Effects of Shell Abrasion and Aerial Exposure on the Performance of Pacific Oysters *Crassostrea gigas* (Thunberg, 1793) Cultured in Tasmania, Australia.

Colleen Maree O'Meley

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Declaration

I declare that this thesis contains no material which has been accepted for the award of any other degree or diploma in any tertiary institution and that to the best of my knowledge and belief, it contains no material previously published or written by any other person, except where due reference is made in the text of the thesis.

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C. O'Meley

Colleen Maree O'Meley
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Abstract

Two of the major management strategies used by Tasmanian oyster farmers for grow-out of unattached (single-seed) Pacific oysters (*Crassostrea gigas*) are shell abrasion, occurring either deliberately or inadvertently during mechanised grading, and manipulation of intertidal growing height (degree of aerial exposure). Some farmers assert that these strategies can promote faster meat growth, and hence higher condition indices [meat weight relative either to shell cavity volume (CIvol), or to shell weight (CIshell)]. These reports, however, are anecdotal and have not been substantiated in the literature. The present study was undertaken to evaluate the effects of shell abrasion and aerial exposure on the performance (growth, condition index, shell shape, glycogen content and gonad development) of Pacific oysters cultured in mesh baskets, in two separate experiments, on two commercial leases in Tasmania.

Pacific oysters in Experiment 1 were subjected to the following shell abrasion treatments; one-third were machine-graded twice (MM group), another third were machine-graded once (M group) and the last group were not machine-graded (C group, control). Their performance was measured over 81 d and in 87% of the 77 data sets (eleven performance indices measured on seven sample dates), shell abrasion was not a significant factor ($P>0.05$). It is suggested that this was because the available oysters had little 'shell frill' (fragile shell extensions on the outer margins).

Pacific oysters used in Experiment 2 had large shell frill extensions, prior to being treated as follows; two-thirds of the oysters were initially machine-graded (M group) and one-third was not (C group), and then half of the M group oysters were shaken in their baskets after six weeks, and twelve weeks (MB group) into the experiment. Oysters machine-graded once (M group) lost a mean of 3.3 ± 0.4 mm in shell height and 5.9 ± 1.0 mm in shell length (mean ± s.e.; n=13). Additional shell frill was removed when oysters were shaken in their baskets (MB group). On the first occasion, the mean shell height and shell length were reduced by 3.4 ± 0.5 mm and 2.5 ± 0.4 mm (mean ± s.e.; n=29), respectively. When the baskets were shaken again, six weeks later, reductions of 4.5 ± 0.6 mm in shell height and 2.9 ± 0.7 mm in shell length (mean ± s.e.; n=29) were recorded.

The C group grew faster than the MB group, whilst results for the M group were usually intermediate. By the final sample (124 d) in Experiment 2, the

results ($P<0.05$) were, for; whole weight (g oyster^{-1}) C>M, MB, shell height C>M>MB, shell length C, M>MB, shell depth C>M, MB, dry shell weight (g oyster^{-1}) C>M, MB, and for dry meat weight (g oyster^{-1}) C>M but the MB group was not significantly different ($P>0.05$) to the other two. Reduced shell growth relative to meat growth, is one of the major factors influencing condition index; the MB group had a higher mean CIvol than both M and C groups ($P<0.05$), while the CIvol of the last two groups were not significantly different ($P>0.05$) by the final sample. The trends in CIshell values were similar, but less pronounced, and by the final sample the mean CIshell values were similar ($P>0.05$). Shell shape was significantly altered such that the MB group had a higher ($P<0.05$) mean cup index [= (shell height x shell length)$^{0.5}$/shell depth] but lower ($P<0.05$) mean roundness index (= shell length/shell height) compared to the other two groups. Throughout the experiment the mean glycogen content did not differ significantly ($P>0.05$) amongst groups.

The range, for average daily aerial exposure treatments, was much greater in Experiment 1 (0-26% exposure d^{-1}) than in Experiment 2 (0-7% exposure d^{-1}). By the final sample in Experiment 1, the mean whole weight, shell height, shell length, shell depth and dry shell weight of subtidal (0% exposure d^{-1}; L group) oysters were higher ($P<0.05$) than those held at 26% exposure d^{-1} (H group). Because their dry meat weights were similar ($P>0.05$), the H group developed a higher ($P<0.05$) mean CIvol and CIshell than the L group. The H group had a higher ($P<0.05$) mean cup index but lower ($P<0.05$) mean roundness index compared to the L group, and the mean glycogen content of the H group was higher ($P<0.05$) than in the L group.

Aerial exposure levels of 0% exposure d^{-1} (L group) compared 7% exposure d^{-1} (H group) did not significantly affect ($P>0.05$) the mean whole weight, shell height, shell depth, dry shell weight or dry meat weight indices, although the shell length of the H group was higher ($P<0.05$) than that of the L group by the final sample in Experiment 2. Compared to the L group, the H group had higher, but not significantly different ($P>0.05$), mean CIvol and CIshell indices, and were slightly rounder but less cupped in shape. The H group did have a significantly higher ($P<0.05$) mean glycogen content by the last sample.

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In neither experiment did shell abrasion or aerial exposure have a consistent effect on gonad development, or sex group ratio (male: female: indeterminate).

This study has shown that shell abrasion can retard shell growth, but improve the CIvol, CIshell and cup index for Pacific oysters which have substantial shell frill prior to abrasion. The roundness index and glycogen content, however, were not improved. Increased levels of aerial exposure led to an improved glycogen content, compared to subtidal oysters. Increased levels of exposure will also retard shell growth, but will improve the CIvol, CIshell and cup index, but not the roundness index. As such they are useful management tools but they do not promote faster meat growth.

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