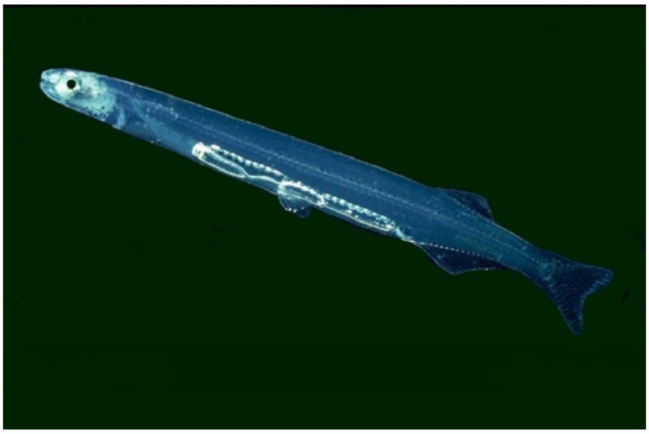
IMPACTS OF SEDIMENT ON ĪNANGA

Sediment can affect māhinga kai by influencing habitat, behaviour, feeding, growth and survival.

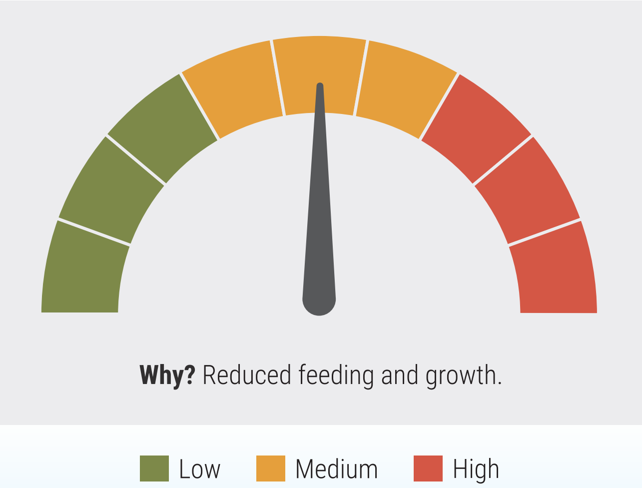
Background on īnanga (*Galaxias maculatus*)

Īnanga are one of six species in New Zealand's whitebait catch. They make up over 87% of the whitebait caught in rivers around the whole country[1]. Īnanga are diadromous - they spend half their life in the ocean as larvae and the other half in rivers as juveniles and adults[2]. They mature after re-entering freshwater, but unlike salmon, most do not return to the river where they were born[3]. Maturing īnanga have very general habitat requirements[4]. They are more active during daylight, forming large shoals in a wide range of coastal waterways[4]. Īnanga feed on a broad range of aquatic[5-7] and terrestrially-derived[8] food. Most adults only live for one year and spawn once before dying[9]. Females lay up to 4,000 eggs[9] in riverbank vegetation while it is submerged during spring (full and new moon) high tides. The eggs need dense vegetation to protect them from temperature extremes and from drying out while they develop[10]. Īnanga also occur in Australia (where they are called 'common jollytail') and South America (where they are called 'puye').

Īnanga juvenile (*Galaxias maculatus*)



Īnanga sensitivity to elevated sediment



Why? Reduced feeding and growth.

🟩 Low 🟧 Medium 🟥 High

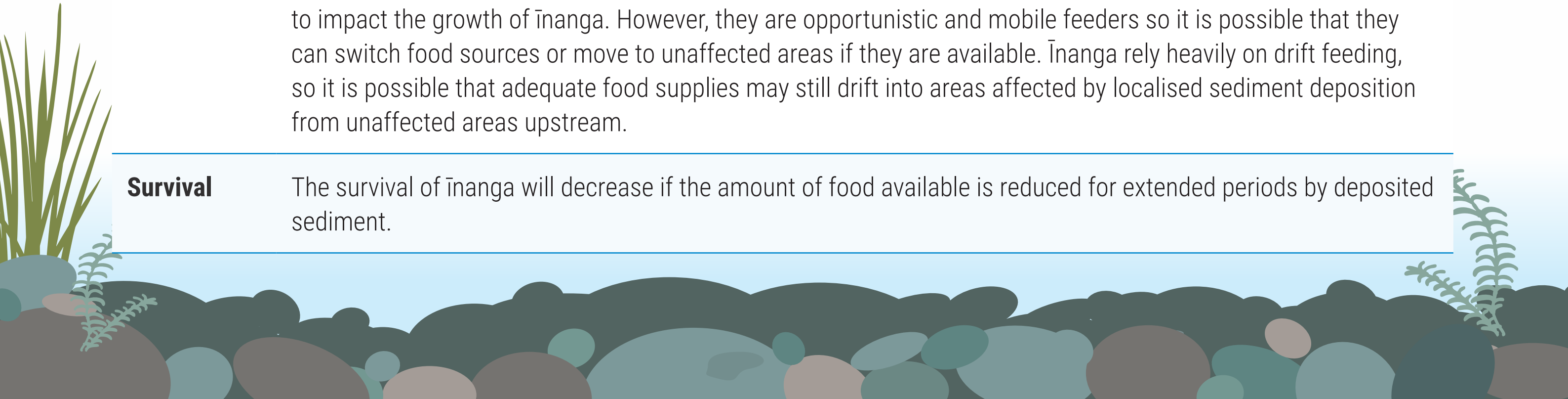
Prepared by Mike Hickford, Michele Melchior and Melanie Mayall-Nahi from NIWA for Our Land and Water National Science Challenge, March 2023. Image of īnanga whitebait by Dr R M McDowall.

For references and further information see niwa.co.nz/sediment-impacts

IMPACTS OF SEDIMENT ON ĪNANGA

Effects of suspended sediment on īnanga	
Habitat	Direct effects unknown.
Behaviour	Īnanga are mobile and do not have territories, so their likely response to a change in water quality will be avoidance if possible. Īnanga whitebait will not swim into very turbid water[11]. However, it is unlikely that this level of turbidity would occur for a long enough period during whitebait migrations to reduce the overall number of juvenile īnanga that enter a river. Adult īnanga that are already living in a river may move to areas of less turbid water (e.g., backwaters or among bank vegetation) during a flood event if they are available. This behaviour may allow them to avoid turbid water, but it may also increase their risk of predation or reduce their ability to access food.
Feeding	Īnanga are highly dependent on sight for feeding, but their ability to see food is not reduced significantly until very high turbidity levels[12]. They are probably more visually sensitive than other whitebait species because of their large eyes[13] and optic lobes[14]. Feeding in juvenile īnanga reduces when turbidity reaches very high levels[12], this reduced feeding rate comes directly through a reduction in their ability to feed rather than indirectly through a stress-related reduction in appetite[12]. Adult īnanga show no change in feeding rate at high suspended sediment levels[15].
Growth	Sustained periods (21 days) of moderate levels of turbidity reduce the growth of juvenile īnanga[16]. This is probably an indirect effect caused by reduced feeding efficiency.
Survival	Repeated, short-term (< 24 hours) exposure to very high turbidity does not reduce the survival of juvenile īnanga[17]. Even long-term (21 days) exposure to very high turbidity has no effect on survival[16]. Studies have shown that turbidity levels have to reach around 20,000 NTU to cause 50% of juvenile īnanga to die and 30,000 NTU to cause 100% mortality[17]. The cause of death is likely sediment damaging their gills. In the wild, other conditions may occur at the same time as high turbidity, like increased water acidity or low oxygen levels. Together these conditions might mean reduced fish survival rates.

Effects of deposited sediment on īnanga	
Habitat	Īnanga live their lives in open water, so sediments deposited on the bottom of rivers are unlikely to impact them directly. However, for spawning, īnanga use habitats that are very vulnerable to deposited sediments[18]. Īnanga eggs need the protective microclimate underneath riparian vegetation to survive[10]. If deposited sediments clog the aerial root mats under the riparian vegetation, the humidity around the developing eggs will decrease and the eggs will die[19]. Sediment deposited in īnanga spawning sites during flood events can bury and kill developing eggs. The surface layer of īnanga eggs is sticky to help them adhere to riparian vegetation[20]; this prevents the eggs being washed downstream. However, the adhesive layer does cause the eggs to become coated with sediment and this may reduce oxygen transfer to the embryo developing inside[21].
Behaviour	Direct effects unknown.
Feeding	Īnanga are mid-depth feeders and avoid feeding on the substrate[7], so deposited sediments probably won't directly affect their feeding. However, deposited sediment will probably reduce the abundance of their common food sources (e.g., chironomids)[22]; īnanga feed on these insects as they drift downstream with the currents to colonise new habitats.
Growth	Any indirect reduction in feeding, through deposited sediment reducing the abundance of food sources, is likely to impact the growth of īnanga. However, they are opportunistic and mobile feeders so it is possible that they can switch food sources or move to unaffected areas if they are available. Īnanga rely heavily on drift feeding, so it is possible that adequate food supplies may still drift into areas affected by localised sediment deposition from unaffected areas upstream.
Survival	The survival of īnanga will decrease if the amount of food available is reduced for extended periods by deposited sediment.



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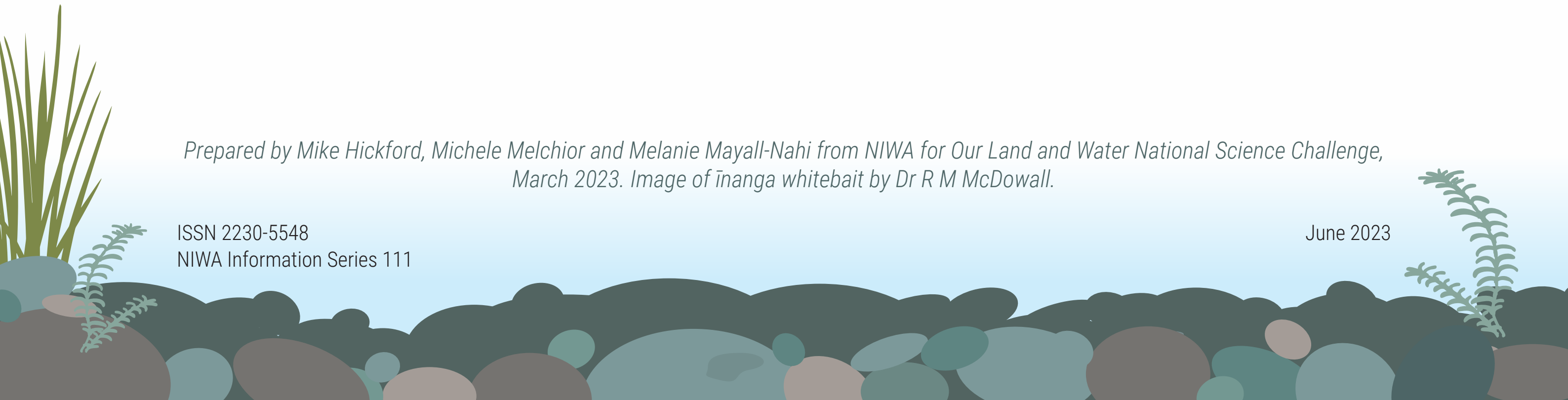

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