NIWA
Taihoro Nukurangi

Te Wai Māori

VERY HIGH VULNERABILITY

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

Tuna (Longfin eel)

Anguilla dieffenbachii

VERY HIGH VULNERABILITY

SENSITIVITY

Longfin eels have a complex lifecycle. Most of their life is spent in freshwater, followed by migration to the marine environment for reproduction.

DISTRIBUTION	ABUNDANCE	PHENOLOGY
Sensitivity attributes related to taonga species' locations	Sensitivity attributes related to taonga species' productivity	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 longfin eel CCVA scores

Demographics

Longfins are one of the largest, slowest growing and longest–lived eel species in the world. Females can live for over a century, meaning they may be exposed to the impacts of environmental changes over multiple decades and climate change over their lifetime. Large eels play an important role in determining the population structure and these large eels affect species composition, sex ratios and size distribution. Longfin eels breed once in their life and die after spawning. They can produce millions of eggs and larger females are more fecund than smaller females.

Exposure to multiple pressures

Species that are already facing multiple threats are often considered more vulnerable to climate change. Longfin eel are ranked as 'At-Risk Declining' by the Department of Conservation and 'endangered' by the International Union for Conservation of Nature. Pressures on longfin eels include the commercial eel fishery, in-stream barriers to upstream and downstream migrations, and mortality at hydro-structures. Roughly one-third of the available longfin habitat is currently commercially fished and approximately 40% of the longfin eel habitat is estimated to be impacted by both hydroelectric dams and commercial fishing. Drought is recognised as a significant ongoing threat to longfin eel, potentially affecting 50% of the population in New Zealand.

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

Longfin eels have several characteristics that likely increase their vulnerability to climate change. Longfin eels migrate from fresh water to the Pacific Ocean to spawn, a spawning migration that spans thousands of kilometres. Sex-specific differences in migration times are known with males generally migrating to sea during April, and longfin females during late April and May. The adult migration to the spawning grounds takes approximately 6–9 months. Females that do reach the spawning area must encounter males and spawn and they reproduce in large aggregations. However, the location of their spawning ground is unknown and therefore spawning behaviour has never been observed. Gender is thought to be determined principally by environmental factors, particular temperature, meaning sex ratios are vulnerable to changes in temperature. Longfin eels are semelparous meaning they die after reproduction.

EXPOSURE

Longfin eels are only found in Aotearoa–New Zealand. They can travel up to 300 km inland, and are distributed from sea level up to 1,150 metres elevation. This species can be found in many high–country lakes and rivers. Although the adults are highly mobile, they have a narrow home range with an average of just 10 metres.

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

Drought intensity

Longfin eels will likely be highly exposed to changes in drought intensity (indicated by changes to potential evapotranspiration deficit) for mid-century (2081–2100), under the "extreme" scenario (RCP 8.5). Most of the North Island, the central South Island along the Southern Alps, and the east coast of the South Island will experience increases in drought conditions. Populations on the west coast of the South Island are projected to be the least exposed to changes in drought intensity.

Increased stress associated with changes in drought intensity may reduce longfin eel habitat availability, alter prey availability, interfere with environmental triggers, and increase mortality rates. However, like shortfin eels, longfin eels may be resistant and resilient to drought conditions.

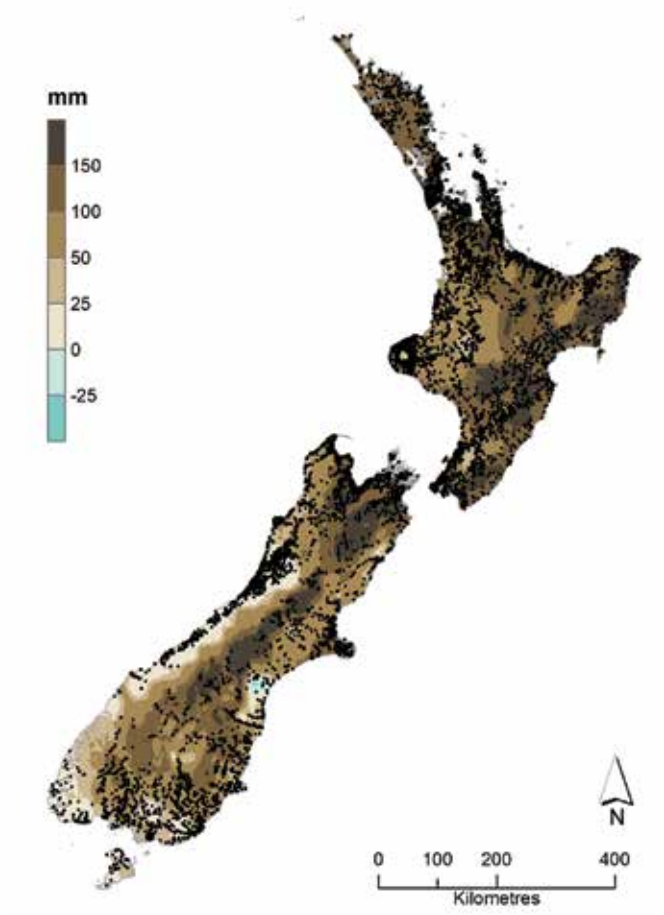
Temperature extremes

Longfin eels will likely be exposed to changes in extreme annual air temperatures for the time period 2081–2100 for RCP 8.5. The number of hot days ranges from 0 to 60 for the annual baseline (time period 1986–2005) with more hot days along the east coast of both North and South Islands. The projections show a large proportion of the North Island and the central South Island along the Southern Alps will experience an increase in the number of hot days (at least 50 more days per year).

Because longfin eels penetrate further inland than shortfins, and live in higher altitude environments, they may be more exposed to changes in temperature extremes. Adult longfin eels have an upper thermal limit of 37.3°C. Increased stress associated with changes in temperature extremes may skew longfin eel sex ratios and reduce reproductive success.

Western Pacific Ocean circulation changes

Longfin eels will likely be highly exposed to projected changes in Western Boundary Currents by late century (2081–2100) for RCP 8.5. Recent modelling shows that there will be strong changes in the intensity and position of the East Australian Current and that significant projected changes in ocean circulation will occur in the future. Connectivity between Australia and New Zealand will reduce, meaning larval transport to northern New Zealand may be affected. Projected changes in the size and temporal extent of eddies might be beneficial for longfin eel larvae as they can obtain more food and potentially grow faster, thereby enhancing larval survival rates.



Current longfin eel distribution (dark circles) mapped with projected changes in mean annual drought intensity indicated by changes to annual potential evapotranspiration deficit accumulation (for time period 2081–2100 under RCP 8.5).

The migratory routes of adult and larval longfin eels are poorly known and it is not clear if the East Australian Current is a major migratory pathway. The spawning period of longfin eels extends from August to December indicating winter, spring and summer spawning events. The extensive spawning indicates that a portion of the population may encounter favourable transport conditions, while another portion may encounter unfavourable larval transport conditions.

Longfins may use several ocean currents to and from their spawning grounds. Until we better understand the needs of longfin eels during their marine life stage, we cannot accurately predict what the consequences of a changing marine environment on longfin eel populations.

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**