Introduced fish and parasites are threats to the Cape Range anchialine ecosystem

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Summary

The Cape Range anchialine system hosts a number of Western Australian and EPBC listed species. Introduced omnivorous invasive fish inhabit an exposed part of the anchialine system. The fish have the potential to introduce a lethal parasitic tapeworm to the cave fish population, and themselves of becoming permanent inhabitants of the subterranean parts of the ecosystem. A sustained effort to eliminate feral populations of introduced fish is recommended, together with a continued monitoring for reintroductions and an educational effort within the Exmouth community.

Introduced fish

Guppy, *Poecilia reticulata*, is a very small opportunistic benthopelagic (feeding on bottom, midwaters, or near the surface), non-migratory fish that can inhabit both fresh and brackish water. It is omnivorous but eats the eggs of native fish species and acts as a host to the Asian fish tapeworm *Bothriocephalus acheilognathi* (Eldredge, 2000), introduced by carp. In Hawaii, *B. acheilognathi* infect native Sleepers (Eleotridae) and 75% of exotic *Poecilia reticulata* in estuaries close to the sea (Vincent & Font 2003); Hawaii is renowned for its anchialine systems (Russ, Santos & Muir 2010).

Bothriocephalus acheilognathi, which is associated with cyprinid fish in China, has been introduced to Australia, where its spread maps the distribution of carp (*Cyprinius carpio*) and Eastern Gambusia (*Gambusia holbrooki*) (Dove et al 1997). The tapeworm causes reduced growth and death of fish, with young fish being particularly susceptible (Dove et al 1997, Henderson 2009). *Bothriocephalus acheilognathi* infects a number of species in the families Eleotridae and Gobiidae in Australia and these families have the highest prevalence rates of the tapeworm (Dove & Fletcher 2000). The Blind Cave Gudgeon, *Milyeringa veritas*, is attributed to the Eleotridae. The tapeworm exhibits low host specificity in respect of both intermediate hosts (copepods) and definitive hosts (fish). Six species of cyclopoid copepods have been identified as intermediate hosts (Dove et al 1997). The free-swimming helminth larvae (coracidia) are consumed by cyclopoid copepods and burrow into the copepod's haemocoel where they develop into a second larval stage (procercoid) (Font Tate 1994). At the temperature of groundwater at Cape Range they would be able to infect their final host in 11-18 days (Marcogliese, 2008).

Guppies [*Poecilia reticulata*] were reported on the Cape Range peninsula, south of Exmouth, from the pool at the Kailis Fisheries bores in 1994. '*As the pool is on a natural drainage line flooding could potentially spread the population. However, they are most likely to be spread by people. If they enter natural freshwater or brackish waters they are likely to eliminate the native fauna (<i>G. Allen, pers. comm. 1993*).' (Humphreys 1994). However, the perception that '*Introduced species are unlikely to be a hazard to the cave fish except in the open locations*.' (Humphreys 1994) has repeatedly been revised in the light of new information and this concern has been expressed through the North West Cape Karst Management Advisory Committee (NWCKMAC).

Over the years a number of species of aquarium fish have been observed in Dozer Cave, an artificial opening that exposed the anchialine waters to daylight. *Stygiocaris* cave shrimps and *Milyeringa veritas* have been reported from the cave since it was opened but not in the last decade or more, possibly owing to the extensive siltation of the entrance that is located in a former gravel pit that receives substantial drainage. Dozer Cave is in direct contact with the adjacent Gnamma Hole and the broader anchialine system fringing the Cape Range peninsula. Several attempts have been made to eliminate the exotic fish from Dozer Cave by poison but Guppy, at least, are still there (7 February 2010), either by reintroduction or survival.

More recently Guppy, in particular, have been recognised to be a more serious threat to the anchialine systems as they are known to be able to invade estuarine waters. The closely related Atlantic Molly, *Poecilia mexicana, widespread in North and Central America --from Rio San Juan, Mexico to Guatamala --* is able to colonise and adapt to cave systems (Parzefall 2001; Plath et al., 2004, 2007; Korner et al. 2006), including those with high sulphide levels (Tobler et al. 2008) such as occurs in the Cape Range anchialine system (Humphreys 1999; Seymour, Humphreys & Michell 2007). This circumstance is the more pressing as, should individuals occur with some adaptation to cave life, this trait may spread quickly because male guppies with rare colour patterns have a breeding advantage in wild populations (Hughes et al 2013). Consequently, the presence of Guppy in anchialine pools on Cape Range for prolonged periods should be considered a threat to the anchialine ecosystem as a whole through predation and competition by a highly invasive predator, and by its potential to introduce a parasite [Asian fish tapeworm) that would threaten at least the gobiod fish populations.

The anchialine system contains as globally recognised, disjunct, anchialine fauna that includes two species of fish listed under both Commonwealth and Western Australian fauna protection legislation, namely *Milyeringa veritas* and *Ophisternon candidum*, as well as a number of species of Crustacea, including an EPBC listed and Cape Range anchialine system endemic *Lasionectes exleyi* (Remipedia), the only member of the Class known from the southern hemisphere.

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The tapeworms are present throughout the Murray-Darling. Primarily vectored by carp and to a lesser extent by gambusia (Dove and Fletcher 2000). The Asian fish tapeworm lodges in the intestines of fish and can cause heavy mortalities of small or juvenile fish through complete intestinal blockage, and cause impaired health and growth in larger fish (Scott and Grizzle 1979). It has already caused significant fish kills of a common small native gudgeon (*Hypseleotris* sp.) in ACT (Lintermans 2007).

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Note added 27/7/2013

Tilapia in anchialine pools on Hawaii prey on grazing shrimps , known locally as Opaeula, causing alabe to accumulate. Lisa Marrack grad student UC Berkeley.

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Guppy biology (from Deacon et al 2011)

Ovoviviparous, sperm storage. Single pregnant female can, and routinely do, establish persistent populations. Single female can give birth to multiple broods of live offspring, Sperm stored for six months Broods may be fathered by several males

Very adaptable evolution; geographic variation in behavior and life history characteristics. Highly cannibalistic



DUZEI Cave C-Z.	Dozer	Cave	C-23
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-21.98330 114.12750

C-23 : 16th May, 1965. George W. Kendrick. DOZER CAVE

Entrance is cave type. Opened by a bulldozer in a gravel quarry sometime prior to this date. The water at the bottom contains blind Gudgeon fish (Milyeringa veritas) and blind eels. (Ophisternon candidum.*) This cave is almost certainly linked to **C-105**, which is 60m away. This link was established by Malcolm and Steve East who dived into the cave and several hours later observed silt clouding the water in **C-105**. Sketched. Tagged. On the 1:50,000 map of NORTH-WEST CAPE, series R712, sheet #1754-III, the grid reference is 0284 6625.

*Cave fish not seen in C-23 for decades and it is now populated by Guppies (*Poecilia reticulata*).

