Summary of Day 1 Hatchery Technology Issues

Issue 1: Genetics

- **TAXONOMIC ISSUES**
  a. **Need baseline genetic diversity data**. Identify stocks, assess gene flow, map gentotypes (**everywhere**, but may be too late for some places, e.g. Madagascar and Ecuador).
  b. Pacific and Indian Ocean sandfish stocks probably distinct species – not tested yet (different hatchery techniques?)
  c. Tonga golden sandfish (*H. lessoni*) or different
- **BROODSTOCK AND HATCHERY GENETIC DIVERSITY ISSUES**
  a. Need to identify risks (are there risks? – how do we know? Paucity of evidence and studies). Need strong scientific evidence to encourage or enforce regulation.
  b. **Need for guidelines for hatcheries** (how many broodstock to use (esp. Since few spawn at any time, how often variety is needed, will genetic bottleneck affect bottom line)
  c. Ideals versus economic reality
  d. Inevitability of movement of stock within most countries
  e. Preservation of genetic diversity is more a question for restocking than commercial production question.
  f. Enforcement of guidelines (role of government in legislating for this issue, scientists must play a role in advising the decision makers).
- **TRANSLOCATION ISSUES (WHERE SPECIES DOES NOT OCCUR NATURALLY)**
  a. Biosecurity (precautionary approach)
  b. Habitat –chances of success
  c. Effect/displacement on other species in similar niches. Survey area first

Important notes

- Accept that the ideal situation is to use hatchery-produced progeny to release to areas where broodstock originate.
- Need advice from geneticists. Theory based, lot of work for other species (Current WorldFish Center study into genetic risk)
- If aquaculture progress continues, likely that selective breeding (genetic improvement) programs will eventuate.
- If precautionary approach to be followed, need strong scientific proof, who will fund this?

Possible actions

- Develop a set of best practice guidelines (based on advice from geneticists).
- Genetic studies.
- Write genetic research components into new project proposals where appropriate

Issue 2: Hatchery scale-up, efficiency, etc

Biological issues – more basic science is required.

- **Better understanding of the biology of the farmed species** for existing species of interest and potential aquaculture candidates (including nutritional requirements, feeding mechanics, growth performance, etc.)
- **Adequate documentation for practical reference purposes.** Information may or may not be know, but eventually it should be collated in such a way to make research findings available to practical applications.

In terms of the ideal hatchery technology choice and management protocols, these will vary among species, but also for the same species depending on 1) geographical location (i.e. depending on local environmental conditions) and 2) scale of operation intended (i.e. large- or small-scale).

Technological issues

- **Flow-through and static systems** – the choice of which may well be species specific.
    - Setup and operation costs may be higher, but on a longer term the overall returns may be better as a result of a significantly higher survival of the larvae and the large quantity of seed material produced;
    - It is essential to determine the **optimal rate of water exchange** that would allow optimal performance of the facility and avoid unnecessary operational expenses.
- **More research and/or better documentation if the information is available on:**
    - Optimal stocking densities at different stages of larval and post-larval development;
    - Improving efficiency in transfers and manipulation (nursery stage);
    - Microalgae selection (optimal species for one sea cucumber species);
    - Alternative feed sources other than live microalgae;
    - Understanding density dependence (stage dependent)
- **Production statistics** – indicating possible performance results under specific culture conditions.
- **Nursery systems**
- **Modular hatchery design (hatchery components)**
- **Aeration technology**
- **Develop hatchery standard operating procedures** – this would include a "what to do manual" if something goes wrong.
- **Develop/access to diagnostic tools**
- **Develop hatchery operating protocols**
- **Better understanding of technical staff rquirement according to production scale**

Issue 3: Nutrition

Generic Issues:

- Greater understanding of nutritional requirements/physiology (all stages/spp.)
- Database of current knowledge/methods

Broodstock:

- Greater nutritional knowledge for conditioning (maximise gamete quality/fecundity, prolong spawning period)
- Methods for assessing gamete quality
- Understanding how local environment influences condition

Larval:

- Investigate potential of 'off-the-shelf' feeds (alternatives to live algae)
- Optimise quality of live algae (related to training/facilities/capacity/skills)
- Identify best spp. of live algae (accounting for species/age specificity)
- Optimise feeding protocols (i.e. ration vs. larval density vs. age/stage)
- Optimise water quality to maximise nutritional benefits of feeds

Settlement/Juvenile Culture:

- Need database of methodologies
- Food availability – what do they eat?
- More information on required characteristics of biofilms
    - composition vs. nutritional value
    - composition vs. stocking density
    - digestion/assimilation of biofilm components
- Optimise substrate conditioning methods

Net/cage:

- More information on required characteristics of biofilms – what are the important components?
- Optimising stocking density vs. food availability

Pond Culture:

- Determine appropriate organic content of substrate (vs. age)
- Methods for assessing appropriate substrate characteristics prior to stocking
- What do they eat? Need more info on optimal particle size/assimilation/digestion etc
- Detailed knowledge of important fractions of substrate and substrate composition (organic and mineral)
- Need more information on nutritional needs of animal – better targeting of feeds used (i.e. shrimp feed)
- Optimise ration vs. stocking density vs. age/stage
- Development of specific diets
- Potential of biofloc

Issue 4: Species Diversification / Broodstock Conditioning

SPECIES DIVERSIFICATION

What are the drivers for diversification?

- species of lower value but higher growth may be commercially viable

-the species available may not be high value. Bring in other species –environmental issues with this, particularly if species not native. The biology/ecology of alternative species not well understood.

-target habitat restoration as a conservation arm of commercial model. Enhancement of depleted species – perhaps as part of a government program.

- don't make assumptions of what is and isn't low value. Markets not well understood, marketing not undertaken on these lesser value species. Alternative product to meat from a variety of species

-differing habitat requirements of different species may make grow-out problematic

Hatchery issues:

-Need hatchery methods for these additional species, likely to be a different protocol. Some thought this may not be so in the early larval stages, but perhaps more likely for settlement cues as metamorphosis may differ depending on habitat.

-using two species with reproduction cycles out of phase with each other allows optimal utilisation of hatchery investment.

BROODSTOCK CONDITIONING

-Classical conditioning versus chemical spawning induction

- Classic conditioning approach requires understanding of control using temperature, light, lunar cycle. Determining biological zero point to reset gametogenesis to zero.

- understand what conditions are required for 'healthy' broodstock. Both nutritional and environmental requirements. Suitable systems for holding broodstock.

- Instead of extending the species' spawning period, could look at holding two groups of broodstock. Each group is held out of phase with the other by manipulating conditioning ques.

- should start with a thorough literature review. Bring together available data – field studies and hatchery work.

-research level conditioning systems not necessarily scalable to commercial situation. Would like to see data from hatcheries that report year-round conditioning ease. Production of numbers year round for small-scale operations is different to that required for larger commercial situations.

- Better understand what is happening at the individual level during a spawning run. When a population of animals are spawned, each individual is out of phase with each other.

- In relation to spawning ques, could utilise byproduct from fishermen to extract the gonads/inducer.

- Reference for spawning inducer – Eckhaut et al. 200?? Invertebrate Reproduction & Development

Issue 5: Health and well being

Three main disease issues to date:

Bloodworms (larvae of Dipteran flies)

- cause fowling of substrates, attach to sea cucumber juveniles, can bloom rapidly if not controlled.
- Only control mechanism to date is to cover tanks to stop ingress of adult flies - not totally successful.
- some hatcheries remove the blood worms by hand - difficult and very time consuming.

Copepod infestations

- Big issue but little information available.
- Chemical (dipterex) treatment of settlement substrates prior to adding to larval tanks is effective.
- Similarly, using algal pastes to condition settlement substrates precludes copepod colonisation.

Protozoans (genera-species unknown)

- Disease issue seen in many hatcheries
- Chlorine treatment for intake water plus screening through 1 micron filters helps avoid the problem.
- Temperature / salinity manipulations of water can eliminate (some?) protozoan diseases.

General conclusions:

- Urgent need to document best management practices, including simple diagnostic procedures and treatments
- This will involve a review and collation of information from multiple hatcheries.
- Best practice includes hatchery biosecurity procedures to prevent disease organisms entering culture tanks, and to avoid spread between tanks.
- Recommendation that more hatcheries test the flow-through system for larval rearing (Annie Mercier's presentation) (Possible if we have a "manual" from Annie and her team)
- Poor nutrition and Trauma recognised as the major pre-cursors to disease problemsTherefore, must have good nutrition at all larval stages; need to minimise handling / physical damage; need to know larval tolerances (eg., salinity, temperature).

Issue 6: Transfer and dissemination of hatchery technology

- Micro-algae culture techniques – Training and Extension
    - These are aquaculture techniques with generic application so there should be a lot of information available, but which source is most applicable to sea cucumber hatchery work?
    - Explore and make available any new techniques which can eliminate live micro-algae altogether
    - Compile a directory of opportunities for work experience attachments in live micro-algal production, and for reputable sources of starter cultures
- Do we need a new Hatchery Manual that consolidates and supplements the two manuals already available?
    - These are good basic manuals for general technique, which can now be supplemented by Compendia of Recent Advances whereby these techniques have been fine-tuned and adapted for site-specific conditions to improve growth and rates of survival.
    - These Compendia should include a Checklist of Simplified Techniques to help make hatchery technology more accessible to those in low-cost low-tech economies.
    - There should be elaboration of underlying Biological Principles to increase understanding of the basis for recommended culture conditions and hatchery parameters, to further encourage development of local solutions for local hatchery problems
    - It would be useful to develop a "Sea cucumber Hatchery Operation Trouble-shooting Guide", with a decision-tree and descriptions of simple diagnostic tests to elucidate hatchery problems
    - Develop a database of "typical values" for hatchery parameters and production outputs, upon which to base project proposals and economic forecasts, for a range of hatchery scales and scenarios. Include a selection of Case Studies and identify ranges of values as well as mean values.
- Improved transfer of technology, accessibility of knowledge and expertise
    - Web-based tools for Knowledge Management should be explored and implemented to increase accessibility of information pertinent to hatchery work, and to foster the creation of an international on-line community of practitioners in "real-time" communication with each other.
    - Options include a Slug Wikipedia site, a Slug-List Yahoo Group, and/or a Slug Site (on FAO, or SPC websites) with downloadable pdf's, directory of contacts and suppliers, a Frequently Asked Questions page, and a Slug Bibliography of key references.