The Index of Estuary Condition (IEC) integrates information for five key aspects of estuary condition: Physical Form, Hydrology, Water Quality, Flora and Fish. These sub-indices are aggregated to provide an overall 'snapshot' measure of environmental condition at the time of monitoring.

# IEC Fish sub-index

As it is rarely feasible to measure all aspects of all biological communities, certain groups of organisms have been identified as useful indicators of biological integrity within estuaries, including fish. Fish are considered to be potentially useful indicators of estuary condition as they occupy relatively high levels in food chains and therefore require a diverse range of intact ecosystem processes for them to survive, grow and reproduce. In addition, they are taxonomically well known, popular with the public and estuaries often have diverse assemblages of them.

Fish respond to chemical, physical and ecological disturbances prompted by major threats to estuaries, including anthropogenic land use, hydrological modification and geomorphological modification, with repercussions for assemblage composition. Estuarine fish assemblages include species with different trophic ecology (herbivores to piscivores), habitat associations (e.g. benthic, demersal or pelagic habitats) and occupancy patterns (e.g. opportunistic use of estuaries or more permanent residents). Therefore, there are multiple pathways by which human pressures can influence fish assemblages, trophic structure and habitat use.

Fish-based multi-metric indices that are responsive to human disturbance have been developed for estuarine condition assessments worldwide. However, estuarine fish assemblages are highly variable and relationships between single metrics of fish assemblages and human disturbances are often unclear. Biogeographic, physical and ecological drivers of fish recruitment to estuaries, along with many other estuary-specific characteristics, all contribute to the inherently high background variation in estuarine fish assemblages that make it difficult to disentangle human impacts from natural variability.

Fish sampling was done in autumn, when there is likely to be greater use of estuaries by fish with marine associations, juveniles that recruited in spring and summer and catadromous migrants. Fish surveys were done across the upper, middle and lower estuary to ensure adequate representation of the longitudinal differences in habitat types across estuaries.
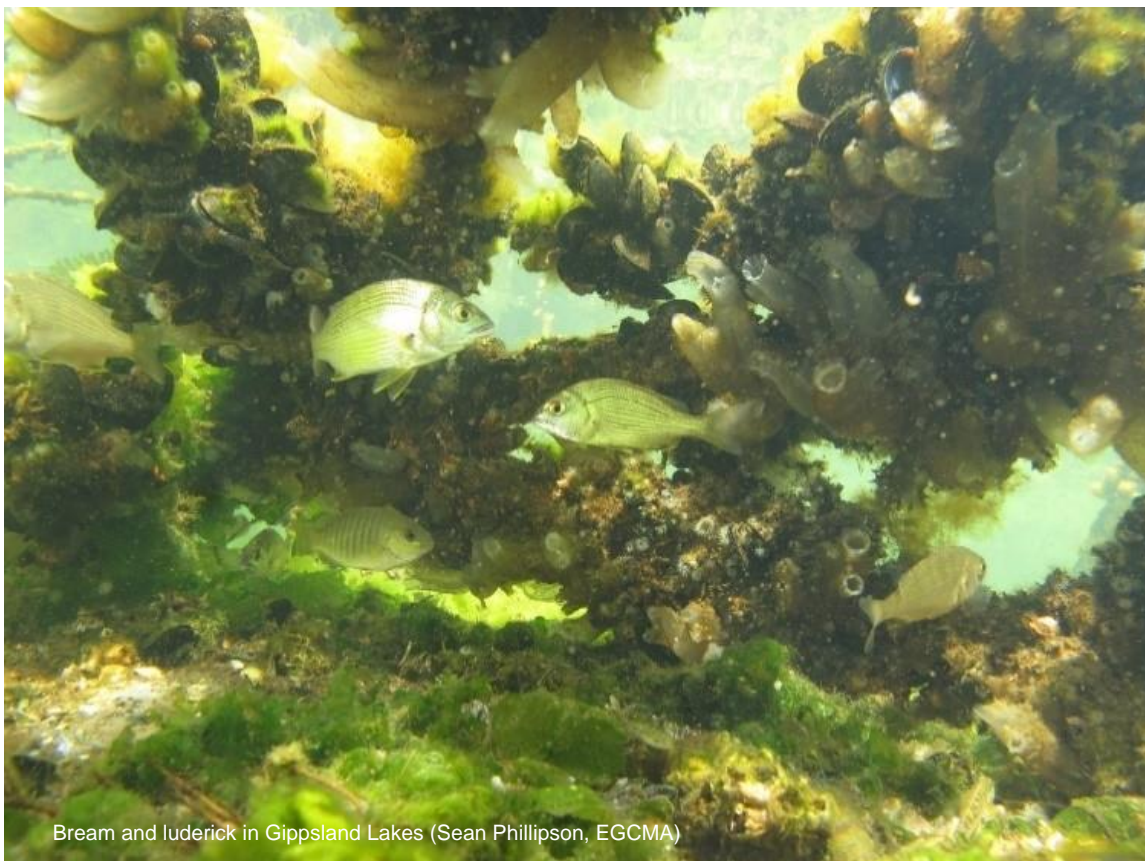
Seven metrics were combined for the IEC Fish sub-index.

**Table 1: Metrics for the Fish sub-index and their predicted response to pressures and stressors**

| Metric | Predicted response |
|---|---|
| Richness of species that can complete their life cycle within estuaries | Decrease |
| Presence of introduced species | Present |
| Richness of demersal species (those living in lower water column, feeding in benthic zone) | Decrease |
| Relative abundance of demersal species | Very high or very low |
| Richness of trophic specialists | Decrease |
| Relative abundance of trophic specialists | Decrease |
| Richness of diadromous species (those that migrate between marine and freshwaters) | Decrease |

State-wide condition assessment programs provide information about the overall environmental condition of Victoria's waterways and are vital for guiding state and regional planning. The current approach is to rotate these assessments among estuaries, wetlands, and rivers at the long time-frames (10 years or more) expected for changes in condition at the broad spatial scales assessed, and in response to changes in threats, management regimes or environmental contexts. In the intervening periods, planning and management will be informed by targeted monitoring of key aquatic values and threats at specific waterway assets, evaluations of the effectiveness of management interventions, and strategic research to fill critical knowledge gaps.

For further details for IEC methods see:
*DELWP (2021). Assessment of Victoria's estuaries using the Index of Estuary Condition: Background and Methods 2021.*


Bream and luderick in Gippsland Lakes (Sean Phillipson, EGCMA)

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