Assessing somatic growth rate and gonad development of the Cape sea urchin



**MSc Minor Dissertation Proposal**

**Aimee Cloete**

**(CLTAIM001)**

Department of Biological Sciences

University of Cape Town

Rondebosch, Cape Town

South Africa

Supervisor (s):

Prof John J. Bolton

Dr Marissa Brink-Hull

Dr Brett M. Macey

**July 2023**

# Research Proposal

## Background

The development of the aquaculture industry has resulted in concerns with regards to effluent discharge (Granada et al. 2016), reliance on natural resources as feeds or alternatively, reliance on commercial feeds, which can become costly. The implementation of integrated multi-trophic aquaculture (IMTA) systems can increase the efficiency of aquaculture systems and contribute to the development of a sustainable aquaculture industry, particularly when species that are ecologically compatible are co-cultured (Kang et al. 2003; Kim et al. 2015). In South Africa, this is possible for the high value abalone species, Haliotis midae, and the Cape sea urchin, Parechinus angulosus, as these species have a similar preferred temperature range (12 – 20 °C) (Fricke 1980; Britz et al. 1997; Day and Branch 2002) and commonly occur together in nature, particularly during the juvenile stages of the abalone life cycle (Day and Branch 2000, 2002).

Considering co-habitation of sea urchins and abalone in natural environments, as well as the potential symbiotic relationships that exist between them, they could be co-cultured as a method of improving animal health through the trophic transfer of microbial communities. This co-culturing concept has been assessed for sea cucumbers (*Apostichopus japonicus*) and juvenile abalone *(Haliotis discus hannai*), where the sea cucumbers feed on the food residues and faecal matter produced by the abalone (Kim et al. 2015). However, the feasibility of the Cape sea urchin as an additional value-added product has not been investigated as yet. Additionally, the effects of different temperatures and feeding regimes on the growth performance of this species has not been assessed. Through the improvement of the culturing protocols for this urchin species, further value could be added to the co-culturing of sea urchins and juvenile abalone.

## Study objectives

Assess the somatic growth rate and gonad development of the Cape sea urchin, Parechinus angulosus, as an additional value-added product from the integrated aquaculture of the Cape sea urchin and juvenile abalone.

1. Assess somatic growth and gonad development of the Cape sea urchin held in different temperatures (ambient vs 18°C).

2. Assess the effects of different diets (Ulva, kelp, 20U formulated feed, as well as the natural diets combined with the formulated feed) on somatic growth and gonad development of the Cape sea urchin

3. Evaluate gonad quality under the above-mentioned temperatures and feeding regimes, as well as of different sea urchin test colours, to assess the feasibility of gonad enhancement and marketability of the Cape sea urchin.

4. Assess nutritional components of Cape sea urchin fecal matter under different feeding regimes, to correlate urchin fecal matter nutritional components with juvenile abalone nutritional requirements.

## 3. Proposed Timeline and Methodology

**3.1. Timeline**

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| --- | --- |
| **Details of Timeline Stages** | **Date** |
| Begin study and writing of introduction and methods | 12th June 2023 |
| Project proposal due | 31st July 2023 |
| Data and statistical analysis | 1st October- 1st November 2023 |
| First draft – Introduction and methods | October 2023 |
| First draft – Results | 1st – 8/11th November 2023 |
| First draft – Discussion and conclusion | 8th – 11th November – 1st December |
| Final draft | February 2023 |

**3.2. Methodology**

3.2.1. Culturing conditions and feeding regimes:

* The sea urchins (Parechinus angulosus) will be collected from in front of the Marine Research Aquarium in Sea Point (n = 650) and divided into oyster mesh baskets (L x W x D: 40 x 29 x 16 cm) suspended in tanks (L x W x H: 42 x 36 x 30 cm) at 20 animals per basket. Equal numbers of animals with different test colours will be collected (pink, light purple, dark purple and red).
* Four feeding regimes will be tested in quadruplicate: Ulva, kelp, a formulated feed containing 20% Ulva (20U), as well as a mixed diet (alternating between each feeding regime on a weekly basis), resulting in a total of 16 tanks (320 sea urchins). All feeds will be administered ad libitum.
* These feeding regimes will be duplicated across two temperatures: ambient incoming water and 17°C. Therefore, a total of 32 tanks will be stocked with sea urchins, equating to 640 sea urchins for inclusion in the study. Animals will be collected one month prior to starting the growth trial to incrementaly increase the water temperature to 17°C for this set of tanks.
* Animals will be provided with constant water supply and aeration. Tanks will be cleaned twice a week or as needed and daily biosecurity checks will be performed.

3.2.2. Measurements and/or samples:

* Measure sea urchins (test diameter and wet weight) to calculate growth rates across feeding regimes and temperatures every month.
* Dissect one urchin per replicate every second month to assess gonad weight, colour and quality across feeding regimes and temperatures. Calculate gonad somatic index (GSI): (gonad weight/urchin weight) x 100. Gonad colour will be measured using a hand-held fibre-optic spectrophotometer.
* Correlate gonad characteristics with urchin test colour.
* Collect fecal matter when tanks are cleaned for fecal matter nutritional component assessment.

## 4. References

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