Resetting urchin barrens: liming as a rapid widespread urchin removal tool

Lead Agency: Institute for Marine and Antarctic Studies (IMAS)

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Aims and Objectives:

The aim of this preliminary liming project is to determine the effectiveness and feasibility of quicklime on Centrostephanus in Tasmania, and determine if large scale investment and field trials and application technology are warranted.

Final Report:

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The Longspined Sea Urchin has rapidly expanded into Tasmanian east coast waters as a direct result of climate change; warming waters and a strengthening Eastern Australian Current (EAC). The urchin population has grown to an estimated 20 million since being first reported in 1978. It's destructive overgrazing of coastal reefs results in bare-rock urchin barrens, largely devoid of the diverse marine community that previously existed. Resultingly, the urchins are threating the biodiversity and productivity of the reefs they are overtaking, including those home to commercially and recreationally important Abalone and Southern Rock Lobster. To combat this threat numerous control mechanisms are being investigated, including fisheries development, diver culling, predator enhancement and Quicklime. The latter being the subject of this report.

Quicklime (Calcium Oxide – CaO) has been used as a sea urchin control measure in North America and Europe. Applied from the surface, or pumped to depth, the CaO rapidly reacts with water and within minutes is converted to Calcium Hydroxide (Ca(OH)2), releasing heat. The hot quicklime and localised corrosive effect from the sharp pH increase damages the Sea Urchin's dermis, epidermis and tube feet (Hans Strand, *pers. comm.*). The subsequent osmotic disturbance and bacterial infection is the primary cause of death which occurs over several weeks post treatment. The reaction between Calcium Hydroxide and water results in harmless Calcium Carbonate (CaCO3). Calcium Carbonate is the main structural component in the shells of molluscs (e.g. abalone, oysters), calcareous marine plants and limestone.

Tasmanian Government

This research examined the efficacy and optimisation of Quicklime as a Longspined Sea Urchin control measure. The effect of Quicklime particle size and concentration on Sea Urchin mortality were tested in a series of laboratory tank trials. Finer quicklime particle sizes resulted in higher mortality rates, with fine

Quicklime particles (<1 mm) inducing 100% mortality in *Centrostephanus* at concentrations of 250g/m2 or greater. In contrast, coarse particles (2-4 mm) only resulted in 31% mortality at the same dosage. Results further show that larger urchins succumb to lower dosages of quicklime but take longer for mortality to be induced. Quicklime was also shown to induce mortality in Blacklip Abalone at rates of 33% and 50% with application of fine quicklime at dosages of 250g/m2 and 350g/m2, respectively. Mortality was high for Feather Stars, very low in Sea Cucumber and zero for Periwinkle following trial application of Quicklime.

The technique appears to be best suited for particular control situations where there are widespread extensive barrens with negligible abundance of abalone, as now occurs in some regions of the east coast. Abalone production has been lost from these locations and any mortality of abalone from quicklime applied will be negligible.

Review of trailed application methods globally indicate that Quicklime effectiveness dissipates rapidly with exposure with water, and coupled with the deep nature of urchin barrens in Tasmania, engineering solutions will be required to distribute Quicklime at depth. Extensive barrens tend to be deeper in Tasmania than places where quicklime urchin control programs have been run elsewhere; 70% of barrens in Tasmania are below 20 m depth. An engineering study to describe the feasibility of and develop efficient engineering solutions to disperse quicklime at depth is warranted. Subsequently, this will provide sureness to Quicklime application cost estimates provided here.

The application cost of Quicklime at depth is highly dependent on the speed and spread that it can be applied. Estimates, based on underlying assumptions highlighted in text, is in the order of $6,000 – 15,000 / hectare, exclusive of R&D costs for engineering solutions to distribute quicklime at depth. This results in the application cost to treat the 461 hectares of extensive barren (2017 estimate) across all depths in Tasmania to be in the order of $3 million - $7 million. Costs reduce to the scale of hundreds of thousands of dollars per annum if operations were restricted to either shallower reef (more productive for fisheries) or deeper reefs (unable to be restored by other methods like diving) and amortised over a decade. Cost estimates of Quicklime application on shallow reefs is on par with current investment in the wild harvest fishery in the form of subsidies. Further research to determine the importance and value of deeper reefs to ecosystem function, resilience and fisheries production may be warranted before progressing with Quicklime investment. It is well known from liming and culling studies that extensive removal of urchins results in rapid recovery of the reef ecosystem and this persists for many years.