NIWA
Taihoro Nukurangi

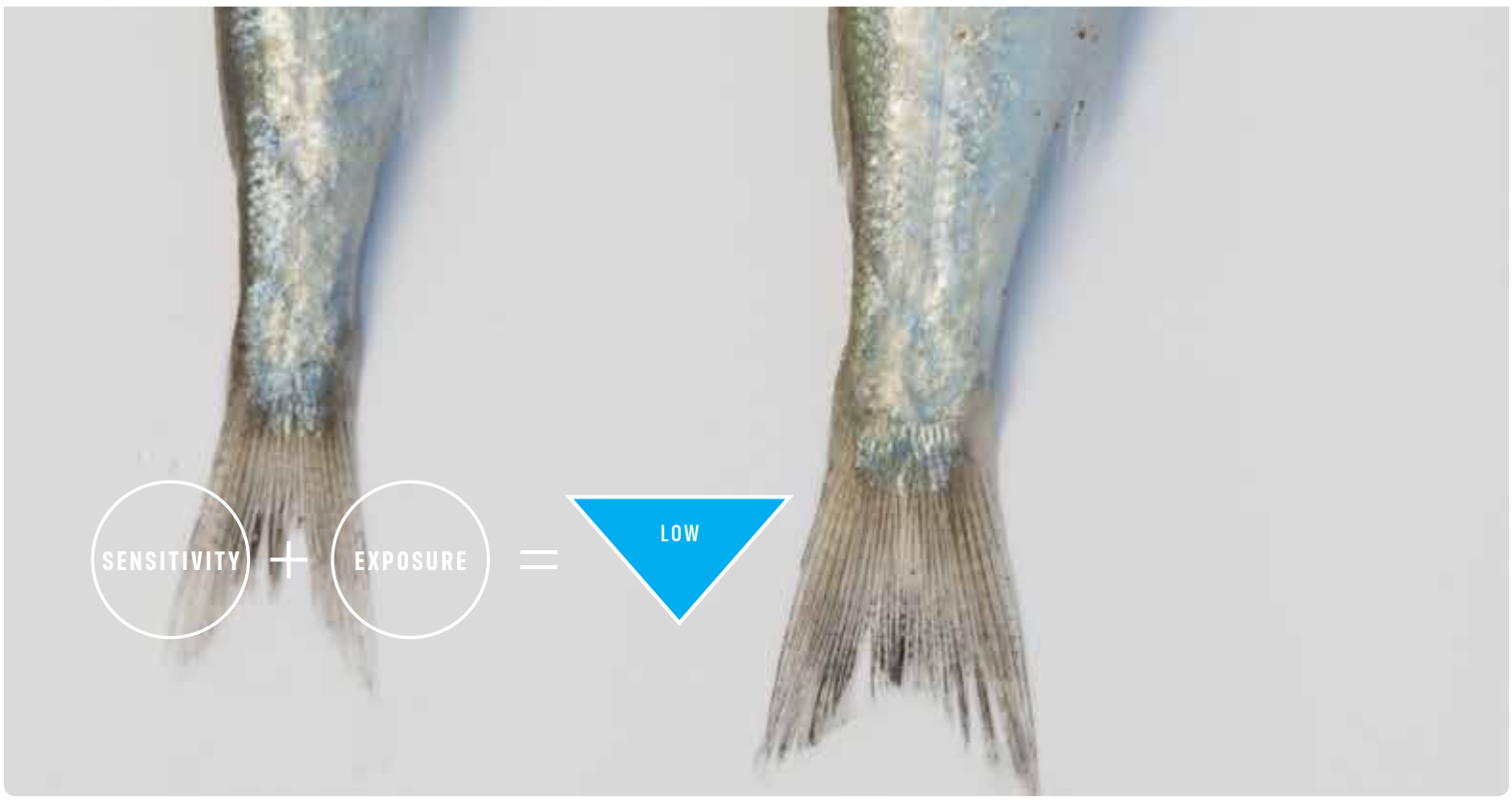
Te Wai Māori

LOW
VULNERABILITY

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

Aua / kātaha (Yellow-eye mullet)

Aldrichetta forsteri



LOW VULNERABILITY

SENSITIVITY

Yellow-eye mullet are a small, rapidly maturing, short-lived species. They commonly reach 300 mm length but can be as large as 500 mm and a maximum age of 7 years. Yellow-eye mullet spawning takes place in the sea and the juveniles use estuaries for rearing.

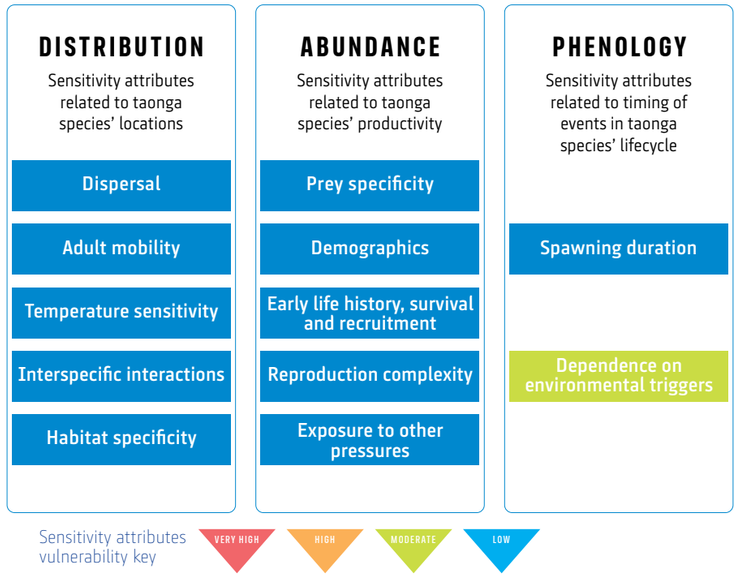
What is a CCVA?

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.



Subset of the sensitivity attributes that contributed to yellow-eye mullet CCVA scores

Environmental triggers

Little is known about the specific environmental triggers associated with yellow-eye mullet spawning, recruitment and movements. Juveniles are known to move into estuaries when inflows are low. Environmental triggers for spawning are not well-known. Offshore winds may trigger their seaward spawning migrations. The speed and direction of surface ocean currents may be an important factor in promoting long distance larval dispersal and thus gene flow.

Complexity in reproduction

Yellow-eye mullet reproduction is relatively simple which likely reduces their vulnerability to climate change relative to other taonga species. Spawning occurs at sea and there is some evidence that biennial spawning occurs, with peaks in winter and summer. Yellow–eyed mullet produce several hundred thousand eggs, which float in the surface waters of the sea up to 33 km offshore. Egg development usually begins in July and maturity occurs by late December. For both sexes, first maturity is reached at 220–230 mm (total length) and age at sexual maturity is typically 2-3 years.

Adult mobility

A species can better survive changes in their habitat if they can leave that habitat in search of a new one. Yellow-eye mullet have a large geographic range and the adults are considered highly mobile. Large aggregations of adults have been observed over open coastal reefs suggesting that this species can migrate considerable distances from their original nursery grounds. Large scale movements occur prior to the spawning period.

In several estuaries throughout Aotearoa–New Zealand, the growth rates of yellow-eye mullet show significant spatial differences. These differences might be indicative of stock structure and more restricted adult movements. In Australia, otolith (fish ear bone) chemistry shows spatial variation among neighbouring estuaries. However, some locations show similar otolith chemistry meaning there is connectivity between populations.

Subset of the exposure variables that will likely increase the vulnerability of yellow-eyed mullet to climate change

Rainfall

Yellow-eye mullet will likely be highly exposed to changes in mean annual and seasonal (autumn and winter) rainfall for the two time periods (mid–century [2046–2065] and late century [2081–2100]) and RCP scenarios 4.5 and 8.5. Changes in seasonal rainfall patterns may affect the estuarine habitats yellow-eye mullet use via increased or reduced inflows of freshwater to estuaries. However, the effects of changes to inflows likely depends on the type of estuarine habitat yellow-eye mullet use in Aotearoa–New Zealand.

Yellow-eye mullet mostly use estuaries for juvenile rearing indicating changes in freshwater inflows will largely affect the juvenile life stage. In parts of Aotearoa–New Zealand with lower projected rainfall (such as the east coast of the North Island), water quality may be reduced which might affect juvenile survival. Increased inflows to estuaries and associated increases in turbidity may also affect yellow-eye mullet swimming performance, movements and feeding.

Variability in freshwater inflows to estuaries affects yellow-eye mullet recruitment. In Australia, years with high annual freshwater inflows are associated with low yellow-eye mullet catches. During high estuarine inflow, juvenile fish consume more larval fish and amphipods compared to low inflows during drought conditions. This indicates that feeding opportunities are better for yellow-eye mullet during high inflows and may facilitate greater recruitment success.

The geographic range of yellow-eye mullet is influenced by salinity which is driven primarily by the magnitude of freshwater inflows. During drought and associated low freshwater inflows, hypersaline conditions can reduce yellow-eye mullet habitat availability. Recent mortalities of yellow-eye mullet have been observed in Hawke's Bay as a result of low freshwater flows and water temperatures close to 29°C. There was an increased prevalence of diseased fish which resulted in mortalities.

EXPOSURE

Yellow–eye mullet occur throughout Aotearoa–New Zealand, they are also found in western and eastern Australia. They are considered locally abundant throughout coastal areas.

Species summary: Aua / kātaha (Yellow-eye mullet)

LOW VULNERABILITY

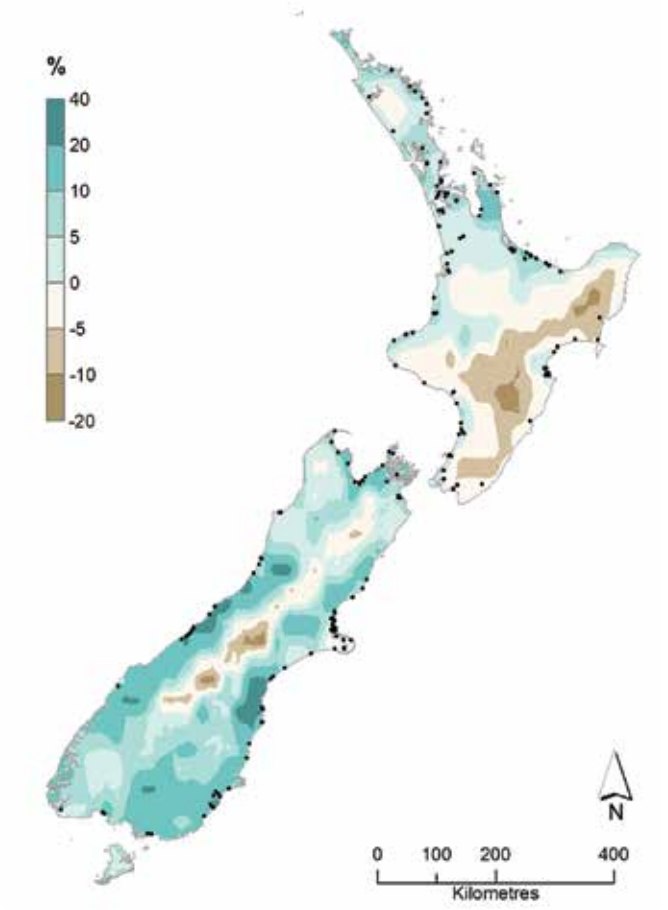
Sea–level rise

Yellow-eye mullet will likely be highly exposed to sea-level rise. Across Aotearoa–New Zealand, sea-level rise is predicted to increase by an additional 0.5 metres by 2050 and 1 metre by 2090. Estuaries, subtidal sand/mud habitats and submerged seagrass are key habitats used by yellow-eye mullet. These habitats are likely vulnerable to increasing saltwater intrusion associated with sea-level rise.

Sea-level rise will likely alter estuarine hydrodynamics, but this is dependent on the shape and characteristics of individual estuaries. Nevertheless, changes to estuarine hydrodynamics as a result of sea-level rise may alter the habitats of yellow-eye mullet especially for juveniles. However, there are few direct links in Aotearoa–New Zealand and globally regards habitat changes due to sea-level rise and fish populations and no data exists for yellow-eye mullet.

Sea surface temperature

For the late century (2081–2100) and RCP 8.5, yellow-eye mullet will likely be highly exposed to changes in sea surface temperatures. Yellow-eye mullet are found in Western and Southern Australia and throughout much of Aotearoa–New Zealand indicating they can tolerate a wide range of temperatures. The preferred temperature range of yellow-eye mullet is 13.5–20.2°C, with a mean of 17.1°C. Species distribution modelling shows that yellow-eye mullet distributions are predicted to increase in Australia at lower (+0.54°C), median (+0.85°C) and upper (+1.24°C) temperature scenarios but no data exists for Aotearoa–New Zealand. Yellow-eye mullet have a large aerobic scope suggesting physiological adaptation to the highly variable temperatures found in coastal environments. However, recruitment surveys along the west and south coasts of Australia during 2011 and 2012 indicated a marked decline of the "cool temperate" yellow-eye mullet on both coasts which may be a result of a marine heatwave during that time. The effects of marine heatwaves on Aotearoa-New Zealand populations of yellow-eye mullet are unknown.



Current yellow–eye mullet distribution (dark circles) mapped with projected changes in mean autumn rainfall (for time period 2081–2100 under RCP 8.5).

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**