OYSTER FARMERS HANDBOOK

Factors that should be considered by those that wish to make their way in the world as an oyster farmer. Selection of ground, spat catching, growing levels, growing oysters and marketing.

JOHN D. THOMSON 2021

Introduction / Preamble

In 1954, my Father Jim Thomson (Emeritus Professor Dr James Miln Thomson dec.) wrote a handbook entitled 'Handbook for Oyster Farmers' which was published by CSIRO as Division of Fisheries Circular No 3.

In that publication, he described the oyster as an animal, and factors that should be considered by the oyster farmer, selection of ground or lease area, catching levels, growing levels, spat catching, growing oysters, fertilizing beds and marketing.

He described methods of cultivation, diseases and pests, and tools and equipment.

I propose to update these to today

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Background

Oysters generally have hard shells with calcium carbonate making up 92% of the shell a with small network of living material while the oyster is alive. The meat is alive, with the shell being secreted by the mantle of the body. The body is attached to the shell by the white adductor muscle. It is round in shape. Oysters are generally white when opened. The mantle is an outer covering of the rest of the body and may have a dark or black fringe particularly in Pacific oysters. In Native or mud oysters the fringe may be a light fawn colour. The mantle covers the gills often referred to as the beard. The gills are a sieve which remove minute particles from the water entering the shell as well as allowing exchange to the oyster's bloodstream. Along the gills are minute hairs called 'cilia', which beating in unison pull water into the shell which is allowed to gape for that purpose. The water is pushed through the sieve of the gills and other cilia move the particles to the mouth which is at the hinge end of the oyster. The stomach or oesophagus then passes the food to two appendices where food is ingested. Waste food is returned to the stomach and travels down the intestine and the faecal matter is discharged from the anus on the other side of the adductor muscle and removed from the shell by the water current created by the gills. If there are too many particles being ingested whether organic or inorganic, the oyster will by-pass mouth and stomach and return the particles covered in mucous as 'pseudo faeces' in the expelled water.

The oyster has a heart and a blood stream. The heart can be seen beating behind the muscle, but the blood is colourless and difficult to see. The brain is primitive, being a slight concentration of nerve cells on the central nerve.

If environmental conditions are right, particularly when food is abundant or when the temperature has reached a certain level (22ºC) or increased by 2-3ºC, oysters may spawn. In Pacific oysters an increase of water temperature will often trigger spawning. In Tasmanian scallops *(Pecten fumatus)*, spawning is more frequently induced with food concentration. Oysters can select particles down to 1µm in size. They can therefore feed on bacteria and help clean up water in which they grow. One bacteria they seem not to able to ingest is *Vibrio parahaemolyticus* which can be toxic to humans. It is common in the US Gulf states and is associated with warmer water temperatures.

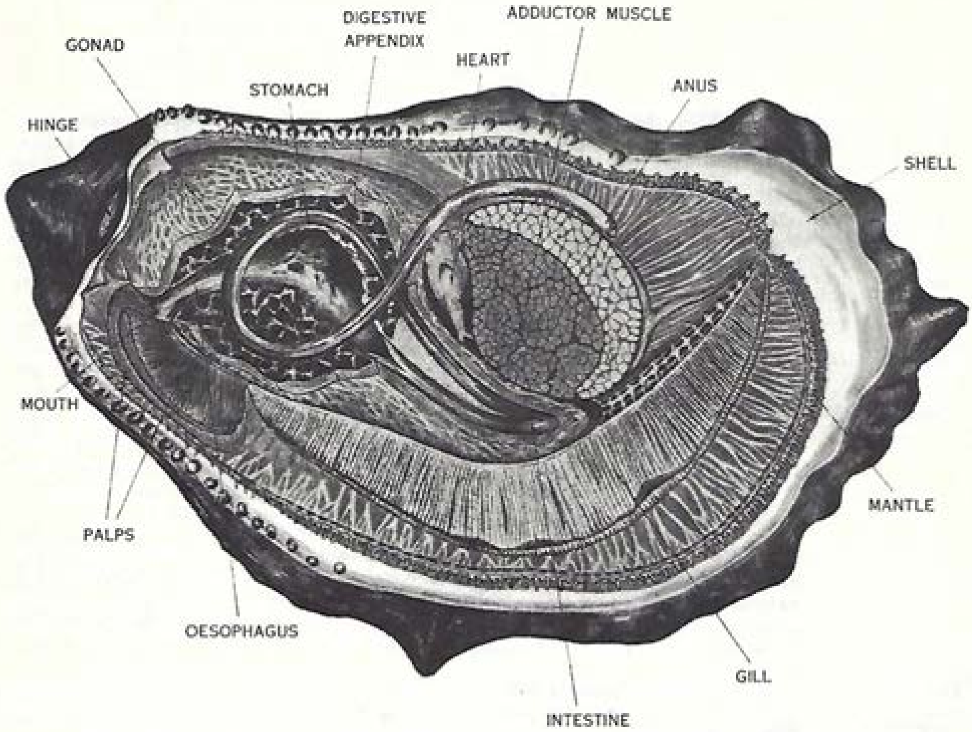
When oysters spawn en masse, streams of milky white clouds appear over the oysters. The gonads have spread over the body prior to spawning and their white appearance give what is known as 'condition' After spawning the gonad shrinks. In winter when gonads are not developing, 'condition' in oysters is an accumulation of glycogen, a fat that covers the oyster body as an energy reserve.

For the oyster farmer, particularly in southern regions, oysters may spawn once in a complete spawning or in other years may 'dribble' spawn, with slight amounts of egg release over several months. A complete spawning will render the oysters unsaleable but dribble spawning may give clear 'tips' on the oyster but still be saleable. The black colour seen in spawned out oysters is the gut.

Fertilization in Sydney Rock oysters and Pacific oysters takes place in the water. The fertilized eggs become larvae which swim around in the sea for 2-3 weeks, grow a small shell then settle down to a sedentary lifestyle. Oysters select a suitable settlement site either on timber or stone or shells, but artificial cultch, like cemented sticks or plastic slats may be suitable. The CSIRO found in the 1950's that fibre cement slats work well for spat settlement. Modern fibre-cement no longer has asbestos fibres so is safe. Plastic slats, being flexible allow the easier removal of the spat from the cultch. Oyster larvae may hover over suitable cultch in up to a 1knot current before settling. If no suitable cultch is found the oyster larvae will drift around and be eaten or eventually die. Mortality rates are high in young larvae and spat. Those that survive may live up to 10 and possibly to 30 years.

THE OYSTER AS AN ANIMAL

The oyster is an animal. It sleeps, breathes, eats, and produces young as do all creatures. The succulent meat within its hard shell is alive, the shell itself is only a by-product.



General Anatomy of the Oyster

The oyster is shown lying on its upper shell, with its left mantle and left outer palp cut away. Along the lower edge the mantle is against the shell and is covered in part by the gill and towards the hinge by the labial palps, which lead to the mouth. From the mouth a short oesophagus leads to the stomach, on either side of which lies the digestive appendix. From the stomach the intestine leads in a double loop to the anus, which is situated above the adductor muscle. The heart is between the intestine and the adductor muscle. The gonad is near the hinge and is shown here partly cut away.

Fig 1: Oyster anatomy.

History of Oyster cultivation in Australia

After English settlement in NSW in 1788, the local rock oysters *(Saccostrea glomerata)* were exploited from the rocks on which they grew and then oysters in deeper waters were dredged. In southern Tasmania, the native oyster *(Ostrea angasi)* was exploited by dredging and millions of them were sent to market in Sydney. A disease *(Bonamia)* and overfishing led to a decline in populations and led to Saville Kent establishing oyster Parks in Taranna, Oyster Cove and Cloudy Bay Lagoon on Bruny Island. Oysters were laid on the seabed where they were expected to grow and to later be harvested. The Tasmanian government abandoned these plans and the beds once Saville Kent moved to NSW. It is interesting that Jim Thomson describes slat catching of spat, stick cultivation, tray cultivation, rock cultivation, shell beds and dredge beds but does not describe scallop shell as cultch nor raft culture nor line culture which he saw in Japan in 1948. On that trip, he chose Pacific oysters *(Crassostrea [now Magallana] gigas*) to be brought to Australia by ship. The oysters were examined carefully for oyster drills to try to avoid bringing that pest to Australia (Thomson 1952, 1959).

The cultivation of the Sydney Rock oyster began in the nineteenth century and continued. Initial farming used rocks and black mangrove sticks before sawn sticks and trays were added to the tool kit.

In the NSW Sydney Rock farming industry, oyster spat catchers *(cultch)* were deployed at the seaward ends of the estuaries, either on rocks placed on the sea bed or on tarred sticks. Once the caught spat had grown sufficiently, the oysters were knocked off the sticks with a hammer and the oysters put into trays to grow to market size. The Sydney Rock Oyster occurs naturally from Queensland (1770) down to the north east River on Flinders Island, Tasmania. In the 1930's the Tasmanian government asked the Commonwealth government if Pacific oysters could be imported to develop an oyster industry in that state and the Western Australian government also sought help to establish an oyster industry in that state. Because of the drums of war, these imports were delayed until after WWII. In 1947, CSIR employee Ferguson Wood was sent to Japan to bring back a shipment of oyster juveniles; as sufficient survived, Jim Thomson was sent over in 1948, he looked at oyster culture techniques and examined oysters to determine if they were suitable for export to Australia. He went to Hokkaido, Sendai and Hiroshima and ordered oysters which were shipped to Kure where he and they embarked on the MV *Duntroon*. The ship arrived at Sydney then they flew to Tasmania where the oysters were set out in Pittwater near the Hobart airport.

Others were later taken to Oyster Harbour in WA. Those in Pittwater survived and reproduced. Those in Oyster Harbour did not. In those years, the water temperatures were cold in southern Australia which may have affected spawning or larval settlement. I have also been told by locals in Albany that the oysters were delicious. Too many seem to have been eaten for them to survive and breed. Further imports of Pacific oysters were brought to Tasmania in 1950 and up to 1953. Oysters were relayed in virtually every estuary in Tasmania. They reproduced in many estuaries, but in the Tamar estuary, the oyster population exploded, probably fed by the sewage that flowed into it. The first oyster leases were issued in Tasmania in 1970 and 1971. Spat cultch material was laid out in the Tamar each year. Initially all cultch was tarred sticks covered with cement. Then a few individuals started putting out scallop shells on wire circles to catch oyster spat. The Tasmanian Division of Sea Fisheries employed a university student each summer to take plankton samples in the Tamar estuary; when sufficient eyed oyster larvae were present in the plankton samples, the word went out to the oyster farmers to deploy their collectors; This usually occurred around Christmas.

In 1978 and 1979 there were failures in spat collection in the Tamar; the industry approached the Sea Fisheries for help. Dr Trevor Dix, Martin Sjardin and Carol Dix began to spawn oysters at the Taroona laboratories and raised the spat. Once the hatchery techniques were running smoothly, the techniques were handed over to Shellfish Culture Ltd a company set up by the oyster farmers to guarantee their spat. The Cameron Company also started a hatchery at the same time

In South Australia, Mick Olsen, Director of Fisheries was pushing for an oyster industry there. Sydney rocks would not grow, but Pacifics would. Initial farms were set up in the early seventies without much progress due to a lack of naturally occurring spat. In the 1980's, South Australian terrestrial farmers asked oyster farmer Roger Calvert from Pipeclay Lagoon, Tasmania, would he go to South Australia to show

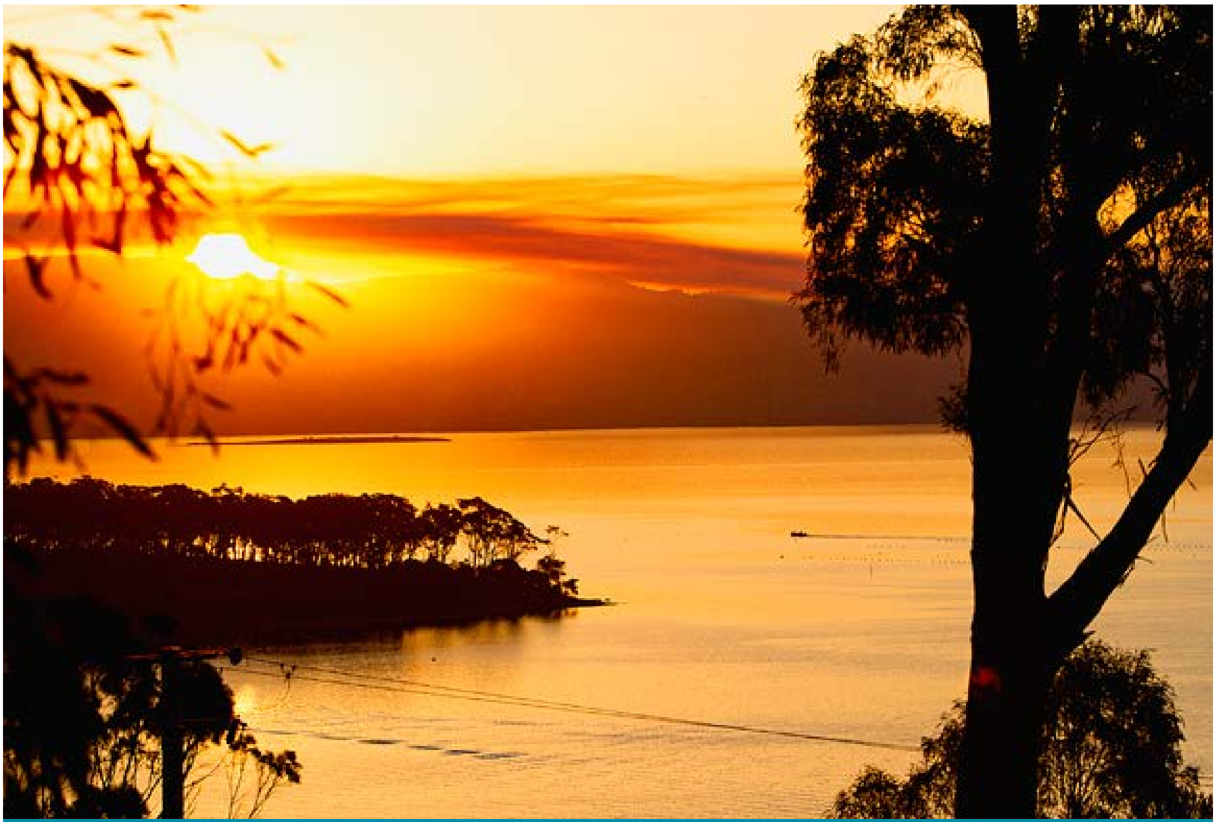


Fig 2: Ford Bay, Bruny Island, Tasmania, a pleasant evening overlooking the 'office'

them what to do to grow oysters? This he did, and the South Australian industry took off. Initial attempts at hatchery production of spat in South Australia were not successful, so the South Australian growers obtained their spat from the Tasmanian hatcheries, including the Cropps of Bicheno and Ken Bailey at St Helens.

When POMS affected oyster farms near Hobart, the South Australian government banned imports of live oysters from Tasmania for relaying. The Tasmanian east coast hatcheries stopped producing. These incidents put a hole in South Australian production until two new hatcheries in South Australia built in conjunction with Shellfish Culture and Camerons of Tasmania, and started producing oyster spat in ever increasing numbers. With the loss of up to 60% of their spat market, the Tasmanian hatchery companies have turned more to farming the oysters.

In Western Australia, there is an oyster farm at Oyster Harbour near Albany. There was a farm near Carnarvon. In Victoria only native oysters may be produced, and are mainly grown in Port Philip. In Queensland, there have been Sydney Rock oyster farms in Moreton Bay for at least 70 years, but the effects of QX disease have wiped out their farms many times. The solution has been to raise QX resistant stock in hatcheries. This goes against normal practice in NSW and Qld where most spat are wild collected. In Tasmania, to overcome the POMS problem, the Australian Seafood Industries group (ASI) have produced POMS resistant Pacific Oyster broodstock which has allowed the industry to recover. Sydney Rock oysters seem not to be susceptible to this disease.

In New Zealand, they received POMS in their waters before Australia and before them, the French discovered POMS in their waters. In their industries, up to 95% of growing oysters were wiped out. In NZ, most of their spat are wild-caught whether Sydney Rock or Pacific Oysters, so POMS in Pacifics is a greater problem there. The solution is to switch to POMS resistant broodstock in hatcheries. POMS or Pacific Oyster Mortality Syndrome is a Herpes-like virus, not believed to come from a laboratory.

Oyster Farming

If not purchasing an existing lease, the selection of an area in which to farm, depends on the delineation of aquaculture areas in each State or Territory. The type of site will also depend on the species to be cultured and the culture methods chosen

For intertidal leases, the area should not be exposed to heavy seas (wind induced wave action), nor strong flooding. If an area is prone to flooding, oysters can stay shut for up to a week, but after that they must open to exchange oxygen and feed. Generally, oysters do not like salinities below about 10ppt (parts per thousand). They prefer saliinites of 20-25ppt. Normal seawater is 34-35ppt. Temperatures in the area may also influence selection of a site; juvenile oysters will stop pumping water below 10ºC, adult oysters will cease pumping below 6ºC. If oysters cannot pump, they cannot grow. That said, Pacific oysters in their native habitat in Japan live in waters from below zero in winter time in Hokkaido to 28ºC in summer in the Inland Sea. In the Bras d'Or in Nova Scotia, Pacific oysters stay alive in winter even though the surface is covered by ice. As they do not occur further south than Flinders Island in Tasmania, Sydney Rock oysters prefer water temperatures above 15ºC.

Fig 3: Seed trays being taken to shore, Cloudy Bay Lagoon, Tasmania

For Sydney Rocks, the best catching areas are towards the mouths of estuaries and the best growing areas are further upstream where the bottom substrate is muddier. For Pacific Oysters, although they grow better in brackish water, they can grow quite successfully in full strength seawater. They can also grow in muddy areas but grow better over sandy substrates. Too much freshwater affects the oysters, but the algae on which the oysters feed, grow best at salinities around 25ppt.

One of the great advantages of oyster farming is that the oysters are not fed by the farmers but by mother nature. The algae are microalgae, not seaweed macro algae, and are single cell organisms or small-length chains. They can be diatoms or dinoflagellates. Whatever algae are in the water, the oysters will feed on; different species of algae have different temperature and salinity tolerances. Accordingly, algae present in large numbers in summer may be completely absent in winter. Interannual variability in water parameters can cause algal differences which mean different growth rates and finishing from one year to the next.

Oysters grow reasonably well on the seabed and on racks or lines above it, but do not grow well within 200mm of the substrate, seemingly an ionic exchange with the substrate that the oysters do not like.

The gradual decline of annual NSW Rock Oyster production since 1970, is associated with the growth of human population in NSW and the preference for people to live near the coast. Bacterial and viral contamination occurs if sewage is not treated sufficiently. Nationally there is the Australian Shellfish Quality Assurance program (ASQAP) which creates standards for oysters for exports and approves export establishments. The States have comparable Shellfish Quality Assurance Programs. The oyster producing states have microbial testing of growing areas before approval, and monitoring for heavy metals etc. Growing areas tend to be shut down based on rainfall in a growing area because of a general correlation with bacterial load. In particular, Departments of Health measure overall numbers of coliforms or faecal coliforms rather than measuring specific *Escherichia coli* that affect humans. It is a precautionary principal that costs oyster farmers dearly. *Noro* virus comes from

raw sewage and if detected shows a breakdown of the sewerage system; in St Helens, Tasmania, in the past, flood waters have inundated the sewerage system causing oyster leases to be closed until the sewerage system could be restored. In the Wallace Lakes in NSW, a court decided in favour of the local municipal council saying they did not owe the oyster farmers a duty of care to provide a clean lake to grow oysters in; arrant nonsense in my opinion; their sewerage scheme was faulty and should have been fixed. The oyster farmers should have been compensated.

Another consideration is access; it is preferable to be able to have a foreshore shed in which to shelter from the weather to grade and market oysters, to store equipment and be able to easily load that equipment into a vessel to be able to deploy it. Distance to the lease from the shore base also will determine the size of vessel and running costs. As an example, in Coffin Bay South Australia, the local council provided an area where oyster farmers could erect their sheds; they have to move with their vessels to the boat ramp built for the purpose of launching their vessels. Although there are some leases close by, most are towards the mouth of the estuary and necessitate a 22km journey; accordingly the vessels must be large enough to carry a load, traverse rough seas and get to the leases in quick time.

Whichever species is grown and whether upstream or down, of primary consideration is water movement. The movement of freshwater over the lease or the tidal movement of seawater bringing new algae; if either water is depauperate in terms of algae, then the oysters will not grow and fatten.

Seabed Culture

In other parts of the world, shell beds were maintained by carting oysters to the seabed and allowing spat to settle on the shells on the reef to maintain the reef. Harvest is done by hand or as in the Chesapeake Bay fishery by tongs. In other parts of the world, oyster beds are dredged just as they did in Tasmania and NSW in a fishery.

These beds can also be augmented by addition of spat caught elsewhere. Apart from the labour intensive replacement of spat collecting shell, pests can easily attack a bed of oysters; seastars, mud-worms, oyster drills and bream can destroy the beds. Skates and rays will hoover up any oysters scattered on the bottom

Intertidal

These methods are traditional, where oystermen can retrieve their oysters at low tide. In France, the horse and dray were used to move oysters and their sticks and tiles over the sandy substrate. In Tasmania, tractors were used to transport vessels across the dried sea bed and often to launch flat bottomed punts to continue the work in shallow water. In NSW, the punts are open with high sides; the oyster farmers lean out of the punts to do their work; in Tasmania and South Australia, closed deck punts are used with gated sides for long distance travel. Here waders and wet suits are worn to enable the farmer to step off the punt onto the seabed to do his work bending over the rack or longline. In NSW, one farmer told me that if he stepped over the side, he would sink up to his crutch in the mud and would have great difficulty extracting himself. The Sydney Rock Oyster tends to be grown further up the estuaries in areas with reduced salinities and softer sediments than Pacific Oysters.

In consequence of their tidal range, the South Australian farmers (Baker, Schutz and Turner) came up with the idea of the adjustable longline. Here, plastic coated cord (Bayco) is used as the 'longline' strung between posts 100m apart. There are intermediate droppers every 2m. The posts and the droppers are fitted with riser clips at 3-4 different heights 100mm apart. The farmer can walk along lifting or lowering the line to limit biofouling in the cylinders or speed up growth of juvenile oysters. This system is used by both BST and Seapa (Gary Thompson), with small differences in the shape and construction of the baskets and the type of clips that hold the cylinders or units to the longline.

Another South Australian company produces hexcyls (Gary Seidel) with a hexagonal shape and a slightly longer unit.

Whether rack and rail or adjustable longline, wooden posts are driven into the seabed. To deter toredo worms, posts are usually treated pine (CCA-copper chrome, arsenite), though plastic coated pine posts (Woodshield) and recycled plastic posts are being used. For rack and rail, 50 x 50 mm posts are driven into the seabed manually by 'post thumpers' (square section steel tube with reinforced end and two handles) or using petrol driven post drivers used in agriculure or as I have used, a pneumatic post driver by Marchant Engineering. While larger posts can be driven this way or using tractor mounted agricultural post drivers, a hydraulic spear is the implement of choice for 75, 100 or 200mm diameter posts. The spear is usually galvanised water pipe or aluminium tube through which salt water water is pumped, usually by a fire pump, also petrol driven. The post is stood up on the bottom and the spear driven into the substrate next to the post; by using the spear around the post a hole is soon made beneath the post and the post pushed down to the required depth. The sediment around the larger posts should be allowed to consolidate for a few weeks before applying a load to the post. Shell in the substrate can make it more difficult to sink the posts; Pipis can be blown through easily, but remnant *Ostrea angasi* shell bands are harder to penetrate. If using rails, they should be nailed to the posts at low tide; although nailing underwater is feasible, it is easier to get the rails parallel to the water surface if rails and water are separated.

Fig 4: Longline vessel, Dover Tasmania, showing deck crane and tooltech trays.

Fig 5: Rod Terry, Batemans Bay, NSW punt showing high sides and Zapco floating poches or envelopes that clip onto ropes or lines with the stainless shark clips shown.

Fig 6: A larger NSW punt *(Proali)* with loose oysters Hawkesbury River.

Stick Culture

In Arcachon in France, in NSW and Japan, oysters have been raised on sticks driven vertically into the substrate. In Japan, that system was called shibi. In NSW 25mm x 25mm sticks were tarred and often cemented. The sticks were laid out horizontally in spat collection areas in double density and separated to normal density and the sticks nailed onto horizontal rails (see Figure 7&8).

The oyster would grow out to market size and be knocked off the stick with a hammer. Small oysters were put into trays and then grown to market size. Initially trays were made of wood with zinc coated chicken wire, but later plastic mesh was used and then wholly plastic trays were manufactured.

Plastic meshed wooden trays are often used to grow out spat. If 2mm mesh is used, 3mm spat can be grown out. If 4mm spat is used, then 3mm mesh in the trays can be used. The tray consists of 50mmx25mm treated pine around the perimeter and across the trays. The trays are 1.5m long and 900mm wide or for easier handling the trays can be half width. The length of the tray and the timber extending lengthwise is to allow attachment to racks whether by nailing or more commonly by use of rubber bands. The rubber bands are made by cutting up used tyre inner-tubes which in these days of tubeless tyres are not common. Lids of the trays are made using 25mm x 25mm timber with sometimes 25mm x 12mm slats across. Lids are usually screwed to the bases but sometimes nailed. There must be a tight fit or the spat will be forced out any gaps by wave action. Mesh is attached to the timber by staples. Usually four to six sections are created in the tray by the cross beams (Figure 9).

For growing out larger oysters, particularly those that have been rejected once by grading for market, the lid may not be required. In rougher waters, lids are needed to stop wash-out of oysters. Tooltech make a 1 m square oyster tray (Figures 10,11).

Two trays can be clipped together to stretch over the traditional oyster racks or trays can be attached across two Bayco lines. (Figure 14)

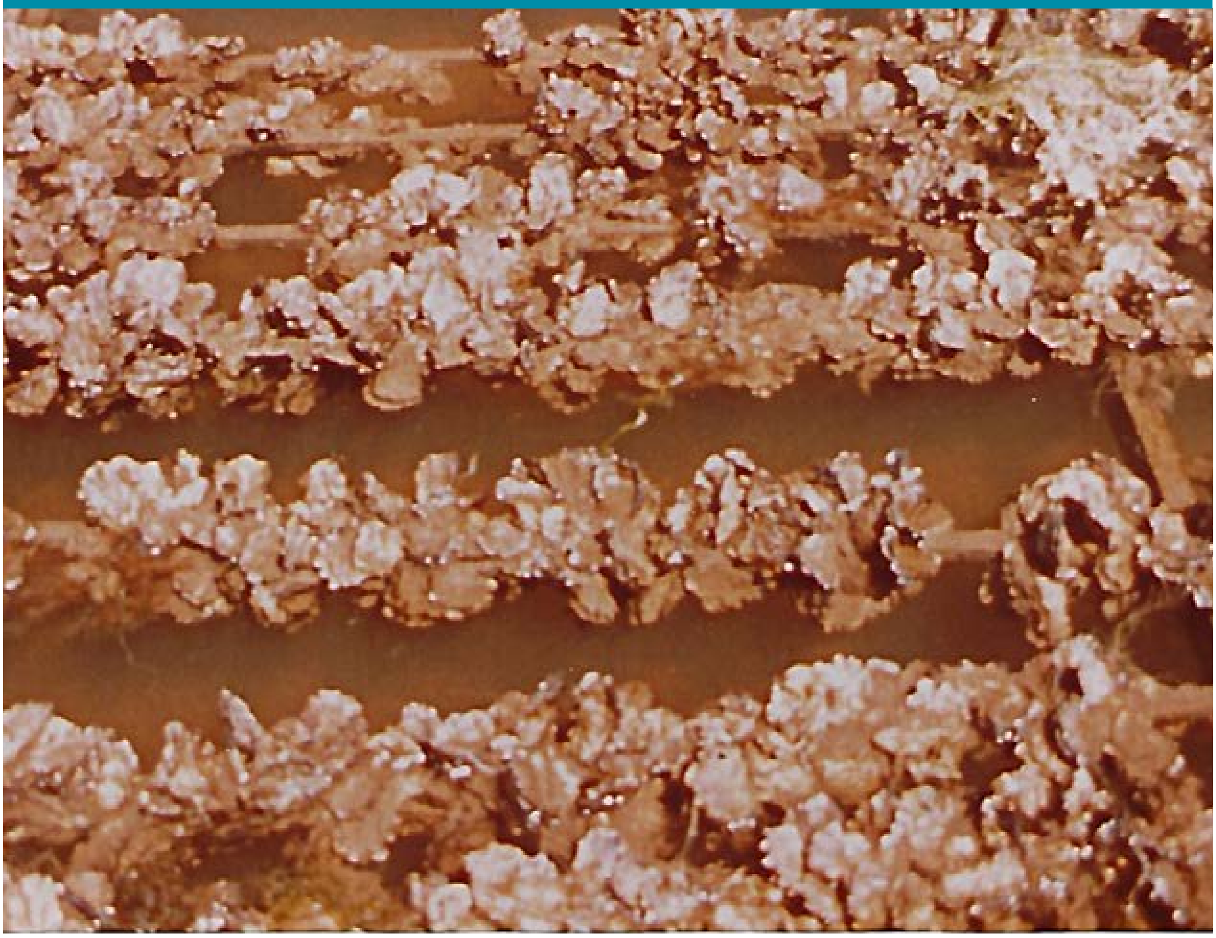
Stick and tray culture were the usual method of culture in NSW replacing the old vertical sticks. In other parts of the world like Arcachon in France, the shibi method is still used, as well as limed tiles. The tiles are laid out in spat collecting areas in bundles and after spat catch are relayed on growing areas also in smaller clumps. Also in Arcachon, and in the UK, steel frames are placed on the seabed and 'poches' or pockets are laid on top for growout. Oysters must be removed from sticks and tiles, using hammers or 'picks but many fall off. Any rejects need to be put in trays or poches to finish.

Loosanoff and Galtsoff, both NOAA scientists in the US, wrote tomes on oysters in which they described the anatomy and physiology of the Chesapeake Bay oyster, the Portugese oyster and the Pacific oyster. The oyster is alive and it grows by enlarging its shell through opening the shells, putting the mantle outside and depositing new shell at the margin. Because of the likelihood of predation during daylight hours, shell growth tends to be during the hours of darkness. Oysters can grow more quickly if the conditions are calm. Rough conditions (wave action) prevent the oysters opening and the mantle cannot do its work. To grow shell on oysters, conditions need to be calm. If conditions are rough, then the oysters will not open to make the shell bigger but will deposit shell inside, thickening the shells and making them stronger. Another plus if this happens is that nutrients are used to make the meat bigger. So to reduce shell growth and make the meats bigger, allow oysters to have some wave action. If wave action is too severe, the oysters cannot open to feed and will not improve, the shells become abraded if cultch free and can become smaller in shell size.

If low tides occur during winter nights, the oysters cannot grow. This happens in southern Tasmania.
For meat condition, algae must be sufficient to 'fatten' the oysters. Some farmers will raise the growing height of oysters they wish to finish so they cannot grow as much shell as they are out of the water longer during the tidal cycle.

Fig 7: Stick culture racks in Tasmania

Fig 8: Close up of oysters growing on sticks showing frilly shell and how oyster may clump together



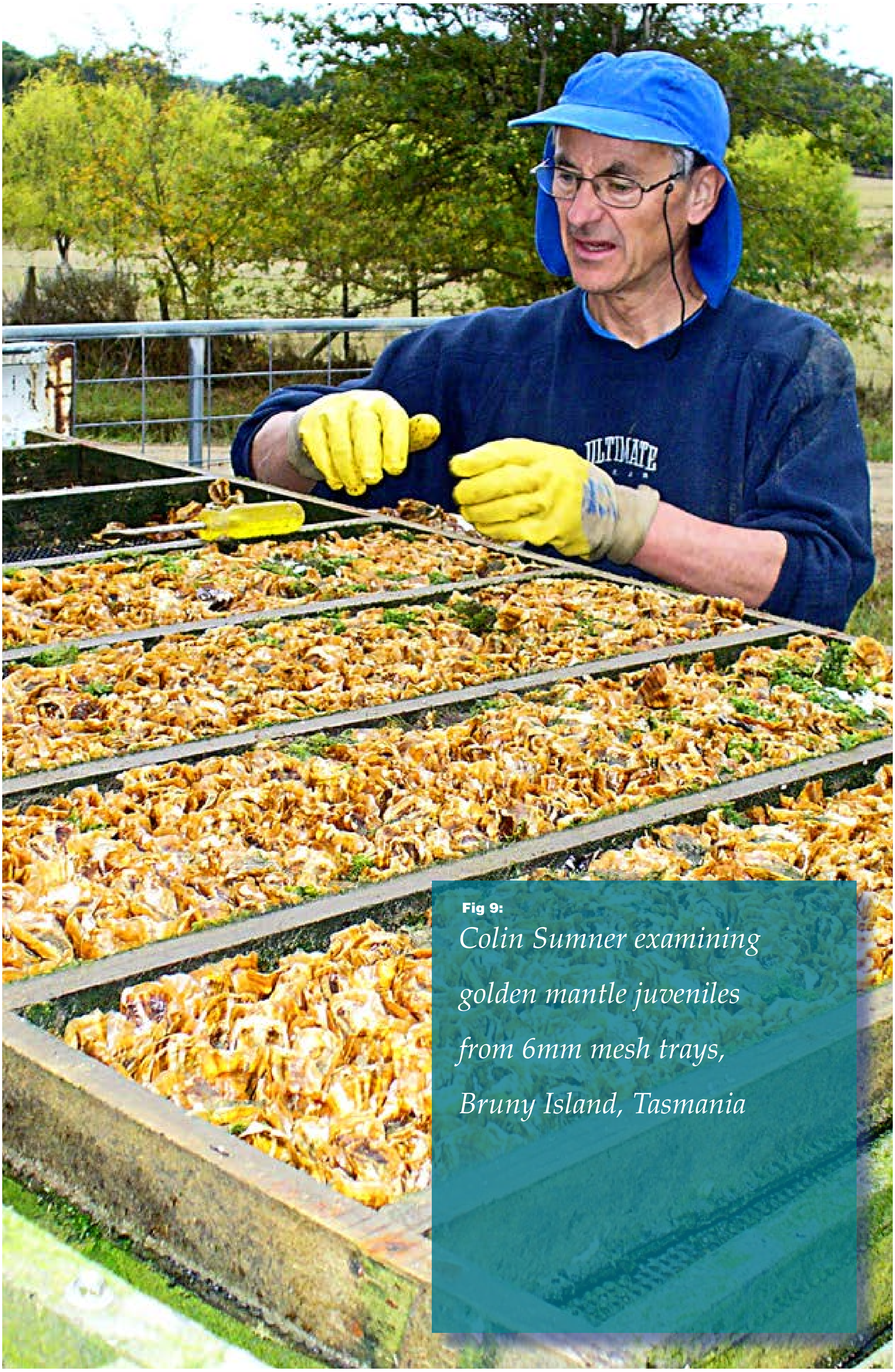


Fig 9:
Colin Sumner examining golden mantle juveniles from 6mm mesh trays, Bruny Island, Tasmania

Fig 10: Plastic tray with lid removed

Fig 11: Pacific Oysters grown in tray culture Shoalhaven, NSW

SEABED CULTURE

Fig 12: Tooltech Trays, Dover Tasmania

Fig 13: Tooltech trays with lids adjacent, Batemans Bay, NSW

Fig 14: Showing oyster trays placed across Bayco lines, Tuross, NSW

Fig 15: Stanway spat cylinders on longlines, Shoalhaven, NSW

Fig 16: 1mm mesh liners for Seapa cylinders for small spat.

Poche or Plastic Basket Culture

In Tasmania, the failure of wild caught spat, threatened the viability of the industry so hatcheries became the main method of spat production. Once oysters were produced in hatcheries, the spat were initially settled on small pieces of ground-up shell; the size of particles were carefully chosen (0.2mm) so only one spat would settle on each shell particle and not two. This meant hatcheries needed nurseries to produce spat for sale that could be placed into 3mm plastic mesh. An alternative is to grow oyster spat in smaller mesh, down to 1mm (Figure 16).

This means that more containers are required and the small mesh bags clog quickly with algae. Nowadays, a chemical like L-Dopa or epinephrine is introduced to the veliger larvae to induce them to settle on the container or flexible plastic strips, which allow simple removal of the spat at a later date.

In response to POMS, the NZ industry is producing spat in a hatchery and nursery. Figure 17, shows small spat (3mm) Figure 18, shows larger spat (5mm) and Figure 19, shows spat at 12mm. The overall nursery system is shown in Figures 20,and 21.

The Zapco spat strips can be assembled into stacks or now purchased as a unit with plastic ends that prevent the slats from being washed away by wave action. A photo of one of these slats is shown in Fig 22 and the old method of building a spat collector from the slats is shown in Fig 23.

Fig 17: 3mmm spat ready to go into 2mm mesh or less.

Fig 18: 5mm Pacific Oyster spat ready for 3mm mesh trays basket or cylinders

Fig 19: 12mm spat ready to go into 5 or 6mm mesh trays, baskets or cylinders

Fig 20: Nursery system at Cawthron Institute Nelson, NZ

Fig 21: Upweller detail Cawthron Institute, Nelson NZ

Fig 22: Detail of slat with caught Sydney Rock spat

Fig 23: Zapco slats being assembled before deployment for spat catching Batemans Bay, NSW

Fig 24: Two basket unit containing oysters

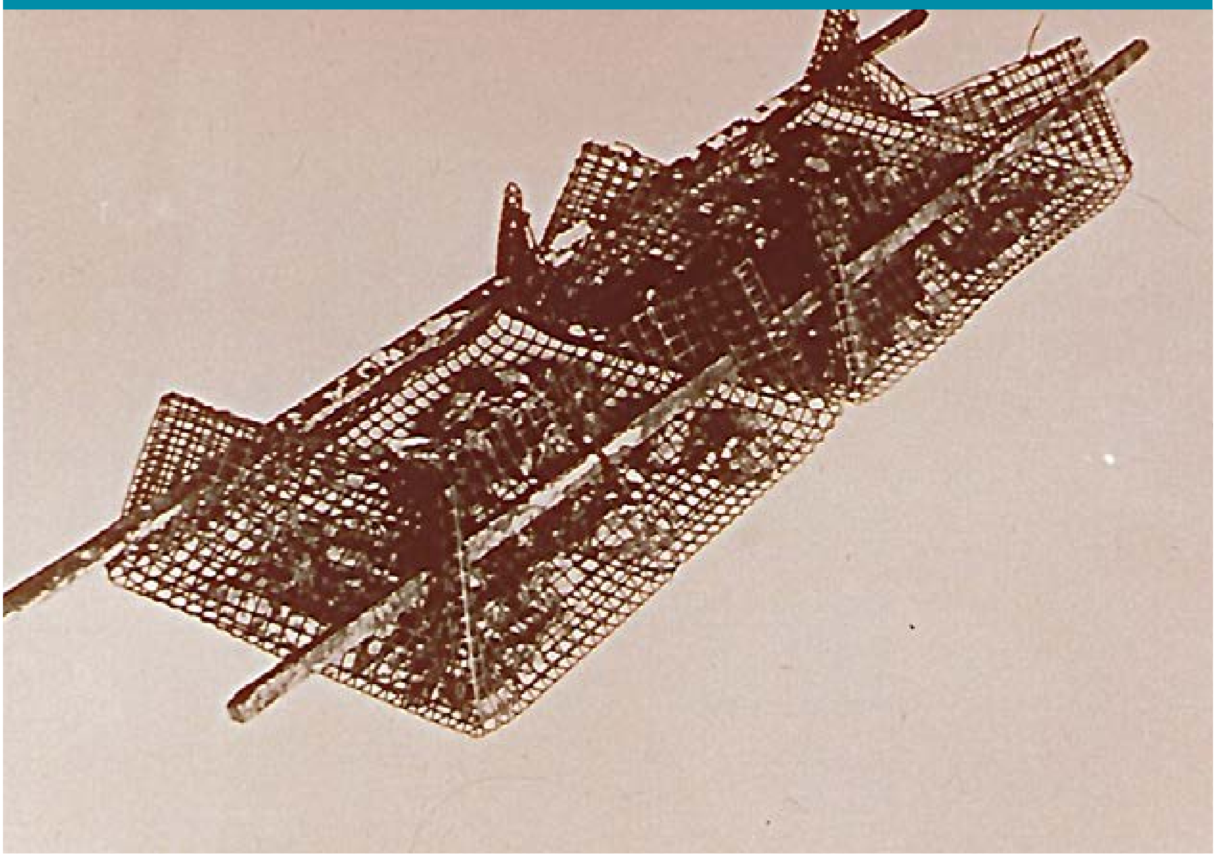


Fig 25: Two unit baskets on rack and rail Cloudy Bay Lagoon, Tasmania

In Tasmania, once 'cultch-free' oysters were available, a range of baskets made from plastic mesh were tried.

The two basket unit as shown in Figures 24, 25 was very common in Tasmania. The size of the mesh in the baskets increased as the oysters increased in size.

Alternative culture methods include the use of Seapa cylinders on sticks or BST, Seapa and Hexcyl cylinders on intertidal longlines. In Figure 26, large Seapa units are shown on sticks on post and rail racks. The advantage of this compared with the open two basket unit is that washout cannot occur with wave action.

Traditional racks could be used for bag culture by nailing sticks across the racks and stapling or nailing the bags to the sticks. These methods have been used in both NSW and Tasmania.

Figures 26, 27 show Seapa cylinders used on an intertidal rack in Cloudy Bay Lagoon Tasmania.

One problem occurs with these Seapa units or Hexcyls on sticks close together, is that they present a resistance to wave action which especially if combined with biofouling of the cylinders, jacks the posts out of the substrate. Either more space between units or longer posts will solve the problem.

In France, the poche or envelope is placed across racks. The zapco basket/poche used in China and Australia has two floats attached. The basket is attached to a Bayco Line or rope strung between two poles. This means the basket is always at the surface and always in the water until inverted. Flipping these baskets kills off the biofouling and is done for 2-3 days and the baskets flipped again to resume normal growth of the oyster.

Being out of the water helps harden the oyster muscle and shell. Figure 29 shows Zapco baskets at Narooma, NSW. This system works well where the estuaries are sheltered, but does not work well if the bags and lines are subject to much wave action.

Spat of 4mm are placed in to 3mm mesh bags or cylinders. Once they grow to 8-10mm in shell length, the spat are graded using mesh sieves. The spat that sit on the sieves are then placed into 5 or 6mm mesh cylinders or bags. Those that fall through the sieve are returned to the 3mm containers. The oysters that sat on the sieves are grown to 30-40-mm shell when they are then sieved on 20mm sieves and put into 15, or 16mm cylinders or bags. They are then grown out to 40-50mm shell length and then sieved on 30mm or 40mm sieves and put into 20mm mesh bags or cylinders.

At Cowell on South Australia's Eyre Peninsula, the growers (Baker, Schutz and Turner) invented an adjustable longline. The original BST system and Seapa (Gary Thompson) longline system have strainer posts at each end (usually 200mm diameter) and the lines are 100 metres long. Every 2m there is a dropper (50-75mm diameter).

Posts and droppers have plastic 'riser clips' nailed or screwed onto them allowing the line to be adjusted in 100mm height differences. Originally two or three lines were placed together to form a 'rack' but now most new installations have four lines together. The baskets or cylinders hang from the line on plastic clips; these clips have been modified over the years, and in rough water rubberised clips are used. The original clips were hollow, but the newer ones are solid plastic, because in rough weather, wave action suspends sand particles which get into the moving clip/line joint and wear away the clips.

Figure 28 shows an intertidal longline with Seapa cylinders North Stradbroke Island, Queensland.

Fig 26 : Closeup of Seapa cylinders on sticks

Fig 27: Closeup of Seapa cylinders on sticks

Fig 28: Intertidal longline at North Stradbroke Island Qld

Fig 29: Zapco bags on lines Wagonga Inlet, Narooma NSW

Fig 30: Henry Hewish, 7m Lyndcraft vessel, with Seapa basket from an intertidal longline and stick baskets for rail and post rack..

Fig 31: Bamboo oyster rafts near Myajima and Hiroshima Japan

Deepwater Culture

By deepwater I mean sub-tidal; the oysters cannot be retrieved by standing on the seabed. In Japan in the 1940's bamboo rafts were used and are still used to grow juvenile oysters to market size. Cross beams of the rafts carried rope droppers into which scallop shells were wedged. These scallop shells had been put out to collect the naturally occurring Pacific Oyster spat. This type of culture allows oysters to grow together if there are too many spat per shell, and the oyster tend to grow out long, thin, and flat. In Spain and Australia similar rafts and dropper techniques have been used to culture mussels. In Japan, the dropper ropes can sometimes be strung between two vertical bamboo poles stuck into the substrate, but the oysters don't grow as well as those on vertical droppers.

Figure 31 shows the rafts near Myajima, not far from Hiroshima, Inland Sea Japan.

Fig 32: Juvenile Pacific Oysters caught on shell inserted in rope droppers Japan.

In Figure 32, is a sample of oysters being grown on rope droppers in Japan.

In Japan, Pacific oysters and scallops *(Patinopecten. yessoensis)* are grown on deepwater longlines with spat being caught in fine (1mm) mesh bags containing scrunched up nylon filament mesh on which the spat may settle. Spat bags are retrieved and the spat removed from the inner mesh and placed into 4mm single level lantern cages. They are grown out and as they grow are transferred to larger mesh lantern cages with from 10 to 15 levels.

The advantages of deepwater culture are the three dimensional spread of oysters, the full utilisation of all the food flowing past in the water, but the disadvantage is the extreme amount of biofouling that occurs in productive water from ascidians, barnacles, mussels etc.

Figure 33, shows scallop spat being stripped from spat bags at Triabunna, Tasmania. A nylon or polythene mesh is scrunched up into 1mm mesh bags which are deployed into the sea and retrieved some 3-4 months later and the spat removed. A similar system is used on the Canadian west coast for oysters. In Tasmania, the utilization of deepwater was initially rafts and longlines with rope droppers; the Scallop Enhancement Research Project at Triabunna used lantern cages in 23m of water.

Now, deep water oyster culture in southern Tasmania, is by rope longlines with attached Seapa modules. Usually there are six Seapa cylinders per module, if using a crane or derrick, but if hauling by hand, a five cylinder unit may be better. It depends on how much biofouling occurs and that may depend on how frequently the units are raised and exchanged and which season of the year.

Inshore intertidal farms are marked by signs on posts driven into the substrate, but deepwater farms must be marked by buoys; some States do not like white floats, so black floats must be used, but for corner markers, yellow is preferred to prevent collision by other vessels.

Such markers have St Andrew's cross which acts as a radar reflector as well as reflective tape; they usually will have a solar powered flashing light.

Fig 33: Scallop spat bags at Triabunna Tasmania can be used for oyster spat.

Fig 34: Lantern cages filled with scallops, Triabunna Tasmania.

Fig 35: Six unit Seapa modules.

Fig 36: Fouling by oysters and ascidians on cage module

A typical deepwater farm will have longline backbones of 100m similar to the intertidal longlines. Most 22mm and 25mm rope comes in 220m coils, so two long lines can be produced from each coil.

Aaron Pannell from MarlboroughSounds in NZ, has developed another method of floating culture of oysters in deep water. The Marborough Sounds have many green lip *(Perna canaliculus)* mussel farms. The 'Flip Farm' uses a similar 25mm longline as the mussel farms. The floating cages or baskets have a hinge which is threaded onto the main line. The Flipfarm system uses Hexcyls developed by Gary Seidel and family in South Australia. The baskets can swing with the waves. The beauty of the system is that the baskets do not have to be brought ashore. A secondary leaded line hangs beside the main line and the barge can winch itself along that line flipping the baskets as it goes. This prevents biofouling of the baskets. For grading or harvest, the baskets come up a ramp onto the barge and are opened and the oysters taken ashore for grading or market. If the vessel is large enough it is possible to grade on the vessel and return the oysters to different baskets. Like the other brands of baskets, the baskets have differing mesh sizes to cater for differing oyster sizes.

The longlines can be anchored by posts in shallow water or with concrete blocks or steel anchors in deeper water. If using posts, do not tie off the lines to the posts, but use hoops or large rings over the posts so the line and baskets can move up and down with the tide. Otherwise, with a tied line, the tide will fall and the baskets may flip when not intended. If you must tie off, inadvertent flipping can be prevented by allowing enough spare rope at each end so the baskets are always in the water, even at low tide.

The flipped basket have the floats beneath and the oysters and basket above. They should be kept in this position for two days and flipped back to where they were. This should kill the biofouling without killing the oysters. A longer period may be needed for mussel and oyster biofouling but this will cause a check to the growth of the caged oysters.

Fig 37: Corner markers for deepwater farms showing the cross with reflective tape.
Fig 38: Deepwater Farm, with corner marker and black floats on the longline, Great Bay, Tasmania
Fig 39: Tasmanian 10m oyster barge with deck crane and rollers.

Disease and Pests

As indicated previously, any oysters on the seabed are prey to seastars, mud worms, oyster drills, bream, leather jackets which can eat juvenile oysters as can rays.

Even intertidal oysters are subject to seastars climbing the posts to attack oysters on sticks or open baskets. Bream and leather jackets are pests of oysters on sticks and open trays and baskets. Rays find it hard to eat anything that is not flat on the seabed. The cylinders are better at keeping these pests at bay.

In NSW and Qld there are whelks that are the main oyster drills; fresh water flushes them away as they are susceptible to low salinities. The tingle whelk and mulberry whelks drill neat round holes in the oyster shells but the hairy whelk chips away the shell margin making a square shaped hole into which digestive juices are secreted and the oyster is killed and eaten.

The mangrove crab *(Scylla serrata)* can crush oysters with its powerful claws. They also burrow next to posts which can fall over. In NSW estuaries, some farmers erected mesh fences to keep out rays and fish from their oyster racks.

In all waters, some of the biggest pests are the toxic dinoflagellates; dinoflagellates are generally oyster food; these dinoaflagellates do not harm the oysters but the toxins that accumulate in the oysters can cause diahrroea, memory loss or paralysis of the nerve system in humans

As part of the Shellfish monitoring programs of the State departments, seawater samples are monitored for the presence of dinoflagellates, and the oyster meats are monitored for saxitoxins. If dinoflagellate numbers exceed threshold numbers or toxins concentrations are too high, oyster harvesting is suspended until two readings a week apart are below the thresholds.

Mud worms, *Polydora* and *Boccardia* usually invade oysters if they are too close to the bottom or the baskets fall to the bottom. They can drift into long line oysters but are much less common. The mudworms drill through the shell leaving 'mud' inside, which the oyster 'papers' over with nacre; the thin shell is much darker than normal nacre and is unsightly to the point of the oysters being unsaleable; part of the reason for this is if the shucker breaks the thin nacre over the mud worm, there is a foul smell and the mud may come out which may taint the oyster meat. Sydney Rock Oysters are not susceptible to the POMS virus. Neither Sydney Rock nor Pacific oysters are susceptible to *Bonamia* which periodically decimates Native Oyster beds. It has been suggested that *Bonamia* may reside in Pacific oysters.

QX disease affects Sydney Rock Oysters in southern Queensland and northern NSW; the responsible organism is *Marteilia sydneyi*. The best way to overcome this disease is for farmers to purchase QX resistant spat.

In southern NSW is the disease 'winter mortality'. for which there is no definitive cause; *Bonamia roughleyi* has been speculated to be the cause as have *Microcytos, Bonamia exitiosa* and *Haplosporidium costale*. Spiers et al were unable to attribute the lesions observed in *Saccostrea glomerata* in Georges River and the Shoalhaven to any of these microorganisms (Spiers et al 2014).

Heavy metals may cause problems in shellfish; in Hobart, Tasmania in 1972, an emetic dose of zinc was discovered in Ralph's Bay Pacific Oysters. Imbibing alcohol at the same time exacerbated the problem (Thrower and Eustace 1973 a, b). As a result, the NH&MRC revised the permissible concentrations of zinc, cadmium, copper, lead and mercury and oysters are monitored for these metals before a growing area can be approved.

Heavy metals can affect the oyster's ability to lay down shell. The heavy metals copper and tin have both been used as 'antifoulants' on vessel hulls. Because of the effects of tributyl tin on oysters and other bivalves, tributyl tin is now banned for use on inshore vessels; only high seas ships should be painted with tributyl tin paints. One problem is that some of these paints are 'self ablative' which means they are coming off the hull as the vessel proceeds. Heavy metals affect young oysters more than older ones (Wisely and Blick 1967; Calabrese et al 1973; Calabrese and Nelson, 1974; Calabrese et al 1977). Lower salinity may increase uptake of heavy metals in oysters (Thomson, 1982) and low pH may make heavy metals more available (Zirino & Yamamoto 1972, Thomson 1979, Schindler et al 1980).

Some seaweeds growing on oysters can float the oysters out of open baskets or trays, or the amount of weed can assist waves to wash them out of the basket. Time ashore will kill the algae or the shells blasted with high pressure water can remove the weed.

All growing hardware is subject to overcatch by oysters, mussels, ascidians, and barnacles. Turning baskets over will keep floating baskets free of biofouling, if using BST or Seapa lines lift the lines to eliminate fouling.

Mussels, ascidian and barnacles will settle on baskets and the oysters; keeping the oysters out of the water for 2-3 days will kill ascidians and mussels but barnacles take about a month to die in dry conditions.

Technical and Electronic Improvements

In the industry there are now several computer programs or apps which track the stock placed on a farm or removed from it. We troglodytes used to use white boards. On one farm with which I was familiar, orders were conveyed from the owners to the workers as to which rows (racks) to harvest; the owners knew, because the computer told them which oysters had been there the longest. While time should be the determining factor with juvenile oysters, with market oysters, they may have spawned, they may not have grown or fattened as well as the ones in the other corner where water flow is slightly better; for these reasons, a sample of oysters must be opened before bringing in the harvest.

The app Smartoyster has the advantage that it operates on mobile phones and data input while at the racks or lines.

Troglodyte farmers like myself were content with a white board, but which ever method is used it is advantageous to keep track of batches of spat as they grow through, to determine which are the best sources of spat for your growing area.

A Tasmanian oyster farmer, Richard Roff, told me that whenever you think you know what you are doing, the next year will be different; this was regarding, when oysters are in condition, when they spawn and when they put shell on but do not condition, when the calm weather will be, when the storms come and the subsequent effects on tides.

He asserted that only close observation would tell the oyster farmer what was happening on his farm and when to bring in which oysters.

The time taken to grow oysters to market size will affect the profitability of the operation. In Sydney Rock Oysters, this was around 4 years and for Pacific Oysters it was 2-3 years. With selected lines of oysters, Sydney Rocks may reach market size in 18 months and Pacifics now reach market size in one year. Variables are the amount of time in or out of the water, the amount of algal food in the water, the checks to shell growth caused by rough seas or too much handling, and the selected strain of oysters. In my experience at Cloudy Bay lagoon, with two batches of spat from the same hatchery, one batch was received on 14 January and the first market oysters were sold in March the next year. The second batch was purchased on 29 June in the same year, and the first oysters were marketed on 4 January the following year. These oysters were purchased as 4mm spat and sold as 70mmm oysters; the earliest of the first batch was 14 months, the earliest of the second was 6 months and 5 days.

One of the down-sides of submersed deepwater culture is that the oysters do not experience the same movement from wave action that intertidal or floating oysters do. There is more frilly shell growth and shells are thinner. This may mean that the oysters cannot be shipped long distances as the shells are thinner and more fragile and the adductor muscles are not strong so the oysters gape and lose their water and die. Oysters sold in the shell are live. The better approach is to grow juveniles in deep water and to finish off in the intertidal. Handling will have a similar effect on the shells as wave action in that the 'frill' will come off the shells and the oysters when put back in the water will thicken and harden the shell. Too much handling will retard the growth of the oysters and increase the time to market size.

As well as thickening the shell, handling and wave action will help the oysters to cup up, and become deeper in the shell.

The stages of growth and the length the oysters stay in each size basket depends on the growth in your particular area, the height in the water column if intertidal and how long the oysters are out of the water each day. Most places in Australia have a semidiurnal tide where there are two highs and two lows each day but the high low can be very similar to the low high in height above the seabed. We aim to have the oysters out of the water about one third of the time each day. Seasonal differences mean winter tides may be completely different to summer ones. In southern Tasmania and the WA south-west coast, tides are similar to the open ocean, ie around 0.9m tidal range. With high atmospheric pressures, the water will go down and with low atmospheric pressure the seawater will come up. The sea water height changes around 1cm for every millibar deviation from 1010 hectapascals.

Operations

Put spat in tubes (cylinders), trays or bags depending on spat size, mesh will be 1mm, 2mm, or 3mm. Usually 6 weeks will suffice for Pacific oyster spat, depending on whether the water temperatures are cold or warm. For Sydney Rocks 8 weeks will be better. If the oyster have not grown sufficiently, do not handle or grade them unless the containers are fouled with ascidians, mussels or barnacles; in those cases rehouse the spat in clean containers but do not grade. We aim to have better than 50% of individuals pass the grade. Better to have two thirds or more.

Initially, graders were flat screens that were agitated by eccentric cams, but they were noisy and in hot weather they killed many oysters. Rotating drums were tried, and were more successful but the fall of oysters from the top of the drum to the bottom could crack oyster shells, particularly Pacifics. Figure 40 shows a drum grader with two mesh sizes in the barrel.

Although adequate for Sydney Rocks, barrel or drum graders can kill Pacific oysters in hot weather. SED sell an underwater barrel grader which is shown in Figures 41 and 42. The underwater grader is gentler on the oysters and was designed for small juvenile oysters, but larger oysters can be graded on it with the appropriate holes in the barrels.

If spat are purchased at 4mm of size, they are placed in 3mm cylinders. Then the following program applies to Pacific Oysters:

Spat 4mm put into 3mm trays or tubes (cylinders) for 6-8 weeks then graded on 8-10mm screen.
10mm juveniles into 5-6mm baskets or cylinders for 8 weeks then graded on 20-25mm screen.
25mm juveniles into 10-12mm baskets or cylinders for 8 weeks then graded on 30-40mm screen.
30 mm juveniles into 15-16mm baskets or cylinders then graded on 40mm screen.
40mm oysters into 20mm baskets or cylinders to finish.

The growth and condition of the oysters may be affected by densities in the baskets or cylinders:

For 3mm trays or tubes, 10,000 per tray section or tube.
For 5-6mm baskets or cylinders 1000 spat.
For 10-12mm baskets or cylinders, 200 juveniles.
For 15-16mm baskets or cylinders, 100 oysters.
For 20mm baskets or cylinders, 60 oysters.

If spat are not sufficiently dense, in trays or tubes, they will grow ‘curl back’. If spat are in denser concentrations, they cup up better.

The standard in the 1970’s was to put 8 dozen in a finishing basket; it will depend on the food resource available in each area, and whether you just want shell growth or you want condition.

It is not necessary to finish in 20mm baskets or cylinders, oysters can be finished in 15-16 mm or even in 12mm if there are insufficient large mesh baskets available.

Sydney Rock Oysters will take twice as long, but if baskets become fouled with ascidians, barnacles, mussels or over catch of oysters, put oysters into new baskets or cylinders.

For harvesting, barrel graders can be used but the popular choice is the SED vision grader which utilizes conveyor belts, a camera and computer to sort oysters by size in two dimensions, length and width. .Staff stand by the first conveyor to remove any obviously dead, or ‘ double’ oysters. After the camera has determined the

Fig 40: Barrel Grader for Sydney Rocks, Batemans Bay, NSW

Fig 41: SED underwater barrel grader, Oyster Cove, Tasmania

Fig 42: Close up of underwater barrel grader showing spat sieves and two grading sizes in barrels.

oyster's size, on the conveyor, a jet of compressed air will knock the oyster into the appropriate bag or cylinder or bin. Craig Lockwood from St Helens in Tasmania, has a grader which washes the oysters before they are seen by the camera and weighs them as well as measures them and in this case the metal cup in which the oyster sits, is tipped over at the appropriate place.

Colin Sumner found that Pacific oyster spat caught in the Tamar River and transferred to Pipeclay Lagoon grew to 75mm in 12 months on intertidal stick culture (Sumner 1980). He also looked at sub-tidal growth of spat from the Tamar that had been transferred to Dover to grow on sub-tidal longlines. These oyster grew to 100mm in 12 months. Colin asserted that the growth rate in Pipeclay was greater than that obtained in 1948 in Pittwater (Thomson 1952). He attributed the difference in growth rate to the supposition that the oysters in the Tamar River were now hybridized, whereas those in Pittwater were the original strains imported from Hiroshima, Sendai and Kumamoto in Japan. It should be pointed out that Colin's oysters were attached to sticks whereas those of Jim Thomson were in trays and therefore able to be moved about by wave action. An alternative explanation is that the seawater in Pittwater in 1948-49, was cooler than the water in Tasmania's south-east in the 1970's by about 1.5ºC (Rochford 1974).

The question of survival, is important for the economics of oysters farming; if 95% of the crop is wiped out by POMS or similar disease, profitability will be absent. Harsh grading in hot weather may kill 14% of the graded oysters. I was always mystified by the statistics of spat sold from hatcheries and oysters harvested from farms. The latter number was always about half the former. It is normal for some small spat to die faster than larger oysters. If you ask a farmer, he will tell you he loses 10 or maybe 20% from spat to harvest.

In general, I have found around 3% of cultured oyster will die per month. So getting oysters through to market quicker does two things: it frees up baskets for the next cohort of oysters and it reduce the time the oysters are subject to approximately 3% mortality per month and therefore reduces overall mortalities and increases profits.

Fig 43: SED vision grader, Budd Island, Batemans Bay, NSW

Fig 44: Ewan McAsh explaining the intricacies of the SED vision grader, Batemans Bay, NSW

Marketing

There are two distinct markets: spat and finished product;

Hatcheries can sell spat as small as 2mm. In some US hatcheries eyed larvae can be purchased for settlement, but in Australia, most hatcheries have a nursery phase so they sell at 2, 3, 4, 5, 8, 10, 12,mm spat. Other growers purchase spat at say 4mm and grow them up to 30-40mm shell length and market them as 'on-growers' to other farmers.

Some farmers do not purchase spat but are content to purchase 12mm, 25mm or 30-40 mm juveniles, thus avoiding the smaller sizes where mortality is usually highest.

For finished product, the oysters are sold by shell length; some attempts were previously made to grade quality, but the variability between individuals and batches makes this difficult.

Tasea, a Tasmania growers company tried to standardize sizes as:

Cocktail	40-50mm
Bistro Oysters	50-60mm
Buffet (Plates)	60-70mm
Standard	70-85mm
Large	85-100mm
Jumbo	100-120mm
Grande	>120 mm

While these sizes are applicable to both Pacifics and Sydney Rocks, it is unlikely to get Sydney Rocks bigger than standards. Small Sydney Rocks (cocktail and bistro) are likely to be in better condition than a fast growing Pacific of the same size.

Native or mud oysters *(Ostrea angasi)* have been grown in all the southern States. Victoria encourages the growing of these native oysters. While they grow quickly to about 60mm diameter (one year), to get them to 80-100mm takes at least another year. To my palate, they have a metallic iodine taste, but some oyster lovers love them.

They are very similar to the European Oyster *(Ostrea edulis)*, from which they are almost indistinguishable. French people love this oyster. In Australia, the chief problem with marketing the *angasi* oyster is that they do not travel well.

Sydney Rock Oysters can last out of the water for a month without gaping unless it is hot. Pacific Oysters last a week out of water, and the Native oyster lasts 2-3 days at most. They also do not like intertidal growing conditions, preferring deepwater or bottom culture where their growth can be continual. They are susceptible to *Bonamia* disease and mudworm.

In the old days of Sydney Rock Industry, the better shaped oysters were sold in the shell and the misshapen oysters were sold in bottles as meat. Due to stricter health controls, this practice is no longer widespread. More oysters are now sold to wholesalers who shuck the oysters and sell them as half shell oysters which are sold in packs to restaurants and supermarkets. In the early days in Tasmania (1970's) oysters were frozen in the half shell and this practice is still pursued in NZ where oyster will have their top shell removed, glazed with freshwater and frozen then exported, including to Australia.

Most farmers sell off the farm in bags. I prefer jute or hessian potato sacks as they absorb any errant liquid; polypropylene sacks make the oysters 'sweat' especially in hot weather. Oyster sacks can be closed with metal ties, zip ties, hand sewing or with an electric bag closer. Oysters should be put into the cold chain as soon as possible. Although the best temperature for the oysters is 10ºC, cool rooms and refrigerators are run at 4ºC.

Oysters should not be frozen unless extending the selling season past spawning or if exporting. Freezing oysters that are close to spawning will cause them to spoof on thawing, rendering the oysters unsaleable and leading to a loss of income. Freezing oysters that are not close to spawning can enable oysters to be sold when the rest of the farm has spawned. Spending Friday afternoons taking 5 doz oysters to every pub is unlikely to make a farmer wealthy and could lead to a loss of driving licence. Those on major roads can sell to the general public if it does not interfere with the ongoing operations. Farmers' markets can be lucrative, but shucking on-demand can be difficult to keep up with that demand. If oysters are transported by air, they need to be put into 100μm goose-necked polythene bags, polystyrene boxes with water absorbent pads and preferably with cardboard sleeves. Airlines often want to inspect a box or two.

Fig 45: Designed in South Australia by Oceantech Design, built in Tasmania by Cawthorn Welding, 10m oyster punt

The trend now is for Chefs in the better restaurants to shuck the oysters on demand to retain the liquor that is in the shell to give that salty taste. Oysters that have been dipped in water or flushed under a tap to remove broken pieces of shell will not have the salty taste.

There are websites which now sell oysters on-line for delivery around Australia.

Tools and Equipment

All oyster farmers need oyster knives, gloves, aprons, gum boots. In South Australia, they need wet suits and in Tasmania chest waders or wet suits. Hats and block-out are required when working over the water. To gain access to farms, most farmers need a punt, possibly a tractor or an aquatractor. For driving posts they need post thumpers, fence post drivers and/or compressors and fire pumps. A jimmy or gemmy bar is required to lever off rails or a specially made rail remover. Rails can be cleaned with a spade or hoe-like long handled scrapers.

For filling intertidal baskets, a long handled shovel is required. For straining Bayco line, special grippers and/or fence strainers are required. In Tasmania, Harvey Calvert invented the ‘Aquatractor’, designed to go onto submerged sand to deploy and retrieve oyster gear. On vessels for sub-tidal leases, they need derricks or cranes for lifting modules; for flipfarm systems they need a punt or barge with a flipper, a ramp for opening hexcyls and refilling them.

All farmers need an onshore depot with a shed for shelter and grading and an area adjacent for storage and repair of baskets and trays, floats and rails and anchors and corner markers etc.

All on-shore depots need a shed to get out of the weather, to make up baskets and lines,to shelter electronically controlled machinery, to grade and pack shellfish. Specific standards are required for packing sheds and if exporting, more stringent standards. In Queensland, small sheds are built over the water to enable oysters to be graded and checked on the lease.

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Commercial Partners of Oyster Farmers: A non-exclusive list:

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Australian Seafood Industries
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BST Oyster Supplies Pty Ltd
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Ashley Turner
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Cameron of Tasmania
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Hexcyl Systems
37 Thiselton Way, Denial Bay, SA 5690
Gary Seidel
www.hexcylsystems.com.au
hexcylsystems@bigpond.com
Ph 08 8625 3297

Lyndcraft
6-10 Molly St., St Helens, Tasmania, 7126
Gregory Lynd
www.lyndcraft.com.au
info@lyndcraft.com.au
Ph 03 6376 2672

Marchant Engineering Pty Ltd.
24 Toohey Rd. Wetherill Park, NSW 2164.
www.picketpostdriver.com.au
mareng@bigpond.net.au
Ph 02 9756 2112

Oceantech Design
18-20 Shipwright Rd. Largs North, SA 5026.
www.oceantech.com.au
enquiries@oceantech.com.au
Ph 08 8242 0336

Proali Design Pty Ltd
16 Glennie St. West, Gosford, NSW, 2250.
www.proali.com.au
jon@proali.com.au
Ph 02 4323 2755

Seapa
26-28 Erudina Ave., Edwardstown SA 5039
Gary Thompson
www.seapa.com.au
sales@seapa.com.au
Ph 08 8357 6611

SED Shellfish Equipent
16643 Bass Highway, Wynyard, Tas. 7325
Mathew Brown
www.sedgraders.com.au
rob@sedgraders.com.au

Shellfish Culture Ltd
290 Bicheno St., Clifton Beach Tas. 7020
James Calvert
www.shellfishculture.com.au
info@shellfishculture.com.au
Ph 03 6248 9441

Smartoysters
Smartoysters.com
Col Bridges 0474 479 720.
www.smartoysters.com
col@smartoysters.com

Commercial Partners of Oyster Farmers: A non-exclusive list: - cont

Tooltech Plastics Pty Ltd
19-21 Antimony St., Carole Park Qld 4300.
www.tooltechplastics.com.au
sales@tooltechplastics.com.au
Ph 07 3271 1755

Woodshield
1 Quarry Rd. Tottenham Vic 3012
www.woodshield.com.au
info@woodshield.com.au
Ph 1300 622 906

Zapcoaquaculture,
4.9 Cleaver St., West Perth WA 6005.
www.zapcoaquaculture.com
info@zapcoaquaculture.com

The inclusion of a business in the above list does not imply personal or corporate endorsement of the businesses or their products.

They are included because their products are common in the oyster industry particularly in Australia and New Zealand. Equipment like oyster knives, gloves, protective gear, ropes, etc can be purchased in local ship chandlers.

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