Freshwater mussels in Oakley Creek   (NOT for eating)

In 2010, Rosemary Phillips conducted a study of freshwater mussels, kakahi, *Echyridella aucklandica* (formerly *Hyridella*) in Auckland streams.   In Oakley Creek, a total of three specimens were found. Two specimens were found in the lower reaches of the creek, while the other was found some way above the waterfall, in a bed of dead shells.   She thinks that it is possible that these were remnants of a larger population or they may have been washed down from a larger population still existing upstream.   The stream was very difficult to survey that year due to poor water clarity.

It was exciting therefore, when a freshwater mussel was found in sediment in an old tyre that was pulled out of the creek during the annual cleanup in March 2014.   It was returned to the stream after photographing, but without the tyre!

Rosemary says that freshwater mussels are very similar to marine mussels, but their habit tends to be more like clams – freshwater mussels burrow into sediment instead of using byssal threads to attach to rock.   Also, unlike some of the more well known marine mussels, freshwater mussels do not have a shell shape with a sharp tip.   Rosemary has collated some more fascinating information about freshwater mussels for us, which appears below.

Photos: left, A. Stanton, right, R. Phillips

Freshwater Mussels   **by Rosemary Phillips (2010)**

Introduction:

Freshwater mussels form a key component of the river systems in the world. As filter feeders, they are thought to play a role in removing debris and chemicals from the water column(Vaughn & Hakenkamp, 2001). Unfortunately, they are declining. In North America, 297 species and their subspecies are highly threatened. 45 species have become extinct in ten years from 1993(Vaughn & Taylor, 1999). Ecology, distribution and abundance factors all affect the survival of freshwater mussel species (Bauer & Wachtler, 2001). Information on the ecology and distribution of at least two species in New Zealand is unknown.   Though with limited specific information on species ecology and morphology, there may be more species yet to be located in the New Zealand environment (Fenwick & Marshall, 2006).

Filtering effects
Freshwater mussels are all filter feeders, getting their food from the particles in the water column (Bauer & Wachtler, 2001; Dell, 1953; Vaughn & Hakenkamp, 2001). Siphons in the mantle of the mussel intake and exhale water. The water in the mussel is filtered for food particles and oxygen. The total amount of water that a mussel population can filter depends on the number of mussels in the population and the species. Global research has indicated that dense beds of freshwater mussels can affect the overall quality of the body of water by removing the particulate matter from the water column (Vaughn & Hakenkamp, 2001).

During the course of filtration, filter feeders uptake nutrients from the water column, as well as pesticides and heavy metals. These chemicals are usually retained within the mussel tissue for a number of days. Uniod freshwater mussels, of the family Unionoidea, can retain chemicals for 1790 to 2849 days, depending on the species, before excretion (Vaughn and Hakenkamp, 2001). Studies into the accumulation of metals in *Hyridella depressa* yielded complex results for introduced compounds (S. J. Markich, Brown, Jeffree, & Lim, 2003). Cadmium was one of the easiest metals to be stored into the tissues, while nickel was the least likely to be absorbed (Scott J. Markich, Brown, & Jeffree, 2001). In a New Zealand study, pesticide presence was investigated in mussels to determine the effects of industry and agriculture on the aquatic environment. In built up areas, toxins such as wastes and pesticides accumulate in the tissues of mussels and can cause problems in the population. The accumulation of metals and chemicals has led to freshwater mussels being used as a conservation monitor to determine change within the water column and habitat (Bauer & Wachtler, 2001; Phillips, 2007; Strayer, 2008).

The individual mussel filtration rate is affected by water temperature, flow regimes and particle size (Vaughn and Hakenkamp, 2001). Filtration rates may also differ throughout the year as they are affected by the long brooding period (Byrne, 1998). For Australasian mussels, as the food amount increases, filtration rate has been known to decrease and the filtration rate increase when food is low (Bauer & Wachtler, 2001).

The accumulation of chemicals within the tissues of freshwater mussels and the sedentary nature of the population provides a useful tool for helping monitor the development around waterways. It is essential to first find and identify mussel populations within waterways that could potentially serve as biological monitors.

Ecology
Freshwater mussels are classified into two super families, based on their basic morphology. Both super families, Unionoidea and Etherioidea, contain mussels that live solely in freshwater. Though the families differ on the type of larva produced the mussel species belonging to the super families are all bivalves, filter feeders and the larva are a parasite for a time on fish. The majority of freshwater mussel species are grouped under the family Unionoidea, as they form glochidia type larva (Bauer, 2001).

Glochidia larvae are small (0.05-0.4mm) bivalves, with a hook along the apical edges. Glochidia shape, size and hook orientation, size, shape and teeth number differ between genera (Wachtler et al, 2001). The larvae are expelled from the adults to attach to a host fish species. The hooked larvae attach to both the gills and body surface of the host fish, but opercula and fins are favoured (Wachtler et al, 2001). Once the internal organs have metamorphosed, the larvae drop off and hopefully rejoin the population (Byrne, 1998; Percival, 1931; Souza Do Vale *et al*, 2003). Metamorphose time can vary depending on the species, from 3 days to 10 months (Wachtler et al, 2001). *Hyriopsis myersiana* metamorphoses in 12-13 days (Noparatnaraporn, Vilarinho, Machado, Pakkong, & Uthaiwan, 2002) while *Hyridella australis* takes 22-23 days attached to fish to change from larva to adult (Hiscock, 1950). The metamorphosed larvae in the sediment can take up to four years to become sexually mature (Neves & Widlak, 1987).

In the intervening years before sexual maturity, the main activity of freshwater mussels is growth. As individuals grow, mantle excretion forms annual growth rings when growth slows over the winter months (Percival, 1931). This growth is dependant on location, food supply and water quality. A good location with a sandy bottom and other mussels present will ensure survival and reproduction (Caryn C. Vaughn, 2001).

Reproduction normally occurs when the water temperature starts to warm. The male individuals release sperm into the water column which the females intake into their shells to fertilise the eggs. Fertilised eggs are brooded in the gills of the females until release (Bryne, 1998). The number of gills and structure that is used differs between genera and species (G.Bauer, 2001). Brooding period of the fertilised eggs (glochidia) also depends on the species. Studies of *Hyridella depressa,* an Australian species, indicate that the breeding period is from mid-winter (July /August) to late summer (February /March) - a total of 7-8 months. The brooding period follows an increase in the water temperature and cessation is thought to coincide with the decrease in water temperature (Byrne, 1998). A study of the Neotropical mussel in Brazil suggested that the end of the breeding season could be due to the change in nutrients within the habitat or the seasonal flood, rain cycle (Souza Do Vale *et al*, 2003). Glochidia release is an important part of the lifecycle of mussels. Uniods have evolved strategies to improve fish host infection. Glochidia are produced in large amounts to ensure some attach to a fish host as well as the glochidia release being synchronized with the reproduction cycle of the fish host. Species from the family Anodontinae release glochidia in small amounts as a host is encountered. Unionidae and Hyriidae families have species that release glochidia in conglutinates to attract fish (Bauer, 2001).

Due to the plastic nature of individuals within freshwater mussel populations in New Zealand, taxonomic status is debatable. The general taxonomic grouping is based on the taxonomic review by McMichael 1958 on Australiasian species and those of the Southern Hemisphere. Individuals are placed in Hyriidae if they have an ‘S’ shaped pointed tooth with one or two hinge teeth. *Cucumerunio* genera have an elongate shell, with extensive shell sculpture and a V shaped beak (Dell, 1953; Mark C. Fenwick & Marshall, 2006; McMichael, 1958). At the moment, three species are recognised as present in New Zealand: *Cucumerunio websteri, Hyridella menziesi*, and *Hyridella aucklandica*. More species may be present in New Zealand as indicated by the studies of Fenwick and Marshall (2006) into rDNA that revise previously amalgamated species.

Literature about New Zealand species does not record ecological differences between the three species. In New Zealand, glochidia larvae are released into the water column in response to contact with a host species. The larvae then attach themselves to the fish, *Galaxias* and *Gobiomorphus*. Cells on the flaps of the larval mantle absorb food from the host while the larva metamorphoses into an adult (Percival, 1931). Not much is known about the settlement and recruitment of the larvae from the fish host to the substratum for New Zealand freshwater mussels (Roper and Hickey, 1994). The basic lack of knowledge about the distribution and abundance of each species makes it hard to identify specific ecology for each of the New Zealand species and further our knowledge by studying them.

Hyridella aucklandica specimens appear in historical collections collected from the Auckland area. Specimens have historically come from a creek at Henderson, a creek near Avondale and a creek near Glen Eden (Dell, R.K, 1953). More recent investigations into populations around Auckland have found a number of populations and individuals in the Opanuku Stream, 3 small populations in Swanson Stream, a population in Motutu Stream, and individuals in Oakley Creek, Cochrane Stream and Oratia Stream.

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