# “Anthropogenic disturbances affecting the mollusc populations of Queensland freshwater systems”

***Introduction***

There is sufficient evidence to show that global warming through climate change is having a marked effect on habitat deterioration and population loss of freshwater shellfish (Jones & Byrne, 2014; Cowie et al., 2017; Bohm et al., 2021) but it is also possible that other, local conditions may have further consequences for these particular animals (Galbraith et al., (2015)).

The following literature review confirms that although freshwater molluscs are of significant value to freshwater systems, their rapidly declining populations have downstream effects on water quality and the nourishment of aquatic ecosystems for other dependent species. Other supporting literature indicates the extent of depletion through extinction, isolation and disturbances driven by anthropogenic impacts but also discusses methods to adapt and mitigate these problems.

The literature search was conducted by choosing relevant peer-reviewed literature from 2002 to the present to assist in the discussion of how anthropogenic disturbances have impacted the shellfish populations in Queensland, Australia.

The search was conducted using the databases of SCOPUS, Web of Science and Google Scholar with reference only to peer-reviewed literature. The keywords used were: Freshwater molluscs, Value to ecosystems, Worldwide distribution, Australian distribution, Local populations of shellfish, Human uses (including local history) and Anthropogenic impacts.

The most significant of the disturbances recognised by the majority of literature examined is that of climatic change. This is not unique to Australia but is reflected in other parts of the world (WMO, 2021, p.7) and may also have similar effects on other areas where freshwater shellfish are affected by similar concerns.

***Global Loss of Freshwater Molluscs***

Freshwater molluscs according to Smith, (1979); Walker et al., (2014) & Vaughn & Hollein, (2018);, are filter feeders and perform important ecological functions and impact aquatic ecosystems by nutrient and energy recycling. Their research further describes bivalves in more detail as dominant filter feeders which increase water clarity and light penetration, stimulating macrophyte growth in adjacent habitats; they increase the abundance of benthic insects and they consider them as "sentinels of environmental change". Their article offers a considerable data source for reviewing the present state of shellfish and the global declines in mussel populations.

Data also is available regarding the loss of invertebrate species by Lydeard et al., (2004) & Patoka et al.,( 2018) who indicate that as of 16 May 2003: "a total of 708 freshwaters and 1222 terrestrial mollusk species were included in the 2021 IUCN Red List of Threatened Species and further, recounts that: "Mollusks have the dubious honour of having the highest number of documented extinctions of any major taxonomic group." Their article offers greater drilling down into the more vulnerable species at risk.

Crook et al.(2015) & Dudgeon et al. (2006) further compel the reader to consider the effects of aquatic ecological connectivity that have experienced disturbances contributing to this situation. These articles consider water flow interventions such as the construction of Dams and weirs, River flow regulation, Habitat alteration and loss, the often unwitting assistance in the spread of invasive organisms and Climate Change. This research falls well within the ambit of a sound discussion on anthropogenic disturbances.

***Anthropogenic Disturbances***

As identified by Crook et al. (2015) there is a diverse range of disturbances to freshwater ecosystems caused by humanity. This article also discusses the connections of physical, biological and biochemical pathways that affect biodiversity and discusses management and conservation initiatives. It also reviews in more detail the aforementioned anthropogenic disturbances but offers further data on an operational understanding of the altered connectivity of ecosystems. This includes a discussion of methodologies for studying the movements of individuals over short timeframes (p.53).

Strong et al. (2007) & Lopes-Lima et al. (2021) offers data on the global diversity of the main groups of freshwater molluscs identifying the relative position in which freshwater mussels in Queensland are placed. Their works refers to the issue of how more research attention should be given to “the ability of freshwater mussels to evolve and adapt under the strong anthropogenic selective pressures such as the physical modification of habitats, pollution, climate change and introduction of invasive species” (Lopes-Lima et al., 2021, p. 2842). These authors also discuss abundance and population dynamics, abiotic tolerances such as increased sediment, anthropogenic modifications of riverine habitats and tolerances such as changing oxygen and ammonia concentrations. Biotic interactions such as host dispersal and predator/prey relationships are also described along with human and domestic stock diseases.
Both Crook et al. (2015) and Lopes-Lima et al. (2021) thus provide extensive data on how changes have occurred in shellfish populations with descriptive evidence of how anthropogenic disturbances have contributed to these changes.

***Restoration of freshwater mussel populations - possible solutions***

Chester & Robson (2013) describe freshwater anthropogenic water bodies as refugia for freshwater biota. They describe the concept of Restoration ecology which relies in part on “anthropogenic (human-created) or heavily modified ecosystems to support biodiversity”. There is further discussion in their article on the range of habitats of this nature such as Irrigation pipes and canals, rural and urban drainage ditches, transport canals, stormwater retention basins, agricultural wetlands and ponds, large reservoirs and quarry ponds. Their studies result in evidence that anthropogenic water bodies may indeed support freshwater biodiversity and emphasise the need for revised management practices to maximise the biodiversity of species, particularly concerning the climate change excesses of increasing inundation and prolonged periods of drought. However, there is little evidence of recognising the possibility of anthropogenic habitats also becoming an ecological trap owing to possibly conflicting management practices and/or the introduction of invasive species.
Buelow & Waltham (2020) & McLeod et al (2019) also provide further discussion in their articles of the viabilities of restoration of coastal wetland quality and the efforts made in northeast Queensland in the study of bivalve filtration and biodeposition. The findings of their research also indicate “the importance of wetland context for ecosystem service provisioning by freshwater bivalves” ( Buelow & Waltham, 2020, p. 13).

***Conclusion***

Freshwater mussels are often referred to colloquially as “Livers of the Rivers” (Zhongming & Wei (2022) citing Lymbery, (2022)) and is a fair title for such a relatively small species providing an inversely proportionally large benefit to the freshwater bodies in which it persists to exist in. There is little doubt that this species is critically endangered as a result of anthropogenic disturbances. However, there has been sufficient research not only to highlight what and how these disturbances have arisen but offer methods to mitigate further decimation and provide the potential for population increase.

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