HATCHERY REARING THE DOUGHBOY SCALLOP, *CHLAMYS (MIMACHLAMYS) ASPERRIMUS* (LAMARCK)

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Hatchery rearing and growout trials were conducted with the doughboy scallop, *Chlamys (Mimachlamys) asperrimus* (Lamarck) as a first step towards assessing their aquaculture potential. In 1992, broodstock, from Jervis Bay were in peak reproductive condition in June, August and September. Induced spawnings produced larvae that took 18–20 days to reach pediveliger stage and a further five days before all pediveligers had left the water column. An estimated 10 000 settled spat were deployed on a longline in Port Stephens, grew to an average 10mm and were transferred to lantern cages. Growth over the first year averaged c.1mm per week and reproductive maturity was reached at 30–35mm shell height. Initial observations suggest doughboy scallops have aquaculture potential and could be grown with *Pecten fumatus*.

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The doughboy scallop or fan shell, *Chlamys (Mimachlamys) asperrimus* (Lamarck), is a subtidal bivalve of southern Australia, found from Shark Bay, Western Australia, to New South Wales (Wells & Bryce,1988; Fig.1). Up to 100+ mm long (Zacharin et al.,1990), it is commonly byssally attached to solid objects in depths of 7–69m (Young & Martin,1989). Unlike the commercial scallop *Pecten fumatus*, it is unisexual with the orange gonad of mature females clearly distinct from the off-white gonad of males.

In the Pacific region *Chlamys* have provided valuable fisheries but *C. asperrimus* has only been of minor commercial importance despite being dredged in Tasmania (Sanders,1970). In southern Australia scallop fishing and aquacultural effort are largely directed toward *P. fumatus*, although increasing pressure on *P. fumatus* stocks could see a revival of the past practise of fishing *C. asperrimus* for sale as a 'roe on' product in the same market (Young & Martin,1989). Alternatively *C. asperrimus* could potentially form a new culture industry (Cropp,1989). However, only one report of its artificial propagation (Rose & Dix,1984) has been made. More information on its biology is required to evaluate its potential for aquaculture and to allow management of wildstocks should fishing effort increase.

METHODS

Broodstock

Fortnightly throughout 1992 scallop broodstock were collected by divers from Jervis Bay (Fig.1); reproductive condition was determined by macroscopic observations and through calculation of the gonado-somatic index (GSI). While stock capable of spawning were available most of the year, the population was in peak reproductive condition in June, August and September. This peak in condition is several months later than reported for stocks in the D'Entrecasteaux Channel, Tasmania (Grant,1971).

Spawning

Spawning procedures were initially based on those of Gruffydd & Beaumont (1972). Brood stock were scrubbed clean of fouling organisms and maintained in the hatchery at the Brackish Water Fish Culture Research Station (BWFCRS), Port Stephens (Fig.1). Scallops were

FIG.1. Distribution of the doughboy scallop around Australia.

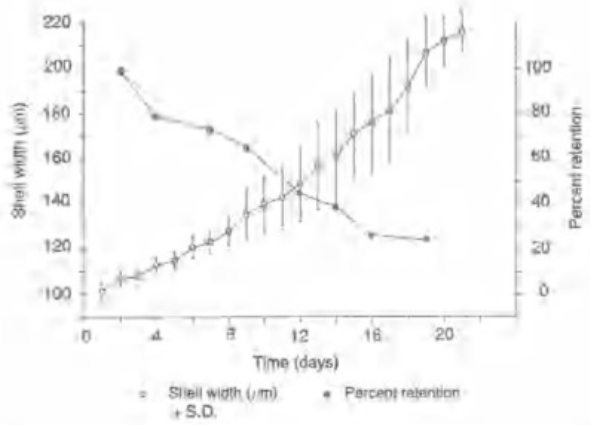

FIG.2. Growth and retention of hatchery reared *C. asperrimus* larvae.

induced to spawn by placing broodstock in a bath of seawater (17.8°C, ambient to previous holding tank) for 1h and then increasing temperature 3–4°C over the following hour. Subsequent studies have shown that mature individuals can also be induced to spawn using intragonadal or intramuscular injections of serotonin, however, while a greater proportion of females can be induced to spawn with serotonin than with temperature induction the average fecundity is markedly reduced (O'Connor et al., unpubl. data).

RESULTS

Larval Rearing

Larval rearing techniques and development followed those of Rose & Dix (1984). When scallops commenced spawning they were placed in separate 5l beakers of seawater. Spawning individuals released 0.6×10^6 to 5×10^6 eggs on many occasions exceeding the maximum fecundity reported by Rose & Dix (1984). As soon as possible following gamete release, sperm solution from several animals was mixed and added to the eggs. Fertilised eggs were then placed in a 1000l polyethylene tank at a density of 8 eggs ml^{-1}.

Trochophores (78.8±5.1µm width) were first observed 24h after fertilisation and the first D veligers (101±3.5µm in shell width) were observed after 42h, 11% of the larvae sampled still being trochophores at this time. After 48h 'D' veliger larvae were collected on nylon mesh sieves and a 1000l tank stocked at 4 larvae/ml^{-1}. Every 2–3 days larvae were sieved from the culture water and placed in a new tank of seawater. Water temperatures ranged 17.5–19.5°C during the larval rearing period. Mean larval size was determined daily, while larval densities were determined at each water change (Fig.2). Larvae were fed algae (Tahitian *Isochrysis* aff. *galbana*, *Pavlova lutheri* and *Chaetoceros calcitrans)* twice daily on an equal dry weight basis. Feed rates were increased daily according to changes in larval size and density, ranging from the equivalent of 3500–20000 *T. Isochrysis* cells $larva^{-1}$ day^{-1}.

The first pediveligers were observed on day 18 after fertilisation and settlement substrates were introduced on day 20. By day 25 larvae had left the water column with the majority choosing to settle on the base and lower wall of the tank.

Settlement

Four types of settlement substrate were placed in the tank: PVC discs (140mm diameter); monofilament mesh; 15mm black nylon mesh and 5mm black nylon mesh bags. Four lines supporting PVC discs were hung in the tank. Each line supported 4 discs, equally spaced from the bottom of the tank to the water surface. Three bags each of the 3 types of mesh substrate were weighted and lowered into the tank. After 3 days the PVC discs were removed and settlement was evaluated on upper and lower surfaces of each disc. Settlement was poor (30–50 spat/disc) and most spat settled in the central recess on the underside of the disc. Mesh substrates were left in the tank for a week before being deployed in Port Stephens. Settlement on the mesh substrates was not assessed until spat were large enough to be retained by the surrounding bag if detachment from the substrate occurred as a result of handling. Following removal of all substrates, large numbers of larvae were found to have settled on the lower surfaces of the tank.

Spat

Settlement on the mesh substrates deployed in Port Stephens was assessed after 3 weeks. Spat numbers were greatest upon black nylon mesh collectors and spat were concentrated in regions where mesh was densely packed.

The lack of *C. asperrimus* spat on other similar materials held on the longline showed no natural spat fall had occurred. Within twelve weeks spat had reached 10mm in size and were transferred to Japanese lantern cages. At this stage fewer than 6% of the number of the pediveligers put to set had been retained.

Growth in lantern cages in Port Stephens approximated 1mm a week throughout the first year (Fig.3) and sexual maturation occurred between

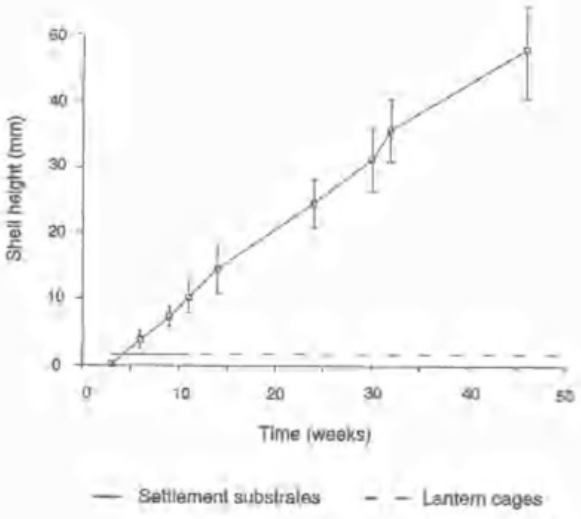

FIG.3. Growth of hatchery reared *C. asperrimus* in Port Stephens.

30–35mm shell height. Motile sperm was extracted from males of 26mm shell height, while oogenesis was evident in females as small as 28mm. This may indicate precocious maturity in the warmer northern extent of the species range and warrants further investigation.

DISCUSSION

Experience in the hatchery production of mollusc species at the BWFCRS has indicated that *C. asperrimus* is well suited to mass production. Larval and spat survival have been good, but improved settlement techniques would be required. The recent success of nylon mesh screens in downwelling systems to settle *P. fumatus* (Heasman et al., this volume) larvae could be extended to *C. asperrimus* as a means to exert greater control of settlement. Similarly the potential for early maturation to retard growth needs to be addressed. The possibility of growth retardation associated with the early onset of functional maturity may be overcome in this species by induction of triploidy.

The incidence of either parasitic trematodes (*Bucephalis* sp.) or mudworm infestation (*Polydora* sp.) in mature *C. asperrimus*, collected from Jervis Bay, often exceeded 10 and 90% respectively per collection. While *Polydora* sp. has been a significant cause of mortality in *P. fumatus* held in lantern cages in Tasmania (Dix, 1981), neither *Polydora* or *Bucephalis* have been observed in *C. asperrimus* reared on longlines in Port Stephens. Potential problems associated with sale of wildstock from Jervis Bay, notably mudworm, appear to have been eradicated with suspended culture, although mudworm may be a site specific problem.

Techniques used to rear *C. asperrimus* in these preliminary trials have been closely based upon those under development at the BWFCRS for the commercial scallop, *P. fumatus*, and may not be the most appropriate for this species. Adjustments to larval rearing techniques, such as feed rates and water temperatures, could improve larval growth and survival, while different growout techniques could benefit juvenile growth. Unlike other commercially exploited Australian scallop species, *C. asperrimus* retains the ability to form bysall attachments throughout its life which may permit the use of culture techniques developed for similarly attached bivalves such as mussels.

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