Bath sponge aquaculture:

Aspects of culture and quality.

Thesis submitted by

Daniel James Louden

BSc (Zoology), G. Dip. Res. Meth. (Aquaculture)

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James Cook University

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I acknowledge that Stefanie Inderbitzin, a fourth year mechanical engineering student, determined the initial sponge size and shape for the compression and tensile testing of *Spongia graminae* and also conducted these tests for this species.

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(Signature) (Date)

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Abstract

With increased demand on sponges for cosmetic and biomedical purposes, natural sponge fishing grounds are no longer able to cope with the demand. With sufficient research and development, sponge aquaculture is likely to supply demand while allowing the preservation of natural sponge stocks. However, due to the array of different environmental conditions found amongst the habitats of different species, and differences amongst the species themselves, detailed research on the amenability to common culture methods, survival and growth rates, recovery processes, and the environmental requirements for any one species is required before commercial culture may be considered. Furthermore, due to the diverse morphological variation that occurs in sponges due to the environment, quantitative quality testing protocols must be established to experimentally determine the optimal environmental conditions required for production of quality bath sponges.

In this study, survival (*in situ* and *in vitro*), growth rates (*in situ*), and recovery processes (*in vitro*) were measured for two potential sponge aquaculture candidates, *Rhopaloeides odorabile* Thompson *et al* (1987) and *Coscinoderma* n. sp. [Phylum Porifera: Order Dictyoceratida Minchin (1900): Family Spongiidae Gray (1867)], cultured at the Palm Islands, central Great Barrier Reef. Sponge survival was dependent on species, culture method, and time with the highest mortality occurring soon after excision of sponge material from the parent stock. *R. odorabile* had the greatest survival of the two species *in vitro*, and the lowest survival *in situ*. Growth rates of 85.9 ± 23.7% and 115.2 ± 23.4% per annum, for *R. odorabile* and *Coscinoderma* n. sp. respectively, were not significantly different over the 21 month experimental period. Both species demonstrated initial size dependent growth rates with smaller explants growing fastest through the first season (78 days). Explant recovery rates were rapid for both species with a protective layer of collagen forming

over the surface within 24hrs. This layer was later replaced by pinacoderm as the subsurface tissue was reorganised to recreate a functional surface including redevelopment of the aquiferous system.

A quantitative testing protocol was developed to assess the quality of sponges using mechanical engineering techniques. Techniques quantified the directly measurable physical properties of sponges (density, fibre width, and fibre length) and the quality characteristics of firmness, compression modulus, compressive strength, tensile strength, elastic limit, elastic strain, modulus of elasticity, modulus of resilience, absorbency, and water retention efficiency. These were measured for *R. odorabile* and *Coscinoderma* n. sp. and three commercial species. There were significant differences between species for all quality parameters creating a unique profile for each species. *R. odorabile* was the firmest (37.8 ± 4.3kPa), strongest (157.4 ± 17.3kPa), and most rigid (838.7 ± 53.5kPa) species tested, while *Coscinoderma* n. sp. was one of the softest sponges (7.3 ± 1.1kPa) with the highest elastic energy (30.5 ± 3.5kJ/m^3) and water retention efficiency (40.1 ± 1.4%) of all species tested. These quality tests enable comparisons of quality between and within species with scientific rigour. Comparisons between species may be used as a marketing tool to promote aquaculture products for specific applications. Within species testing will allow quantification of differences in quality caused by genetic or environmental factors.

This research provides a foundation for the further research necessary to establish sponge aquaculture in Australia.