NIWA
Taihoro Nukurangi

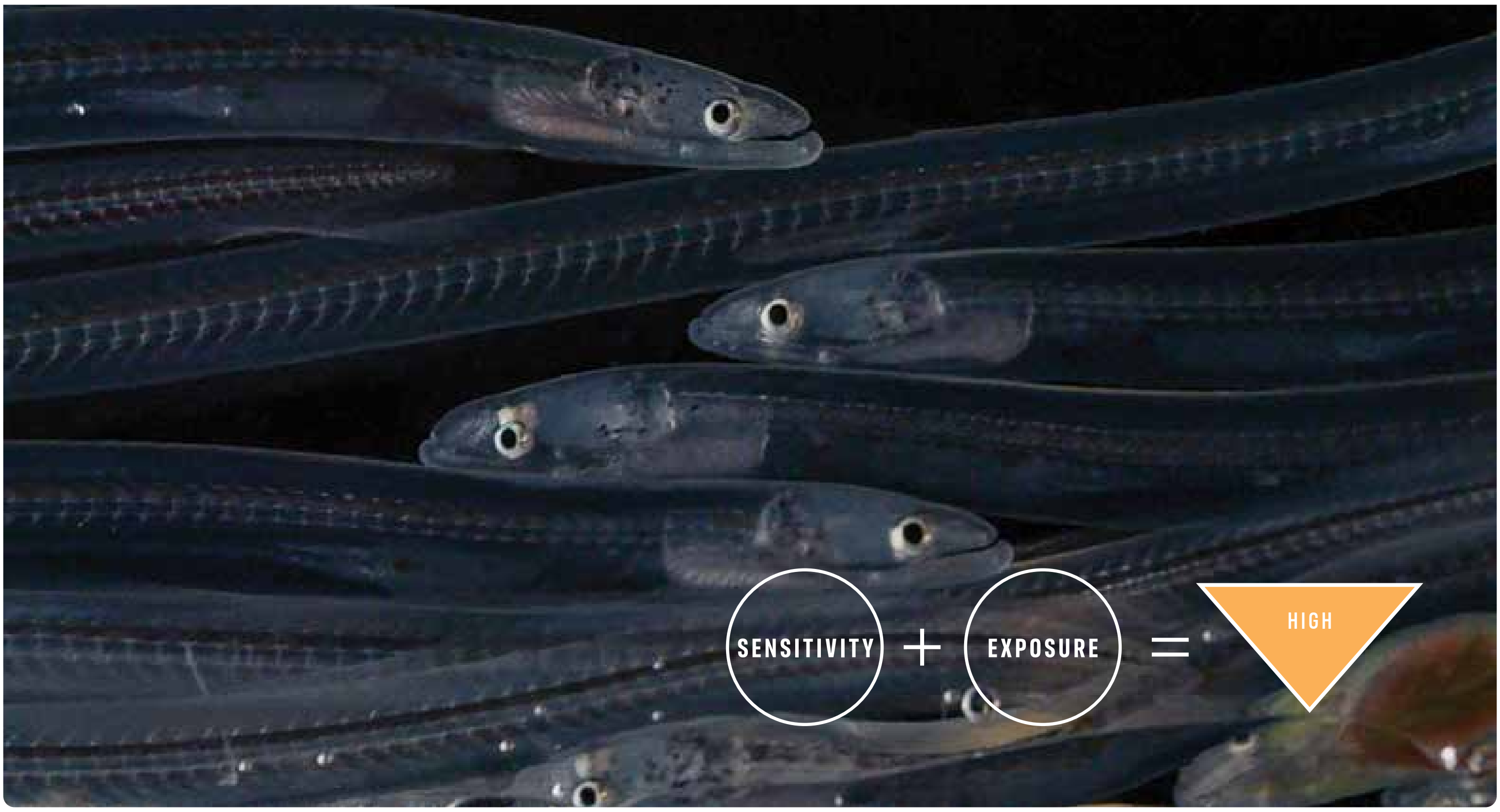
Te Wai Māori

HIGH VULNERABILITY

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

Tuna (Shortfin eel)

Anguilla australis



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SENSITIVITY

Shortfin eels have a complex lifecycle. Most of their life is spent in freshwater, followed by migration to the marine environment for reproduction. Some individuals do not reach maturity until they are 50 years old.

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.

DISTRIBUTION Sensitivity attributes related to taonga species' locations	ABUNDANCE Sensitivity attributes related to taonga species' productivity	PHENOLOGY Sensitivity attributes related to timing of events in taonga species' lifecycle
Dispersal	Prey specificity	
Adult mobility	Demographics	Spawning duration
Temperature sensitivity	Early life history, survival and recruitment	
Interspecific interactions	Reproduction complexity	Dependence on environmental triggers
Habitat specificity	Exposure to other pressures	

Sensitivity attributes vulnerability key: VERY HIGH, HIGH, MODERATE, LOW

Subset of the sensitivity attributes that contributed to shortfin eel CCVA scores

Complexity in reproduction

Shortfin eels have several reproductive characteristics that likely increase their vulnerability to climate change. Shortfin eels migrate from fresh water to the Pacific Ocean to spawn. The adult migration to the spawning grounds takes approximately 6–9 months. The characteristics of these migrations are not well-known. Females that reach the spawning area must encounter males and spawn. The location of their spawning ground is not well-described. They may use environmental markers (e.g., salinity fronts) and geographic markers (e.g., seamounts) to locate their spawning habitats. A critical knowledge gap is that it is unknown if a minimum number of eels are required to reach the spawning grounds to achieve successful spawning and recruitment. Eels have sex-specific life-history strategies and gender is thought to be determined principally by environmental factors, in particular temperature.

Exposure to multiple pressures

Species that are already facing multiple threats are considered more vulnerable to climate change. Shortfin eels are exposed to multiple pressures including harvest pressure from the commercial eel fishery, in-stream barriers to upstream and downstream migrations, and mortality at hydro-structures. Drought is recognised as a significant ongoing threat to shortfin eels that may affect 50% of the population. Shortfin eel were ranked as 'Not Threatened' by the Department of Conservation in 2017 and 'Near Threatened' by the International Union for Conservation of Nature in 2020.

Dispersal

The widespread dispersal of shortfin eels' larvae in the marine enviroment likely makes them less vulnerable to climate change. Shortfin eels are approximately 7–8 months old when they arrive at our coastline. Like freshwater eels worldwide, the New Zealand species are assumed to be panmictic (i.e., they consist of single genetic stock despite occupying broad geographic ranges). Shortfins from Australia and New Zealand show small but significant differences in morphology, but genetic homogeneity, at least at the glass eel stage. Whether these small morphological differences are a result of spawning in separate areas is unknown, but on the weight of current evidence this would seem unlikely, meaning that the species should be recognised and managed as a single trans-Tasman one.

EXPOSURE

Shortfin eels are widely distributed throughout the Southern Hemisphere. They are found in both Australia and Aotearoa–New Zealand but we do not yet know if these stocks spawn in different places in the Western Pacific Ocean. In Aotearoa–New Zealand they are principally found in lowland habitats such as lowland lakes, estuaries and the lower reaches of rivers. Their upper elevation limit is 700 m. The adults have a narrow home range with an average of just 30 metres meaning they are highly site-attached.

Subset of the exposure variables that will likely increase the vulnerability of shortfin eels to climate change

Autumn air temperature

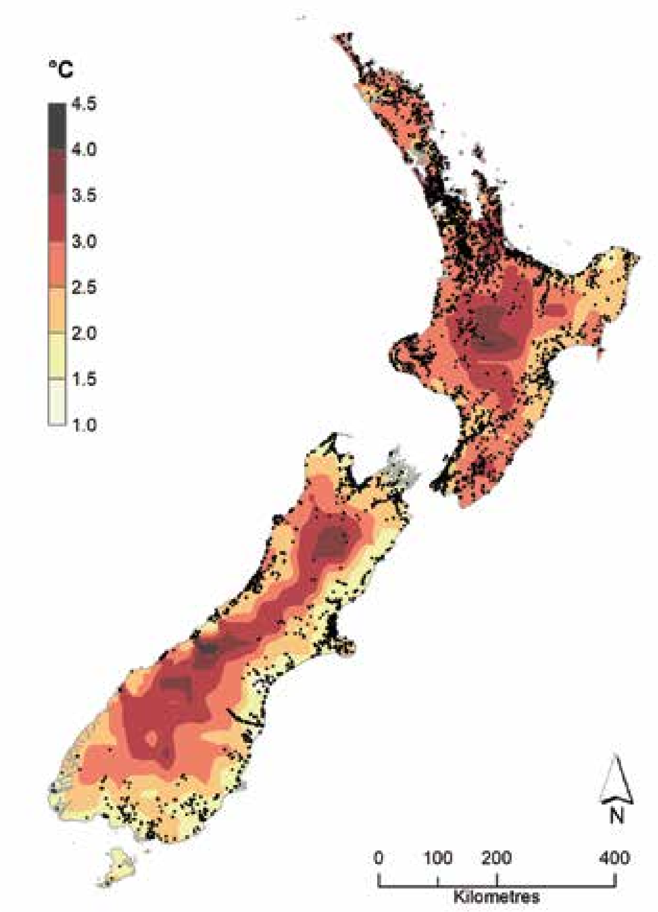
For the late century (2081–2100) time period and RCP 8.5, shortfin eels will likely be highly exposed to changes in autumn mean air temperatures. The relationship between eel movement, growth rates and water temperature is not fully resolved so the effects of increased water temperatures are unknown. However, it is known that water temperature affects the length of the growing season and indirectly affects eels' foraging and feeding activity. Summer is considered the peak growing period but in warmer autumns, the growing period may be extended which would likely be beneficial for shortfins. Water temperatures more than 12.4°C promote growth rates for shortfins in some rivers. Shortfins are usually inactive when water temperatures are less than 12°C. When they exceed 12°C, shortfin feeding activity increases.

Glass eel catches are strongly and inversely related to water temperature, with 99% of catch in the two years studied occurring at temperatures between 12.6 and 13.1°C.

Winter precipitation

For the two time periods and RCPs (4.5 and 8.5), shortfin eels will likely be highly (mid-century [2046–2065] or very highly late century [2081–2100]) exposed to changes in mean winter precipitation. The projections for the west and east coasts of Aotearoa–New Zealand show different patterns in changes to winter precipitation, indicating that shortfin eels will be affected differently depending on their location. Increased winter precipitation may stimulate the migrations of glass eels to freshwater and facilitate better recruitment. The migration of mature adults out to sea for reproduction can occur in the winter months. Changes to the magnitude, frequency and predictability of winter rainfall may therefore affect shortfin eel migrations. However, in catchments that are highly regulated for hydro-generation, the relationship between winter rainfall and downstream eel migration will likely be unclear.

A lack of winter rainfall for three consecutive years was hypothesised to be associated with eel mortalities in Canterbury rivers. Shortfins are generally considered more responsive to changing water levels than longfin eels, because they predominantly occupy the main stem of rivers rather than the tributaries.



Current shortfin eel distribution (dark circles) mapped with projected changes in mean autumn air temperatures (for time period 2081–2100 under RCP 8.5).

Circulation change in the Western Pacific Ocean

For the late century (2081–2100) and RCP 8.5, shortfin eels will likely be highly exposed to projected changes in Western Boundary Currents. The migratory routes of adult and larval shortfin eels are poorly known. Until a better understanding of the marine life of eels is achieved, we cannot predict what the consequences of a changing marine environment on shortfin eels may be.

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**