled hatchery. Loh Mbongi Bay is about 10 ha, and on average about 15 m depth. The flush rate is unknown, but a very conservative estimate would be once

per month (the flush rate in reality is probably much higher). Hence, a minimum estimate for the total volume wherein the effluent is discharged amounts to 10 (ha) * 10,000 (surface area of 1 ha in m^2) * 15 (m depth) * 12 (times flushed per year) = 18 million m^3. It follows that the effluent of the upscaled hatchery will remain well within standards, both in respect to volume of the effluent and to concentration of pollutants.

Before upscaling, a more detailed EIA will be conducted, ensuring that the characteristics of effluent will remain below published 'not-to-exceed' values. Furthermore, trials to reuse the treated water will be carried out for the 25-ton capacity unit, and will possibly be operational when up-scaling and EIA for a 200-ton capacity unit become an issue.

***Table 4**. Tolerance limits for aquaculture wastewaters discharged into inland surface or marine coastal water in Sri Lanka. Source: Technical Guidelines for the Environmental Assessment of Coastal Aquaculture Development, Aquaculture and Aquatic Resources Management Program, Asian Institute of Technology, Network of Aquaculture Centers in Asia, Bangkok. Draft, February 2000.*

Parameter	Values (not to exceed)	
	Inland Surface	Marine Coastal
BOD_5 (5 days at 20°C) mg/l	30	50
COD (mg/l)	250	250
PH	6.0 - 8.5	6.0 - 8.5
Suspended solids (mg/l)	50	100
Temperature (°C)	30	35 at point of discharge
Oil and grease (mg/l)	10	20
Total Nitrogen (mg/l)	2.0	2.0
Phosphate (mg/l)	2.0	2.0
Phenolic compounds (mg/l)	1.0	5.0
Cyanides (mg/l)	0.2	0.2
Sulphides (mg/l)	2.0	5.0
Fluroides (mg/l)	1.0	1.0
Total residual chlorine (mg/l)	1.0	1.0
Arsenic (mg/l)	0.2	0.2
Cadmium (mg/l)	0.1	2.0
Chromium (mg/l)	0.1	1.0
Copper (mg/l)	3.0	3.0
Lead (mg/l)	0.1	1.0
Mercury (mg/l)	0.0005	0.01
Nickel (mg/l)	3.0	5.0
Selenium (mg/l)	0.05	0.05
Zinc (mg/l)	5.0	5.0
Pesticides	Absent	Absent
Radioactive materials		
Alpha emitters (μc/ml)	10^{-7}	10^{-8}
Beta emitters (μc/ml)	10^{-6}	10^{-7}

9.2 Design

The present infrastructure of the 25-ton hatchery complex is based on a modular concept. The main reasons are to develop a model that can be easily replicated when scaling up the system. As an illustration, the water reservoir will be the same and will be duplicated to accommodate increased water needs.

The design concept for up-scaling will be based on a 100-tonne capacity module. When required, the module can be duplicated to upscale to a 200-ton or larger capacity module. The complexes required to support a 100-ton grow-out enterprise are described below. Further specifications can be found in Tables 5 and 6.

1. Algae and nanno-plankton complex (Figure 8)

The tanks are arranged as a scale-up production unit. There is a roof of polycarbonate transparent material. It will allow sunlight to penetrate into the tanks. There are no walls. The roof top is supported by wooden or concrete pillars. The preferred pillar is made of hard wood supported on a 20 cm concrete footing.

2. Rotifer culture complex (Figure 9)

The tanks are arranged as a scale-up production unit. There is a roof of polycarbonate transparent material. It will allow sunlight to penetrate into the tanks. There are no walls.

NB Other live feeds (e.g. copepods) are not included in the set-up. However, other live feeds can be cultured in the rotifer facility and stocks can be kept in the algal unit.

3. Larvae culture complex (Figure 10)

The design consists of 3 separate units serviced by a common facility. Each unit can be isolated and quarantined for health management without affecting production in the other 2 units. Entering into each unit will be according to appropriate fish health requirements (e.g. gears, attire, footbath). There is space for a multi-purpose function (e.g. extra tanks for fish grading and sorting and working area; storage of equipment). A portable hood (not shown) with controlled daylight lighting is incorporated as standard equipment. The roofing will be of polycarbonate material. The walls are made of cement.

The common area is the operations area. The common area consists of an analytical laboratory, live feed cultures tanks, short-term storage of artificial feeds, general storage, work space for transferring fish in and out of the building, cloak room, changing rooms. The setup of these features are not shown in the diagram. The roofing will be of prefabricated material (non-toxic). The walls are made of cement.

4. Nursery complex (Figure 11)

The design of the building is similar as the larvae culture complex with the following differences. The number of tanks and the tank heights are not the same. The tanks are arranged in 2 sets for the nursery but as 1 set for the larval culture. A hood is not used (not required) for the nursery complex.

A ramp will be incorporated in the operations area for transportation of live fingerling container on to a ute. The ute will then transfer the fish to the holding tanks of the boat waiting at the jetty.

5. Broodstock Tanks (Figure 12)

There will be 10 broodstock tanks, each of 100 tons water containing capacity. One tank will be used for one species only.

6. Aquacultural wastewater treatment complex

The up-scaled wastewater treatment complex has the same design as the 25 ton version.

7. Culture laboratory (Figure 13)

The laboratory will be used for commercial experimental studies. Portable tanks can be arranged as replicates in an experimental design. The roofing will be of polycarbonate. The roof is supported by pillars similar as for algae / nanno-plankton culture. An office is attached to the laboratory.

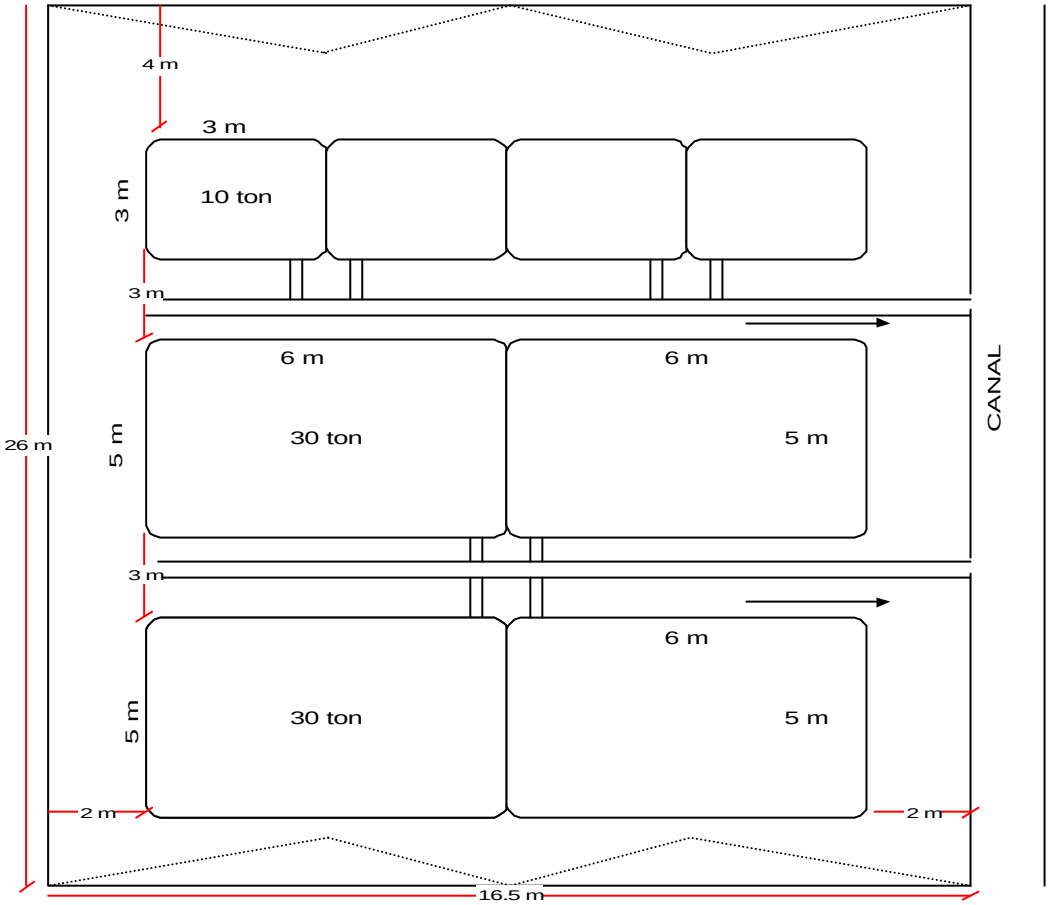


Figure 8 *Algae and nanno-plankton complex.*

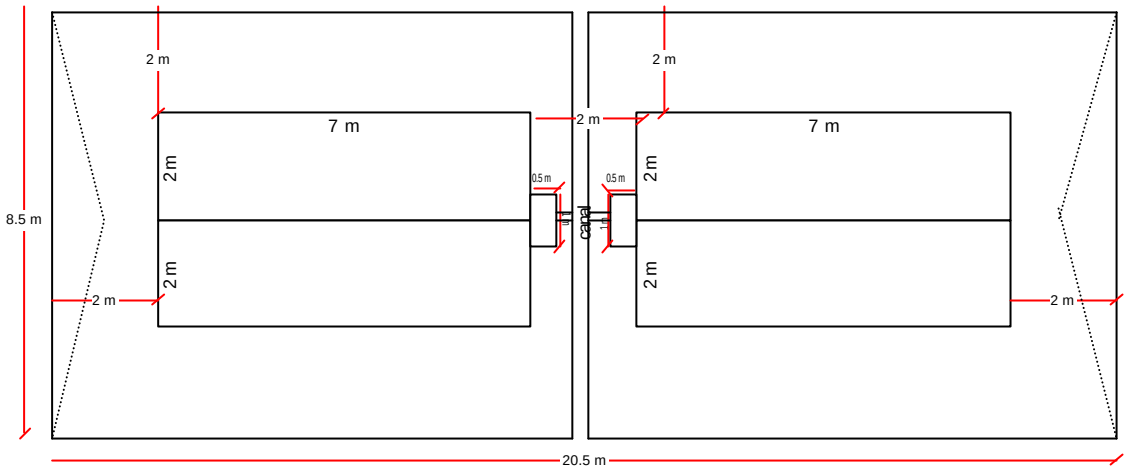


***Figure 9**. Rotifer culture complex.*

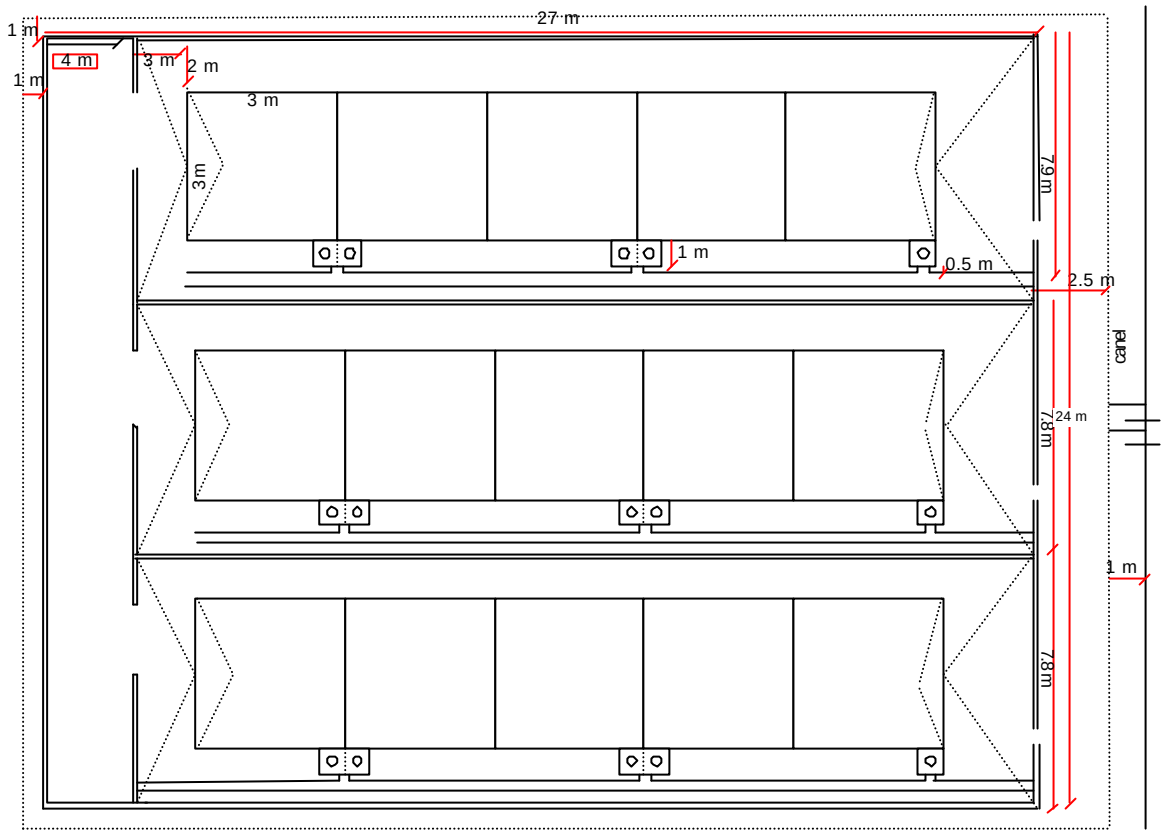


***Figure 10**. Larvae culture complex.*

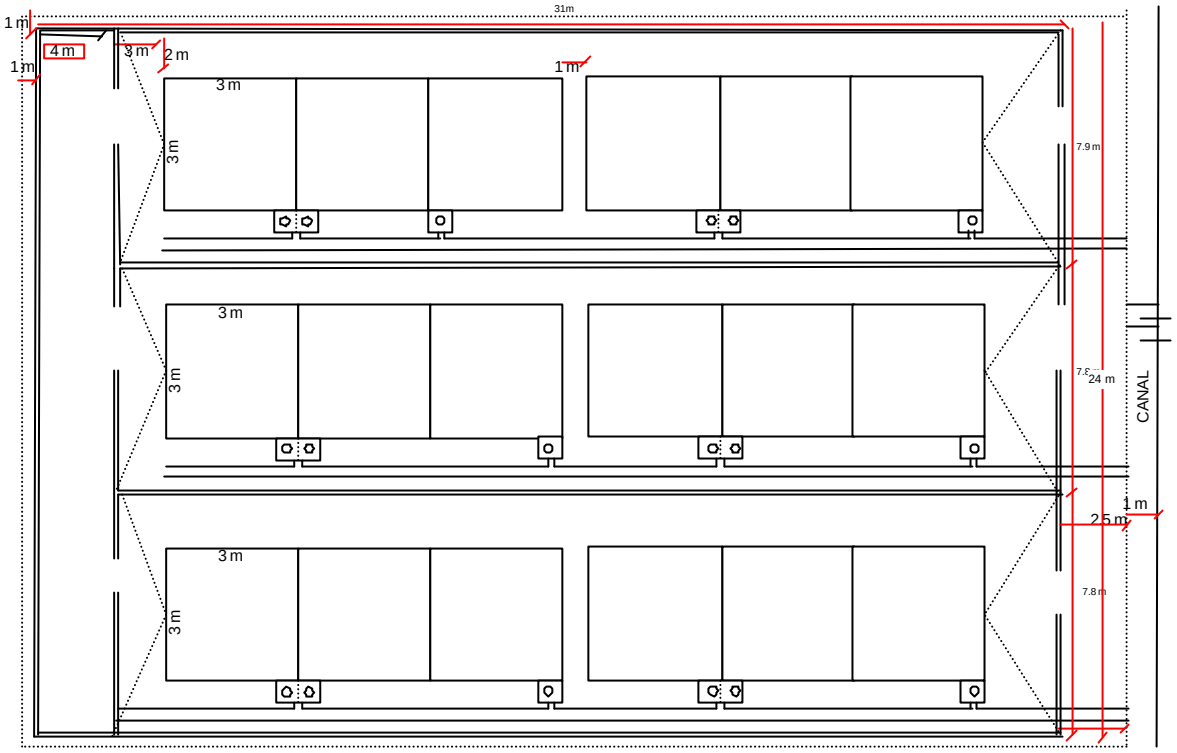


Figure 11. *Nursery complex.*

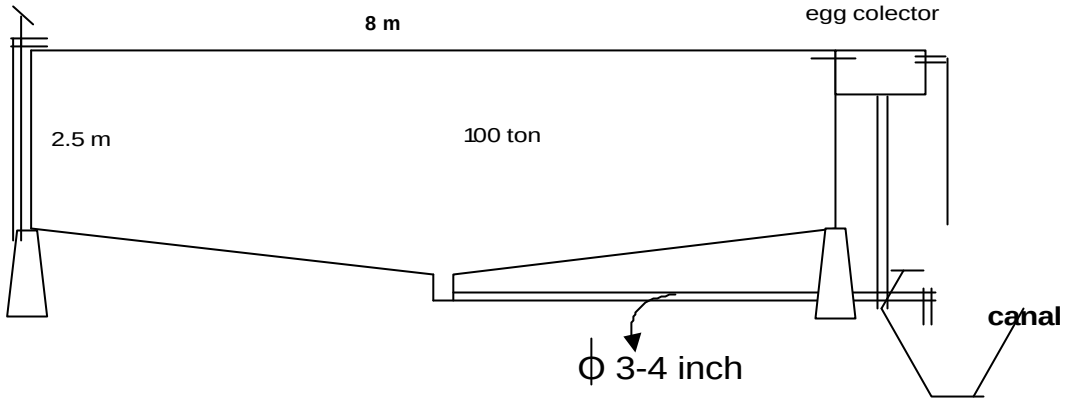


***Figure 12**. Broodstock tanks*

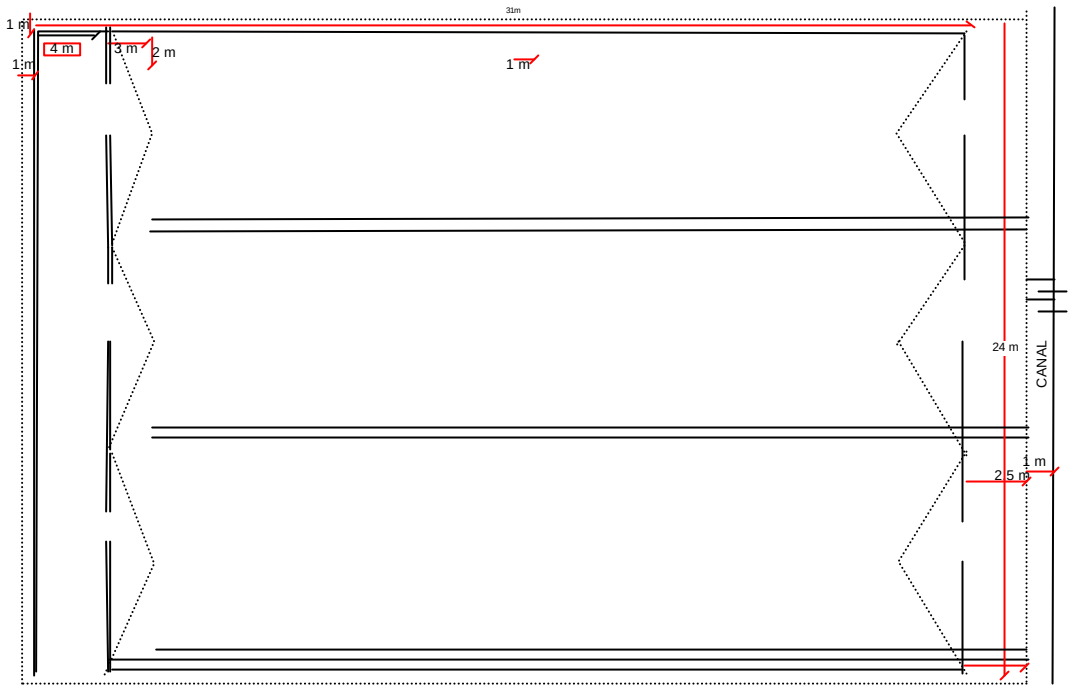


Figure 13. *Culture laboratory*

***Table 5**. Areas needed for the the construction of all facilities that make up a hatchery complex supporting grow-out enterprises with a combined annual production capacity of 100 tons.*

No	Building	Specifications (metres)	Area (Square metres)	Quantity
1	Algae / Nanno-plankton Culture	26 L x 16.5 W x 5 H	429	1 unit
2	Algae Laboratory	6 L x 6 W x 5 H	36	1 unit
3	Rotifer Culture	20.5 L x 8.5 W x 5 H	174.25	1 unit
4	Algae Reservoir	2 L x 1 W x 1.2 H	2	1 unit
5	Larvae Culture	29 L x 24.5 W x 5 H	710.5	1 unit
6	Nursery Culture	33 L x 24.5 W x 5 H	808.5	1 unit
7	Broodstock Culture (each)	10 L x 10 W x 3 H	100x3	3 units
8	Culture Laboratory	31 L x 24 W x 5 H	744	1 unit
9	Wastewater Treatment A	40 L x 30 W x 1.5 H	1200	1 unit
10	Wastewater Treatment B	25 L x 24 W x 1.5 H	600x3	3 units
11	Reservoir (seawater)	30 L x 10 W x 2 H	300	1 unit
12	Reservoir (freshwater well)	5 L x 5 W x 2 H	25	1 unit
13	Generator Plant	10 L x 8 W x 5 H	80	1 unit
14	Pump House (sea water)	6 L x 4 W x 5 H	24	1 unit
15	Blower Shed	6 L x 3 W x 5 H	18	1 unit
	Total Build-up Area		6649.25 +	
	Total Rain Water Area		3024.25 +	

Table 6. *Capacity and size of tanks for hatchery facility that can supporting grow-out enterprises with a combined annual production capacity of 100 tons.*

Item	***Dimensions***	***Quantity***
Algae Tank	a. 10 tonnes	4 tanks
	(3 L x 3 W x 1.2 H) metres	
	b. 30 tonnes	4 tanks
	(6 L x 5 W x 1.2 H) metres	
Algae Reservoir	2.4 tonnes	1 tank
	(2 L x 1 W x 1.2 H) metres	
Rotifer Tank	16 tonnes	4 tanks
	(2 L x 7 W x 1.2 H) metres	
Larvae Tank	10 tonnes	15 tanks
	(3 L x 3 W x 1.25 H) metres	
Nursery Tank	13.5 tonnes	18 tanks
	(3 L x 3 W x 1.5 H) metres	
Broodstock Tank	100 tonnes	10 tanks
	Diameter : 8 metres	
	Depth 2.5 metres	
Culture Laboratory	Various sizes	Portable tanks
	(31 L x 24 W x 5 H) metres	
Wastewater Treatment A	450 tonnes	4 tanks
	10 L x 30 W x 1.5 H	
Wastewater Treatment B	225 tonnes	4 tanks
	25 L x 6W x 1.5 H	
Seawater Reservoir	600 tonnes	1 tank
	(30 L x 10 W x 2 H) metres	

ANNEX 1. CURRENT TERMS OF REFERENCE FOR POSITIONS IN THE FISH CULTURE PROJECT

A1.1 Hatchery manager

Scope

Destructive fishing practices, such as reef gleaning and cyanide fishing, are major threats to the natural richness of the marine part of Komodo National Park. As part of its program to conserve the natural richness of Komodo Natural Park, TNC strives to offer alternative livelihoods for fishermen who presently use unsustainable fishing methods, such as blast fishing, reef gleaning ('meting') and cyanide fishing. The mariculture project is one of the modules of the alternative livelihood program, and it aims to involve local communities in the culture of estuary grouper *Epinephelus coioides*, mouse grouper *Cromileptes altivelis*, tiger grouper *Epinephelus fuscoguttatus*, sea bass *Lates calcarifer* and mangrove jack *Lutjanus argentimaculatus.* The mariculture project will also contribute to the market transformation of the live reef fish trade from unsustainable, capture-based to sustainable, culture-based.

The project aims to establish a complete production chain: artificial reproduction, hatchery rearing of larvae, and grow-out of fingerlings until marketable size by local communities. Total project duration is five years, after which the hatchery enterprise should be self-sustaining, with fishing groups from the Komodo area (Pulau Misa, Seraya and Labuan Bajo) permanently employed in the mariculture business.

TNC has already secured broodstock of each of the species, and has secured funds for hatchery construction. The land for the hatchery is currently being purchased.

The hatchery manager will be based in Labuan Bajo, where he supervises 3 coordinators (broodstock coordinator, nursery coordinator, grow-out coordinator) and ca. 20 workers who perform routine activities such as feeding the broodstock and guarding the cages. The hatchery manager is responsible for the total project, including management of project funds, the design, construction and operation of hatchery itself, and the grow-out at the village level. He will regularly compile reports, and he will regularly consult with the main partners of the Komodo mariculture project (Gondol Research Station for Coastal Fisheries, Bali, and Queensland Department of Primary Industries, Australia) to maintain state-of-the-art hatchery practices. In the field, the hatchery manager will be supervised by the TNC CMP Indonesia Komodo Project Leader. The general supervision of the grouper culture project is with the TNC CMP Deputy Director.

Time allocation

On-site project management, including design, construction, operation and supervision: 80%

Reporting: 10%

Networking with partners and stakeholders: 5%

Team participation - Contribute to the Coastal and Marine Indonesia Program and respond to other duties, as assigned: 5%

Duration of contract: The expert will be contracted for at least 6 months, starting as soon as possible.

Entrance requirements

1. A MSc. degree in forestry, fishery, agriculture, or environmental sciences
2. Minimum of 10 years experience in cage culture of finfish, preferably grouper, sea bass and mangrove jack.
3. Minimum of 5 years experience in project management
4. Experience with treatment of fish diseases
5. Experience with grouper grow-out practices, including keeping, feeding, and formulation of natural and artificial feeds.
6. Experience with finfish hatcheries and with reproduction of finfish in captivity, preferably of grouper, sea bass and mangrove jack.
7. Understanding of the live reef fish trade (including fingerlings)
8. Able to work in a team of mostly Indonesian professionals
9. Fluent in English (read, write, speak)
10. Fluent in Bahasa Indonesia (read, speak), or willing to learn Bahasa Indonesia
11. Affinity with conservation issues
12. Willingness and ability to provide on-the-job training
13. Willingness and ability to work irregular hours and weekends.

A1.2 Nursery coordinator

Scope

The larval rearing and nursery coordinator will be based in Labuan Bajo, where he assist to supervises a team of 1 larval rearing and nursery officer and 4 assistants who perform routine activities such as feeding, handling larvae and juvenile. The larval rearing and nursery coordinator will keep standards for larval rearing and nursery maintenance at a high level. He will provide adequate on-the-job training for the workers. He will regularly consult with the main patners of the Komodo mariculture project (Gondol Research Station for Coastal Fisheries, Bali, Queensland Department of Primary Industries, Australia) to maintain state of-the-art broodstock housbandry practices. He will assist to treat larvae and juvenile diseases and seek the opinion of other experts for diagnosis and treatment. He will assist to keep records for environment, stocking, feeding, growth and survival, of which he will compile a short report every month. The larvae and nursery coordinator will assist to propose and implement any improvements to the TNC hatchery complex near

Labuan Bajo, and he will be responsible for the procurement of project materials. The larval rearing and nursery coordinator will be supervised by the Mariculture manager, Komodo Project Leader and Senior Program Officer.

Time allocation

On- site larval rearing and nursery management, including supervision and on-the-job-training : 60 %
Logistic support of the fish culture project : 20 %
Reporting : 10 %
Team participation-Contribute to the Coastal and Marine Indonesia Program and respond to other duties, as assigned : 10 %

Duration of contract

The Larval rearing -nursery will be contracted for at least 1 year, starting on Januari 2001.

Entrance requirements

1. Degree in fishery, biology, agriculture, or environmental sciences
2. Minimum of 5 years experience in larval rearing and nursery of finfish, preferably grouper, sea bass and mangrove jack.
3. Experience with treatment of larvae and juvenile diseases.
4. Experience with finfish grow-out practices, including keeping, feeding, and formulation of natural and artificial feeds.
5. Understanding of the live reef fish trade (including fingerlings)
6. Affinity with conservancy issues
7. Willingness and ability to provide on-the-job training
8. Willingness and ability to work during irregular hours and weekends.

A1.3 Grow-out coordinator

Scope

The Grow out coordinator will be based in Labuan Bajo, where he assist to supervises a team of 4 grow out officer and assistants who perform routine activities such as grow out monitoring : feeding, handling, maintenance by communities. The person will have to coordinate preparation works for grow out farming dissemination such as to establish contact and working relationships with community groups, select fisher/villager/group the program want to work with (after developing appropriate criteria), design arrangements to define such working relationship, training those fishers to build proper grow-out cages, going through the process of selecting and ordering the materials with them, assembling the cages, selecting proper mooring sites for the cages, following procedures of AMDAL outside the Park and EIA plus carrying capacity issues in multiple use zones.. The person will also conduct some on the job training and counseling on fish growing and live fish marketing and

enterprising for surrounding fishery communities. The grow out coordinator will keep standards for grow out maintenance at a high level. He will provide adequate on-the-job training for the workers. He will regularly consult with the main partners of the Komodo mariculture project (Gondol Research Station for Coastal Fisheries, Bali, Queensland Department of Primary Industries, Australia) to maintain state of-the-art broodstock husbandry practices. He will assist to treat fish diseases and seek the opinion of other experts for diagnosis and treatment. He will assist to keep records for environment, stocking, feeding, growth and survival, of which he will compile a short report every month. The Grow out coordinator will assist to propose and implement any improvements to the TNC grow out complex in Loh Mbongi, near Labuan Bajo, and he will be responsible for the procurement of project materials. The Grow out coordinator will be supervised by the Mariculture manager, Komodo Project Leader and Senior program Officer.

Time allocation

On- site grow out management, including supervision and on-the-job-training : 60 %

Logistik support of the fish culture project : 20 %

Reporting : 10 %

Team participation-Contribute to the Coastal and Marine Indonesia Program and respond to other duties, as assigned : 10 %

Duration of contract

The grow out coordinator will be contracted for at least 1 year, starting on Januari 2002.

Entrance requirements

1. Degree in, fishery, biology, agribusiness, or environmental sciences
2. Minimum of 5 years experience in larval rearing and nursery of finfish, preferably grouper, sea bass and mangrove jack.
3. Experience with treatment of larvae and juvenile diseases.
4. Experience with finfish grow-out practices, including keeping, feeding, and formulation of natural and artificial feeds.
5. Understanding of the live reef fish trade (including fingerlings)
6. Affiniti with conservancy issues
7. Willingness and ability to provide on-the-job training
8. Willingness and ability to work during irregular hours and weekends.

A1.4. Broodstock coordinator

Scope

The broodstock coordinator will be based in Labuan Bajo, where he supervises a team of 4 workers who perform routine activities such as feeding the broodstock and

guarding the cages. He is also expected to supervise an assistant once this vacancy is filled. The broodstock coordinator will keep standards for broodstock maintenance at a high level. He will provide adequate on-the-job training for the assistant and workers. He will regularly consult with the main partners of the Komodo mariculture project (Gondol Research Station for Coastal Fisheries, Bali, and Queensland Department of Primary Industries, Australia) to maintain state-of-the-art broodstock husbandry practices. He will treat fish diseases and seek the opinion of other experts for diagnosis and treatment. He will keep records for feeding, growth and survival, of which he will compile a short report every month. The expert will propose and implement any improvements to the TNC fish cage complex near Labuan Bajo, and he will be responsible for the procurement of project materials. The export will be asked to contribute to the development of any future mariculture proposals. The expert will be supervised by the Komodo Project Leader and the Senior Program Officer.

Time allocation

On-site broodstock management, including supervision and on-the-job training: 60%

Logistical support of the fish culture project: 20%

Reporting: 10%

Team participation - Contribute to the Coastal and Marine Indonesia Program and respond to other duties, as assigned: 10%

Duration of contract

The expert will be contracted for at least 1 year, starting in August 2000.

Entrance requirements

1. A BSc. degree in forestry, fishery, agriculture, or environmental sciences
2. Minimum of 7 years experience in cage culture of finfish, preferably grouper, sea bass and mangrove jack.
3. Experience with treatment of fish diseases
4. Experience with grouper grow-out practices, including keeping, feeding, and formulation of natural and artificial feeds.
5. Experience with finfish hatcheries and with reproduction of finfish in captivity, preferably of grouper, sea bass and mangrove jack.
6. Understanding of the live reef fish trade (including fingerlings)
7. Affinity with conservation issues
8. Willingness and ability to provide on-the-job training
9. Willingness and ability to work irregular hours and weekends.

A1.5 Broodstock officer

The Broodstock officer will be based in Labuan Bajo, where he assist to supervises a team of 4 assistants who perform routine activities such as feeding the broodstock,

and guarding the cages. The Broodstock Officer will assist to keep standards for broodstock maintenance at a high level. He will provide adequate on-the-job training for the workers. He will regularly consult with the main partners of the Komodo mariculture project (Gondol Research Station for Coastal Fisheries, Bali, Queensland Department of Primary Industries, Australia) to maintain state of-the-art broodstock husbandry practices. He will assist to treat fish diseases and seek the opinion of other experts for diagnosis and treatment. He will assist to keep records for feeding, growth and survival, of which he will compile a short report every month. The Broodstock Officer will assist to propose and implement any improvements to the TNC fish cage complex near Labuan Bajo, and he will be responsible for the procurement of project materials. The Broodstock officer will be supervised by the broodstock coordinator, the Mariculture Manager, Komodo Project Leader and Senior Program Officer.

Time allocation

On- site broodstock management, including supervision and on-the-job-training : 60 %

Logistik support of the fish culture project : 20 %

Reporting : 10 %

Team participation-Contribute to the Coastal and Marine Indonesia Program and respond to other duties, as assigned : 10 %

Duration of contract

The Broodstock officer will be contracted for at least 6 months, starting on November 2000.

Entrance requirements

1. A BSc. Degree in fishery, biology, agriculture, or environmental sciences
2. Minimum of 1 year experience in cage culture of finfish, preferably grouper, sea bass and mangrove jack.
3. Experience with treatment of fish diseases.
4. Experience with grouper grow-out practices, including keeping, feeding, and formulation of natural and artificial feeds.
5. Experience with finfish hatcheries
6. Understanding of the live reef fish trade (including fingerlings)
7. Affiniti with conservancy issues
8. Willingness and ability to provide on-the-job training
9. Willingness and ability to work during irregular hours and weekends.

A1.6 Feed supply officer

The feed supply officer will be based in Labuan Bajo, where he assist to supervises a team of 4 assistants who perform routine activities such as feed production for larvae

and juvenile. The feed-supply officer will keep standards for feed production and maintenance at a high level. He will provide adequate on-the-job training for the workers. He will regularly consult with the main partners of the Komodo mariculture project (Gondol Research Station for Coastal Fisheries, Bali, Queensland Department of Primary Industries, Australia) to maintain state of-the-art broodstock husbandry practices. He will assist to feed production technique and seek the opinion of feed culturing and formulating. He will assist to keep records for environment, culture technique, feed formulation of which he will compile a short report every month. The feed supply officer will assist to propose and implement any improvements to the TNC feed supply complex near Labuan Bajo, and he will be responsible for the procurement of project materials. The feed supply officer will be supervised by the feed supply coordinator, the Mariculture manager, Komodo Project Leader and Senior program Officer.

Time allocation

On- site feed management, including supervision and on-the-job-training : 60 %

Logistik support of the feed culture and formulation project : 20 %

Reporting : 10 %

Team participation-Contribute to the Coastal and Marine Indonesia Program and respond to other duties, as assigned : 10 %

Duration of contract

The feed supply officer will be contracted for at least 1 year, starting on Januari 2001.

Entrance requirements

1. Bsc. Degree in fishery, biology, agriculture, or environmental sciences
2. Minimum of 1 years experience in feed production of finfish, preferably grouper, sea bass and mangrove jack.
3. Experience with feed culture and formulation.
4. Affinity with conservancy issues
5. Willingness and ability to provide on-the-job training
6. Willingness and ability to work during irregular hours and weekends.
7. Experience with finfish grow-out practices, including keeping, feeding, and formulation of natural and artificial feeds.

A1.7 Larvae rearing officer

The Larval rearing-nursery Officer will be based in Labuan Bajo, where he assist to supervises a team of 4 assistants who perform routine activities such as feeding the larvae and juvenile, and guarding the hatchery. The Larval rearing-nursery Officer will assist to keep standards for larvae and juvenile maintenance at a high level. He will provide adequate on-the-job training for the workers. He will regularly consult with

the main patners of the Komodo mariculture project (Gondol Research Station for Coastal Fisheries, Bali, Queensland Department of Primary Industries, Australia) to maintain state of-the-art larval rearing and nursery housbandry practices. He will assist to treat fish diseases and seek the opinion of other experts for diagnosis and treatment. He will assist to keep records for feeding, growth and survival, of which he will compile a short report every month. The Larval rearing-nursery Officer will assist to propose and implement any improvements to the TNC larval rearing- nursery complex near Labuan Bajo, and he will be responsible for the procurement of project materials. The Larval rearing-nursery Officer will be supervised by the larval rearing & nursery coordinator, the Mariculture manager, Komodo Project Leader and Senior program Officer.

Time allocation

On- site larval rearing and nursery management, including supervision and on-the-job-training : 60 %

Logistic support of the fish culture project : 20 %

Reporting : 10 %

Team participation-Contribute to the Coastal and Marine Indonesia Program and respond to other duties, as assigned : 10 %

Duration of contract

The mariculture assistan will be contracted for at least 6 months, starting on November 2000.

Entrance requirements

1. A BSc. Degree in fishery, biology, agriculture, or environmental sciences
2. Minimum of 1 year experience in hatchery grouper, sea bass and mangrove jack.
3. Experience with treatment of fish diseases.
4. Experience with grouper grow-out practices, including keeping, feeding, and formulation of natural and artificial feeds.
5. Understanding of the live reef fish trade (including fingerlings)
6. Affiniti with conservancy issues
7. Willingness and ability to provide on-the-job training
8. Willingness and ability to work during irregular hours and weekends.

A1.8 Grow-out officer

The Grow out officer will be based in Labuan Bajo, where supports the supervision of a team of assistants performing routine activities such as grow out monitoring, feeding, handling, and maintenance. This person will has to assist in preparation works for grow out farming dissemination such as to establish contact and working

relationships with community groups, select fisher/villager/group the program want to work with (after developing appropriate criteria), design arrangements to define such working relationship, training those fishers to build proper grow-out cages, going through the process of selecting and ordering the materials with them, assembling the cages and selecting proper mooring sites for the cages. The person will also assist to conduct some on the job training and counseling on fish growing and live fish marketing and enterprising for surrounding fishery communities. The grow out coordinator will keep standards for grow out maintenance at a high level. He will provide adequate on-the-job training for the workers. He will regularly consult with the main partners of the Komodo mariculture project (Gondol Research Station for Coastal Fisheries, Bali, Queensland Department of Primary Industries, Australia) to maintain state of-the-art broodstock husbandry practices. He will assist to treat fish diseases and seek the opinion of other experts for diagnosis and treatment. He will assist to keep records for environment, stocking, feeding, growth and survival, of which he will compile a short report every month. The Grow out coordinator will assist to propose and implement any improvements to the TNC grow out complex in Loh Mbongi, near Labuan Bajo, and he will be responsible for the procurement of project materials. The Grow out officer will be supervised by the grow out coordinator, the Mariculture manager, Komodo Project Leader and Senior program Officer.

Time allocation

On- site Grow-out assistant, including supervision and on-the-job-training : 60 %

Logistik support of the fish culture project : 20 %

Reporting : 10 %

Team participation-Contribute to the Coastal and Marine Indonesia Program and respond to other duties, as assigned : 10 %

Duration of contract

The grow out officer will be contracted for at least 1 year, starting on Januari 2002.

Entrance requirements

1. Degree in fishery, biology, agribusiness, or environmental sciences
2. Minimum of 1 years experience in larval rearing and nursery of finfish, preferably grouper, sea bass and mangrove jack.
3. Experience with treatment of larvae and juvenile diseases.
4. Experience with finfish grow-out practices, including keeping, feeding, and formulation of natural and artificial feeds.
5. Understanding of the live reef fish trade (including fingerlings)
6. Affiniti with conservancy issues
7. Willingness and ability to provide on-the-job training
8. Willingness and ability to work during irregular hours and weekends.

A1.9 Mariculture assistants

The Mariculture Assistant will perform all the day-to-day duties assigned by the Coordinators and Officers and indirectly, by the Manager. An assistant will learn all the "hands-on" skills required for routine activities such as feeding, sorting, fish handling, cleaning activities and hygiene, keeping records of dead fish, stock numbers, water quality analysis and recording biodata on the log book sheets. Administrative duties such as responsibility of particular building is an Assistant's duty. An Assistant is required and learn trade skills pertinent to mariculture. He/she will be required from time to time to help out in other tasks as deem applicable.

Requirements

1. Resident from the targeted villages in and around the Komodo National Park as trainees for the grow-out scheme arrangements. Other trainees as applicable.
2. Employment of new recruits only on special circumstances.
3. Positive attitude and motivation to learn maricultrue as a small scale grow-out farmer.
4. Ability to read and write.
5. Willingness to work on a 12-hour shift basis.

A1.10 Boat Driver / Mariculture Boat (Fatmawati / Manta)

Supervisor: Office Manager and/or Broodstock Manager
Location: Labuan Bajo, Komodo
Date preparer: October 20, 2000

Summary of position:

The boat driver is responsible for the operation of the 'Fatmawati' Boat (name to be changed later). This boat is aimed for the Mariculture Program and for the Hatchery. The Boat Driver will work closely with the Boat Crew and report directly to the Office Manager. The Boat Driver should also work closely with the Broodstock Manager. The Boat Driver should have the ability in operating and maintaining the boat also have to have the good knowledge especially the Labuan Bajo and Komodo marine area.

Duties:

1. Be responsible in operating and maintaining the boat also be responsible for the safety of the boat.
2. Supervise and work closely with the boat crew.

Entrance requirement:

1. Indonesian nationality preferably Labuan Bajo resident.
2. Has relevant license as the boat driver
3. Excellent knowledge in operating and maintaining the boat
4. At least 3 (three) years experience as Boat Driver

5. Willing to work long hours (after office hours, weekends and/or public holidays).
6. Has a good knowledge of Komodo and surrounding area, especially coastal and marine area.
7. Able to work as a team and has strong interest in conservation.

A1.11 Assistant Boat Driver / Mariculture Boat (Fatmawati / Manta)

Supervisor: Office Manager and/or Broodstock Manager
Location: Labuan Bajo, Komodo

Summary of position:

The Assistant boat driver is responsible in assisting the boat driver for the operation of the 'Fatmawati' Boat (name to be changed later). This boat is aimed for the Mariculture Program and for the Hatchery. The Assistant Boat Driver will work closely with the Boat Driver and report directly to the Office Manager. The Assistant Boat Driver should have the ability in operating and maintaining the boat also have to have the good knowledge especially the Labuan Bajo and Komodo marine area.

Duties:

1. Together with the Boat Driver be responsible in operating and maintaining the boat also be responsible for the safety of the boat.
2. Work closely with the Boat Driver.
3. Responsible in maintaining the machine and act as the mechanic for the boat.
4. To always report any damage to the boat driver to be forwarded to the Office manager.

Entrance requirement:

1. Indonesian nationality preferably Labuan Bajo resident.
2. Has relevant license as the boat driver.
3. Excellent knowledge in operating and maintaining the boat.
4. At least 3 (three) years experience as the Assistant Boat Driver/Boat Crew.
5. Willing to work long hours (after office hours, weekends and/or public holidays).
6. Has a good knowledge of Komodo and surrounding area, especially coastal and marine area.
7. Able to work as a team and has strong interest in conservation.

ANNEX 2. PROPOSED TERMS OF REFERENCE FOR FISH CULTURE POSITIONS

All new contracts and renewed contracts will be based on the TORs as described here, unless the human resources department of The Conservancy advices on any changes for procedural reasons.

A2.1. Manager

No. of positions: 1

Presently, a consultant (Dr. Phillip T. Arumugam) occupies this position.

Scope

The manager will plan and develop the mariculture complex at Loh Mbongi, Labuan Bajo and grow-out sea cage culture. The development will be on an ecologically sustainable basis to include facilities for wastewater management and rehabilitation of the effected environments. The manager will manage and operate the mariculture complex and the grow-out sea cages as a state-of-the-art program for The Nature Conservancy. The manager will supervise and coordinate the personnel, manage project funds, training and research programs and manage the alternative livelihood scheme for all the participating communities. The manager will liaise with its main partners and other local agencies towards a best practice management. The manager will be supervised by the TNC CMCC Head of Research and Development and the TNC CMP Indonesia Komodo Project Leader.

Location: Loh Mbongi

Requirements

1. Preference for a PhD in aquatic science, aquaculture and fisheries with a minimum of 5 years experience preferably grouper, seabass or snapper. M.Sc in aquatic science, aquaculture and fisheries with a minimum of 10 years experience preferably grouper, seabass or snapper.
2. Minimum of 5 years experience and skills in project management.
3. Minimum of 5 years experience, knowledge and skills in aquaculture systems (pond, cage, tank) for commercial hatchery, nursery and grow-out production.
4. Knowledge and skills for mass production of algae, live feeds and artificial feed formulation.
5. Knowledge and skills in fish health management and occupational health and safety procedures.
6. Understanding of the live reef fish trade.
7. Affinity with conservation issues.
8. Willingness and ability to work as a team.
9. Fluent in English (read, write and speak)

10. Ability to speak and write in Bahasa Indonesia or willing to learn Bahasa Indonesia.
11. Willingness and ability to provide on-the-job training for personnel, grow-out culture trainees and supervision of graduate and post-graduate students.
12. Willingness and ability to carry out research.
13. Willingness and ability to work irregular hours and weekends.

A2.2. Coordinators

No further recruitment is required for 2002 budget and 2003 budget. Experienced and highly skilled mariculturists occupy the 2 positions – Sudaryanto (Broodstock) and Herno Minjoyo (Larval & Nursery). The positions are now referred as Broodstock & Grow-out Coordinator and Nursery Coordinator.

No of positions: 2

Scope

The Broodstock and Grow-out Coordinator will coordinate all activities as required for broodstock management and grow-out culture. The Nursery Coordinator will coordinate all activities as required for algal, larval and nursery production.

Both these positions function in specialized areas and both coordinators are required to have a capability in all areas of mariculture besides their respective specialization(s). A coordinator has "hands-on" experience in mariculture. A coordinator will manage a pool of personnel consisting of mariculture officers & assistants and supporting personnel and assist the manager on a day-to-day basis. A coordinator will ensure daily records of biodata, water quality and production are kept in log books and computer database. A coordinator will keep and maintain records of personnel working schedules, shift basis, emergency duties, salaries, training and other administrative duties. A coordinator will prepare monthly reports on budget analysis, stock inventory, biodata update and other matters as deemed fit. The coordinator will assist the manager to develop training manuals and participate in training and research activities. The manager will supervise the Coordinators.

Location: Preferred at Loh Mbongi. Alternatively, the 2 coordinators will be required to stay in Loh Mbongi for particular periods when deemed applicable.

General requirements

1. Preference for a MSc. in mariculture, fisheries or aquatic sciences with 5 years experience in mariculture or BSc. in mariculture, fisheries or aquatic sciences with 10 years experience in mariculture.
2. Minimum 3 years of "hands-on" experience in finfish culture preferably marine fishes.
3. Knowledge and experience with treatment of marine fish diseases.
4. Knowledge and experience in biodata monitoring, budget management and log book maintenance.

5. Willingness and ability to acquire computer skills (word processing, spreadsheet, database).
6. Minimum of 5 years experience in management of personnel.
7. Broad based knowledge with the grouper, seabass and snapper culture.
8. Willingness and ability to liaise with targeted fishing communities, fisheries sector and government agencies.
9. Willingness and ability to make regular inspection of grow-out culture schemes.
10. Understanding of the live reef fish trade.
11. Familiarity with the conservation issues.
12. Willingness and ability to work as a team.
13. Willingness and ability to execute on-the-job training to personnel and trainees.
14. Willingness and ability to carry out research.
15. Willingness and ability to work irregular hours, weekends and weekly stay-in shift.
16. Willingness and ability to learn other mariculture skills and supporting trade skills.

Additional requirements Broodstock Coordinator

1. Excellent skills in broodstock management and grow-out culture.
2. Excellent skills in all management systems (pond, tank, cage).

Additional Requirements Nursery Coordinator

1. Excellent skills in algal, rotifer, larval and nursery production techniques.

A2.3. Mariculture Officers

There are 3 positions that are filled up to 30 June 2002 (fiscal year 2002). One officer is required for the fiscal year 2003 budget. Y.F.G. Bataona (Broodstock), Dwi M. Ellyanti (Live Food) and Gatot Wibisono (Larval & Nursery) are the existing Officers. The indication of a specialization (e.g. Live Food) ceases to exist in the amended TOR.

No of positions: 4

Scope

The Mariculture Officer will be multi-skilled in mariculture. An Officer will acquire mariculture skills and trade skills pertinent to mariculture during the course of his/her contract. The Officer will directly supervise the mariculture assistants and support personnel for the daily duties carried out at the various sections of mariculture. The various sections are algal, rotifer, larval, nursery & grow-out culture, broodstock management and administrative duties. The Officer will work in each section on a monthly or bi-monthly assignment basis. An Officer will assist the coordinator for the

daily duties required of each section and assist the coordinator in the preparation of the monthly reports and training of personnel. The Officer will prepare all the dosages and nutrient media required for culture procedures and medical treatment for fishes. The officer will assist the coordinator and manager in the development of procedures as best practice in aquaculture. The Officer will assist to implement any improvements. The Officer will be in-charge of safety management, First Aid, purchasing & quotation. He/she will be required from time to time to help out in other tasks as deem applicable. The officer will be supervised by the 2 coordinators and by the manager

Location. Preference for 1 Officer as a full time resident at Loh Mbongi. Other Officers will stay at Loh Mbongi on a weekly shift basis or as deemed applicable.

Requirements

1. A BSc (S 1) Degree in fishery, aquaculture, or aquatic sciences.
2. Minimum of 1 year experience in aquaculture (includes research project).
3. Knowledge of analytical chemistry and biodata monitoring.
4. Willingness and ability to develop skills in all aspect of aquaculture. Experience and knowledge in aquaculture especially mariculture is an advantage.
5. Understanding of the live reef fish trade.
6. Affinity with conservancy issues.
7. Willingness and ability to make regular supervision of grow out culture schemes.
8. Willingness and ability to assist the coordinator when liaising with participating fishing communities for grow out culture schemes.
9. Willingness and ability to acquire trade and administrative skills.
10. Knowledge and experience in the use of computers. Willingness and ability to work with a data base program and acquire computer skills.
11. Willingness and ability to work as a team.
12. Willingness and ability to assist the manager and coordinators in on the-job training.
13. Willingness and ability to work during irregular hours, weekends and weekly stay-in shift.

A2.4. Mariculture Assistants

There are 4 positions that are filled. Wengking Latul, 'Edi' Juaedi Koro, Jamarong Djudje and Darius Murut are the existing personnel. Six assistants are required for the fiscal year 2002 budget.

No. of positions: 10

Scope

Mariculture Assistants will perform all the day-to-day duties assigned by the Coordinators and Officers and indirectly by the manager. An Assistant will learn all the "hands-on" skills required for routine activities such as feeding, sorting, fish handling, cleaning activities & hygiene, cage maintenance, keeping records of dead fish, stock numbers, water quality analysis and recording biodata on the log book sheets. Administrative duties such as responsibility of a particular building is an Assistant's duty. An Assistant is required to acquire and learn trade skills pertinent to mariculture. He/she will be required from time to time to help out in other tasks as deem applicable.

Location: One senior assistant will be a resident at Loh Mbongi. Other senior Assistants will stay in on an alternating weekly shift basis. All trainees from the targeted villages will be resident at Loh Mbongi.

Requirements Category A (Present Personnel)

This category consists of the present mariculture assistants (Wengking Latul, 'Edi' Juaedi Koro, Jamarong Djudje and Darius Murut). New recruits for this category will only be considered under special circumstances.

1. Completed secondary schooling. Elementary schooling with 2 or more years experience in the aquaculture and fisheries sector.
2. Minimum legal working age of 17 years plus (Indonesia).
3. Good reading and writing skills.
4. Willingness and ability to develop multi-skills in aquaculture.
5. Willingness to work on a 12-hour shift basis.
6. Willingness and ability to assist the officers.
7. Willingness and ability to develop trade skills.
8. Willingness and ability to accept responsibility to taking charge of a building and other responsibilities (inventory, cleaning activity).
9. Willingness and ability to work as a team.

Requirements Category B (Trainees)

1. Resident from the participating villages in-and-around the Komodo National Park as trainees for the grow-out scheme arrangements. Other trainees as deemed applicable.
2. Employment of new recruits only on special circumstances.
3. Positive attitude and motivation to learn mariculture as a small scale grow-out farmer.
4. Ability to read and write.
5. Willingness to work on a 12-hour shift basis.
6. Willingness and ability to work as a team.

A2.5. Support Personnel, Transport

There are 2 positions that are filled. Hedar and Martinus Sengga are the existing transport Personnel. One Transport Personnel is required for fiscal year 2002 budget, dependent on acquisition of a boat. KMP has 2 boats. Manta is a 20-tonne capacity boat and the dinghy, named KMP No. 1, is a 40 h.p. boat.

No. of positions: 3

Scope

The main function of the Transport Personnel is to drive the boats and general maintenance of the boats. Transport duties consist of daily transport of personnel from Labuan Bajo to Loh Mbongi to and fro and other incidental trips as required from time to time. General maintenance duties consist of boat engine servicing, keeping inventory of oil, lubricating oil, spare parts and general repairs like painting and cleanliness of the boat and workshop.

Other duties include maintenance of all engines (generators, pumps, blowers) in the mariculture complex and sea-cages. He/she will cooperate with a mariculture personnel on duty to take charge of the workshop. He/she will be required from time to time to help out in other tasks as deem applicable. A crew should have both, boat handling and mechanical skills. When a personnel is lacking in one skill, he will be trained to acquire the other skill as an in-house training program. The Officers will supervise the Transport Personnel.

Location: One stay-in Transport Personnel at Loh Mbongi on a weekly shift basis.

Requirements Boat Driver

1. Relevant licence as a boat driver.
2. Ensure the boats are in good working condition by carrying out regular servicing and repairs.
3. Supervise the maintenance and servicing of the major engines (generators, pumps, blower) in Loh Mbongi.
4. Work in cooperation with mariculture officers for operation of all boats.
5. Supervise the assistant drivers.
6. Willingness to help out in other tasks.
7. Williness and ability to work as a team.
8. Willingness and ability to train mariculture personnel in engine maintenance and servicing.
9. Willingness and ability to work during irregular hours, weekends and weekly stay-in shifts.
10. Drive and operate the boats ensuring safety of all passengers, crew and life-span of the boat.

Requirements Assistant Boat Driver

1. Relevant licence as a boat driver.

2. Assist the boat driver in ensuring the boats are in good working condition by carrying out regular servicing and repairs.
3. Assist the boat driver in the maintenance and servicing of the major engines (generators, pumps, blower) in Loh Mbongi.
4. Willingness to help out in other tasks.
5. Williness and ability to work as a team.
6. Willingness and ability to train mariculture personnel in engine maintenance and servicing.
7. Willingness and ability to work during irregular hours, weekends and weekly stay-in shifts.
8. Drive and operate the boats ensuring safety of all passengers, crew and longetivity of the boat.

A2.6. Support Personnel, Security-Caretaker-Gardener

These are new positions. Two will be required for fiscal year 2002 budget.

No. of positions: 2

Scope

The security of the premises will be maintained on a 24-hour basis. Mariculture personnel staying in the premises can carry out minor security duties, especially on weekends. The mariculture complex is closed on weekends except for key personnel. The major duty of the security is night vigilance on a 7-day basis. The Security guard will coordinate with each other, supervised by the manager's office. Each week, the 2 personnel will change their shifts. The night shift guard will be strictly night vigilance. The guard on day shift will carry out care taking and gardening duties.

Care taking duties: Care taking duties refers to general cleanliness of premises on a daily basis on weekdays and occasionally on weekends when situation demands. It includes garbage management, cleaning of office buildings, dormitory, toilets and surroundings. The job description does not cover some of the buildings like the internal area of hatchery infrastructure (e.g. algal, rotifer, larvae, fingerlings, experimental). Mariculture personnel will carry out these duties inside their respective buildings.

Gardening duties: Gardening duties refers to general maintenance of aesthetics in the premises. It includes maintenance of the flowerbeds, vegetable garden, ornamental / fruit trees. The personnel is required to do grass cutting, pruning and trimming on a routine basis.

Location: One stay-in Security-Caretaker-Gardener at Loh Mbongi on a weekly shift basis.

Requirements

1. Handyman skills.
2. Willingness to work on a night shift.
3. Willingness to do security, caretaking and gardening duties.
4. Willingness to manage the stores for gardening and caretaking tools and materials.
5. Ability to read and write.
6. Willing to help out in other tasks
7. Willingness and ability to work as a team.

A2.7. Support Personnel, Cook

The Mariculture Complex requires 2 cooks for the fiscal year 2002.

No. of positions: 2

Scope

The main duty of the cook is the planning and preparation of all the meals. This duty includes purchasing of all ingredients, management of the inventory for food, cooking & dining utensils and maintenance of the kitchen cleanliness and hygiene. The cook will also maintain the cleanliness and hygiene of the dining area. The cook will prepare lunches and dinners only. Water, tea and coffee will be placed in a convenient area for easy access of all personnel to make their own drinks. The cook will ensure that tea, coffee, sugar and powdered milk and hot and cold water are always available.

Location: One stay-in cook at Loh Mbongi on a weekly shift basis.

Requirements

1. Cooking skills
2. Willingness and ability to maintain the dining and kitchen cleanliness and hygiene.
3. Willingness to stay at Loh Mbongi on a weekly shift basis.
4. Willingness to do daily purchase of materials in the morning prior to the boat leaving for Loh Mbongi.
5. Ability to read and write.
6. Willing to help out in other tasks
7. Willingness and ability to work as a team.

A2.8. Contractors FY02

There are 4 categories (i) labour; (ii) technical; (iii) engineering; (iv) experts. For the first 3 categories, contractors will be local. Local and foreign contractors constitute the expert category. Remuneration is calculated as Number/person/month basis.

Labour: [small assignments] (120 person-months)

Construction of buildings etc – 30 persons x 4 months = 120 person-months

Technical: (45)

Mechanical – 2 persons x 3 months = 6 person-months
Plumbing – 2 persons x 4 months = 8 person-months
Electrical – 2 persons x 3 months = 6 person-months
Metal/wood/fiberglass – 3 persons x 3 months = 9 person-months
Computer – 1 persons x 4 months = 4 person-months
Communications – 1 persons x 3 months = 3 person-months
Others – 3 persons x 3 months = 9 person-months

Engineering: (3)

Civil – 1 person x 1 months = 1 person-months
Mechanical – 1 person x 1 months = 1 person-months
Electrical – 1 person x 1 months = 1 person-months

Experts: (2) mainly for EIA and carrying capacity studies in FY02 (and for evaluation and business plan for up-scaling to 200-ton enterprise in FY03)

FY02: 2 person x 1 months = 2 person-months

FY03: 3 person x 1 months = 3 person-months