NIWA
Taihoro Nukurangi

Te Wai Māori

HIGH
VULNERABILITY

Rob Suisted

Assessing the vulnerability of taonga freshwater species to climate change – species summary:

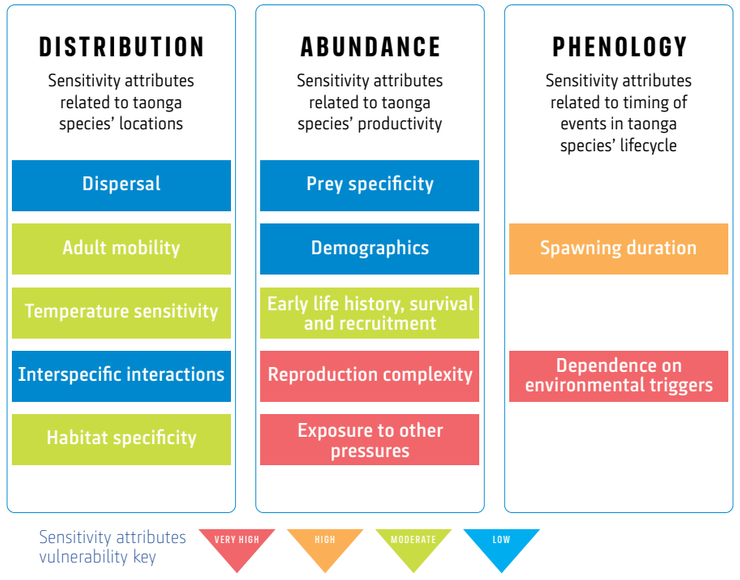
Banded kōkopu (Whitebait)

Galaxias fasciatus

Rob Suisted

SENSITIVITY

Banded kōkopu are a large galaxiid that migrate between freshwater and the marine environment to complete their lifecycle. They can also form land–locked populations in lakes. Adults are commonly found up to 200 mm.



Subset of the sensitivity attributes that contributed to banded kōkopu CCVA scores

What is a CCVA?

Climate Change Vulnerability Assessments (CCVAs) are used to assess species' vulnerability to climate change. They identify which species may be most vulnerable to climate change in the future based on:

(1) their exposure to predicted changes in the environment (e.g., warming oceans or more frequent droughts)

(2) their sensitivity or ability to cope with changes in their environment based on their unique characteristics (e.g., food, habitats, reproduction).

Together, exposure and sensitivity form a species' climate change vulnerability score.

Complexity in reproduction

Banded kōkopu usually migrate downstream to their spawning habitats (in lakes and rivers) and reproduction occurs in aggregations. Spawning occurs from autumn/early winter close to typical adult habitats. Variation in spawning times among years has been observed in some catchments. The same spawning areas are used within and between years indicating banded kōkopu have a fidelity to their spawning sites. They can lay their eggs within the stream in gravels or on bankside grasses, although the suite of plant species they use is unknown. Eggs have been observed to be deposited terrestrially during high water events, hatching after re-inundation. Larvae rear in estuaries or at sea and return to fresh water after 4–6 months as whitebait. Olfactory cues from other migratory galaxiids help post–larvae to select a river to return to.

Dependence on environmental triggers

Banded kōkopu require hydrological cues for reproduction. Spawning occurs from autumn/early winter close to typical adult habitats. Eggs have been observed to be deposited terrestrially during high water events, hatching after re-inundation. Fishes requiring specific rainfall regimes and water level changes are likely to have limited tolerance to climate change as the frequency, intensity, and predictability of rainfall is anticipated to change.

Little is known about the cues banded kōkopu use for inward migration to freshwaters, but migration is likely trigged by seasonal changes in water temperature and day length along with flood flows. It is presumed that upstream migration rate is influenced by water clarity and stream flows as well as temperature.

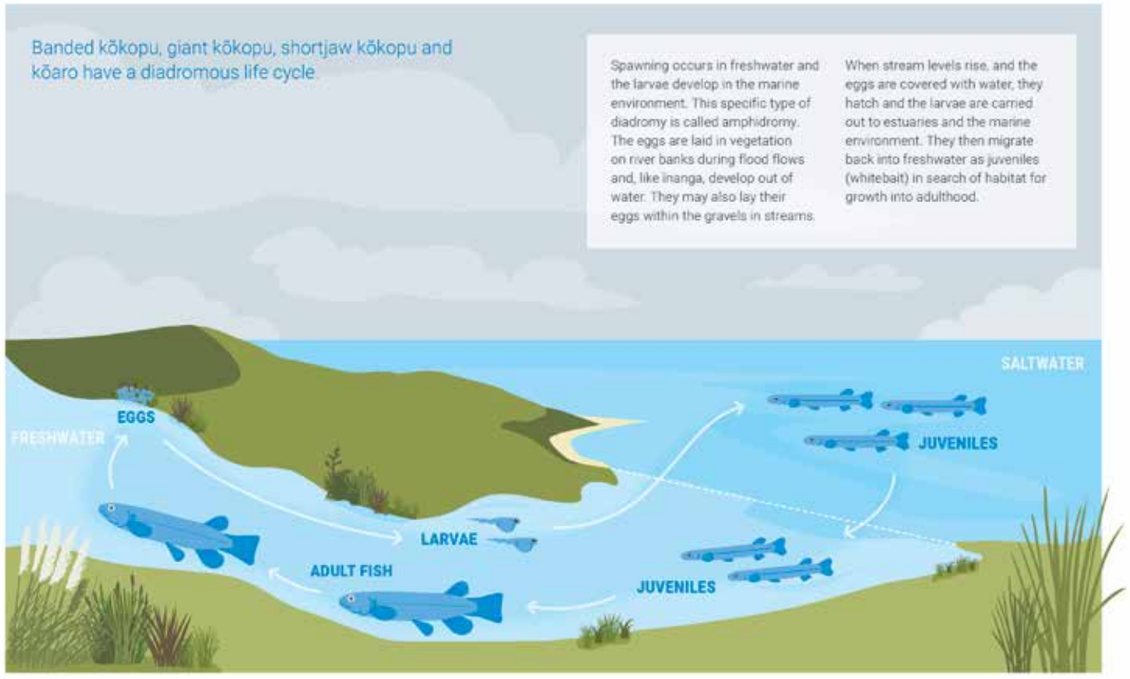
HIGH VULNERABILITY

Exposure to multiple pressures

Species that are already facing multiple threats are likely to be more vulnerable to climate change. Banded kōkopu are exposed to multiple pressures including harvesting of the juvenile whitebait stage in New Zealand, artificial barriers to migration, habitat destruction, pollution of waterways, changes in catchment land use and the impacts of introduced species. Natural pollutants such as ammonia, which occurs in livestock waste and poorly treated wastewater, can adversely affect fish populations through displacement and, at high concentrations, death.

EXPOSURE

Banded kōkopu are only found in Aotearoa–New Zealand. They are found in the North and South Islands, Stewart, Chatham and many offshore islands around the main islands, but not the sub–Antarctic islands. Banded kōkopu have a coastally restricted distribution, similar to īnanga, but are not as widely spread throughout the country.



HIGH VULNERABILITY

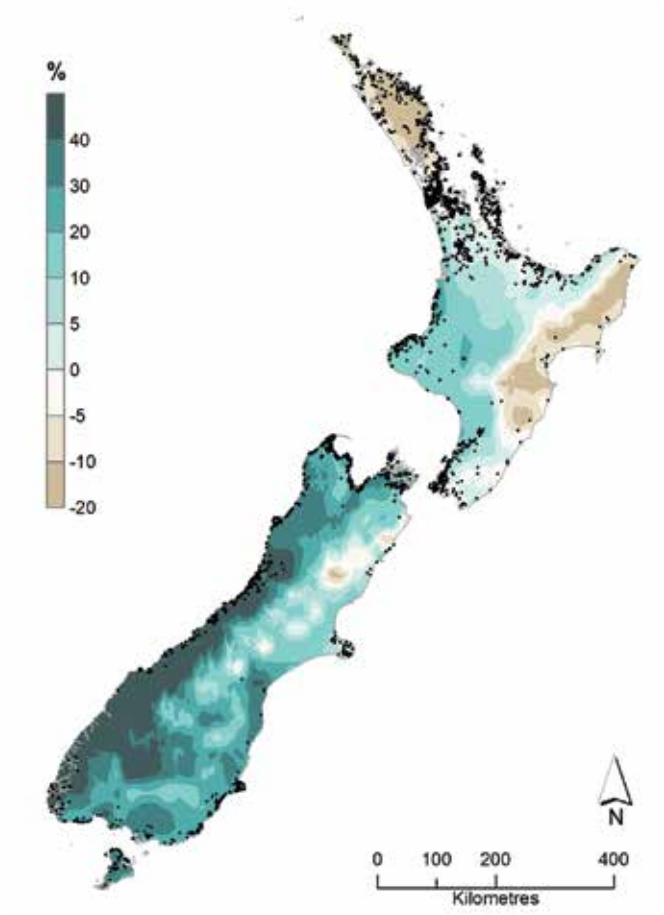
Subset of the exposure variables that will likely increase the vulnerability of banded kōkopu to climate change

Winter precipitation

For the two time periods (mid–century [2046–2065] and late century [2081–2100]) and RCP 4.5 and 8.5, banded kōkopu will likely be highly exposed to projected changes in mean winter rainfall. Predictable periodicity in rainfall is an important environmental trigger for banded kōkopu reproduction which occurs mostly during the winter although reproduction timing is only know from a few locations around the country. Changes in the frequency, timing and magnitude of flood events that are predicted to occur with climate change may alter the reproductive cues used by banded kōkopu. Extreme precipitation especially during the spawning season could result in egg mortalities either in the gravels or in riparian vegetation that banded kōkopu use. Little is known about the cues banded kōkopu use for inward migration to freshwaters, but migration is likely trigged by seasonal changes in water temperature and day length along with flood flows.

Drought intensity

For the time period 2081–2100, under the "extreme" scenario (RCP 8.5), banded kōkopu will likely be highly exposed to changes in the potential evapotranspiration deficit (as proxy for drought intensity). It is speculated that diadromous galaxiids may be affected by drought conditions because spawning and larval migration to the sea occurs during periods of increased drought prevalence (i.e., in the summer and autumn). During drought conditions, low flows can result in gravel and sediment build up at river mouths and can block the inward migrations of the post–larval stages, with the effects of drought exacerbated in regulated rivers. Variable and extreme weather conditions such as droughts likely affect spawning and recruitment, but these effects have not been measured in Aotearoa–New Zealand.



Current banded kōkopu distribution (dark circles) with projected changes in mean winter rainfall (for time period 2081–2100 under RCP 8.5).

Sea surface temperature

For the late century (2081–2100) time period and RCP 8.5, banded kōkopu will likely be highly vulnerable to projected changes in sea surface temperatures. Banded kōkopu larvae typically rear in estuaries or at sea, and the post-larvae (whitebait) return to freshwater after 4–6 months. Their marine phase is important for growth and to facilitate connectivity of populations from multiple rivers. Changes in sea surface temperatures may affect the dispersal of the larvae and increase or decrease population connectivity. If sea surface temperatures are warmer the larvae may grow quicker and return to freshwater earlier.
However, conditions in freshwater may not be favourable for juvenile growth.

This document summarises some of the key findings from the report: Egan, E., Woolley, J.M., Williams, E. (2020) Climate change vulnerability assessment of selected taonga freshwater species: Technical report. NIWA Client Report: 2020073CH. April 2020. 85 p.

For more on the methodology of CCVAs and the assessment of 10 freshwater taonga species (eight fish and two invertebrates) visit: **niwa.co.nz/te-kuwaha/CCVA**