IMPACTS OF SEDIMENT ON KŌARO

NIWA
Taihoro Nukurangi

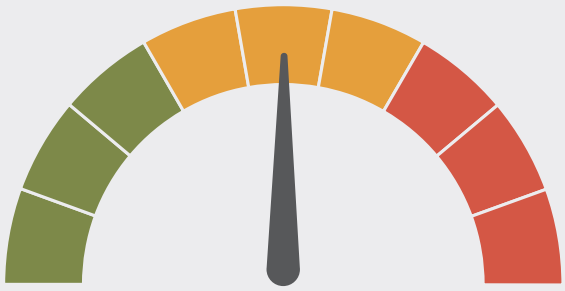
Sediment can affect māhinga kai by influencing habitat, behaviour, feeding, growth and survival.

Background on kōaro (*Galaxias brevipinnis*)

Kōaro are one of six species in Aotearoa New Zealand's whitebait catch. They are diadromous – they spend over 4½ months in the ocean as larvae before entering rivers[1]. Kōaro make up about 5% of the whitebait caught in rivers around the whole of New Zealand, but they are rare in east coast regions, particularly Canterbury[2]. Kōaro whitebait mostly migrate into cold water rivers coming from glaciers and mountain regions[3]. Seagoing populations can migrate large distances inland (250 km upstream) and to over 1,000 m of altitude[4]. In addition to seagoing populations, kōaro also form lake-limited populations in which the larvae do not go to sea but develop in lakes[5]. Kōaro reach sexual maturity after two years[6] and almost certainly spawn several times. They probably live for six to eight years, perhaps longer[7]. Kōaro are the only New Zealand freshwater fish found on the sub-Antarctic islands of New Zealand and are found also in Tasmania and mainland Australia[7].

Kōaro (*Galaxias brevipinnis*)

Kōaro sensitivity to elevated sediment



Why? Avoidance, and reduced habitat suitability 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 kōaro by Dr R M McDowall.

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

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Effects of suspended sediment on kōaro	
Habitat	Adult kōaro are found in rapidly flowing, tumbling rocky streams in native forest[7]. Studies in West Coast rivers show kōaro are abundant only in clear-flowing rocky streams, with few occurring in brown, tannin-stained streams. Kōaro are rarely found outside forests, and then, only in streams that have just left forest-cover or in the tributaries of high-country lakes. However, kōaro appear relatively insensitive to increases in suspended sediments in rivers[4] and their occurrence is not related to the duration of turbid conditions in rivers[4].
Behaviour	In the laboratory, kōaro whitebait quickly move from highly turbid water to less turbid water[8]. However, kōaro whitebait are relatively more abundant in snow-fed rivers, which tend to become turbid during the spring snow thaw, than in rivers draining coastal hills[4, 9]. This is not to say that kōaro whitebait prefer turbid waters, just that the proportion of kōaro whitebait in catches is often higher immediately after floods, when the water is still turbid[9].
Feeding	Kōaro whitebait are better able to feed in turbid waters than the other whitebait species. Even very high turbidity levels have no significant effect on the mean feeding rate of juvenile kōaro[10]. This is despite vision being important for feeding by kōaro whitebait - the absence of light reduces their feeding by 90%[10]. Although high turbidity does not affect the feeding rate of kōaro juveniles, even short-term exposure (two hours) to high turbidity levels stresses them such that when they return to clear water their feeding rates are supressed significantly[10].
Growth	Sustained periods (21 days) of moderate levels of turbidity reduce the growth (length, but not weight) of juvenile koaro[11]. This is probably an indirect effect caused by reduced feeding efficiency.
Survival	Long-term (21 days) exposure to very high turbidity has no effect on the survival of juvenile kōaro[11].

Effects of deposited sediment on kōaro	
Habitat	Kōaro usually live in the swifter rapids of streams, under logs, or more usually, under and amongst boulders[7]. During the day and night, kōaro use microhabitats that are faster-flowing, deeper, and more turbulent, with larger substrate particles and more interstitial (between substrate particles) refuge spaces than elsewhere in the reach[12, 13]. Interstitial spaces are important habitat for kōaro, so deposited sediments will reduce the amount of interstitial space available in streams and cause population decline[14]. It is likely that kōaro spawn high on stream banks during flood events and that their eggs are deposited well above baseflow water levels[15, 16]. The few records of kōaro spawning sites in New Zealand[15] and Australia[17] show eggs are laid in the interstices of cobble and pebble substrate adjacent to the stream channel even though other sediment types are more commonly available. Any sediment that is deposited on stream margins during floods will reduce the availability of the preferred spawning substrate.
Behaviour	Direct effects unknown.
Feeding	Benthic invertebrates are numerically the greatest food source for kōaro, but larger, terrestrial prey are more important by weight[18]. High sediment loads can affect benthic invertebrate communities, generally causing increased drift, along with reduced densities and biomass[19-21]. It is possible that deposited sediments may reduce some key items in the diet of kōaro.
Growth	Direct effects unknown.
Survival	Direct effects unknown.

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

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