PRIMARY INDUSTRIES AND RESOURCES SA

FACT SHEET

FS

Using Cages in Marine Aquaculture

General

The use of offshore cages to culture marine finfish is particularly well known in Australia and has been used successfully to culture a number of species for many years. Similar success has been achieved overseas with several species, with cage culture being used since the 1950's in some regions.

The consumer popularity of marine finfish in recent years has led to an increase in the demand for the culture of traditional species and also experimentation with several new species. This 'popularity' has led to an increased demand for marine aquaculture sites in several areas in South Australia.

In South Australia, the South East region has seen expansion in Atlantic Salmon (*Salmo salar*) farming in recent years and has increased as culture sites became available as a result in changes to the Marine Aquaculture Management Plan for the region. The Southern BluefinTuna (*Thunnus maccoyii*) industry, based at Port Lincoln, has grown steadily over recent years in terms of both whole weight production and value. Interest in Snapper (*Pagrus auratus*) culture has declined in recent years due to slow growth rates and the replacement of the species with two new and possibly more economical species: Yellowtail kingfish (*Seriola lalandi*) and Mulloway (*Argyrosmus hololepidotus*). See the respective fact sheet on each of these species for further detail on their culture and aquaculture potential. The principles of cage management and associated husbandry practices are analogous for all of the species mentioned which are all grown in South Australian waters.

Site Selection

Site selection is probably the single most important factor that determines the commercial viability of an aquaculture operation. An aquaculture operation should be located, designed and operated to provide optimum water quality and to avoid conditions that may induce stress, reduce growth or predispose the fish to disease. Some biological and natural distribution information for the species should be known before a site is selected for cage grow out ie. is the species found naturally in that location, are the temperature limits of the area within that of the species etc. The area should be of a suitable depth, have good tidal flow with pristine conditions and ideally sheltered from intense wind and wave action.

The main physio-chemical parameters that need to be considered in grow out systems include factors such as water temperature, water quality, dissolved oxygen and light. Other than a limited ability to influence the quality of the surrounding water by modifying feeding and other management practices, open, offshore grow out systems are inherently dependent on natural conditions to provide a suitable growing environment.

FS
ISSN 1323-0409
Revised January 2001

Sea cage grow out

The type, size and design of a sea cage best suited for a particular application is dependent upon several factors that include the species selected for culture, site conditions, environmental features and capital investment. Sea cages can be relatively productive and, in a suitable site, support high stocking densities; however the need for adequate clearance beneath cages and suitable flushing characteristics may limit the suitability of many near shore areas for large scale sea cage production systems. Advantages of sea cages include the use that can be made of offshore water bodies, which extends the areas in which marine aquaculture may be carried out beyond the sometimes limited areas of suitable coastal water. Other advantages include the ease of expansion involving the addition of more cages to a site, all of which can be moved relatively easily to take advantage of better water quality and avoid adverse conditions. Disadvantages of sea cages include the complete lack of control the aquaculturist has over water quality and weather conditions. Algal blooms and other pollution can cause serious losses of stock.

Fundamental design criteria should take into consideration accessibility for feeding, ease of maintenance and the safety of the complete system. The design and engineering of sea cage aquaculture production systems should give consideration to the following five principle elements: the net or cage bag; frames; collars and supports; linkages and groupings; and mooring systems.

Cage Management

The major reason why the growth potential of properly fed fish is not fully realised is that stocking density has exceeded the carrying capacity of the system. An optimum density and proper feeding rate are musts for economical production. If rearing records are accumulated at a particular site for at least three years, the optimum stocking density and feeding rate for maximum growth and feed efficiency relative to season and fish size can be estimated.

The depth, area and speed of the water current at the culture grounds determine the culture density of finfish species. A maximum stocking density of fish will only be achieved if environmental conditions are favourable and may only be realised after many years of data are collected at a site. The mesh size of the netting should be increased as the fish grow to allow for maximum water exchange.

Cage culture requires frequent net exchanges because of biofouling, a build up of marine organisms on the nets over time, which clogs the mesh and restricts water exchange. In Japan this problem was overcome with the use of tri-butyl tin which has ultimately been banned because of toxicity problems. By treating the netting with anti fouling agents, nets can be used for longer periods without replacement, however the addition of any such materials should only be used if allowable under licence conditions. New anti fouling chemicals have been made but their use is so far limited due to licensing constraints. Cages can be purchased, for example steel cages, which have characteristics which resist fouling and have anti predatory functions.

Fallowing of a licence site is a good husbandry practice. This involves moving the cages over different areas of the sea bed in order to minimise the build up of organic wastes in any one area, and to subsequently allow these areas enough time for the environment and natural marine processes to assimilate any wastes.

Environmental Considerations

An important factor associated with sea cage culture is the capacity of the environment to deal with the wastes. The intensity of the production system to some degree determines its effect on the environment.

Environmental concerns from cage systems include:

- eutrophication as a consequence of increased nutrient loadings (faecal and uneaten feed wastes will either dissolve or settle on the sea beneath the cage);
- the impact cages may have on wild fish populations;
- the genetic or competitive effect escapees may have on wild populations;
- the impact of disease transmissions on wild populations; and
- loss of visual amenity.

Sea cages, if not well managed, may have an impact on the environment in that large quantities of uneaten food and faeces sink to the bottom beneath the cages, which may effect the water quality, kill stock and create deleterious impacts on the surrounding environment.

Under the cages, oxygen depletions may occur due to decomposition of accumulated waste materials. During Autumn the oxygen depleted layer may rise due to convection and cause oxygen depletions and associated mortalities in cages. Eutrophication in culture areas can lead to the development of phytoplankton blooms that have caused mortality at levels of thousands of tons of cultured fish annually in Japan.

It must be noted that a well managed farm with good husbandry practices will have negligible, if any, of the previously mentioned impacts on the environment. An efficiently run farm will have several people monitoring and observing different facets of the operation on a daily basis. If the correct amount of feed is given to the stock without overfeeding, this will have implications not only economically but also to minimise potential ecological impacts. The amount of feed eaten in a particular cage will be lower if any of the stock are sick or dying, so accurate observations on the health of each cage is also important in order to reduce the amount of feed. Differences in season will also play a major role in the amount of food consumed on an aquaculture farm. Any farmer using cages in South Australia to culture fish must undergo an accredited environmental monitoring program in order to comply with their licensing requirements.

Economic Considerations

Under suitable site conditions, offshore cage farming systems would usually be expected to be cheaper to establish and operate than onshore farms with equivalent production capabilities and provide more attractive financial returns on invested capital. However, the suitability of the site is an important factor.

In Australia, the number of sheltered sites with the features needed for successful cage culture is limited. Those that may be available will be subject to strict environmental controls and competing use of the resource. Increasing constraints are likely to be placed on the expansion of near shore cage farms, particularly those with the potential to affect the seagrass meadows found along many of the temperate coastlines. As such, the growth of the industry may be limited unless more exposed sites further from shore are used. These latter sites will require the use of more sophisticated and hence more expensive production systems. They will also be more difficult and expensive to operate under often poor weather conditions. There are however numerous overseas examples of such technology being efficiently used and in time may be adaptable to South Australia's aquaculture industries.

The various Marine Aquaculture Management Plans, covering the coastal waters of South Australia, can be found on the PIRSA website at www.pir.sa.gov.au/aquaculture

.