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Short Communication

Biology, ecology and trials of potential methods for control of the introduced ascidian *Eudistoma elongatum* (Herdman, 1886) in Northland, New Zealand

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Editor's note:
This paper is a contribution to the proceedings of the 3rd International Invasive Sea Squirt Conference held in Woods Hole, Massachusetts, USA, on 26–28 April 2010. The conference provided a venue for the exchange of information on the biogeography, ecology, genetics, impacts, risk assessment and management of invasive tunicates worldwide.

Abstract

The Australian native colonial ascidian *Eudistoma elongatum* has spread throughout harbours and oyster farms in Northland, New Zealand. This paper summarizes results of a study on the biology, ecology and potential methods of control of this recently introduced species. Colonies were reproductive for nine months of the year and embryos were present in zooids at water temperatures above 14°C. Low salinity was most likely the cause of variation in reproductive status observed. Larvae were able to swim for up to 6 hours, and remain viable at temperatures as low as 10°C at salinities above 20 psu. Only acetic acid was effective at killing colonies. Control using heat or other chemicals was not feasible for shallow subtidal populations identified in the study. *E. elongatum* has the potential to spread further within already occupied harbours, and to more southern harbours in New Zealand.

Key words: tunicate, New Zealand, invasive, *Eudistoma elongatum*, aquaculture, larval swimming, treatment control

An infestation of the colonial ascidian *Eudistoma elongatum* was reported on Pacific Oyster *Crassostrea gigas* farms in Houhora Harbour, Northland, New Zealand in early 2005 (Handley 2005). The sudden appearance of this native Australian species and subsequent spread to oyster racks and natural substrata throughout harbours in Northland over the following 5 years suggests an invasion of a recently introduced ascidian undergoing a localized population explosion (Smith et al. 2007).

We undertook research on the reproductive biology and habitat preferences, and developed and tested the efficacy of treatment control options and techniques to eradicate or manage *E. elongatum*. Methods are detailed in Morrisey et al. (2008).

Eudistoma elongatum populations were reproductive for at least nine months of the year from October through to June (spring to late autumn). The onset of embryo production in late October, determined by presence of pre-neural fold embryos in the atrial chamber of zooids (Scott 1946), corresponded with an increase in water temperature above 14°C. Recruitment of larvae to settlement plates in the field occurred approximately 14 days after the onset of embryo production. Variation in the number of zooids containing larvae was most likely a result of high rainfall and low salinity at spring tide (Figure 1). Observations of colonies over-wintering as buds, and differences in size between newly settled colonies and colonies on old farm structures, suggest winter regression and subsequent rapid re-growth of year 2 colonies (Figure 2). Larval swimming experiments over a range of temperature-salinity treatments showed larvae can swim for up to six hours, and appear to

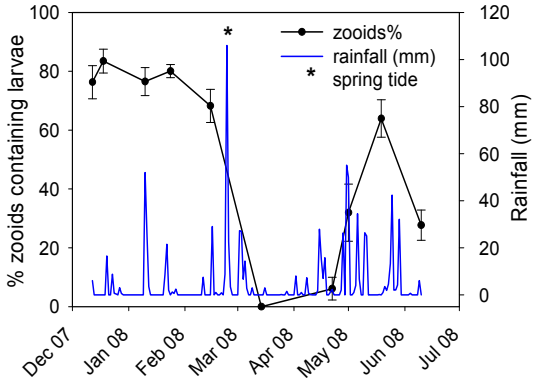

Figure 1. Percentage of zooids of *Eudistoma elongatum* (mean ± 1 SE, n=6) containing larvae during the period December 2007 – July 2008 in Northland, New Zealand. Daily rainfall data from Russell (5 km from the collection site) are also shown.

Figure 2. Example of the size of *Eudistoma elongatum* colonies growing on old farm racks, possibly developed from over-wintering buds (**A**), compared with newly settled colonies on a clean farm rack and a 10 × 10 cm settlement plate, all grown and collected over the same time period (**B**).

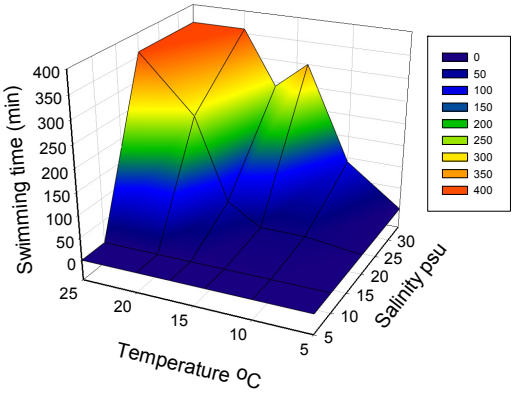

Figure 3. Response surface of larval swimming time of *Eudistoma elongatum* to combinations of temperature and salinity.

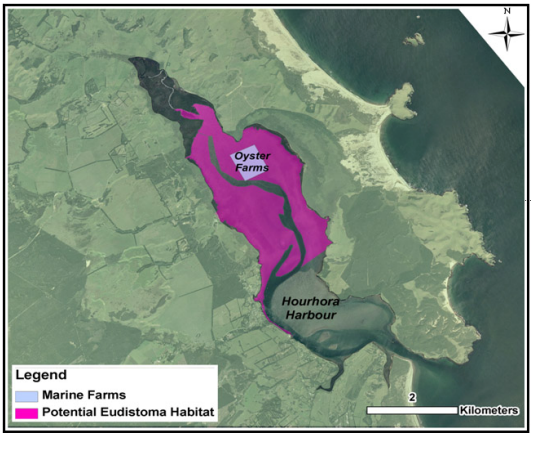

Figure 4. Distribution of potential habitat for *Eudistoma elongatum* in Houhora Harbour, Northland, New Zealand.

remain viable swimmers at temperatures as low as 10°C above 20 psu (Figure 3).

Eudistoma elongatum can occupy a wide range of habitats in sheltered bays, but is absent from areas exposed to waves and currents. *E. elongatum* colonized both artificial and natural substrata. Dispersal may occur by fragmentation; however, we have no data on the ability of fragments to reattach. Suitable habitat for *E. elongatum* represents a significant portion of the total area of many of the sheltered bays and harbours along the east coast of Northland. The total habitat potentially suitable for *E. elongatum* in the three harbours examined ranged from 50–100% of the total inter- and subtidal area (Figure 4).

Acetic acid (concentrated), hydrated lime (sodium hydroxide, saturated solution), ammonium sulphate solution (ammonium concentration of 200 mg l^{-1}), each with acid- and alkali-stable surfactants added to improve penetration of the test, and heat treatment, were identified as potential control agents. Toxicants were applied using garden sprayers with the nozzle adjusted to cover a 5 cm diameter and sprayed 15 cm from the target surface. Heat treatment was applied using an LPG-fuelled weed-burning torch. Treatments were applied to rocky substratum and oyster racks at low tide (Morrisey et al. 2008). Control plots for rock and oyster rack substrata were untreated. Only acetic acid was effective, reducing cover of *Eudistoma elongatum* to near zero, except for partially submerged colonies.

Potential spread to southern harbours in New Zealand may be greater than first suggested by Smith et al. (2007). They based predictions of range extension potential on the southern limit of the native distribution of this species at the 16°C winter isotherm. Our study suggests *E. elongatum* is able to grow and reproduce at 14°C. Furthermore, colonies can over-winter as 'buds', re-growing the following spring at 14°C and brood larvae capable of swimming at low temperatures. Control of vectors by oyster farmers (movements of stock, equipment and vessels) is the only feasible management tool because eradication is difficult or impossible due to the subtidal distribution of many colonies.

Acknowledgements

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