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Rapid Communication

The Chilean black urchin, *Tetrapygus niger* (Molina, 1782) in South Africa: gone but not forgotten

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Abstract

It is important to keep lists of invasive and alien species up to date, but it can be difficult to determine when species should be removed from such lists. One such example is the urchin, *Tetrapygus niger* (Molina, 1782), which is believed to have been unintentionally introduced to Alexander Bay on the west coast of South Africa with oyster spat imported for aquaculture (the only recorded alien population of *T. niger* globally). This species is a kelp grazer in its native range, capable of converting healthy kelp populations to barren landscapes. This study involved the re-survey of two aquaculture dams in September 2014, which previously contained the urchin, as well as intertidal and subtidal transects of the surrounding coast. *Tetrapygus niger* were absent from all sites, despite the presence of a healthy population of native urchins *Parechinus angulosus* (Leske, 1778). There was also little indication of urchin grazing on kelp stipes. As a result of this absence record, it is recommended that *T. niger* be removed from the South African list of introduced marine species, and from global lists of invasive species.

Key words: aquaculture, bioinvasion, marine alien, species lists

Introduction

There are many sources of uncertainty in invasive and alien species lists (McGeoch et al. 2012). Uncertainty can arise as a result of limited survey information, with data lacking on abundance, distribution, or natural population variation (McGeoch et al. 2012). Species that were once recorded as invasive in a region can also experience substantial reductions in population size or disappear completely over time (Simberloff and Gibbons 2004). Here we present the case of *Tetrapygus niger* (Molina, 1782), Family Arabaciidae, in South Africa.

Tetrapygus niger is native to the Pacific coast of South America from northern Peru to southern Chile (Clark 1910) where it is found on rocky substrata or artificial structures in rocky habitat (Dumont et al. 2011), particularly in areas with extensive kelp forests and strong wave surge. In its native range, it inhabits the low intertidal zone to a water depth of 10 m (Hancock 1948) with juveniles found predominantly in crevices shallower than 2.5 m (Rodriguez and Ojeda 1993). *Tetrapygus niger* has a broad diet principally comprised of kelp, but also including algal turfs, encrusting coralline algae, drift algae (Contreras and Castilla 1987; Rodriguez 2003), mussel recruits, and crustaceans (Hidalgo et al. 2013). In its native range, the urchin can prevent the colonisation of the mussel *Semimytilus algosus* (Gould, 1850), indirectly reducing the diversity of associated species (Hidalgo et al. 2013). In Peru and Chile, *T. niger* is the most abundant urchin, reaching densities of up to 85 individuals per m^2 (Vasquez and Buschmann 1997; Rodriguez 2003). At these high densities, urchin barrens can develop, whereby the growth of kelp and

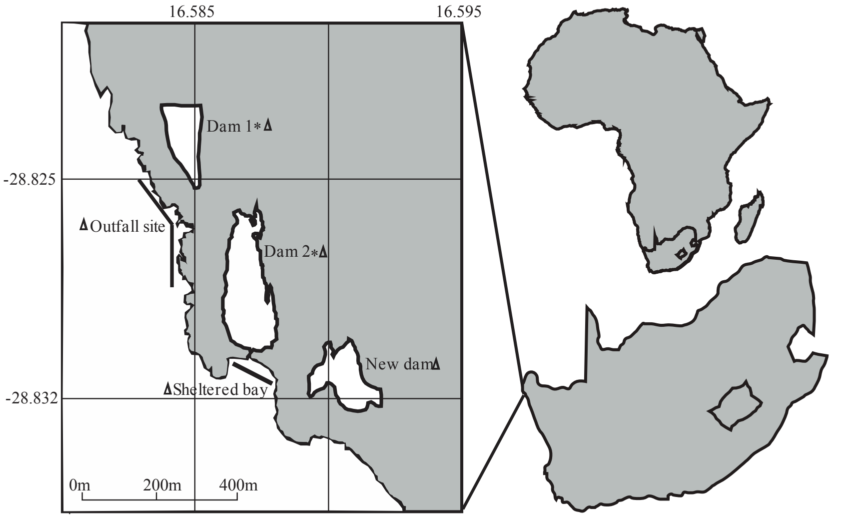

Figure 1. Map showing the Alexander Bay diamond mine area on the West coast of South Africa. During the previous survey in 2007, dam 1 was supplied with fresh seawater and stocked with oysters. Overflow ran from this into dam 2. The sites surveyed and found to contain *Tetrapygus niger* in 2007 are indicated by *. In the present study, dams 1 and 2, plus a newly formed dam to the South were surveyed. In addition, the intertidal and subtidal zones in the outfall area as well as the sheltered bay were surveyed, as indicated by the bold lines. All sites surveyed in the present study (with a confirmed absence of *T. niger*, see Results) are indicated by Δ.

other algal species is inhibited due to extensive grazing (Ojeda and Santelices 1984; Vega et al. 2005). These observations suggest that, if it were to become invasive, *T. niger* might have significant ecological impacts on native kelp communities.

While *T. niger* has not previously been detected outside of its native range (GISD 2013), an alien population was recorded in 2007 from a land-based aquaculture dam in Alexander Bay, a diamond-mining town on the west coast of South Africa (Haupt et al. 2010a). The identification of the species was taxonomically confirmed and specimens were archived at the Iziko South African Museum (SAM A28054). The mariculture facility was farming the Pacific oyster *Crassostrea gigas* (Thunberg, 1793) and it is thought that *T. niger* larvae were introduced with the oyster spat (Haupt et al. 2010a). During the 2007 survey, two farmed dams were found to contain the urchin. There is also a risk that the urchin may have spread to the surrounding shoreline, as routine husbandry operations included the rinsing of equipment, with the runoff discharged down a dune towards the intertidal zone (C. Griffiths, University of Cape Town, South Africa, pers. comm.).

The South African west coast offers a very similar habitat to the urchin's native range, with similar water temperatures (Wieters et al. 2009), dense kelp forests, and high wave exposure (Rodriguez and Ojeda 1993; Bustamante and Branch 1996; Rodriguez 2003), all of which could allow *T. niger* to thrive. In addition to the ecological impacts of grazing on South Africa's diverse kelp bed communities, the potential spread of *T. niger* could have severe economic consequences. Kelp is used in abalone aquaculture, plant growth hormone production, and alginate extraction, with the latter industry valued at several million South African Rand annually (R. Anderson, University of Cape Town, South Africa, pers. comm.). If the species were to spread along the coast, it could also affect the commercial farming of abalone in Port Nolloth, approximately 100 km south of Alexander Bay. As a result of these potential economic and ecological impacts, *T. niger* was listed as a target for eradication under South Africa's National Environmental Management: Biodiversity Act of 2004 (NEM:BA) (i.e. listed as a category 1a species in the Alien and Invasive Species lists, 2014). The objective of this study was to determine the current population status and distribution of *T. niger* in Alexander Bay.

Methods

The survey sites were located within an active diamond mine in Alexander Bay (Figure 1). In order to assess the status and distribution of the urchin, the two aquaculture dams from which it was previously reported, as well as the intertidal and subtidal areas surrounding the discharge sites of the dams, were surveyed in September 2014. SCUBA divers surveyed the aquaculture dams by conducting transects every 25 m across the length of the dams.

Table 1. Range of *Tetrapygus niger*, *Parechinus angulosus,* and *Ecklonia maxima* densities recorded during the intertidal surveys at the sites surrounding the outfall (n = 78) and within the sheltered bay (n = 39).

Site	Intertidal zone	Range of *T. niger* density/m^2	Range of *P. angulosus* density/m^2	Range of kelp stipe density/m^2
Outfall	High	0	0	0 – 8
	Mid	0	0 – 1	0 – 24
	Low	0	0 – 8	0 – 92
Sheltered bay	High	0	0	0 – 4
	Mid	0	0 – 8	0 – 28
	Low	0	0 – 16	0 – 112

Fifteen intertidal transects running from mean high water spring to mean low water spring were conducted every 10 m north and south of the outfall and across a sheltered bay nearby. The latter survey area was selected as it was connected to the southern dam at high tide. Gullies were avoided, as these environments were assessed during subtidal searches, however, special attention was paid to rock pools and the underside of rocks. To estimate urchin densities and the extent of urchin feeding on kelp, counts of *Tetrapygus niger,* the native urchin *Parechinus angulosus* (Leske, 1778) and stipes of the native kelp *Ecklonia maxima* (Osbeck) Papenfuss were made. A total of 1940 kelp stipes were recorded within triplicate 0.25 m^2 quadrats, placed randomly in each tidal zone.

Nine subtidal transect lines of 50 m length were conducted perpendicular to the shore at the outfall at 20, 40, 80 and 160 m north and south of this point. In addition, four subtidal transects were conducted in the sheltered bay. Three replicate 0.25 m^2 quadrats were placed along the line at 0, 5, 10, 15 and 50 m offshore. Each quadrat was searched for urchins and the condition of kelp stipes within the quadrat was described (intact, grazed or severed).

Results

None of the surveyed habitats in 2014 supported live *Tetrapygus niger*. Oyster farming has been discontinued since the last survey in 2007; consequently, the supply of water to the dams has ceased, causing the northern one to dry up. *Tetrapygus niger* tests (shells) were found in this empty dam. In addition, the other original dam has deepened and another new dam has developed beside it. The two remaining dams are hypersaline and do not support either urchin species.

The low intertidal zone contained the highest densities of the native *Parechinus angulosus* and *Ecklonia maxima* in all sites, with counts decreasing up the shore (Table 1).

The native sea urchin *Parechinus angulosus* was found at 57% of subtidal sites around the outfall with a median density of 4.0 individuals per m^2 (range 0–128 urchins per m^2) while densities were much lower in the sheltered bay (0–4 per m^2). The counts of intact kelp were much higher in the sheltered bay, with a range 0 to 88 stipes per m^2, while densities at the outfall sites were lower with a range of 0 to 36 stipes per m^2.

Discussion

Following the establishment of the Alexander Bay oyster farm in 1994 (Haupt et al. 2010b), *Tetrapygus niger* was introduced and we estimate that a population persisted in the two dams for 10–15 years. However, it appears not to have spread from these dams and there is no evidence that the species naturalized outside of captivity (i.e. category B2 under Blackburn et al. 2011).

During the current study, despite intense surveying, no live *T. niger* were recorded. The subtidal and intertidal sites surveyed did contain *Parechinus angulosus*, and thus represent suitable habitat for urchins. Kelp stipes were not heavily grazed, however, implying that the effects of urchin grazing are low. This was not unexpected given that *P. angulosus* primarily traps drift kelp (Day and Branch 2002) and, unlike *T. niger*, is generally not an active grazer of attached macroalgae (Fricke 1979; Anderson et al. 1997).

As the aquaculture facility is no longer actively farmed, *T. niger* is unlikely to be introduced again to Alexander Bay. The species is not yet recorded on the World Register of Introduced Marine

Species, but if it were to be included, this record should be categorized "absent" (Pagad et al. 2015).

This case serves to highlight the importance of monitoring spat imports which are known vectors of marine alien species (Haupt et al. 2010a). It is possible that *T. niger* could be introduced to other oyster farming facilities within South Africa, and its ecology in its native range, suggests that, if *T. niger* were to invade the South African west coast, it could have significant impacts. As such, we consider it prudent to retain the species on a prohibited list and on a watch list until there is evidence of an absence of vectors to South Africa.

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