



## **Pacific oyster aquaculture in South Australia**

The first attempts to cultivate oysters in South Australia were those by Chief Inspector Randall in Proper Bay from 1910 to 1912 (Grove-Jones 1986). These attempts it seems, were instigated by poor catch rates of the native, mud or flat oyster, *Ostrea angasi* and an attempt to re-stock natural populations.

*Ostrea angasi* stocks had been commercial exploited in Coffin Bay and surrounds since the 1860's. This led to the Bay being closed in 1885 to assist recovery of the species. In 1910 Chief Inspector Randall attempted to collect spat and on-grow the native oyster although death rates in the spat were very high and further development was hindered (Grove-Jones 1986).

Native oyster farming was attempted again in the 1960's, however this too failed due to poor spat survival. At this time it was decided that a hardier species such as the Pacific oyster, *Crassostrea gigas*, which was being farmed in Tasmania, was required.

The Pacific oyster is a native species of Japan which was first introduced to Tasmania in the 1940's. By the early 1960's Pacific oysters were being farmed in Tasmania and by 1969 the first shipment of Pacific oysters arrived in SA from Tasmania.

Present day Pacific oyster farming activities are based in five major areas in South Australia; Murat Bay, Smoky Bay, Streaky Bay, Coffin Bay and Franklin Harbour, as well as on the eastern side of Yorke Peninsula and the north-eastern side of Kangaroo Island.

Today, the oyster farming industry is a major economic contributor of seafood in South Australia. In 1996/97 \$5.8 million of Pacific oysters were produced in South Australia, an increase of approximately 48% from 1995/96 values. Demand for oysters currently outstrips supply, and by the year 2000 the South Australian industry expects to be producing 3.5 million dozen oysters a year, worth around \$12.5 million.

### **Life history**

Pacific oysters are protandrous hermaphrodites, that is, they begin life as males before becoming functional females. They have a simple reproductive system consisting of gonads (the creamy-white area of the oyster) which hold the gametes.

Pacific oysters begin their life as a fertilised egg, formed by the union of gametes which are released by sexually mature oysters and are distributed by ocean currents. Spawning (release of gametes) is induced by a rise in water temperature (December in South Australia).

Hatching of the fertilised egg occurs approximately 24 hours after fertilisation and results in the formation of a free-floating larvae. After approximately 3 weeks in this free-floating phase the larvae enter the fixed stage of their life-cycle known as the "spat" or juvenile stage (see below). In order for larvae to develop into oysters they must attach themselves to a suitable substrate and undergo metamorphosis into spat.

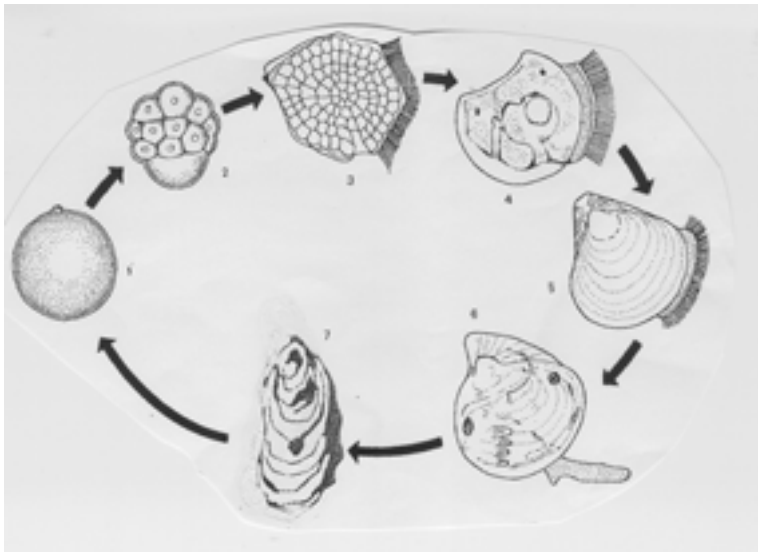
## Quick Facts

Pacific Oysters will grow in temperatures above 10°C although they prefer temperatures between 15 to 18°C. Pacific oysters will also survive between salinities of 14 to 15 ppt although the salinity for optimal growth is between 25 to 32 ppt.

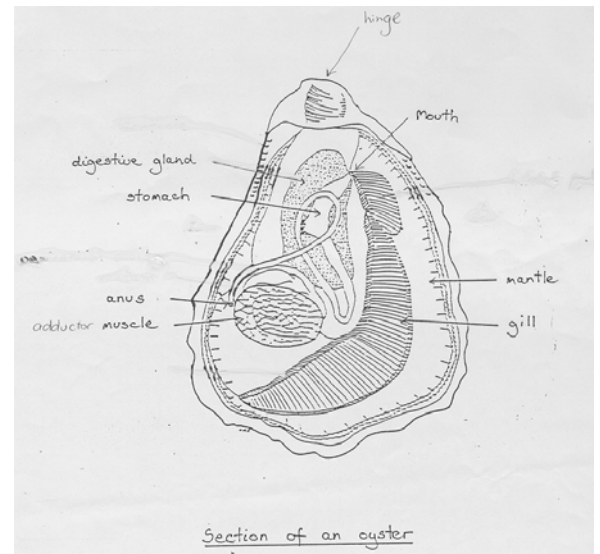
## Filter feeders

Oysters are filter feeders, they consume a variety of species of phytoplankton (or microalgae), bacteria, detritus and viruses from the surrounding water. Adult oysters (80 to 100mm in length) may filter up to 10L of water per hour. Oysters prefer golden-brown microalgae and diatoms because of their size, digestibility and nutritional value.

## The Pacific oyster's life-cycle



1=Embryo 2=Embryo division 3=Free swimming veliger 4=D-shaped veliger 5=Umbo-veliger 6=Spat (juvenile oyster) 7=Adult oyster.



The anatomy of an oyster

## Pacific oyster culture

### Hatchery

Hatcheries are land-based facilities which serve two functions:

- spawn sexually mature oysters; and
- culture larvae and spat until they reach a size suitable for on-growing on a intertidal or subtidal nursery site.

Pacific oyster larvae do not survive in sufficient numbers to use as spat because of the high salinity levels (sometimes above 40ppt) which occur in most oyster growing parts of the State. Consequently the main benefit of a hatchery is so that farmers do not have to rely on wild spat-fall for stock.

Hatcheries are typically operated by personnel who have knowledge and skills in the areas of spawning, larval rearing, larval settlement and microalgae culture.

Preferred techniques and equipment vary widely between hatcheries. The following techniques are examples of how one oyster hatchery may operate.

## **Broodstock**

Broodstock is the term used to describe sexually mature oysters which are spawned in hatcheries. Broodstock are usually selected on the physical characteristics of the oyster. For example a good shaped cupped-shell and high meat to shell ratio. Selecting broodstock on this basis will ensure that these traits will be passed on to the oysters progeny.

## **Spawning**

Pacific oysters spawn naturally in the wild, however in a hatchery oysters are induced to spawn in a variety of ways. One of the most effective and commonly used methods of spawning is by temperature cycling.

Temperature cycling involves placing sexually mature oysters in water at a certain temperature then slowly increasing the temperature of the water over a period of time. An example of this would be oysters which are exposed to 20°C water with a slow increase of 1°C every 5 minutes until the water reaches 28°C. In addition to temperature cycling, individual hatcheries have their own methods of inducing spawning. These methods include water cycling and the presence of gametes or microalgae in the water.

Once spawning is induced and gametes are released into the water they are mixed together to fertilise. Once fertilised the eggs are then placed into hatching tanks at approximately 80 to 100 eggs /ml water.

After approximately 4 hours the eggs have hatched and develop into shelled larvae which move around inside the larval rearing tank in search for food. This stage of the oysters life cycle lasts for 2 to 3 weeks during which time the hatchery operator must feed the larvae microalgae each day.

Oyster larvae have a voracious appetite therefore the hatchery must culture their own microalgae. This is a labour intensive procedure which requires the hatchery to grow large volumes (up to 500L bag cultures) of high quality microalgae from small pure-strain samples. At various stages of it's life cycle the oyster prefers different species of microalgae so the hatchery may have a number of different microalgal bag cultures growing at once.

## **Settlement**

Settlement refers to the process whereby oyster larvae attach to a suitable substrate (usually where there is lots of food). This allows the larvae to undergo metamorphosis into a juvenile oyster (spat). Settlement occurs 1 to 3 weeks after hatching. While in the larval rearing tank the hatchery operator must check frequently for larvae settlement. As soon as some larvae begin to settle they are placed in special tanks which contain cultch; crushed shells to which the larvae can attach.

Once all the larvae have all settled, they are sieved out of the tanks and transferred to an indoor nursery tank system. Here they are fed high quality microalgae until they reach 3 to 15mm in length. Once the spat reach this size they can be sold to farmers for on-growing in intertidal or subtidal sites.

At present South Australian oyster growers can obtain their Pacific oyster spat from the South Australian Oyster Hatchery at Louth Bay, near Port Lincoln, or from hatcheries in Tasmania.

## **Grow-out**

### ***Techniques and equipment***

There are a number of different methods used for intertidal oyster culture in South Australia. These methods have been developed to best suit the physical factors of the site as well as the

size of oysters transferred on to the farm.

### **a) Intertidal racks and baskets**

The rack and basket method of oyster culture has been used since the inception of oyster farming in SA.

Rectangular shaped baskets, handmade from tough polypropylene mesh, are secured to the racks by two wooden sticks (approximately 1m length). The oyster racks are made of wooden posts (uprights) which are drilled vertically into the seabed and act as the main supporting structure. Attached to these are more wooden posts which run parallel to the seabed and hold up the baskets.

Farmers position the posts and oyster baskets according to the water depth and tides experienced at the farm site.

### **b) Intertidal racks and trays**

Spat, straight from a hatchery need greater protection than adult oysters when on the farm site. For this reason trays are generally used for spat smaller than 10mm. Trays allow good water exchange but also protect them from excessive currents which can cause the spat to fall out.

An oyster tray used to hold oyster spat. They are made of wooden frames with mesh covering secured to racks. They are usually separated into compartments to prevent oysters "clumping" up at one end.

### **c) Intertidal Long-lines**

In some areas of South Australia intertidal longlines and bags are used to on-grow oysters. The bags are made of polypropylene mesh; cylindrical in shape, 90cm length x 15cm diameter, and hung on a wire suspended by wooden uprights. The benefit of this system is that the height of the wire can be adjusted so the oyster bags can be lowered or raised depending on the tide.

The intertidal bag method. Similar to baskets, these bags are made of various mesh sizes according to the size of the oysters. The bags are designed to hang on a wire and move with the water currents. This rumbles the oysters and removes excess shell growth and improves meat to shell ratio.

### **d) Subtidal Long-lines**

In some parts of SA, farmers have access to sub-tidal sites where sub-surface or surface longlines are used to suspend a series of stacked trays (approximately 1.5 x 1.5m). These longlines are moored to the sea-bed and supported by buoys.

## **Stocking densities**

The number of oysters per basket (stocking density) can have a major impact on the growth of oysters. Although immobile, oysters compete for space and food and if stocking densities are too high or too low it can affect the rate of growth and shell shape of the stock. Appropriate stocking densities are an individual matter; the farmer evaluates the best densities according to growth of the oyster, the production system being used and environmental conditions of the area.

## **Grading**

Grading of oysters is a daily occurrence on oyster farms during the production season (approximately March to December). Oysters of similar size must be kept together to ensure that larger oysters do not out-compete smaller oysters for space and food. In addition, grading

and sorting oysters assists the farmer to keep stock movement records and coordinate harvesting. A batch of oysters may be graded every 6 to 8 weeks during their life-time.

### ***Harvest and post-harvest handling***

South Australian oysters are known for their creamy texture, fresh sea smell, pearly white inner shell and their "frilled" exterior. Together with a high meat to shell ratio, presentation of SA Pacific oysters is highly appealing. In order to maintain this image oyster growers must not only care for their product while on the farm but also from the time when the product leaves the farm until it reaches the consumer. This involves a whole series of steps which oyster growers in SA have documented as their Industry Code of Practice.

Harvesting for market occurs prior to spawning when the oysters are in peak condition (in SA this is in December when water temperatures rise). Oysters are brought in from the farm and graded into various shell sizes including bistro (50-60mm), plate (60-70mm), standard (70-85mm), large (85-100mm) and jumbo (100+mm).

The oysters are then packed into hessian bags (45 dozen oysters per bag for 50-60mm oysters) and transported in refrigerated trucks directly to the wholesaler or retailer. Delivery of the oysters must be within 24 hours of harvest. Oysters stored at 5°C has a maximum shelf-life of 10 days.

### **Quality assurance**

#### ***Water quality***

The oyster industry are actively involved in a water quality assessment program which aims to provide public health protection for consumers of SA shellfish. This program, called the South Australian Shellfish Quality Assurance Program (SASQAP) meets standards set down by the United States Food and Drug Administration, the benefits of this being the potential for export to otherwise restrictive overseas markets.

In addition to SASQAP, the industry together with SARDI Aquatic Sciences, are undertaking an environmental monitoring program to evaluate and monitor the area surrounding oyster farms in South Australia.

### **Further reading**

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**Author:**

Aquaculture SA.

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