Derbal Yirragan Djarlgarro (Swan Canning Estuary) condition assessment based on fish communities - 2025

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Final Report

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Executive summary

This report, commissioned by the Department of Biodiversity, Conservation and Attractions (DBCA), describes the monitoring and evaluation of fish communities in Derbal Yirragan Djarlgarro (Swan Canning Estuary) during 2025 and applies the Fish Community Index (FCI) that was developed as a measure of the ecological condition of the estuary. This index, separate versions of which were developed for both the shallow (< 1.5 m), nearshore waters of the estuary and for its deeper (> 1.5 m), offshore waters, integrates information on various biological variables (metrics). Each of these metrics quantifies an aspect of the structure and/or function of the fish community, and together they respond to a range of stressors affecting the ecosystem.

Fish communities were sampled using different types of net at six nearshore and six offshore sites in each of four ecological management zones of the estuary (LSCE, Lower Swan Canning Estuary; CE, Canning Estuary; MSE, Middle Swan Estuary; USE, Upper Swan Estuary) during the summer and autumn of 2025. As many fish as possible were returned to the water alive after they had been identified and counted. The resulting data on the abundances of each fish species from each sample were used to calculate a Fish Community Index score (0–100). These index scores were then compared to established scoring thresholds to determine ecological condition grades (A–E) for each zone individually and for the estuary as a whole, based on the composition of the fish community.

Nearshore Fish Communities

The nearshore waters of the estuary as a whole were in good condition (C) during both summer and autumn 2025. Across both seasons, this was the third-highest score recorded, the fourth time good condition was achieved, and an improvement from the fair condition awarded in 2024. The average nearshore FCI scores for each zone of the estuary varied during summer, being best, i.e. good (B) in the MSE and USE, fair/good (C/B) in the LSCE and fair (C) in the CE. Higher scores in upstream areas reflect the saline conditions that increased the occurrence of marine species and concentrated individuals of estuarine-spawning species in these zones. Conversely, the lower scores of the CE and LSCE reflect estuarine species moving upstream to relatively lower salinities and the lower richness and abundance of benthic species. In autumn, the condition of all zones was good, except the LSCE, which was fair. The similarity in scores between the two seasons is likely due to the absence of freshwater flow, which resulted in high salinities and relatively stable hydrodynamic conditions throughout the estuary.

Small-bodied, schooling species of hardyheads (Atherinidae) and gobies (Gobiidae) once again dominated catches from the nearshore waters of the estuary in 2025, representing 73% of all fish recorded and constituting three of the four most abundant nearshore species. The marine-associated Silver Fish, rather than the estuarine-associated Western Hardyhead, was the most abundant species overall, reflecting the saline conditions throughout much of the estuary during the 2025 monitoring period. Other abundant species of small, schooling fish included the Spotted Hardyhead, Perth Herring and Yellowspotted Goby. Densities of the Western Hardyhead and Elongate Hardyhead were substantially lower than those recorded previously. The higher-than-usual temperatures may have influenced the timing of the breeding season and/or the recruitment success for estuarine hardyhead species, which have a one-year lifecycle and die after spawning. A juvenile Queenfish was recorded in the LSCE for the first time, likely due to the marine heat wave.

Offshore fish communities

The offshore waters of the Swan Canning Estuary were in good (B) condition in both summer and autumn during 2025. The overall score was the highest ever recorded, surpassing the previous record set in 2024 and continuing the generally upward trend since 2017. Scores in summer in the USE (A) and MSE (B) were likely driven by relatively high salinities and well-oxygenated conditions. While the score for MSE did not change, the USE score declined from very good (A) in summer to good/fair (B/C) in autumn, likely due to the presence of a protracted *Karlodinium* bloom that may have influenced fish to move outside of the affected area. In summer, the offshore waters in the CE once again exhibited the lowest scores of any zone; scores improved in autumn and were better than in this season in almost all previous years, possibly due to marine and oxic conditions and relatively low densities of harmful algae.

As in all previous years of monitoring, Perth Herring was among the dominant species in offshore waters from all four zones, comprising 25–78% of the total catches. Other abundant species included the Yellowtail Grunter, which represented 60% of the catch in the USE and 11% in the MSE and Tailor and Yellowtail Flathead in the LSCE (11 and 9%, respectively, of the catch). The numbers of both species and individuals recorded from the offshore waters in 2025 were amongst the greatest in any monitoring year. This was similar to 2024, and in both years, high salinities were recorded throughout the estuary, with no widespread hypoxia. In 2025, catches of several species, including the Hawaiian Giant Herring, juvenile Bull Shark and Mulloway, were higher than in previous years. These may reflect stable, warm, saline and oxic conditions in the estuary, together with strong Leeuwin current strength and high water temperatures in the Indian Ocean in 2025. Additional data are required to evaluate trends in the abundance and population sizes of these species.

Overall

Across the entire estuary, the ecological condition of the nearshore and offshore waters in 2025 was assessed as good (B) based on their fish communities, despite the presence of potentially ichthyotoxic algal blooms in some zones. 2022 and 2025 are the only years when good condition was achieved in both waters since annual monitoring began in 2012. Moreover, combined, the nearshore and offshore index scores for 2025 are the highest recorded. This reflects the high and stable saline conditions throughout the estuary in both seasons, as well as the absence of widespread stratification-induced hypoxia.

Derbal Yirragan Djarlgarro (Swan Canning Estuary) condition assessment based on fish communities - 2025

Contents

1. Background

The Department of Biodiversity, Conservation and Attractions (DBCA) works with other government organisations, local government authorities, community groups, and research institutions to reduce nutrient and organic loading into the Derbal Yirragan Djarlgarro (Swan Canning Estuary and river system). This is a priority issue for the waterway, as it impacts water quality, ecological health, and community benefit. Environmental monitoring for the waterway includes water quality reporting in the estuary and catchment and reporting on ecological health. Reporting on changes in fish communities provides insight into the biotic integrity of the system and complements water quality reporting.

The Fish Community Index (FCI) was developed by Murdoch University, in collaboration with the Western Australian government between 2007 and 2012 (Valesini et al., 2011; Hallett et al., 2012a; Hallett et al., 2012b), and provides an assessment of the condition of the Swan Canning Estuary based on fish communities. The FCI has been subjected to extensive testing and validation over several years (e.g. Hallett et al., 2012a; Hallett, 2014). It has been shown to be a sensitive and robust tool for quantifying ecological health responses to local-scale environmental perturbations and the subsequent recovery of the system following their removal (Hallett, 2012; Hallett et al., 2012b; 2016). The development and rationale of the FCI, along with its implementation and outcomes to date, are summarized in Hallett et al. (2019).

2. Rationale

Separate versions of the FCI were developed for the shallow, nearshore waters (< 1.5 m deep) of the estuary and also for its deeper, offshore waters (> 1.5 m deep), as the composition of the fish communities living in these different environments tends to differ, as do the methods used to sample them (Chuwen, 2009; Hoeksema et al., 2009; Potter et al., 2016; Tweedley et al., 2024). These indices integrate information on various biological variables ('metrics'; Table 1), each of which quantifies an aspect of the structure and/or function of estuarine fish communities. Together, the metrics respond to a wide array of stressors affecting the ecosystem. The FCI therefore provides a means to assess an important component of the ecology of the system and how it responds to, and thus reflects, changes in estuarine condition (Hallett et al., 2019; Tweedley et al., 2021).

The responses of estuarine fish communities to increasing ecosystem stress and degradation (i.e. declining ecosystem health or condition) may be summarised in a conceptual model (Fig. 1). In response to increasing degradation of estuarine ecosystems, fish species with specific habitat, feeding or other environmental requirements will tend to become less abundant and diverse, whilst a few species with more general requirements become more abundant. This leads ultimately to an overall reduction in the number and diversity of fish species (Gibson et al., 2000; Whitfield et al., 2002; Villéger et al., 2010; Fonseca et al., 2013; Tweedley et al., 2017). So, in a degraded estuary with poor water, sediment and habitat quality, the abundance and diversity of specialist feeders (e.g. Garfish and Tailor), bottom-living ('benthic-associated') species (e.g. Cobbler and Flathead) and estuarine spawning species (e.g. Black Bream, Perth Herring and Yellowtail Grunter) will tend to decrease, as will the overall number and diversity of species. In contrast, generalist feeders (e.g. Weeping Toadfish) and detritivores (e.g. Sea Mullet), which eat particles of decomposing organic material, will become more abundant and dominant (Krispyn et al., 2021; right side of Fig. 1). The reverse will be observed in a relatively unspoiled system that is subjected to fewer human stressors (see left side of Fig. 1;

noting that this conceptual diagram represents either end of a continuum of ecological condition from very poor to very good).

Each of the metrics that make up the FCI is scored from 0–10 according to the numbers and proportions of the various fish species present in samples collected from the estuary using either seine or gill nets. These metric scores are summed to generate an FCI score for the sample, which ranges from 0–100. Grades (A–E) describing the condition of the estuary and/or of particular zones are then awarded based on the FCI scores (see Section 4 for more details).

Table 1. Summary of the metrics comprising the nearshore and offshore Fish Community Indices developed for the Swan Canning Estuary (Hallett et al., 2012b).

Metric	**Predicted response to degradation**	***Nearshore Index***	***Offshore Index***
Number of species (No. species)	Decrease	√	√
Shannon-Wiener diversity (Sh-div) [a]	Decrease		√
Proportion of trophic specialists (Prop. trop. spec.) [b]	Decrease	√	
Number of trophic specialist species (No. trop. spec.) [b]	Decrease	√	√
Number of trophic generalist species (No. trop. gen.) [c]	Increase	√	√
Proportion of detritivores (Prop. detr.) [d]	Increase	√	√
Proportion of benthic-associated individuals (Prop. benthic) [e]	Decrease	√	√
Number of benthic-associated species (No. benthic) [e]	Decrease	√	
Proportion of estuarine-spawning individuals (Prop. est. spawn)	Decrease	√	√
Number of estuarine-spawning species (No. est. spawn)	Decrease	√	
Proportion of *Pseudogobius olorum* (Prop. *P. olorum*) [f]	Increase	√	
Total number of *Pseudogobius olorum* (Tot no. *P. olorum*) [f]	Increase	√	

[a] A measure of biodiversity

[b] Species with specialist feeding requirements (e.g. those that only eat small invertebrates)

[c] Species that are omnivorous or opportunistic feeders

[d] Species that eat detritus (decomposing organic material)

[e] Species that live on or are closely associated with the substrate

[f] The Bluespot or Swan River Goby, a tolerant, omnivorous species that often inhabits silty habitats (Gill et al., 1993)

3. Study objectives

This report describes the monitoring and evaluation of fish communities in the Swan Canning Estuary during 2025 to apply the FCI as a measure of ecological condition. The objectives of this study were to:

1. Undertake monitoring of fish communities in mid-summer and mid-autumn periods, following an established approach as detailed in Hallett et al. (2012a), including six nearshore and six offshore sampling sites in each ecological management zone.
2. Analyse the information collected so that the FCI is calculated for nearshore and offshore waters in each management zone and for the estuary overall. The information shall be presented as quantitative FCI scores (0–100), qualitative condition grades (A–E) and descriptions of the fish communities. Radar plots shall also be used to demonstrate the patterns of metric scores for each zone.
3. Provide a report that summarizes the approach and results, and that could feed into the broader estuarine reporting framework of the Department of Biodiversity, Conservation and Attractions.

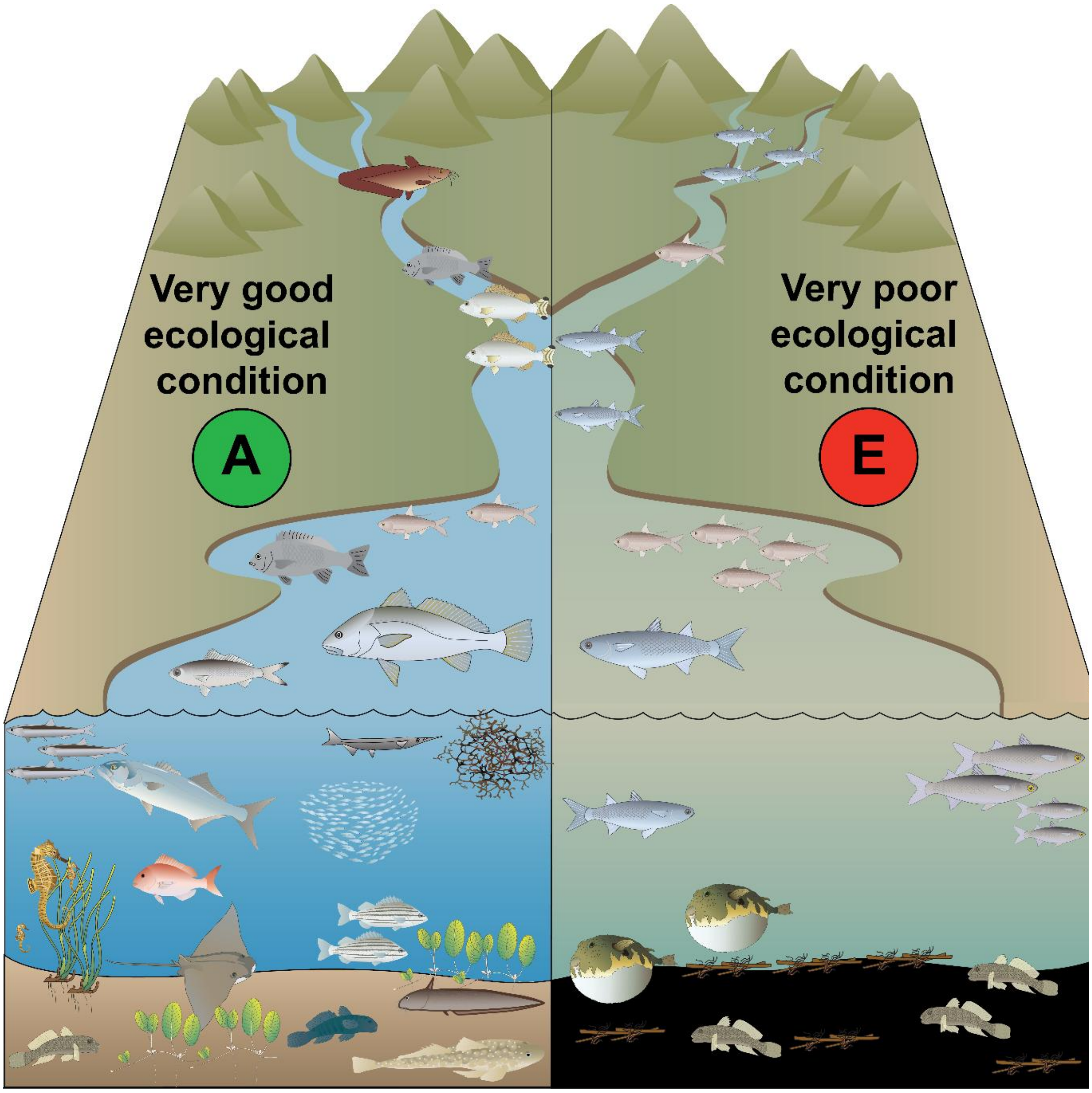


Figure 1. Conceptual diagram illustrating the predicted responses of the estuarine fish community to situations of very good (A) and very poor (E) ecological condition. Images courtesy of the Integration and Application Network [ian.umces.edu/symbols/].

4. Methods

Fish communities were sampled at six nearshore and six offshore sites in each of the four management zones of the Swan Canning Estuary (LSCE, Lower Swan Canning Estuary; CE, Canning Estuary; MSE, Middle Swan Estuary; USE, Upper Swan Estuary; Fig. 2; Appendix i) during both summer (3 - 13 February) and autumn (1 – 14 April) of 2025. All sampling was conducted under permits approved by Murdoch University's Animal Ethics Committee (permit number RW3500/23), the Department of Primary Industries and Regional Development, Fisheries Division (exemption number 251309525) and the Department of Biodiversity, Conservation and Attractions (permit number FO25000254-5).

Nearshore waters were sampled using a 21.5 m seine net that was walked out from the beach to a maximum depth of ~ 1.5 m, deployed parallel to the shore, and then rapidly dragged towards and onto the shore (Fig. 3; Appendix ii). Offshore waters were sampled using 160 m-long, sunken, multimesh gill nets, each consisting of eight 20 m-long panels with stretched mesh sizes of 35, 51, 63, 76, 89, 102, 115 and 127 mm (Fig. 3). These were deployed (i.e. laid parallel to the bank at a depth of 2–8 m, depending on the depth of water at each site) from a boat immediately before sunset and retrieved after three hours.

Once a sample had been collected, any fish that could be identified to species immediately (e.g. larger species caught in relatively low numbers) were identified, counted, and returned to the water alive. All other fish caught in the nets were placed into zip-lock polythene bags, euthanised in ice slurry and preserved on ice for subsequent identification and counting, except in cases where large catches (e.g. thousands) of small fish were obtained. In such instances, an appropriate sub-sample (e.g. one-half to one-eighth of the catch, depending on the total size of the catch) was retained for identification and estimation of the numbers of each species, and the remaining fish were returned alive to the water to minimise the impact on fish populations. All retained fish were frozen until their identification in the laboratory by experienced fish biologists, using available keys and identification guides where required. See appendices i and ii for full details of the sampling locations and methods employed.

The abundances of each fish species in each sample were used to derive values for each of the relevant metrics comprising the nearshore and offshore indices (Hallett et al., 2012a; Hallett et al., 2012b) using bespoke code developed for the R software package. Metric scores were then calculated from these metric values, and the metric scores, in turn, combined to form the FCI scores. The method for calculating these scores is detailed in Hallett et al. (2012a), but can be summarised as follows:

1. Allocate each fish species in a particular sample to its appropriate Habitat guild, Estuarine Use guild and Feeding Mode guild (Appendices iii-vi), then calculate the values for each fish metric from the abundance of each fish species in the sample.
2. Convert metric values to metric scores (0–10) via comparison with the relevant (zone- and season-specific) reference condition values for each metric.
3. Combine scores for the component metrics into a scaled FCI score (0–100) for each sample.
4. Compare the FCI score to the thresholds used to determine the condition grade for each sample (Table 2; Hallett, 2014), noting that intermediate grades, e.g. B/C (good/fair) or C/B (fair/good), are awarded if the index score lies within one point on either side of a grade threshold.

The FCI scores and condition grades for nearshore and offshore samples collected during summer and autumn 2025 were then examined to assess the condition of the Swan Canning Estuary during this period and were compared to previous years through a qualitative examination of the patterns and trends in scores.

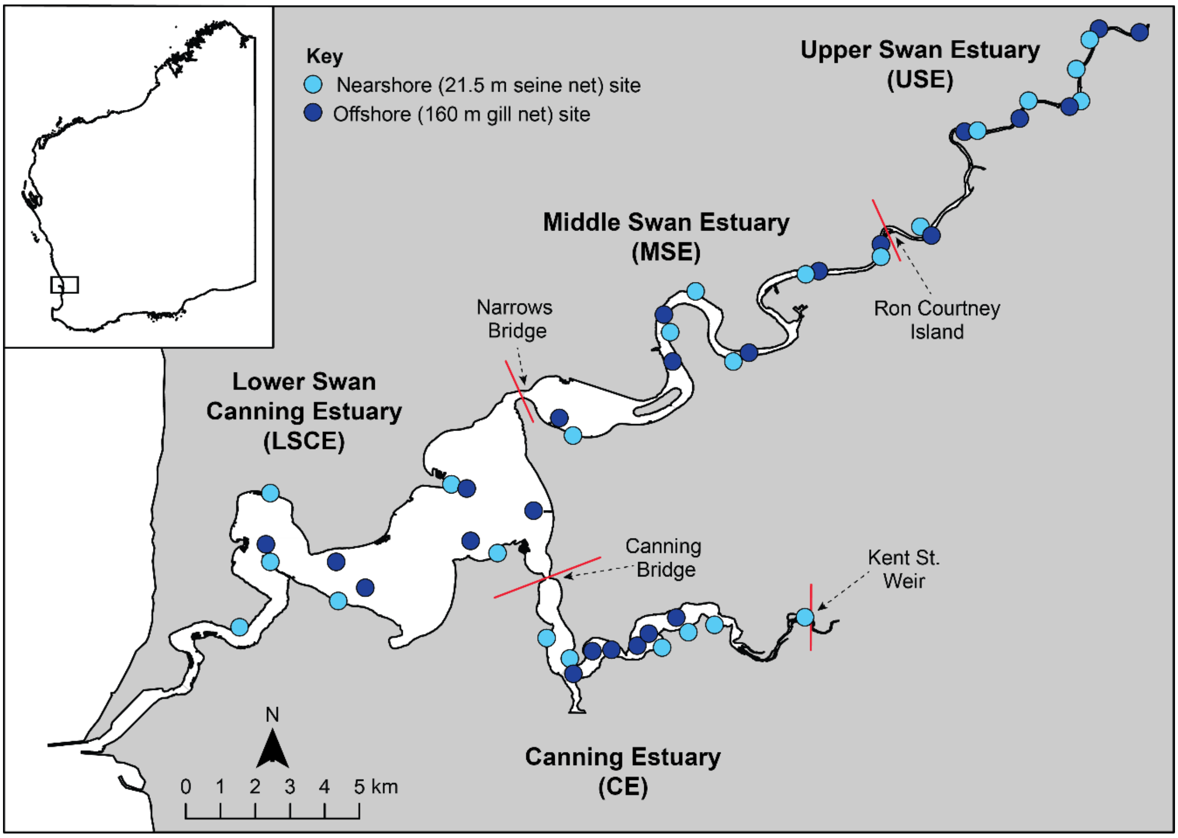


Figure 2. Locations of nearshore (light blue circles) and offshore (dark blue circles) sampling sites for the Fish Community Index of estuarine condition in the Swan Canning Estuary.

Table 2. Fish Community Index (FCI) scores comprising each of the five condition grades for both the nearshore and offshore waters of the Swan Canning Estuary. Intermediate grades, e.g. B/C (good/fair) or C/B (fair/good), are awarded if the index score lies within one point on either side of a grade threshold.

Condition grade	Nearshore FCI scores	Offshore FCI scores
A (very good)	> 74.5	> 70.7
B (good)	64.6 - 74.5	58.4 - 70.7
C (fair)	57.1 - 64.6	50.6 - 58.4
D (poor)	45.5 - 57.1	36.8 - 50.6
E (very poor)	< 45.5	< 36.8

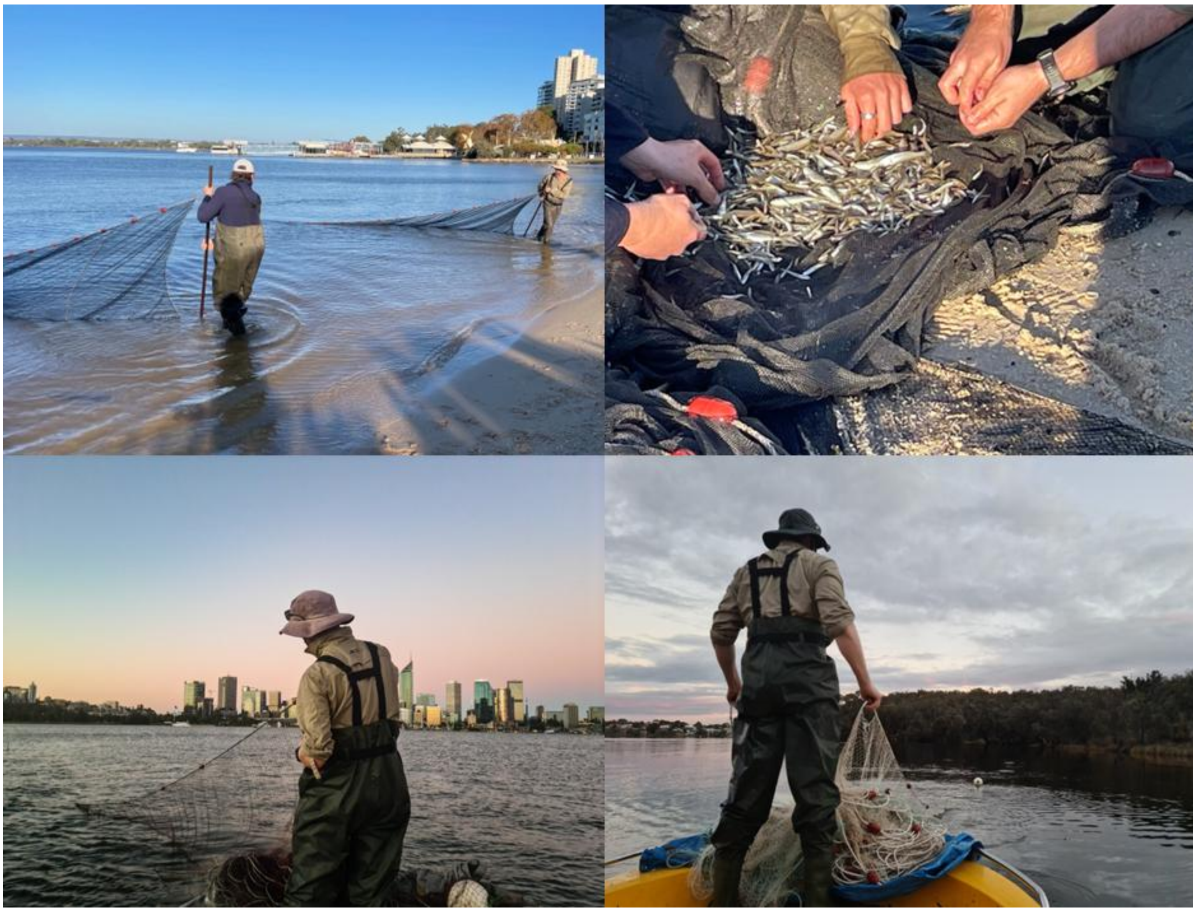


Figure 3. Photographs of the beach seine netting (upper row) used to sample the fish community in shallow, nearshore waters and the multimesh gill netting (lower row) used to sample fish communities in deeper, offshore waters of the Swan Canning Estuary. Images courtesy of Dr Kerry Trayler (DBCA) and Kurt Krispyn (Murdoch University).

5. Results and discussion

5.1 Water quality and environmental conditions influencing the 2025 monitoring period

The pattern of rainfall and flow in the year preceding sampling is important as it can influence fish recruitment, productivity and movement (Gillanders et al., 2002; Broadley et al., 2022). The total annual flow of 125 GL at Walyunga on the Swan River in 2024 was identical to that in 2023 but less than the 424 and 605 GL recorded in 2022 and 2021 (Appendix vii). In 2025, no flow occurred in the Swan River until June, and thus after sampling had been completed. The timing of the flow corresponded with the traditional monthly pattern in south-western Australia, where the majority occurs between May and September (Hodgkin et al., 1998; Hallett et al., 2018). In 2024, 94% of the total annual flow occurred between these months, with the majority occurring in August (i.e. 72 of the 125 GL). Total annual flow at Seaforth in the Canning River in 2024 was 8.7 GL, slightly above the median of ~8.4 GL and the 7.0 GL in 2023 (Appendix viii). Most flow (84%) occurred between May and September. Unlike the Swan River, there was no month with particularly high flow. Instead, values were relatively high between July and September, and combined represented 77% of the annual total.

The environmental conditions present in the Swan Canning Estuary during the monitoring period are shown as vertical contour plots of interpolated salinities, dissolved oxygen concentrations, chlorophyll levels and water temperatures produced by DBCA (Appendix ix). The text below describes the key environmental conditions in the Swan and Canning axes of the estuary in each season in which sampling occurred using the data collected by DBCA. The salinity, oxygen and water temperature values recorded during sampling using a YSI ProDSS are also provided (Appendix x).

Swan axis: physicochemical conditions

Summer: The water column of the USE was brackish (salinity ranged from 10 – 24 ppt) in early January 2025. As January progressed, salinities increased (minimum of 16 ppt) and the salt wedge dissipated due to a lack of freshwater input and vertical mixing. By the end of summer sampling (mid-February) salinities in this region ranged from 18 – 28 ppt. Salinities in the LSCE in January and February exceeded those of full-strength seawater (~35 ppt), ranging from 36 – 38 ppt, and those in the MSE were also highly saline, typically ranging from 26 – 36 ppt. Localised hypoxia (i.e. dissolved oxygen concentrations < 2 mg/L) was observed in the deeper waters of the upper and/or lower reaches of the USE on 6 January and 20 January before sampling commenced. However, areas of low dissolved oxygen (2 – 4 mg/L) were present in the USE and upper reaches of the MSE in early February. In-situ oxygen concentrations were > 4 mg/L, except for 3.4 mg/L at the bottom waters of one site in the MSE (Appendix x). Both the Caversham and Guildford oxygenation plants were in operation in each week of January and February. Water temperatures in January increased in an upstream direction from 25 – 26 °C in the LSCE to 27 – 31 °C in the MSE and USE. Values peaked in late January and had reduced by ~1 – 2 °C by the end of February.

Autumn: As there was no freshwater flow until June, salinities increased during March and April, particularly in the MSE and USE. When sampling started on 1 April, salinities between 33 and 38 ppt were recorded throughout the LSCE and MSE. Salinities remained relatively constant throughout the two-week sampling period, with no notable stratification. Low dissolved oxygen levels, associated with high Chlorophyll levels, were detected in the uppermost areas of the USE on 31 March. While high Chlorophyll levels were also present on 7 April, no hypoxia was detected. However, by 14 April, marked hypoxia was recorded throughout the water column of the upper half of the USE. Water temperatures were homogeneous across the LSCE, MSE, and USE, ranging from 26 – 29 °C at the start of March and declining slightly to 24–26 °C at the end of that month, and 23 – 25 °C when sampling was completed in mid-April.

Canning axis: physicochemical conditions

Summer: The water column of the upper part of the CE (Riverton to Castledare) throughout January was highly stratified by limited freshwater flows through Kent Steer Wier that diluted the surface waters to as low as 12 ppt overlying denser, saltier water (30 ppt). This plume of surface brackish water did not extend past Salter Point, with salinities of between 34 and 38 ppt recorded between Salter Point and Canning Bridge. These waters were relatively well mixed. The degree of stratification in the upper part of the CE decreased during February as more of this zone became saline, and by early March it had almost disappeared (Appendix ix). However, the stratification resulted in day-time hypoxia (< 2 mg/L) being detected in four of the five weeks in January and three of the four in February. Waters between Salter Point and Riverton experienced only low dissolved oxygen levels, whereas those further downstream between Canning Bridge and Salter Point were well-oxygenated (> 6 mg/L). Hypoxia was not recorded during in-situ sampling at night. Water temperatures in January ranged from 26 – 30 °C between Canning Bridge and Riverton and increased in an upstream direction. Values were higher at Castledare, typically exceeding 30 °C and reaching almost 33 °C. Temperatures declined by ~ 1 °C by the end of sampling in mid-February.

Autumn: Salinities had increased by early April, with much of the CE exceeding full-strength seawater and the highest reaching 38 ppt. The water column throughout most of the CE was well-mixed, although stratification was present around Castledare, where surface salinities were ~30 ppt. After 8th April, the magnitude of stratification increased in the area between Riverton and Castledare for the rest of April and all of May, resulting in low oxygen or hypoxic conditions in all weeks of April and May. Water temperatures were lower than in summer, ranging from 23 – 25 °C in early April, with most being 15– 19 °C by the end of May.

<u>Swan axis: harmful algae</u>

Before sampling: Blooms of the single-celled dinoflagellate *Karlodinium* spp. (Place et al., 2012) occurred at levels of concern from early December, exceeding investigation levels (15,000 cells/mL) on 2 December 2024 at three sites in the MSE (i.e. Nile St., St Johns and Maylands; DBCA, unpublished data). Two weeks later on 16 December notification triggers (30,000 cells/mL) were exceeded at Maylands (40,700 cells/mL). This bloom progressed in an upstream direction, reaching a peak of 71,660 cells/mL at Ron Courtney Island (the boundary between the MSE and USE) on 6 January 2025. It subsequently diminished and was well below the investigation level by 3 February when summer sampling started. Another dinoflagellate, *Alexandrium* spp., was first detected on 16 December 2024 and peaked at 44 cells/mL at Nile St. on 13 January 2025 (DBCA, unpublished data).

Summer: Cell counts of *Karlodinium* spp. were conducted at St. John (MSE) on 3 February (a day before sampling the MSE), as that site exceeded investigation levels (i.e. 15,000 cells/mL) in each of the previous six weeks, but density was low (7,180 cells/mL) and below thresholds of concern. *Karlodinium* spp. was present at low densities at all four sites in the USE (range = 160 – 4,160 cells/mL), MSE (range = 2,520 – 6,760 cells/mL) and two sites in the LSCE (range = 20 – 100 cells/mL; DBCA, unpublished data) during the FCI sampling period. Low densities of *Alexandrium* spp. were recorded during summer, peaking at 13 cells/mL at St. Johns on 10 February (DBCA, unpublished data).

Autumn: The USE was affected by a *Karlodinium* bloom for much of the autumn sampling period. Samples of the algae were sent by DBCA to the University of Technology Sydney for culture for identification purposes and confirmed to be *Karlodinium veneficum* (Murray, 2025); a species known to be associated with fish kills (Place et al., 2012; Adolf et al., 2015). The bloom of *K. veneficum* established at West Midland Pool in the USE on 17 March, with densities of 52,200 cells/mL (DBCA, unpublished data). By the following week the bloom extended 10 km upstream to the riverine zone at the powerlines site (POL) and by April it also extended downstream to Kingsley Drive. The bloom remained >30,000 cells/mL until the first week of May. At its peak on 7 April, the bloom reached 158,000 cells/mL at Middle Swan Bridge and was extending through to the Maali Bridge in the riverine zone (upstream of the USE). A fish kill of ~500 Black Bream occurred at Maali Bridge on 18 April, which coincided with a collapse in density of the bloom from 138,140 cells/mL (7 April) to 2,770 cells/mL (19 April). No rainfall was recorded before the event, but low oxygen conditions were present in that zone throughout the water column on 13 April (DBCA, unpublished data). No significant bloom activity of *Karlodinium* spp. was detected in the MSE or LSCE during autumn (range = 0 – 2,680 and 0 – 20 cells/mL, respectively).

Densities of the epipelic diatom *Cylindrotheca closterium* exceeded 20,000 cells/mL between Ron Courtney Island and Kingsley Drive in the USE on 10 March. This microalga is not known to be toxic to fish, but can produce mucilage and exopolysaccharides that are sticky and bind sediment (Staats et al., 2000; Najdek et al., 2005).

<u>Canning axis: harmful algae</u>

Before sampling: Densities of *Karlodinium* spp. briefly exceeded investigation triggers on 19 November 2024 at Castledare (16,220 cells/mL) but diminished thereafter. *Alexandrium* spp. was first detected on 16 December 2024. It reached a maximum density in the CE of 11 cells/mL at Shelley Bridge on 22 December but was not detected in this zone after 5 January 2025 (DBCA, unpublished data).

Summer: No significant blooms of *Karlodinium* spp. were recorded during summer sampling, with densities ranging only from 0 – 3,120 cells/mL (DBCA, unpublished data).

Autumn: A bloom of *Karlodinium* spp. breached the investigation trigger on 8 April with a density of 18,280 cells/mL at a site 50 m below the Kent St Weir. Further examination by DBCA using a targeted surface grab sample recorded substantially greater densities of 104,600 cells/mL. A small fish kill comprising ~100 fish, including Black Bream, mullets and Weeping Toadfish, occurred at this site on 15 April 2025. This mortality event coincided with the release of water from the upstream weir pool, triggering a halocline and the formation of anoxic conditions in the deeper waters. This situation has led to the deaths of fish in other estuaries in south-western Australia (Tweedley et al., 2024). The release of water also reduced *Karlodinium* spp. densities to 1,580 cell/mL (15 April), albeit temporarily, as the population recovered quickly to a maximum integrated density of 23,340 cells/mL on 23 April 2025. The bloom had subsided by 6 May.

5.2 Fish community of the Swan Canning Estuary during 2025

Nearshore waters

An estimated total of 15,370 fish, belonging to 32 species, were caught in seine net samples collected from nearshore waters during the summer and autumn of 2025. The total number of fish recorded in 2025 was greater than in 2024, but the second lowest since monitoring began in 2012. Moreover, the number of fish was ~60% of the average from previous monitoring between 2012 and 2024 (i.e. 24,505 fish; range = 12,335 – 42,935 fish). The 32 species recorded in 2025 was an increase from the 27 recorded in 2024, and the same as the annual average of 32 (range = 25 – 36 species). Overall, 67 fish species have been collected in seine nets as part of this annual monitoring since 2012. One of the new records in 2025 was a juvenile Queenfish (*Scomberoides* spp.) that was ~ 30 mm total length. Four species of Queenfish occur in Australia, i.e. Giant Queenfish (*Scomberoides commersonnianus*), Lesser Queenfish (*Scomberoides lysan*), Barred Queenfish (*Scomberoides tala*) and Needleskin Queenfish (*Scomberoides tol*). They are pelagic, tropical species that are usually found across northern Australia and extending southward to Exmouth Gulf or Shark Bay. Giant Queenfish have been recorded in Coff's Harbour (New South Wales) in summer and autumn, probably due to the East Australia Current (Griffiths et al., 2005). Moreover, a Lesser Queenfish was recorded in Pelican Point in the LSCE in April 2011 during validation of the FCI (Atlas of Living Australia, 2025), which was likely associated with the 2010/11 marine heat wave (Caputi et al., 2014; Coulson et al., 2023). Similarly, the presence of juvenile Queenfish in the Swan-Canning Estuary, together with records from

Murdoch University from Cockburn Sound and the Peel-Harvey Estuary in February 2025, is likely also linked to the 2025 marine heatwave (DPIRD et al., 2025a).

The greatest number of species recorded in the nearshore waters was in the CE (25), followed by the MSE (24) and least in the LSCE and USE (both 19; Table 3). This spatial pattern of species richness was similar to 2024, but did not follow the traditional pattern of decline in the number of species along the longitudinal (downstream – upstream) axis that has been recorded in the nearshore waters of the Swan Canning Estuary in most years and in similar estuaries in south-western Australia (Veale et al., 2014; Valesini et al., 2017). This shift was due to a large decline in the number of species recorded in the LSCE and greater numbers in the other regions. For example, an average of ~24 species has been found in the LSCE (range = 19 – 29 species), whereas only 19 and 16 species were recorded in this zone in 2025 and 2024, respectively. Among the notably absent species were the estuarine-spawning Black Bream, Yellowtail Grunter and Yellowtail Flathead and the marine-spawning Tarwhine and Blue Weed Whiting. In contrast, marine-spawning species such as Western School Whiting, Tarwine, and Hawaiian Giant Herring were found in the CE, MSE and/or USE in 2025. The total number of fish recorded was greater in the LSCE and MSE than in the CE and USE (i.e. 5,528 and 5326 vs 2,499 and 2,017 fish, respectively; Table 3). The total for each region except the LCSE varied from the average of the previous 13 years. Catches in the MSE were 80% higher, while those in the USE and, particularly, the CE were lower (i.e. 42% and 22% of the average).

Hardyheads (family = Atherinidae; five species) and gobies (family = Gobiidae; six species) once again dominated catches from the nearshore waters of the estuary in 2025, representing 73% of all fish recorded and comprising three of the four most abundant nearshore species. The Silver Fish was the most abundant species overall (4,659 fish; Table 3). This was the only year other than 2024 that this species was the most abundant, with < 100 individuals being recorded in four of the previous 13 years. The Spotted Hardyhead (4,410 fish) was the second most abundant; however, the Western Hardyhead (486 fish) and Elongate Hardyhead (205 fish) ranked only seventh and thirteenth, respectively. It is worth noting that the Western Hardyhead was the most abundant species in nearshore waters in seven of the years when monitoring occurred, including each year between 2019 and 2023.

There was clear spatial partitioning of hardyheads throughout the zones of the estuary. Silver Fish comprised ~80% of all fish in the LSCE, accompanied by the Spotted Hardyhead (~9%). This species was the most abundant species in the CE (24%), and particularly the MSE (61%), but declined to only 2% of the overall catch in the USE. Instead, the Western Hardyhead was the most abundant hardyhead in this zone. This reflects the salinity preferences for the various species, with the Silver Fish occurring in coastal waters and the saline downstream reaches of estuaries (Valesini et al., 2009; 2017), the Spotted Hardyhead in the middle reaches and the Western Hardyhead in upstream areas where salinities are less than in other parts of the estuary (Prince et al., 1983; Potter et al., 2015b). Likewise, among the gobies, the Southern Longfin Goby was most abundant in the LSCE, the Yellowspotted Sandgoby in the CE and MSE, and also in the USE with the Bluespot Goby. This reflects the salinity preferences of these species, and the coarse sediment in the downstream zones and finer (silty/muddy) sediments found further upstream (Gill et al., 1995; Hogan-West et al., 2019). Other abundant species recorded in 2025 included Yelloweye Mullet in the MSE and Perth Herring and Eastern Gambusia in the USE.

Compared to previous years, the numbers of some abundant estuarine-spawning species were substantially lower in 2025, as was also the case in 2024. This was most notable for the small-bodied Western Hardyhead, Elongate Hardyhead and the Bluespot Goby and Southwestern Goby, whose abundances in 2025 were only 7, 8, 18 and 27%, respectively, of their averages over the previous 13 years (Appendix xi). In the case of the hardyheads, this could reflect potentially poor recruitment of juveniles from spawning events in spring and early summer (Prince et al., 1983) and, in that of the gobies, higher than usual salinities in the upper reaches (Gill et al., 1995; Hogan-West et al., 2019). Catches of juveniles of larger-bodied species, including Perth Herring and Black Bream, were also slightly lower (i.e. 30% and 24%) than recorded previously (Appendix xi).

Substantially greater numbers of juveniles of several marine-spawning species that use the estuary as a nursery area were also recorded, most notably Hawaiian Giant Herring, Silver Fish, Western Trumpeter Whiting, Yellowfin Whiting and Western School Whiting (Appendix xi). In the case of Hawaiian Giant Herring, 44 of the 49 individuals recorded since 2012 were caught in 2025. As the abundance of the juveniles of these marine-spawning species is influenced by factors occurring in the ocean and the estuary, and the mouth of the Swan-Canning Estuary is permanently open to the ocean, allowing recruitment at any time, the drivers of such changes are less clear. However, the marine heat wave in 2025 may have influenced the far higher catches of this species in the Swan Canning Estuary and also in the Peel Harvey Estuary (Murdoch University, unpublished data), as it is known to move southwards with the warmer currents during the summer (Gomon et al., 2025).

Two non-native fish species have been regularly recorded during this monitoring program, i.e. the Eastern Gambusia and the Pearl Cichlid. Both species were recorded again in 2025, and in abundances similar to the average across previous years (Appendix xi).

Table 3. Compositions of the fish communities (D = Average density fish [100 m^{-2}] and %C = percentage composition) observed across the six nearshore sites sampled in each zone of the Swan Canning Estuary during the summer and autumn of 2025. Data for the three most abundant species in the catches from each zone are shaded in grey for emphasis. Species are ordered by total abundance throughout the estuary. LSCE = Lower Swan Canning Estuary, CE = Canning Estuary, MSE = Middle Swan Estuary, USE = Upper Swan Estuary. * denotes non-native species.

		LSCE (n = 12)		CE (n = 12)		MSE (n = 12)		USE (n = 12)	
Species	**Common name**	D	%C	D	%C	D	%C	D	%C
Leptatherina presbyteroides	Silver Fish	315.30	79.40	17.82	9.92	1.58	0.41		
Craterocephalus mugiloides	Spotted Hardyhead	35.34	8.90	43.25	24.09	235.06	61.43	3.16	2.18
Nematalosa vlaminghi	Perth Herring			6.18	3.44	9.77	2.55	40.09	27.66
Favonigobius punctatus	Yellowspotted Sandgoby	0.36	0.09	9.20	5.12	26.51	6.93	15.73	10.86
Aldrichetta forsteri	Yelloweye Mullet	6.82	1.72	12.07	6.72	23.92	6.25		
*Gambusia holbrooki**	Eastern Gambusia*			1.51	0.84	1.01	0.26	37.21	25.68
Leptatherina wallacei	Western Hardyhead	0.43	0.11	6.25	3.48	13.29	3.47	14.94	10.31
Gerres subfasciatus	Common Silverbiddy	0.07	0.02	6.03	3.36	15.30	4.00	10.27	7.09
Amniataba caudavittata	Yellowtail Grunter			14.44	8.04	14.66	3.83	0.86	0.59
Sillago burrus	Western Trumpeter Whiting	7.69	1.94	13.07	7.28	7.69	2.01	1.01	0.69
Atherinomorus vaigiensis	Common Hardyhead	1.08	0.27	24.64	13.73	0.86	0.23		
Torquigener pleurogramma	Weeping Toadfish	5.03	1.27	7.33	4.08	6.25	1.63	3.02	2.08
Atherinosoma elongatum	Elongate Hardyhead	13.36	3.36	0.72	0.40	0.65	0.17		
Pseudogobius olorum	Bluespot Goby			0.07	0.04	1.58	0.41	10.70	7.39
Mugil cephalus	Sea Mullet	0.43	0.11	4.38	2.44	4.96	1.30	1.51	1.04
Sillago schomburgkii	Yellowfin Whiting	3.09	0.78	4.67	2.60	0.79	0.21		
Acanthopagrus butcheri	Black Bream			0.79	0.44	6.75	1.76	0.07	0.05
Helotes octolineatus	Western Striped Grunter	1.15	0.29	1.94	1.08	2.66	0.69	0.29	0.20
Ostorhinchus rueppellii	Western Gobbleguts	1.51	0.38	0.57	0.32	3.88	1.01		
Favonigobius lateralis	Southern Longfin Goby	4.74	1.19	1.08	0.60				
Arenigobius bifrenatus	Bridled Goby			0.22	0.12	3.95	1.03	0.36	0.25
Elops hawaiensis	Hawaiian Giant Herring			1.94	1.08	0.36	0.09	0.86	0.59
Afurcagobius suppositus	Southwestern Goby					0.43	0.11	2.08	1.44
Engraulis australis	Australian Anchovy							1.80	1.24
Sillago vittata	Western School Whiting	0.14	0.04	1.08	0.60				
*Geophagus brasiliensis**	Pearl Cichlid*			0.14	0.08			0.86	0.59
Redigobius macrostoma	Largemouth Goby			0.14	0.08	0.57	0.15		
Sillaginidae spp.	Whiting spp.	0.29	0.07						
Pelsartia humeralis	Sea Trumpeter	0.22	0.05						
Rhabdosargus sarba	Tarwhine					0.14	0.04		
Hyperlophus vittatus	Sandy Sprat							0.07	0.05
Scomberoides spp.	Queenfishes	0.07	0.02						
	Total number of species	**19**		**25**		**24**		**19**	
	Average total fish density (fish 100 m^{-2})	**397**		**180**		**383**		**145**	
	Total number of fish	**5,528**		**2,499**		**5,326**		**2,017**	

Offshore waters

Samples collected from offshore waters in the summer and autumn of 2025 using gill nets returned 3,198 fish, comprising 23 species (Table 4). The number of fish caught was the second highest ever recorded during this monitoring and continues the relatively high catches observed between 2021 and 2024. Total catches in the last five years (2021-2025; average = 3,090; range = 2,705 – 3,847 fish) are substantially greater than those between 2012 and 2020 (average = 1,826; range = 1,125 – 2,235 fish). The 23 species caught in 2025 equalled that in 2021 (23) and were only fewer than the 24 species recorded in 2022. As such, this value exceeded the average of 20.6 species recorded annually between 2012 and 2024. Overall, 36 fish species have been recorded in gill nets as part of this annual monitoring since 2012. Despite the marine heat wave, no new species were recorded in the Swan-Canning Estuary in 2025.

Among the ecological management zones, the total number of species recorded in each zone in 2025 decreased in an upstream direction from 18 species in the LSCE to 14 in the MSE, 12 in the CE and 10 in the USE. This is a trend that has occurred in most years in this monitoring program and has been recorded in other estuaries (Loneragan et al., 1987; Chuwen et al., 2009). It reflects the fact that most species of fish in the deeper waters of the estuary are marine species and, therefore, prefer salinities similar to full-strength seawater (Potter et al., 1999; Tweedley et al., 2016). The number of species in each zone was considerably greater than the average from previous monitoring in the LSCE and MSE, similar to the average in the USE and less than the average in the CE. The total catch was once again largest in the USE (1,448 fish), compared to 768, 712 and 270 fish in the LSCE, CE and MSE, respectively. The total number of fish in each zone, except the MSE, was greater than the average of the previous 13 years. This was particularly marked in the LSCE and USE, where catches were around double the average of 358 and 768 fish, respectively. However, catches in the MSE were half the average of 535 fish.

As in all previous years of monitoring, Perth Herring was the most abundant species in offshore waters in 2025, representing 46% of all fish recorded. However, its contribution was lower than the average of 58%. This species comprised between 25 and 78% of the total catch in each zone, ranking first in all zones except the USE, where it ranked second (Table 4). The Yellowtail Grunter was the second most abundant species overall, and while found in all zones, it was particularly abundant in the USE, where it was the most caught species (60% of the catch). Tailor and Yellowtail Flathead were abundant in the LSCE (11 and 9% of the catch, respectively). The former species was also abundant in the CE, representing 8% of all fish caught. Other abundant species included the Common Silverbiddy in the LSCE and Black Bream in the MSE and USE.

Catches of several species, including Hawaiian Giant Herring, juvenile Bull Shark, Yellowtail Flathead, Yellowtail Grunter, Common Silverbiddy, Tarwhine and Mulloway, were higher compared with catches between 2012 and 2024 (Appendix xii). Catches of juvenile Bull Sharks (n=10) and Hawaiian Giant Herring (n=77) were the highest and second highest, respectively, recorded during FCI monitoring and are likely to reflect warm water temperatures in the estuary and coastal waters, which are influenced by air temperature and a strong Leeuwin current (Smoothey et al., 2019; DPIRD et al., 2025b; Gomon et al., 2025). The latter can help transport tropical marine species further south (Hutchins et al., 1994; Lenanton et al., 2009). It is important to note that these results do not necessarily mean that there are more Bull Sharks in the Swan Canning Estuary, as these are transitory marine species that can use estuaries as nursery areas (Smoothey et al., 2019), and more information is needed to understand trends in movement and population in south-western Australia.

Table 4. Compositions of the fish communities (CR = Average catch rate [fish/net set] and %C = percentage composition) observed across the six offshore sites sampled in each zone of the Swan Canning Estuary during the summer and autumn of 2025. Species ranked by total abundance. Data for the three most abundant species in the catches from each zone are shaded in grey for emphasis. Species are ordered by total abundance throughout the estuary. LSCE = Lower Swan Canning Estuary, CE = Canning Estuary, MSE = Middle Swan Estuary, USE = Upper Swan Estuary.

		LSCE (*n* = 12)		**CE** (*n* = 12)		**MSE** (*n* = 12)		**USE** (*n* = 12)	
Species	**Common name**	CR	%C	CR	%C	CR	%C	CR	%C
Nematalosa vlaminghi	Perth Herring	31.33	49.02	46.17	77.81	14.58	64.81	30.08	24.93
Amniataba caudavittata	Yellowtail Grunter	3.92	6.13	0.92	1.54	2.58	11.48	72.83	60.36
Pomatomus saltatrix	Tailor	6.92	10.82	4.50	7.58	0.83	3.70	0.42	0.35
Acanthopagrus butcheri	Black Bream			0.08	0.14	1.17	5.19	8.58	7.11
Gerres subfasciatus	Common Silverbiddy	3.33	5.22	4.00	6.74	0.83	3.70		
Platycephalus westraliae	Yellowtail Flathead	5.50	8.60	0.67	1.12	0.33	1.48	0.42	0.35
Elops hawaiensis	Hawaiian Giant Herring	2.25	3.52	1.17	1.97	0.75	3.33	2.25	1.86
Rhabdosargus sarba	Tarwhine	3.92	6.13	0.67	1.12	0.50	2.22	0.17	0.14
Myliobatis tenuicaudatus	Southern Eagle Ray	4.33	6.78	0.17	0.28	0.08	0.37		
Argyrosomus japonicus	Mulloway					0.08	0.37	3.17	2.62
Mugil cephalus	Sea Mullet	0.08	0.13	0.17	0.28			2.33	1.93
Helotes octolineatus	Western Striped Grunter	0.33	0.52	0.75	1.26	0.08	0.37		
Carcharhinus leucas	Bull Shark					0.42	1.85	0.42	0.35
Sillago burrus	Western Trumpeter Whiting	0.58	0.91						
Sillago schomburgkii	Yellowfin Whiting	0.58	0.91						
Torquigener pleurogramma	Weeping Toadfish	0.33	0.52						
Cnidoglanis macrocephalus	Estuary Cobbler	0.08	0.13			0.17	0.74		
Pseudocaranx georgianus	Silver Trevally	0.17	0.26						
Pseudocaranx wrighti	Skipjack Trevally	0.17	0.26						
Engraulis australis	Australian Anchovy			0.08	0.14				
Ostorhinchus rueppellii	Western Gobbleguts					0.08	0.37		
Sphyraena obtusata	Striped Barracuda	0.08	0.13						
Pseudorhombus jenynsii	Smalltooth Flounder	0.08	0.13						
	Total number of species	**18**		**12**		**14**		**10**	
	Average catch rate (fish/net set)	**63.9**		**59.3**		**22.5**		**120.7**	
	Total number of fish	**768**		**712**		**270**		**1,448**	

5.3 Ecological condition in 2025

Nearshore waters

The ecological condition based on fish communities of the nearshore waters of the Swan Canning Estuary was good (B) in both summer and autumn (FCI scores of 67 and 66, respectively; Fig. 4). Scores for individual zones varied markedly from 61 (fair) to 72 (good). In summer, the best scores were in the MSE and USE (both good; B) and the lowest in the CE and LSCE, with fair (C) and fair/good (C/B) scores, respectively. The score in autumn increased in the CE by five points from 61 (fair) to 66 (good) and decreased in the LSCE by three points from 64 (fair/good) to 61 (fair). Shifts of four points in the MSE and one point in the USE occurred but did not alter the condition of either zone (i.e. both remained in good condition; Fig. 4).

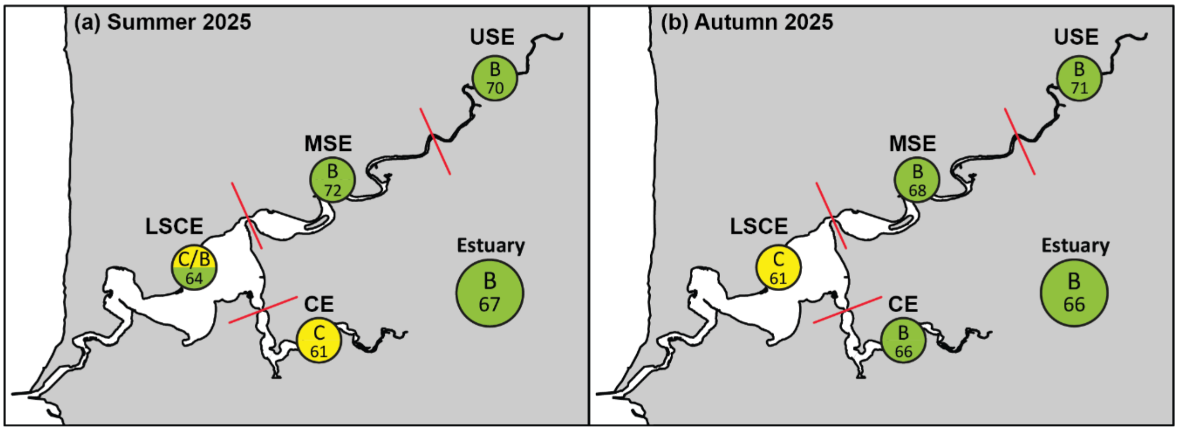
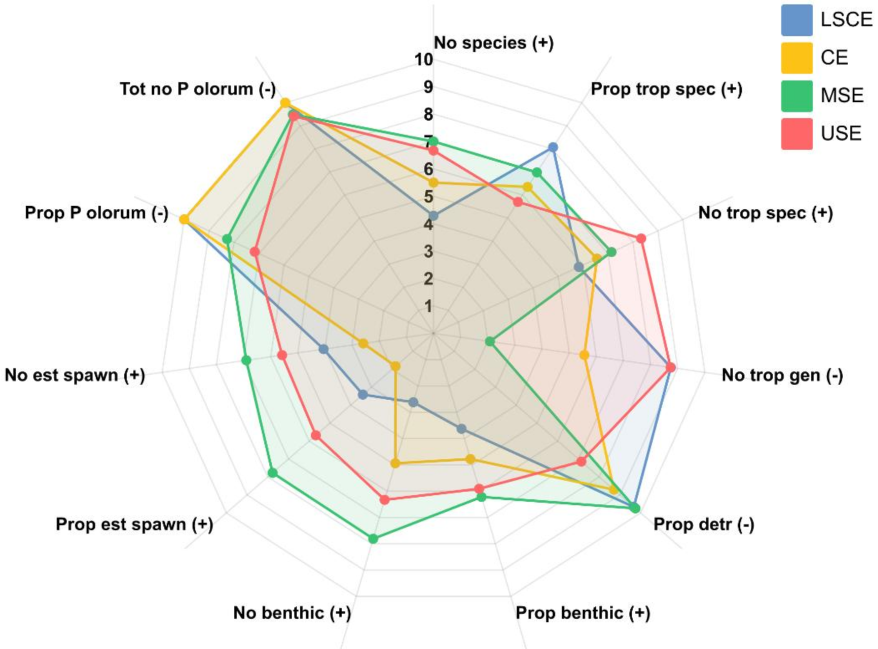


Figure 4. Average nearshore Fish Community Index scores and resulting condition grades (A, very good; B, good; C, fair; D, poor; E, very poor) for each zone of the Swan Canning Estuary, and for the estuary as a whole, in the summer and autumn of 2025.

Radar plots of the nearshore metric scores for each zone in summer showed that the lower scores in the CE and LSCE, compared to the USE and MSE, were influenced by moderately low values for the *Number of species, Number of benthic-associated species* and *Number of estuarine-spawning species* and the *Proportion of benthic-associated individuals* and the *Proportion of estuarine-spawning individuals* (all positive metrics; Fig. 5a). This was due to at least half of the samples from the CE and LSCE containing a relatively low number of species and the species being typically small-pelagic and pelagic species, e.g. hardyheads and mullets, respectively. Furthermore, none of the goby species were recorded in more than half the samples from either the CE or LSCE, and many of the demersal and bentho-pelagic species were also infrequently recorded. Moreover, the fish community in the LSCE in summer was also dominated by the marine-spawning and small-pelagic hardyhead Silver Fish, thus accounting for the intermediate scores for the *Proportion of benthic-associated individuals* and the *Proportion of estuarine-spawning individuals* (both positive metrics). Although some estuarine-spawning hardyhead species were relatively abundant in the CE, abundances were lower than in previous years due to low numbers of the Elongate Hardyhead and Western Hardyhead. Moreover, other relatively abundant species included the Yelloweye Mullet, Sea Mullet and Western Trumpeter Whiting, which are marine-spawning, and all except the Western Trumpeter Whiting are pelagic. The high salinities in these regions may have altered the spatial distribution of species, resulting in marine species, such as the Silver Fish, entering the estuary in greater numbers from adjacent coastal waters (Mitchell et al., 2025; Yeoh et al., 2025), and some estuarine species moving further upstream (Valesini et al., 2017). The high salinities would, however, have impeded habitation of the LSCE and CE by the detritivorous Bluespot Goby (*Psuedogobius olorum*). The absence of this species from both regions resulted in scores of 10 for the *Total number of P. olorum* and *Proportion of P. olorum* (both negative metrics; Fig. 5a).

(a) Summer 2025



(b) Autumn 2025

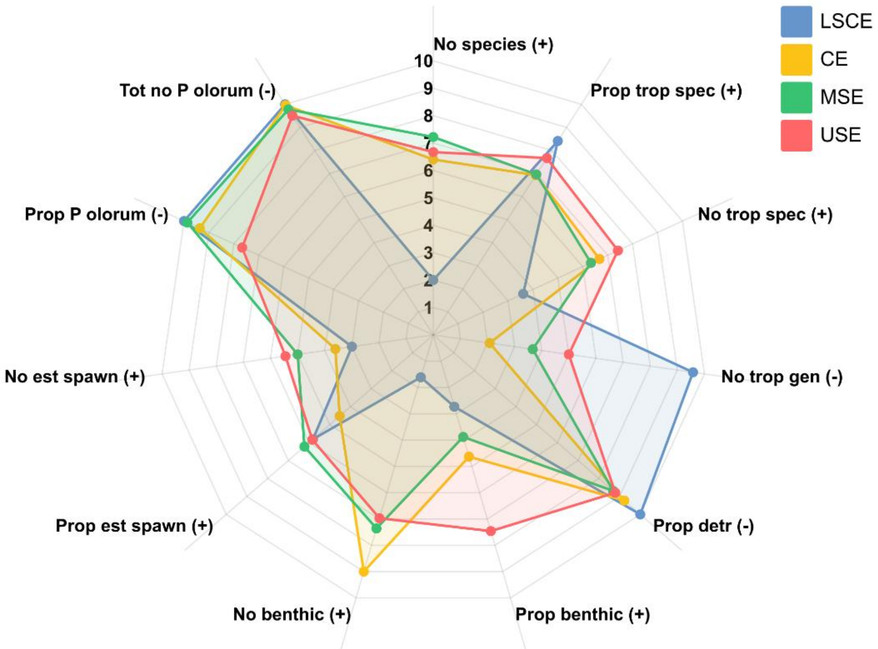


Figure 5. Average scores (0–10) for each component metric of the nearshore Fish Community Index, calculated from samples collected throughout the LSCE, CE, MSE and USE zones in (a) summer and (b) autumn 2025. Note that an increase in the score for positive metrics (+) reflects an increase in the underlying variable, whereas an increase in the score for negative metrics (-) reflects a decrease in the underlying variable. Therefore, the larger the area covered by the radar plot, the better the condition in that zone. Full metric names and explanations are given in Table 1.

Scores in the MSE and USE were greater than those in the LSCE and CE (Fig. 4a), which reflected increases in scores for most metrics except for the *Proportion of trophic generalist individuals* in the MSE and the *Total number of P. olorum* and the *Proportion of P. olorum* in the MSE and USE. The shift in the first metric was due to increased proportions of Yellowtail Grunter, Yelloweye Mullet, Black Bream and Weeping Toadfish in the MSE and the Bluespot Goby in the USE, together with declines in the abundance of some of the trophic specialist taxa such as the Western Hardyhead and Southwestern Goby. The increased abundance of the Bluespot Goby upstream in the estuary led to the sequential decrease in the *Total number of P. olorum* and the *Proportion of P. olorum*. The higher number scores for the *Number of species*, *Number of benthic-associated species* and *Number of estuarine-spawning species* in the MSE and USE compared to the LSCE and CE likely reflect the movement of estuarine species with preferences for moderate salinities further upstream where salinities were less than full-strength seawater. Salinity is one of the principal drivers of fish faunal composition in estuaries globally (Thiel et al., 2001; Barletta et al., 2005; Whitfield et al., 2006), and the partitioning of species along this axis is well established in south-western Australian estuaries (Potter et al., 2015b; Valesini et al., 2017).

The spatial pattern of overall scores for zones and of their component metrics was similar in autumn to that in summer (Figs. 4 and 5). The absence of freshwater flow from the Swan axis of the estuary before sampling was completed in 2025 resulted in the maintenance of the strong salinity gradient present in summer (Appendices vii and ix). The CE and LSCE were the only zones where the condition grade changed. The increase in the CE from fair in summer to good in autumn as was due to an increase in the scores from seven of the metrics, most notably the *Number of benthic-associated species* (+4) and the *Proportion of estuarine-spawning individuals* (+3) and that, among the four metric that declined, only the *Proportion of trophic generalist individuals* did so substantially (-3). In the LSCE there was a slight change in the condition grade from fair/good to fair. The scores for most metrics were relatively similar (i.e. ±1), however, the *Number of species* and the *Number of trophic specialist species* both declined (-2) and that for the *Proportion of estuarine-spawning individuals* increased (+2).

Offshore waters

The ecological condition based on fish communities of the offshore waters of the Swan Canning Estuary was good (B) in both summer and autumn (FCI scores of 67 and 65, respectively; Fig. 6). The condition of each zone varied during summer ranging from 57 to 73, being very good (A) in the USE, good/very good (B/A) in the LSCE, good (B) in the MSE and fair (C) in the CE. In autumn, the range of mean FCI scores was less, from 59 in the USE to 70 in the LSCE. Among zones, the score in the CE increased by 4 points from 57 (fair) in summer to 61 (good) in autumn and the USE decreased by 14 points from 73 (very good) to 59 (good/fair). Metric scores and grades in the LSCE and MSE were the same in both seasons.

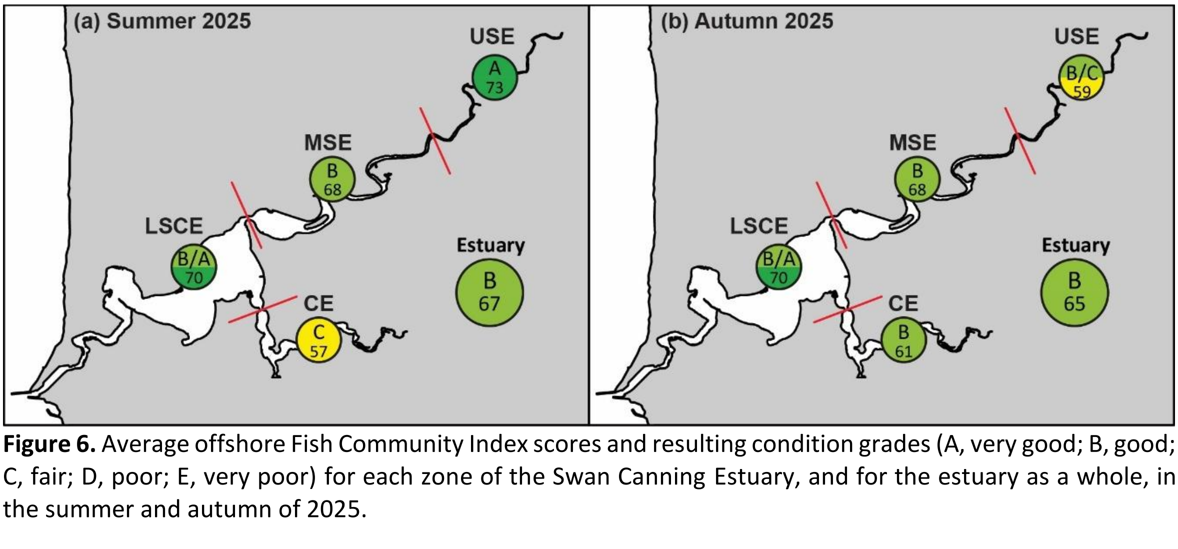


Figure 6. Average offshore Fish Community Index scores and resulting condition grades (A, very good; B, good; C, fair; D, poor; E, very poor) for each zone of the Swan Canning Estuary, and for the estuary as a whole, in the summer and autumn of 2025.

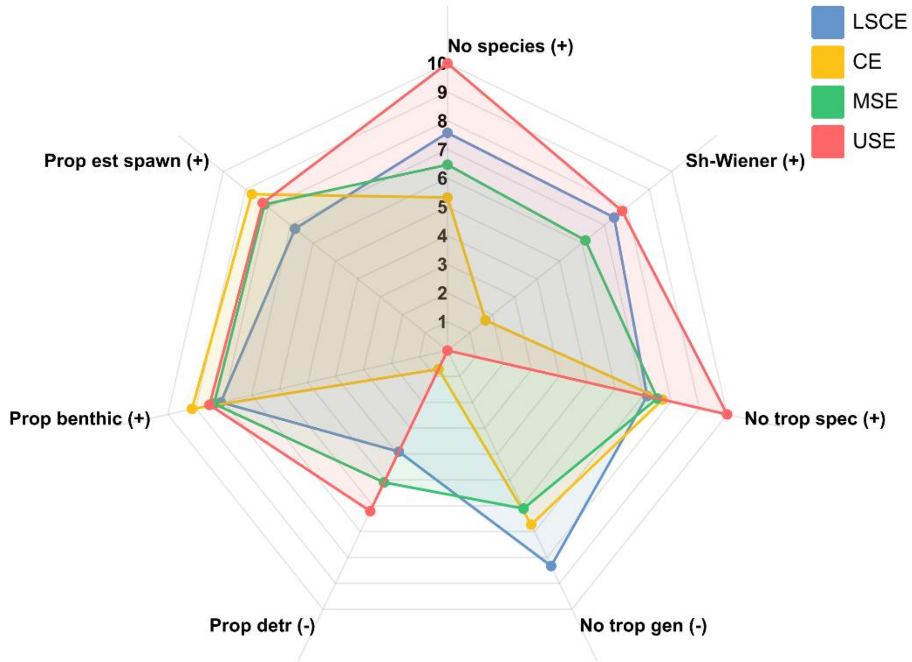
Radar plots of the offshore metric scores showed that the fair condition of the CE in summer was due to very low scores for the *Proportion of detritivores* (negative metric; 0.7 out of 10) and *Shannon-Wiener diversity* (positive metric; 1.7 out of 10) and with a relatively low score of the *Number of species* (positive metric; Fig. 7a). In contrast, very high scores were recorded for the *Proportion of benthic-associated individuals* and the *Proportion of estuarine-spawning individuals* (both positive metrics). These trends reflect the fact that, on average, only 4.5 (range = 4 – 6) species were caught per sample and that Perth Herring, an estuarine-spawning detritivorous species, contributed 88% of all fish recorded in this zone and up to 93% in some samples.

The LSCE, MSE and USE all had relatively high scores for the *Number of species*, *Number of trophic specialists*, and the *Proportion of benthic individuals* (Fig. 7a). In the case of the USE, the values for the first two metrics were the maximum (10 out of 10), which could reflect the movement of more species upstream due to the high salinities at this time. Moreover, the *Proportion of estuarine-spawning individuals* was lowest in the LSCE, most likely due to the marine affinities of the lower estuary being less favourable to estuarine species (Loneragan et al., 1989; Valesini et al., 2017) and increase sequentially in the MSE and USE.

Between summer and autumn, the biggest change in the mean offshore FCI scores occurred in the USE, which declined from very good (73) to good/fair (59), influenced mainly by the reductions in the *Number of trophic specialist species* (-5)*, Proportion of estuarine-spawning individuals* (-5) and, to a lesser extent, *Number of species* (-2; Figs 6 and 7). There was an increase (+3) in the *Number of trophic generalist species* (negative metric), indicating fewer generalist species, e.g. Black Bream and Yellowtail Grunter, were recorded. In summer, the USE was dominated by the estuarine-spawning Perth Herring, Yellowtail Grunter, and Black Bream, and also the marine-spawning Sea Mullet. The occurrence and/or abundance of each of these species declined in autumn, while those of the piscivorous Hawaiian Giant Herring and Mulloway increased. Moreover, the mean number of species decreased from 5.8 to 4.2 and the total number of fish by 90% from 221 to 21 fish/net set. A substantial bloom of *K. veneficum* was present in the USE and in the riverine reaches further upstream for several weeks before autumn sampling commenced and was still at bloom densities during sampling. In early April, shortly after the bloom peaked, ~500 Black Bream died upstream of the USE, in the Swan riverine zone. Densities of *K. veneficum* in the vicinity of the fish kill exceeded 138,000 cells/mL before the event and declined to 2,770 cells/mL shortly afterwards. It is thought that the fish kill was influenced by the collapse of the bloom and the release of ichthyotoxins into the water but the state of decomposition of the fish did not permit further analyses (DBCA, pers. comm.). *Karlodinium veneficum* can produce ichthyotoxins (Place et al., 2012; Adolf et al., 2015) and many of the species abundant in summer, i.e. Perth Herring, Sea Mullet, Black Bream and Yellowtail Grunter, have been shown to move away from previous *Karlodinium* blooms in the USE (Hallett, 2012; Hallett et al., 2016). It is likely that the substantial (14 point) decline in FCI scores for the USE between summer and autumn was driven by the presence of the *K. veneficum* bloom, and while fish kills were not evident in this zone, the bloom may have influenced some of the fish in the USE to move away, lowering the FCI score.

The mean FCI score for the MSE, where *Karlodinium* densities were much lower, remained the same in summer and autumn (i.e. 68; good condition), which is the same as in 2024, but contrasts with the previous three years (2021, 2022 and 2023), where scores were lower in autumn. In each of those three years, freshwater flow led to stratification and associated hypoxia and, in some years, also the presence of *Karlodinium* spp. (Tweedley et al., 2022a, b; 2023; 2025). The maintenance of good condition in both seasons in 2025 and 2024 likely reflects the high and stable salinities present throughout the vertical axis of the water column, as well as the absence of hypoxic conditions and toxic algal blooms. The mean score for the LSCE was also unchanged between seasons, with all metrics increasing slightly (+ 0.3 – 2.9) in autumn, except for the *Number of trophic generalist species* that decreased markedly (-5.6) and, to a lesser extent, the *Proportion of estuarine-spawning individuals* (-1.5).

(a) Summer 2025



(b) Autumn 2025

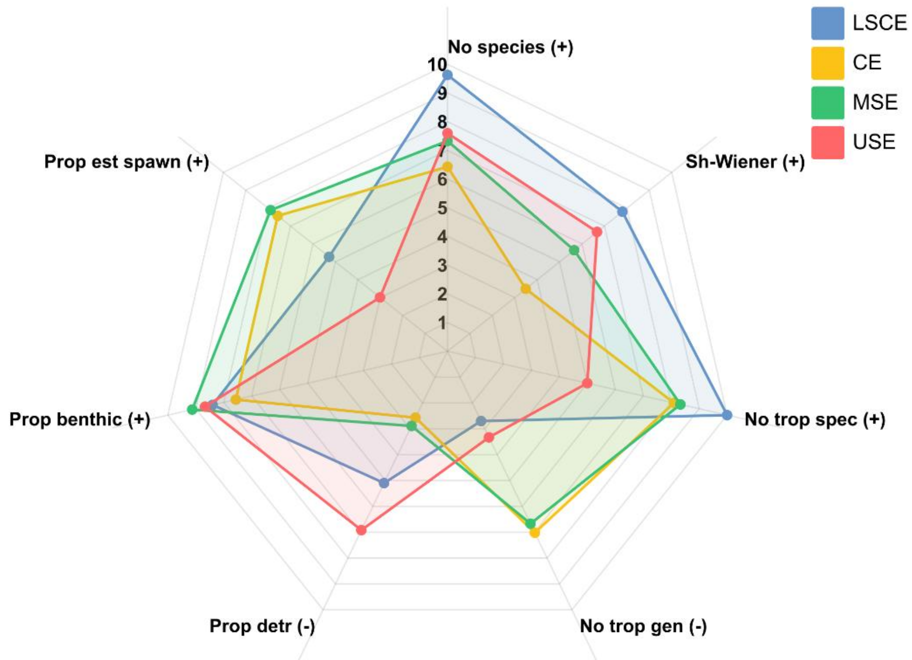


Figure 7. Average scores (0–10) for each component metric of the offshore Fish Community Index, calculated from samples collected throughout the LSCE, CE, MSE and USE zones in (a) summer and (b) autumn 2025. Note that an increase in the score for positive metrics (+) reflects an increase in the underlying variable, whereas an increase in the score for negative metrics (-) reflects a decrease in the underlying variable. Therefore, the larger the area covered by the radar plot the better the condition in that zone. Metric names and explanations are given in Table 1.

The mean FCI score for the CE increased from 57 (fair) in summer to 61 (good) in autumn. This is only the second time since 2012 that this zone has been in good condition in autumn. The increase in FCI was mainly due to higher scores for the *Proportion of detritivores (+2), Shannon-Wiener diversity* (+2) and the *Number of species (+1).* The average number of species increased from 4.6 to 5.8, with species such as Black Bream, Tarwhine, Southern Eagle Ray, Sea Mullet and Australian Anchovy only recorded in autumn. Moreover, there was a decrease in the proportion of Perth Herring from 88% of all fish in summer to 68% in autumn, due to much larger catches of Tailor and Common Silverbiddy. The increased diversity of species in this zone likely reflects the high salinities, which facilitate the presence of marine species, e.g., Tailor, Common Silverbiddy, and Southern Eagle Rays, and the general absence of hypoxic conditions and toxic algal blooms.

Longer-term trends in ecological condition

Overall results for the Swan Canning Estuary in 2025 indicate that the nearshore waters were in good condition (B), with an average score across zones of 67, which represents an improvement from the fair (C) condition in 2024. The score in 2025 is the third-highest score recorded after 2014 and 2016, and the fourth time good condition has been obtained (Fig. 8). The mean offshore FCI score for the estuary overall indicated good (B) condition during 2025 and was the highest ever recorded. The current score of good is in line with the generally upward trend from 2017 onwards (Fig. 9), with six of the nine years in which good condition was obtained occurring since 2019. Combined, the scores for the nearshore and offshore waters are the highest recorded and similar to those in 2022 and 2023, which ranked second and fourth, respectively. Thus, the trend for relatively good conditions for the estuary as a whole in recent years has continued in 2025.

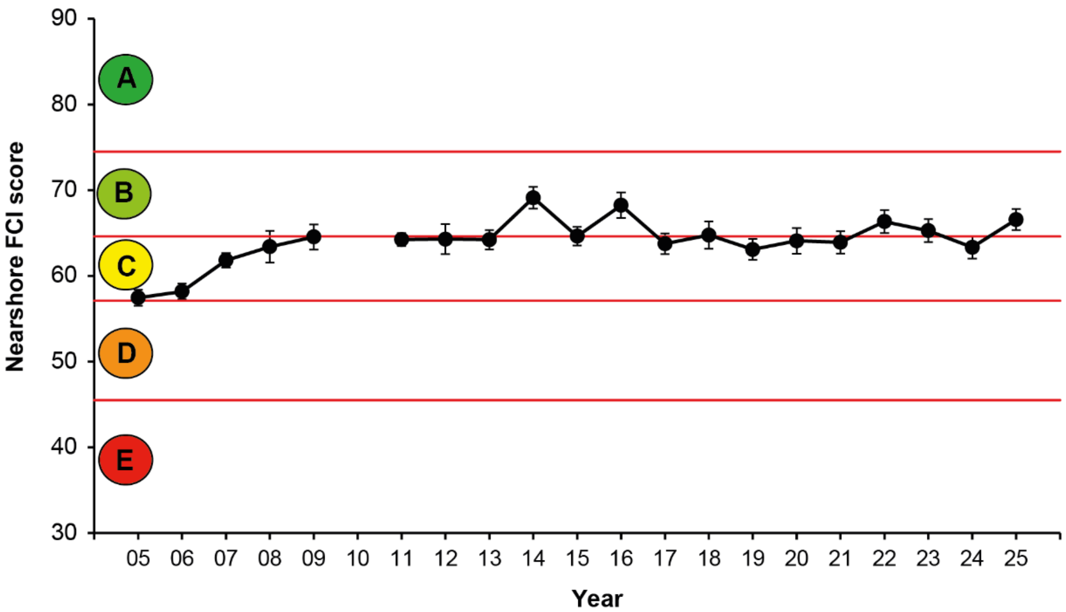


Figure 8. Trend plot of average (±SE) nearshore Fish Community Index (FCI) scores and resulting condition grades (A, very good; B, good; C, fair; D, poor; E, very poor) for the Swan Canning Estuary between 2005 and 2025. Red lines denote boundaries between condition grades. No data were collected in 2010.

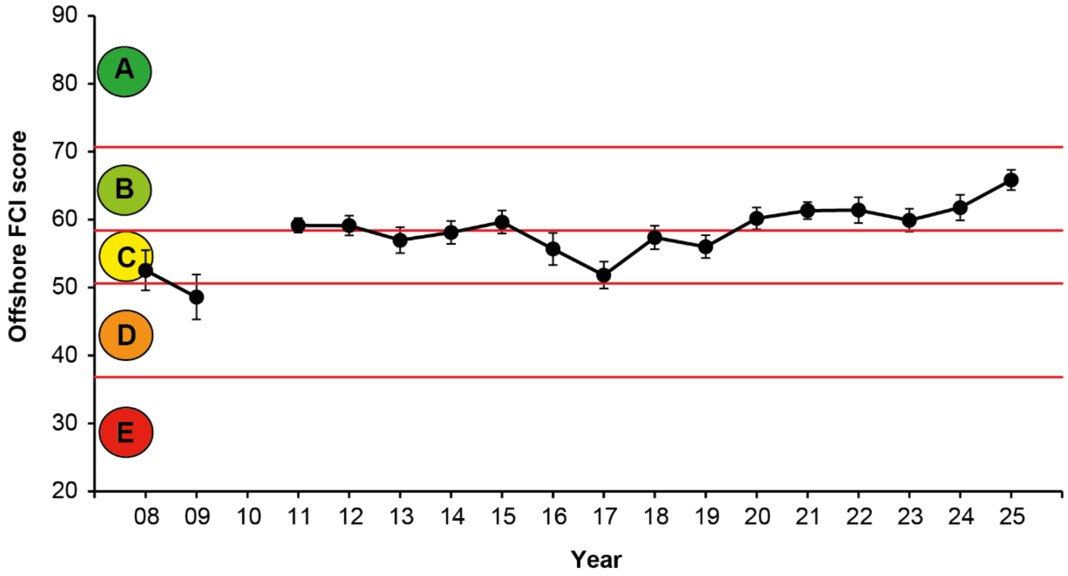


Figure 9. Trend plot of average (±SE) offshore Fish Community Index (FCI) scores and resulting condition grades (A, very good; B, good; C, fair; D, poor; E, very poor), for the Swan Canning Estuary between 2008 and 2025. Red lines denote boundaries between condition grades. No data were collected in 2010.

6. Summary

The Fish Community Index (FCI) considers the fish community as a whole and provides an objective means to assess how the structure and function of these communities in shallow, nearshore (< 1.5 m deep) and deeper, offshore waters (> 1.5 m deep) respond to a wide array of stressors affecting the ecosystem. Note that the FCI does not provide information on the population dynamics or health of particular species (in comparison to e.g. Cottingham et al., 2014; Crisp et al., 2018), nor does it provide information on the size or status of the fish stocks in the estuary (e.g. Smith et al., 2021; Obregón et al., 2022).

Across the entire estuary, the ecological condition of both nearshore and offshore waters in 2025 was assessed as good (B), respectively, based on their fish communities (Table 5). Combined, the nearshore and offshore index scores are the highest ever recorded, continuing a trend that has persisted over the last few years. Among zones, scores for the CE and LSCE in 2025 were similar to the long-term average, whereas those for the USE and MSE were 5 and 8 points greater, respectively (Table 5). In all years since 2012, the mean FCI scores have been higher in nearshore waters than offshore waters; however, the magnitude of the difference was the least this year (0.7 compared to an average of 6.8; range = 1.5 – 12.6 in previous years). This was due to the offshore FCI scores for each zone (across both seasons) being between 6 and 11 points higher than the average between 2008 and 2024 (Table 5). The lack of flow from the Swan River prevented the occurrence of stratification and hypoxia, and thus offshore scores in the MSE did not decline in autumn as occurs in most years. Although offshore FCI scores did decline in the USE in autumn, scores were higher than usual in summer due to the saline conditions present, and the decline in autumn was likely due to the movement of fish away from a bloom of ichthyotoxic dinoflagellate *Karlodinium veneficum*. Offshore FCI scores in the CE across both seasons were amongst the highest recorded. The offshore waters of this zone have consistently scored poorly relative to other zones across both seasons, receiving a poor (D) grade in > 50% of monitored seasons, yet the grades in summer and autumn were fair (C) and good (B), respectively, giving an overall grade of good/fair (B/C) and an FCI score almost 10 points greater than the average (Table 5). This reflects, in part, low concentrations of harmful algal blooms that have occurred previously in this zone and that low rainfall resulted in stable and high salinities and limited the spatial extent of any areas of low oxygen.

Table 5. Fish Community Index (FCI) scores and corresponding ecological condition grades for each zone of the estuary, and the estuary as a whole, during the 2025 monitoring period (mean of all summer and autumn of 2025) and previous monitoring. LSCE = Lower Swan Canning Estuary, CE = Canning Estuary, MSE = Middle Swan Estuary, USE = Upper Swan Estuary. Scores can range from 0 to 100.

	Nearshore			**Offshore**		
	Mean FCI score 2025	*Condition 2025*	*Mean FCI score 2005-2024*	*Mean FCI score 2025*	*Condition 2025*	*Mean FCI score 2008-2024*
LSCE	62.31	C	62.95	70.14	B/A	61.98
CE	63.28	C	63.14	59.13	B/C	49.64
MSE	70.20	B	62.52	68.39	B	57.68
USE	70.50	B	65.58	65.68	B	60.14
Estuary	**66.57**	**B**	**63.87**	**65.84**	**B**	**57.48**

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8. Appendices

Appendix (i). Descriptions of (a) nearshore and (b) offshore Fish Community Index monitoring sites. LSCE, Lower Swan Canning Estuary; CE, Canning Estuary; MSE, Middle Swan Estuary; USE, Upper Swan Estuary.

Zone	Site Code	Lat-Long (S, E)	Description
(a) – *Nearshore*			
LSCE	LSCE3	-32°01'29'', 115°46'27''	Shoreline in front of vegetation on eastern side of Point Roe, Mosman Pk
	LSCE4	-31°59'26'', 115°47'08''	Grassy shore in front of houses to east of Claremont Jetty
	LSCE5	-32°00'24'', 115°46'52''	North side of Point Walter sandbar
	LSCE6	-32°01'06'', 115°48'19''	Shore in front of bench on Attadale Reserve
	LSCE7	-32°00'11'', 115°50'29''	Sandy bay below Point Heathcote
	LSCE8	-31°59'11'', 115°49'40''	Eastern side of Pelican Point, immediately south of sailing club
CE	CE1	-32°01'28'', 115°51'16''	Sandy shore to south of Deepwater Point boat ramp
	CE2	-32°01'54'', 115°51'33''	Sandy beach immediately to north of Mount Henry Bridge
	CE5	-32°01'40'', 115°52'58''	Bay in Shelley Beach, adjacent to jetty
	CE6	-32°01'29'', 115°53'11''	Small clearing in vegetation off North Riverton Drive
	CE7	-32°01'18'', 115°53'43''	Sandy bay in front of bench, east of Wadjup Point
	CE8	-32°01'16'', 115°55'14''	Sandy beach immediately downstream of Kent Street Weir
MSE	MSE2	-31°58'12'', 115°51'07''	Sandy beach on South Perth foreshore, west of Mends St Jetty
	MSE4	-31°56'34'', 115°53'06''	Shoreline in front of Belmont racecourse, north of Windan Bridge
	MSE5	-31°56'13'', 115°53'23''	Beach to west of jetty in front of Maylands Yacht Club
	MSE6	-31°57'13'', 115°53'56''	Small beach upstream of Belmont Water Ski Area boat ramp
	MSE7	-31°55'53'', 115°55'10''	Beach in front of scout hut, east of Garratt Road Bridge
	MSE8	-31°55'37'', 115°56'18''	Vegetated shoreline, Claughton Reserve, upstream of boat ramp
USE	USE1	-31°55'20'', 115°57'03''	Small beach adjacent to jetty at Sandy Beach Reserve, Bassendean
	USE3	-31°53'43'', 115°57'32''	Sandy bay opposite Bennett Brook, at Fishmarket Reserve, Guildford
	USE4	-31°53'28'', 115°58'32''	Shoreline in front of Guildford Grammar stables, opposite Lilac Hill Park
	USE5	-31°53'13'', 115°59'29''	Small, rocky beach after bend in river at Ray Marshall Park
	USE6	-31°52'41'', 115°59'31''	Small beach with iron fence, in front of Caversham house
	USE7	-31°52'22'', 115°59'39''	Sandy shore on bend in river, below house on hill, upstream of powerlines
(b) – *Offshore*			
LSCE	LSCE1G	-32°00'24'', 115°46'56''	In deeper water *ca* 100 m off north side of Point Walter sandbar
	LSCE2G	-32°00'12'', 115°48'07''	Alongside seawall west of Armstrong Spit, Dalkeith
	LSCE3G	-32°01'00'', 115°48'44''	Parallel to shoreline, running westwards from Beacon 45, Attadale
	LSCE4G	-32°00'18'', 115°50'01''	In deep water of Waylen Bay, from *ca* 50 m east of Applecross jetty
	LSCE5G	-31°59'37'', 115°51'09''	Perpendicular to Como Jetty, running northwards
	LSCE6G	-31°59'12'', 115°49'42''	*Ca* 20 m from, and parallel to, sandy shore on east side of Pelican Point
CE	CE1G	-32°01'58'', 115°51'36''	Underneath Mount Henry Bridge, parallel to northern shoreline
	CE2G	-32°01'48'', 115°51'46''	Parallel to, and *ca* 20 m from, western shoreline of Aquinas Bay
	CE3G	-32°01'49'', 115°52'19''	To north of navigation markers, Aquinas Bay
	CE4G	-32°01'48'', 115°52'33''	Adjacent to Old Post Line (SW-ern end; Salter Point)
	CE5G	-32°01'36'', 115°52'52''	Adjacent to Old Post Line (NE-ern end; Prisoner Point)
	CE6G	-32°01'20'', 115°53'15''	Adjacent to Old Post Line, Shelley Water
MSE	MSE1G	-31°58'03'', 115°51'03''	From jetty at Point Belches towards Mends St Jetty, Perth Water
	MSE2G	-31°56'57'', 115°53'05''	Downstream of Windan Bridge, parallel to Burswood shoreline
	MSE3G	-31°56'22'', 115°53'05''	Downstream from port marker, parallel to Joel Terrace, Maylands
	MSE4G	-31°57'13'', 115°54'12''	Parallel to shore from former boat shed jetty, Cracknell Park, Belmont
	MSE5G	-31°55'57'', 115°55'12''	Parallel to southern shoreline, upstream of Garratt Road Bridge
	MSE6G	-31°55'23'', 115°56'25''	Parallel to eastern bank at Garvey Pk, from south of Ron Courtney Island
USE	USE1G	-31°55'19'', 115°57'09''	Parallel to tree-lined eastern bank, upstream of Sandy Beach Reserve
	USE2G	-31°53'42'', 115°57'40''	Along northern riverbank, running upstream from Bennett Brook
	USE3G	-31°53'16'', 115°58'42''	Along northern bank on bend in river, to north of Lilac Hill Park
	USE4G	-31°53'17'', 115°59'23''	Along southern bank, downstream from bend at Ray Marshall Pk
	USE5G	-31°52'13'', 115°59'40''	Running along northern bank, upstream from Sandalford winery jetty
	USE6G	-31°52'13'', 116°00'18''	Along southern shore adjacent to Midland Brickworks, from outflow pipe

Appendix (ii). Descriptions of sampling and processing procedures.

Nearshore sampling methods

- On each sampling occasion, one replicate sample of the nearshore fish community is collected from each of the fixed, nearshore sampling sites.
- Sampling is not conducted during or within 3-5 days following any significant flow event.
- Nearshore fish samples are collected using a beach seine net that is 21.5 m long, comprises two 10 m-long wings (6 m of 9 mm mesh and 4 m of 3 mm mesh) and a 1.5 m-long bunt (3 mm mesh) and fishes to a depth of 1.5 m.
- This net is walked out from the beach to a maximum depth of approximately 1.5 m and deployed parallel to the shore, and is then rapidly dragged towards and onto the shore, so that it sweeps a roughly semicircular area of approximately 116 m^2.
- If a seine net deployment returns a catch of fewer than five fish, an additional sample is performed at the site (separated from the first sample by either 15 minutes or by 10-20 m distance). In the event that more than five fish are caught in the second sample, this second replicate is then used as the sample for that site and those fish from the first sample returned to the water alive. If, however, 0-5 fish are again caught, the original sample can be assumed to have been representative of the fish community present and be used as the sample for that site. The fish from the latter sample are then returned alive to the water. The above procedure thus helps to identify whether a collected sample is representative of the fish community present and enables instances of false negative catches to be identified and eliminated.
- Once an appropriate sample has been collected, any fish that may be readily identified to species (e.g. those larger species which are caught in relatively lower numbers) are counted and returned to the water alive.
- All other fish caught in the nets are placed into zip-lock polythene bags, euthanised in an ice slurry and preserved on ice in eskies in the field, except in cases where large catches (e.g. thousands) of small fish are obtained. In such cases, an appropriate sub-sample (e.g. one half to one eighth of the entire catch) is retained and the remaining fish are returned alive to the water. All retained fish are then bagged and frozen until their identification in the laboratory.

Offshore sampling methods

- On each sampling occasion, one replicate sample of the offshore fish community is collected from each of the fixed, offshore sampling sites.
- Sampling is not conducted within 3-5 days following any significant flow event.
- Offshore fish samples are collected using a sunken, multimesh gill net that consists of eight 20 m-long panels with stretched mesh sizes of 35, 51, 63, 76, 89, 102, 115 and 127 mm. These nets are deployed (i.e. laid parallel to the bank) from a boat immediately before sunset and retrieved after three hours.
- Given the time and labour associated with offshore sampling and the need to monitor the set nets for safety purposes, a maximum of three replicate net deployments is performed within a single zone in any one night. The three nets are deployed sequentially, and retrieved in the same order.
- During net retrieval (and, typically, when catch rates are sufficiently low to allow fish to be removed rapidly in the course of retrieval), any fishes that may be removed easily from the net are carefully removed, identified, counted, recorded and returned to the water alive as the net is pulled into the boat.
- All other fish caught in the nets are removed once the net has been retrieved. Retained fish are placed into zip-lock polythene bags in an ice slurry, preserved on ice in eskies in the field, and subsequently frozen until their identification in the laboratory.

Following their identification to the lowest possible taxon in the field or laboratory by fish specialists trained in fish taxonomy, all assigned scientific and common names are checked and standardised by referencing the Checklist of Australian Aquatic Biota (CAAB) database (Rees *et al.* on-line version), and the appropriate CAAB species code is allocated to each species. The abundance data for each species in each sample is entered into a database for record and subsequent computation of the biotic indices.

Rees, A.J.J., Yearsley, G.K., Gowlett-Holmes, K. and Pogonoski, J. Codes for Australian Aquatic Biota (on-line version). CSIRO Marine and Atmospheric Research, World Wide Web electronic publication, 1999 onwards. Available at: http://www.cmar.csiro.au/caab/. Last accessed 29 January 2021.

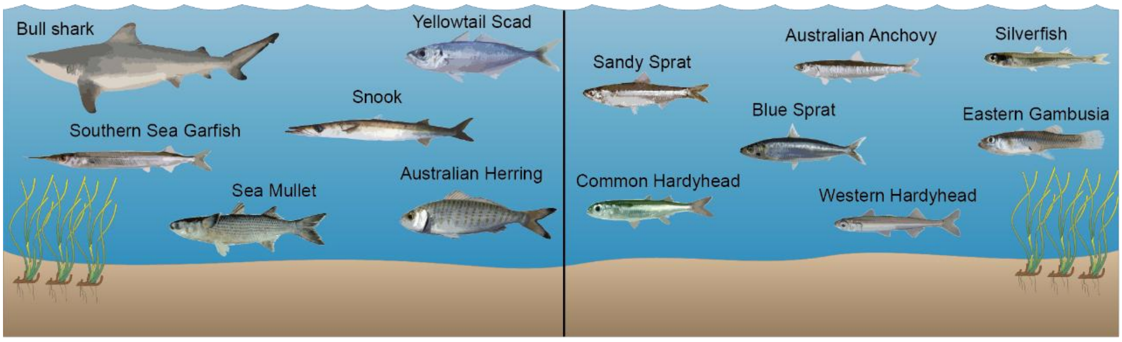
<u>Appendix (iii).</u> List of species caught from the Swan Canning Estuary, and their functional guilds: D, Demersal; P, Pelagic; BP, Benthopelagic; SP, Small pelagic; SB, Small benthic; MS, Marine straggler; MM, Marine migrant; SA, Semi-anadromous; ES, Estuarine species; FM, Freshwater migrant; ZB, Zoobenthivore; PV, Piscivore; ZP, Zooplanktivore; DV, Detritivore; OV, Omnivore; OP, Opportunist; HV, Herbivore. See below for a pictorial depiction of the guilds and Potter et al. (2015a); Whitfield et al. (2022) for a full description and rationale.

Species name	Common name	Family	Habitat Guild	Estuarine Use Guild	Feeding Mode Guild
Heterodontus portusjacksoni	Port Jackson Shark	Heterodontidae	D	MS	ZB
Carcharhinus leucas	Bull Shark	Carcharhinidae	P	MS	PV
Myliobatis tenuicaudatus	Southern Eagle Ray	Myliobatidae	D	MS	ZB
Elops hawaiensis	Hawaiian Giant Herring	Elopidae	BP	MS	PV
Sardinops sagax	Australian Sardine	Clupeidae	P	MS	ZP
Spratelloides robustus	Blue Sprat	Clupeidae	SP	MM	ZP
Hyperlophus vittatus	Sandy Sprat	Clupeidae	SP	MM	ZP
Nematalosa vlaminghi	Perth Herring	Clupeidae	BP	SA	DV
Sardinella lemuru	Scaly Mackerel	Clupeidae	P	MS	ZP
Engraulis australis	Australian Anchovy	Engraulidae	SP	ES	ZP
Galaxias occidentalis	Western Galaxias	Galaxiidae	SB	FM	ZB
Carassius auratus	Goldfish	Cyprinidae	BP	FM	OV
Cnidoglanis macrocephalus	Estuary Cobbler	Plotosidae	D	MM	ZB
Tandanus bostocki	Freshwater Cobbler	Plotosidae	D	FM	ZB
Hyporhamphus melanochir	Southern Garfish	Hemiramphidae	P	ES	HV
Hyporhamphus regularis	River Garfish	Hemiramphidae	P	FM	HV
Gambusia holbrooki	Eastern Gambusia	Poeciliidae	SP	FM	ZB
Leptatherina presbyteroides	Silver Fish	Atherinidae	SP	MM	ZP
Atherinomorus vaigiensis	Common Hardyhead	Atherinidae	SP	MM	ZB
Atherinosoma elongatum	Elongate Hardyhead	Atherinidae	SP	ES	ZB
Leptatherina wallacei	Western Hardyhead	Atherinidae	SP	ES	ZP
Craterocephalus mugiloides	Spotted Hardyhead	Atherinidae	SP	ES	ZB
Cleidopus gloriamaris	Australian Pineapplefish	Monocentrididae	D	MS	ZB
Phyllopteryx taeniolatus	Common Seadragon	Syngnathidae	D	MS	ZB
Hippocampus subelongatus	West Australian Seahorse	Syngnathidae	D	MS	ZP
Urocampus carinirostris	Hairy Pipefish	Syngnathidae	D	ES	ZP
Stigmatopora argus	Spotted Pipefish	Syngnathidae	D	MS	ZP
Stigmatopora nigra	Widebody Pipefish	Syngnathidae	D	MS	ZB
Pugnaso curtirostris	Pugnose Pipefish	Syngnathidae	D	MS	ZP
Vanacampus phillipi	Port Phillip Pipefish	Syngnathidae	D	MS	ZB
Filicampus tigris	Tiger Pipefish	Syngnathidae	D	MS	ZP
Gymnapistes marmoratus	Soldier	Tetrarogidae	D	MS	ZB
Chelidonichthys kumu	Red Gurnard	Triglidae	D	MS	ZB
Leviprora inops	Longhead Flathead	Platycephalidae	D	MS	PV
Platycephalus laevigatus	Rock Flathead	Platycephalidae	D	MS	PV
Platycephalus westraliae	Yellowtail Flathead	Platycephalidae	D	ES	PV
Pegasus lancifer	Sculptured Seamoth	Pegasidae	D	MS	ZB
Nannoperca vittata	Western Pygmy Perch	Percichthyidae	BP	FM	ZB
Amniataba caudavittata	Yellowtail Grunter	Terapontidae	BP	ES	OP
Bidyanus bidyanus	Silver Perch	Terapontidae	BP	FM	OV
Helotes octolineatus	Western Striped Grunter	Terapontidae	BP	MM	OV
Pelsartia humeralis	Sea Trumpeter	Terapontidae	BP	MS	OV
Siphamia cephalotes	Wood's Siphonfish	Apogonidae	BP	MS	ZB
Ostorhinchus rueppellii	Western Gobbleguts	Apogonidae	BP	ES	ZB
Sillaginodes punctatus	King George Whiting	Sillaginidae	D	MM	ZB
Sillago bassensis	Southern School Whiting	Sillaginidae	D	MS	ZB
Sillago burrus	Western Trumpeter Whiting	Sillaginidae	D	MM	ZB
Sillago schomburgkii	Yellowfin Whiting	Sillaginidae	D	MM	ZB
Sillago vittata	Western School Whiting	Sillaginidae	D	MM	ZB
Pomatomus saltatrix	Tailor	Pomatomidae	P	MM	PV
Trachurus novaezelandiae	Yellowtail Scad	Carangidae	P	MS	ZB
Scomberoides spp.	Queenfish	Carangidae	P	MS	PV

Species name	Common name	Family	Habitat Guild	Estuarine Use Guild	Feeding Mode Guild
Pseudocaranx georgianus	Silver Trevally	Carangidae	BP	MM	ZB
Pseudocaranx wrighti	Skipjack Trevally	Carangidae	BP	MM	ZB
Arripis georgianus	Australian Herring	Arripidae	P	MM	PV
Pentapodus vitta	Western Butterfish	Nemipteridae	BP	MS	ZB
Gerres subfasciatus	Common Silverbiddy	Gerreidae	BP	MM	ZB
Acanthopagrus butcheri	Black Bream	Sparidae	BP	ES	OP
Rhabdosargus sarba	Tarwhine	Sparidae	BP	MM	ZB
Argyrosomus japonicus	Mulloway	Sciaenidae	BP	MM	PV
Parupeneus spilurus	Blacksaddle Goatfish	Mullidae	D	MS	ZB
Neatypus obliquus	Footballer Sweep	Scorpididae	P	MS	ZP
Scorpis aequipinnis	Sea Sweep	Scorpididae	P	MS	ZP
Enoplosus armatus	Old Wife	Enoplosidae	D	MS	ZB
Geophagus brasiliensis	Pearl Cichlid	Cichlidae	BP	FM	OV
Aldrichetta forsteri	Yelloweye Mullet	Mugilidae	P	MM	OV
Mugil cephalus	Sea Mullet	Mugilidae	P	MM	DV
Sphyraena novaehollandiae	Snook	Sphyraenidae	P	MS	PV
Sphyraena obtusata	Striped Barracuda	Sphyraenidae	P	MS	PV
Neoodax balteatus	Little Weed Whiting	Labridae	D	MS	OV
Siphonognathus radiatus	Longray Weed Whiting	Labridae	D	MS	OV
Haletta semifasciata	Blue Weed Whiting	Labridae	D	MS	OV
Heteroscarus acroptilus	Rainbow Cale	Labridae	D	MS	OV
Parapercis haackei	Wavy Grubfish	Pinguipedidae	D	MS	ZB
Lesueurina platycephala	Flathead Sandfish	Leptoscopidae	D	MS	ZB
Istiblennius meleagris	Peacock Rockskipper	Blenniidae	D	MS	HV
Omobranchus germaini	Germain's Blenny	Blenniidae	SB	MS	ZB
Parablennius intermedius	Horned Blenny	Blenniidae	D	MS	ZB
Parablennius postoculomaculatus	False Tasmanian Blenny	Blenniidae	SB	MS	OV
Petroscirtes breviceps	Shorthead Sabretooth Blenny	Blenniidae	SB	MS	OV
Cristiceps australis	Southern Crested Weedfish	Clinidae	D	MS	ZB
Pseudocalliurichthys goodladi	Longspine Dragonet	Callionymidae	D	MS	ZB
Eocallionymus papilio	Painted Stinkfish	Callionymidae	D	MS	ZB
Callogobius mucosus	Sculptured Goby	Gobiidae	SB	MS	ZB
Favonigobius lateralis	Southern Longfin Goby	Gobiidae	SB	MM	ZB
Nesogobius pulchellus	Sailfin Goby	Gobiidae	SB	MS	ZB
Arenigobius bifrenatus	Bridled Goby	Gobiidae	SB	ES	ZB
Pseudogobius olorum	Bluespot Goby	Gobiidae	SB	ES	OV
Bathygobius fuscus	Dusky Frillgoby	Gobiidae	SB	MM	ZB
Callogobius depressus	Flathead Goby	Gobiidae	SB	MS	ZB
Favonigobius punctatus	Yellowspotted Sandgoby	Gobiidae	SB	ES	ZB
Afurcagobius suppositus	Southwestern Goby	Gobiidae	SB	ES	ZB
Redigobius macrostoma	Largemouth Goby	Gobiidae	SB	ES	ZB
Tridentiger trigonocephalus	Trident Goby	Gobiidae	SB	MS	ZB
Pseudorhombus jenynsii	Smalltooth Flounder	Paralichthyidae	D	MM	ZB
Ammotretis rostratus	Longsnout Flounder	Pleuronectidae	D	MM	ZB
Ammotretis elongatus	Elongate Flounder	Pleuronectidae	D	MM	ZB
Cynoglossus broadhursti	Southern Tongue Sole	Cynoglossidae	D	MS	ZB
Acanthaluteres brownii	Spinytail Leatherjacket	Monacanthidae	D	MS	OV
Acanthaluteres vittiger	Toothbrush Leatherjacket	Monacanthidae	D	MS	OV
Eubalichthys mosaicus	Mosaic Leatherjacket	Monacanthidae	D	MS	OV
Scobinichthys granulatus	Rough Leatherjacket	Monacanthidae	D	MS	OV
Monacanthus chinensis	Fanbelly Leatherjacket	Monacanthidae	D	MM	OV
Chaetodermis penicilligerus	Tasselled Leatherjacket	Monacanthidae	D	MS	OV
Brachaluteres jacksonianus	Southern Pygmy Leatherjacket	Monacanthidae	D	MS	OV
Meuschenia freycineti	Sixspine Leatherjacket	Monacanthidae	D	MM	OV
Acanthaluteres spilomelanurus	Bridled Leatherjacket	Monacanthidae	D	MM	OV
Torquigener pleurogramma	Weeping Toadfish	Tetraodontidae	BP	MM	OP
Contusus brevicaudus	Prickly Toadfish	Tetraodontidae	BP	MS	OP
Polyspina piosae	Orangebarred Puffer	Tetraodontidae	BP	MS	OP
Diodon nicthemerus	Globefish	Diodontidae	D	MS	ZB

<u>Appendix (iv).</u> Pictorial desciptions of the habitat guilds using species present in the Swan-Canning Estuary with those in bold depicted in the diagrams.

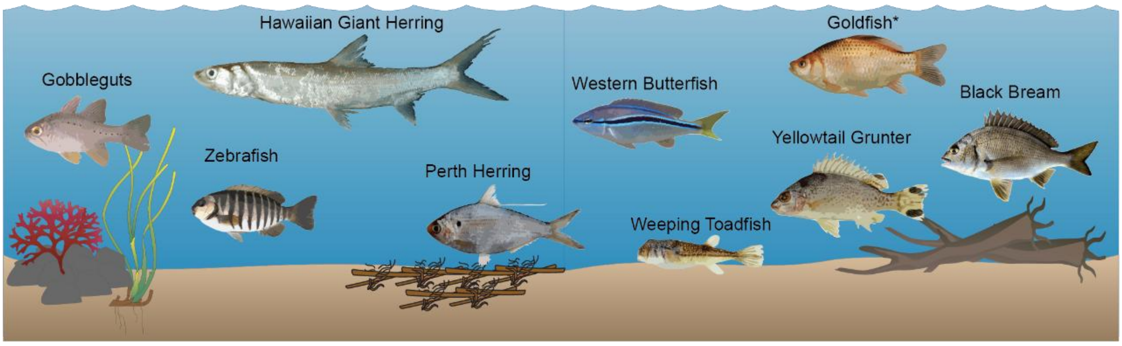
(a) Pelagic **(b) Small pelagic**



Free-swimming species associated with the surface or middle depths of the estuary

Pelagic species that reach ≤ 15 cm total length as adults

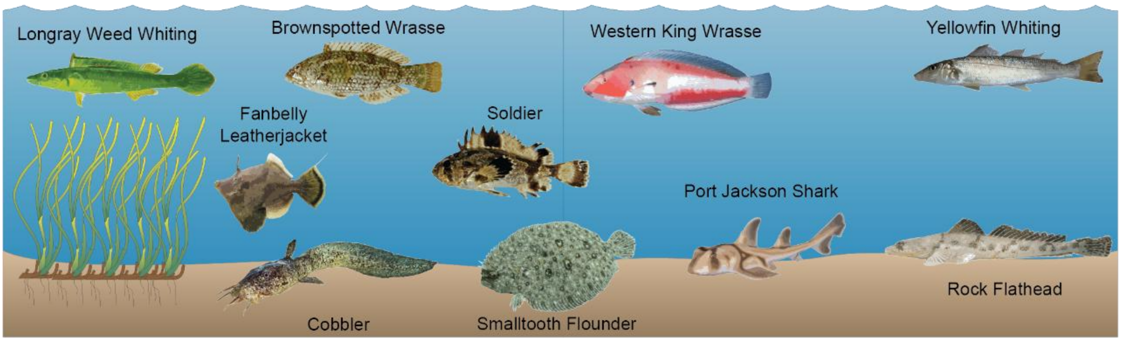
(c) Benthopelagic



Species that live the bottom as well as in midwaters and/or near the surface of the estuary

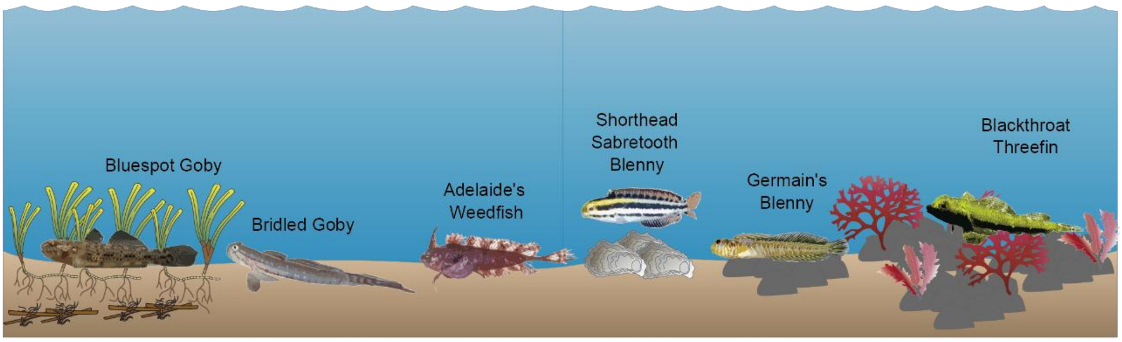
Brownspotted Wrasse

(d) Demersal



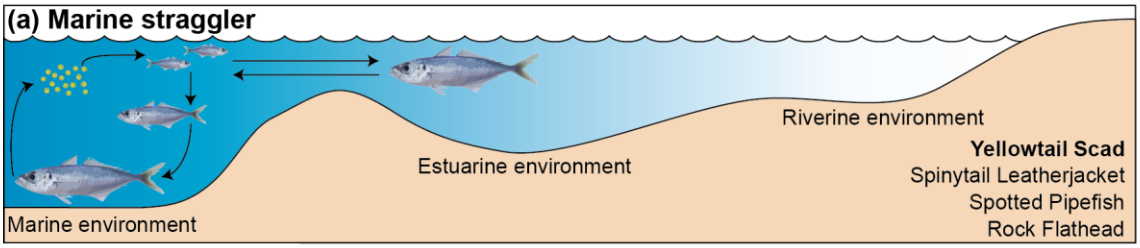
Species that live on or near the bottom of the estuary

(d) Small benthic

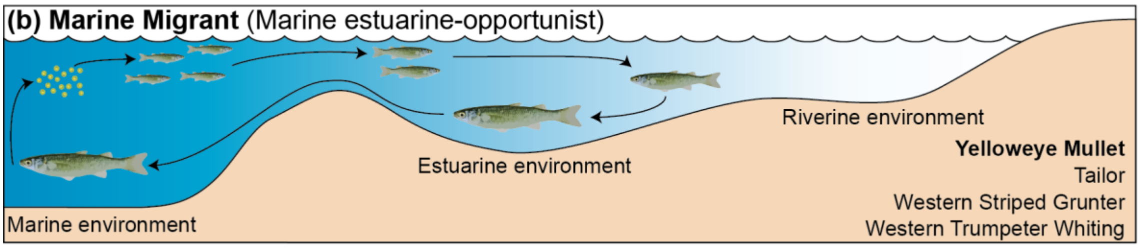


Species that reach ≤ 15 cm total length as adults that live on the bottom of the estuary

Appendix (v). Pictorial descriptions of the estuarine use guilds using species present in the Swan-Canning Estuary with those in bold depicted in the diagrams.

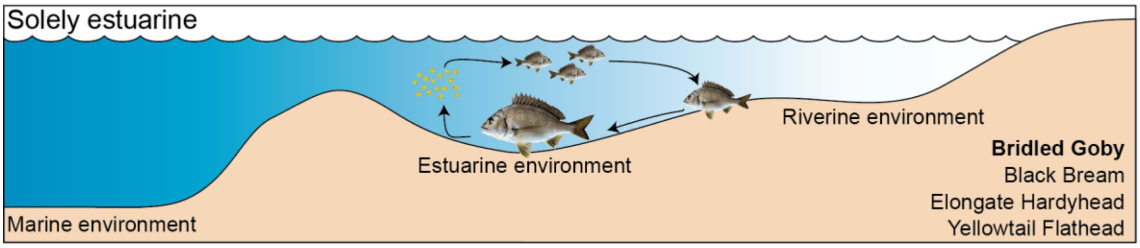


Adults spawn at sea and individuals (adults and juveniles) typically enter estuaries sporadically and in low numbers and are most common in the lower reaches where salinities typically do not decline far below ~35. Belong to populations in marine waters and are often stenohaline.

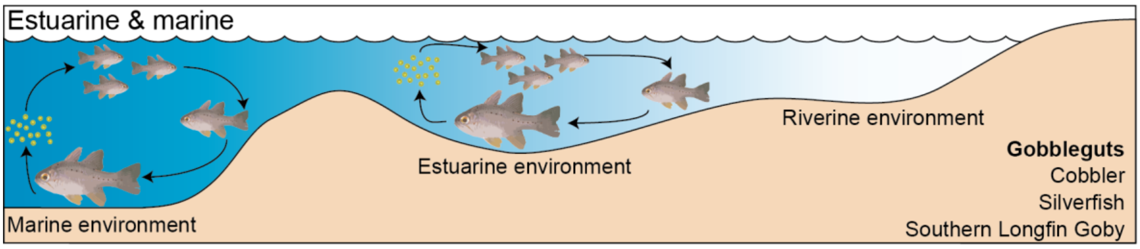


Regularly enter estuaries in substantial numbers, particularly as juveniles, but use, to varying degrees, coastal marine waters as alternative nursery areas.

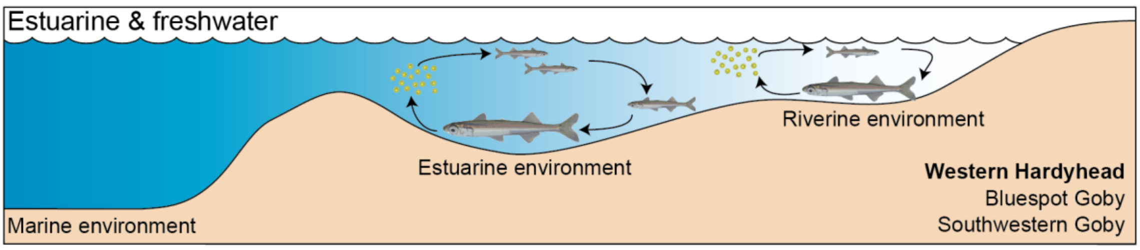
(c) Estuarine species: Species with populations where individuals complete their life cycles in the estuary and includes species with the three life-history strategies below.



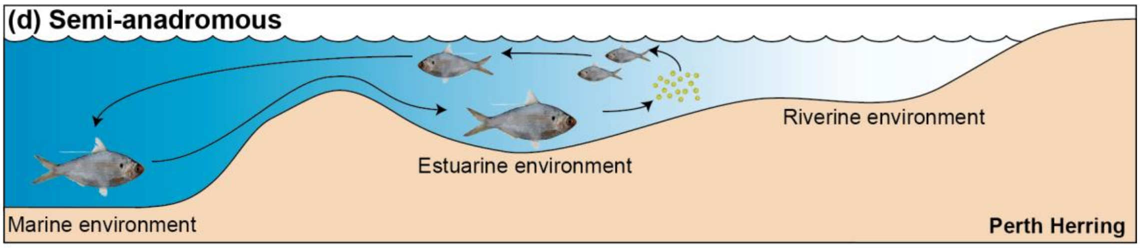
Species found only in estuaries.



Species also represented by marine populations.

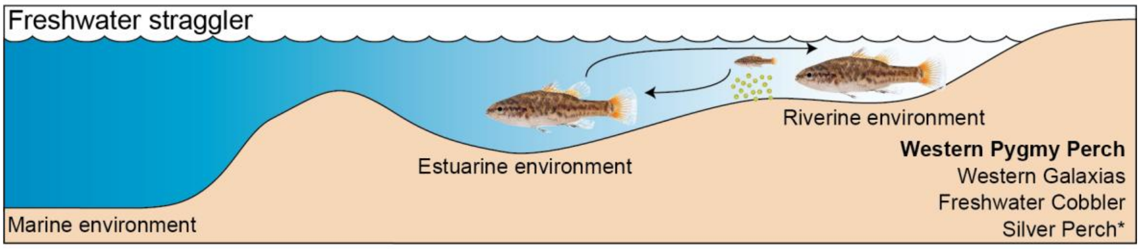


Species also represented by freshwater populations.

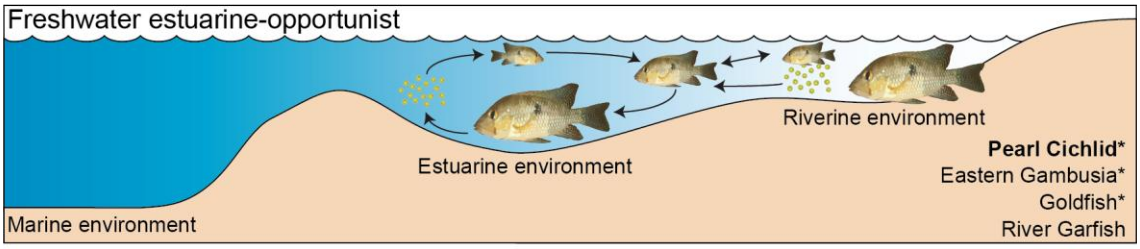


Spawning run from the sea extends only as far as the upper estuary rather than into fresh water.

(e) Freshwater migrant: Species that spawn in freshwater estuary and includes species with the two life-history strategies below.

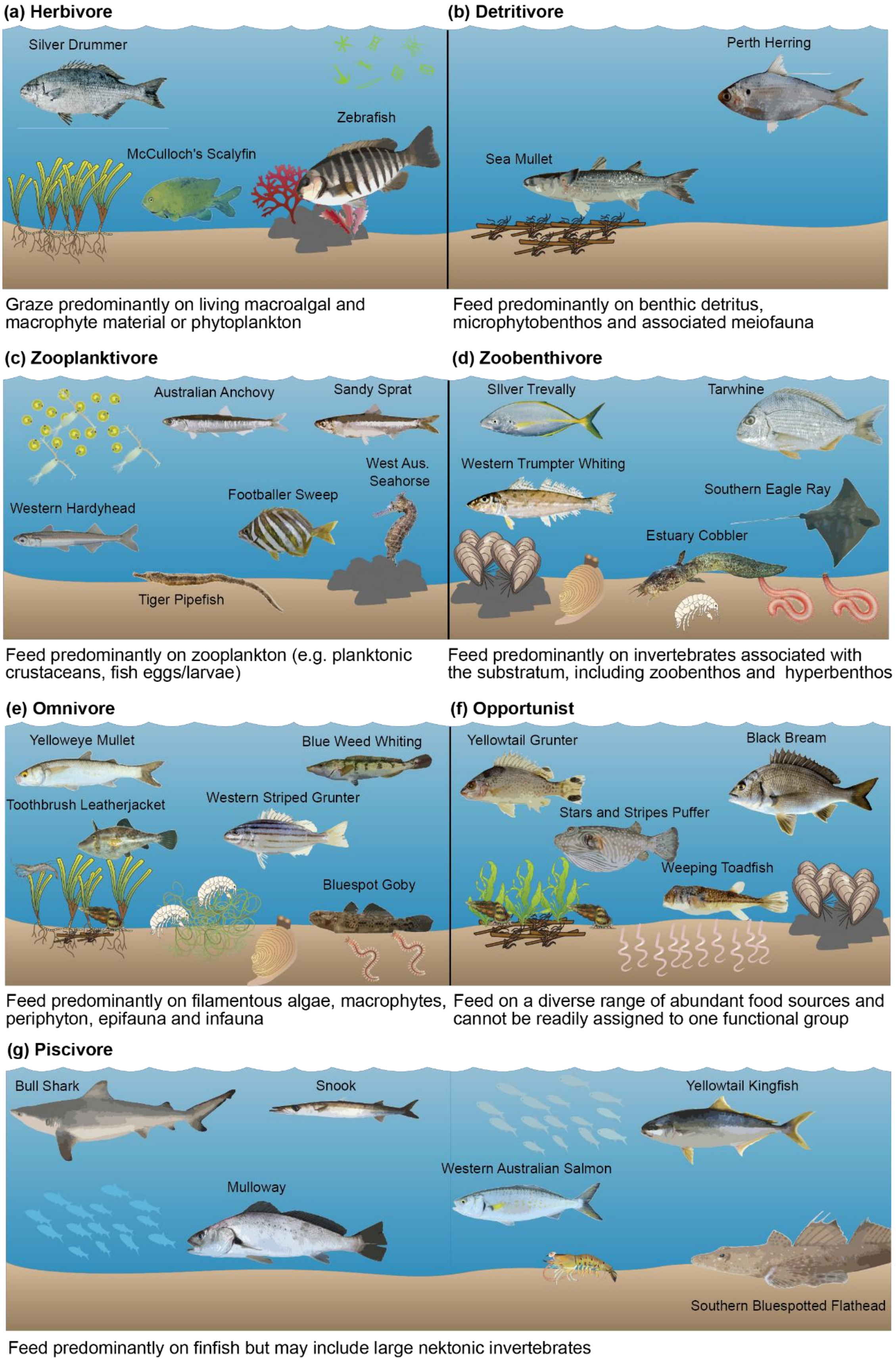


Found in low numbers in estuaries and whose distribution is usually limited to the low salinity, upper reaches of estuaries.



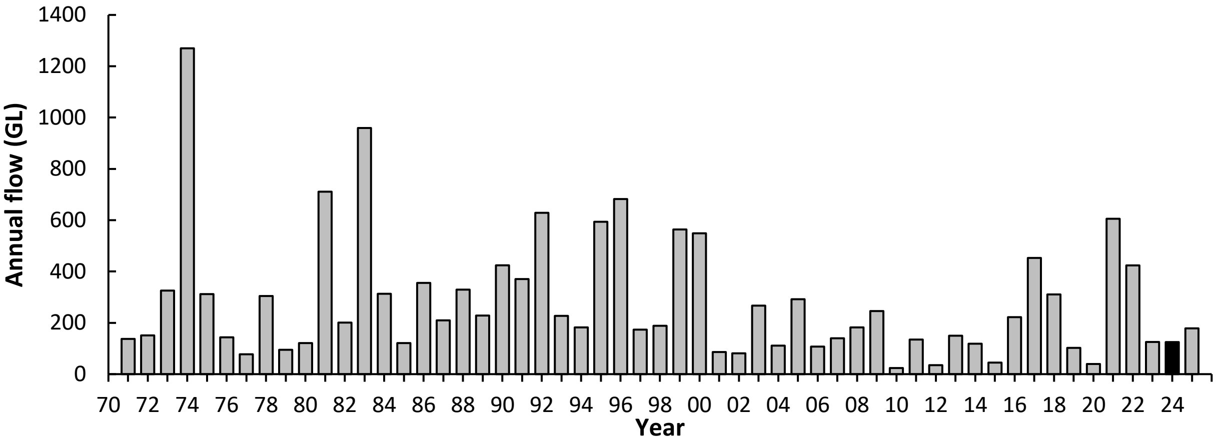
Found regularly and in moderate numbers in estuaries and whose distribution can extend well beyond the oligohaline sections of these systems.

Appendix (vi). Pictorial descriptions of the feeding guilds using species present in the Swan-Canning Estuary with those in bold depicted in the diagrams.

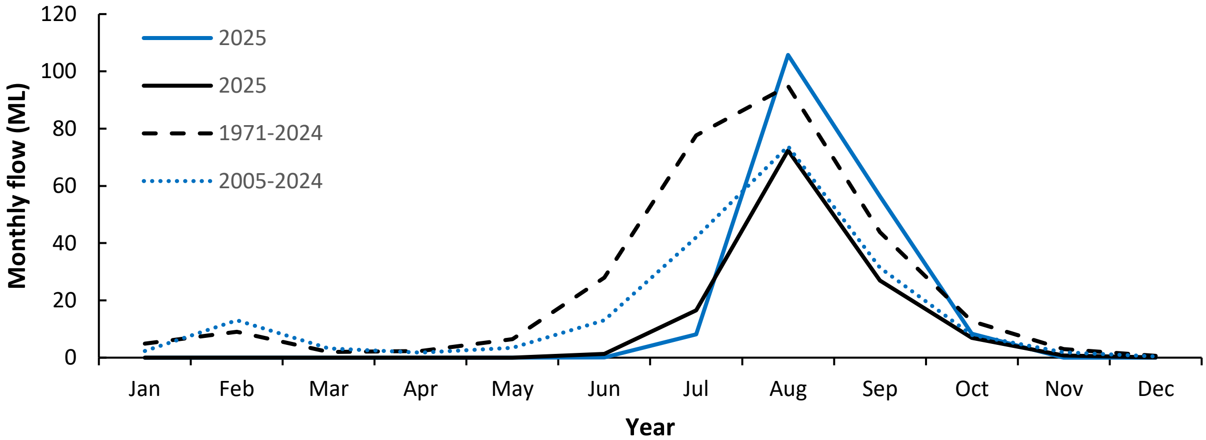


Appendix (vii). (a) Total annual flow between 1971 and 2025 and (b) total monthly flow in 2024 and 2025 compared to longer-term averages at Walyunga on the Swan River (gauging station 16401). Data from 2024 are highlighted in black in (a) and as the solid black line in (b). Data recorded by the Department of Water and Environmental Regulation and extracted from https://wir.water.wa.gov.au/Pages/Water-Information-Reporting.aspx. Data in 2025 current up to 31 October 2025.

(a)

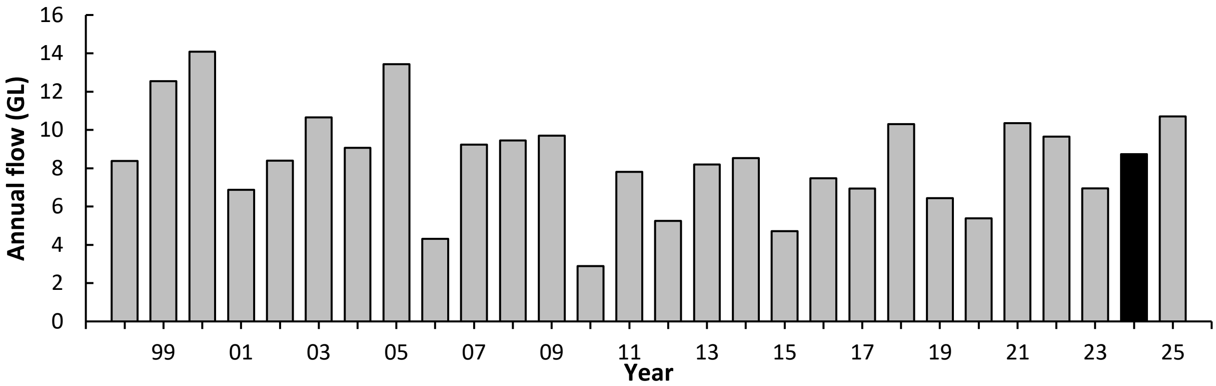


(b)

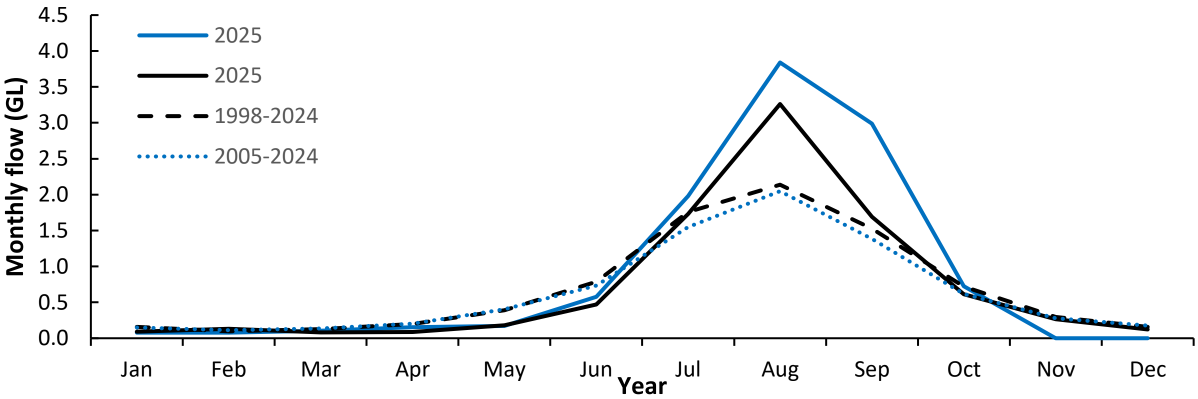


Appendix (viii). (a) Total annual flow between 1998 and 2025 and (b) total monthly flow in 2024 and 2025 compared to longer-term averages at Seaforth on the Canning River (gauging station 16417). Data from 2024 are highlighted in black in (a) and as the solid black line in (b). Data recorded by the Department of Water and Environmental Regulation and extracted from https://wir.water.wa.gov.au/Pages/Water-Information-Reporting.aspx. Data in 2025 current up to 31 October 2025.

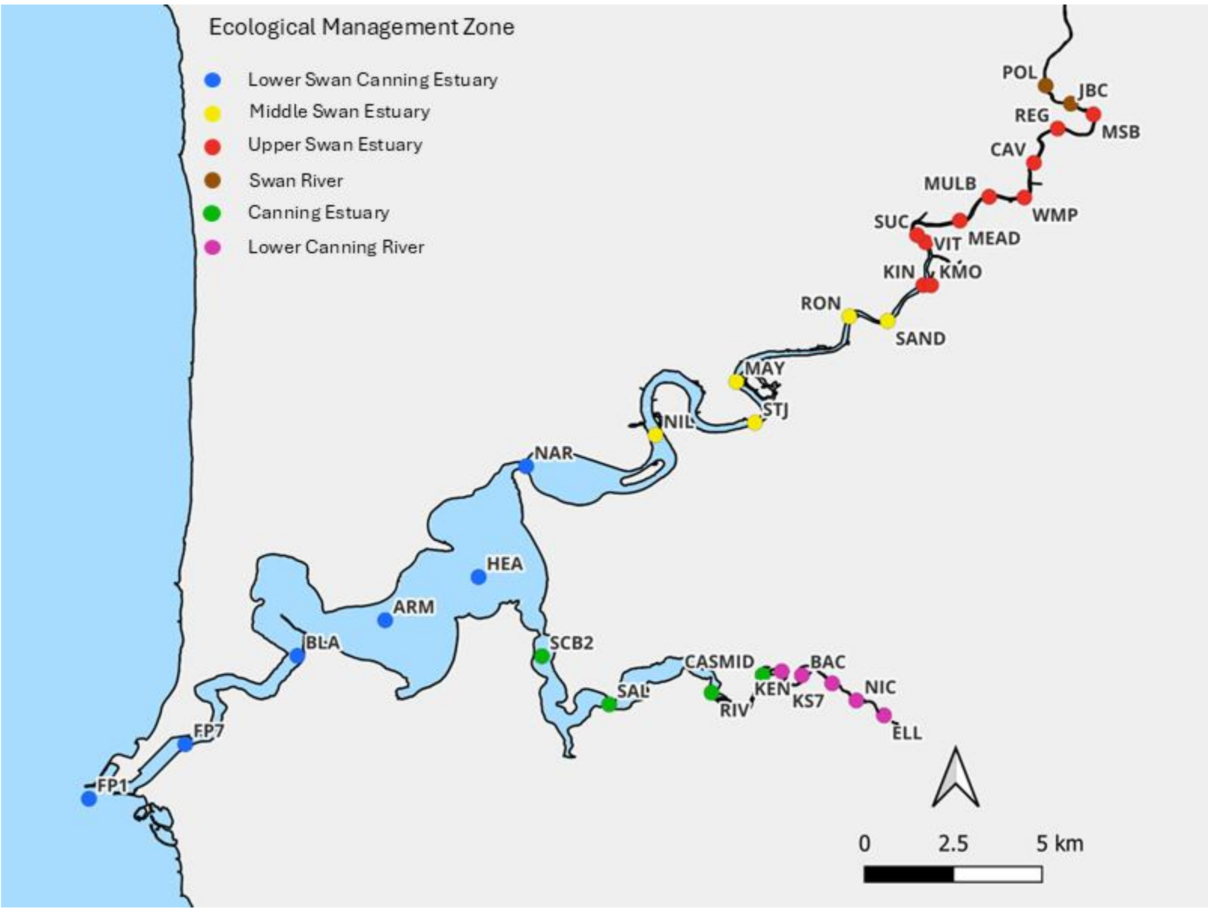
(a)



(b)

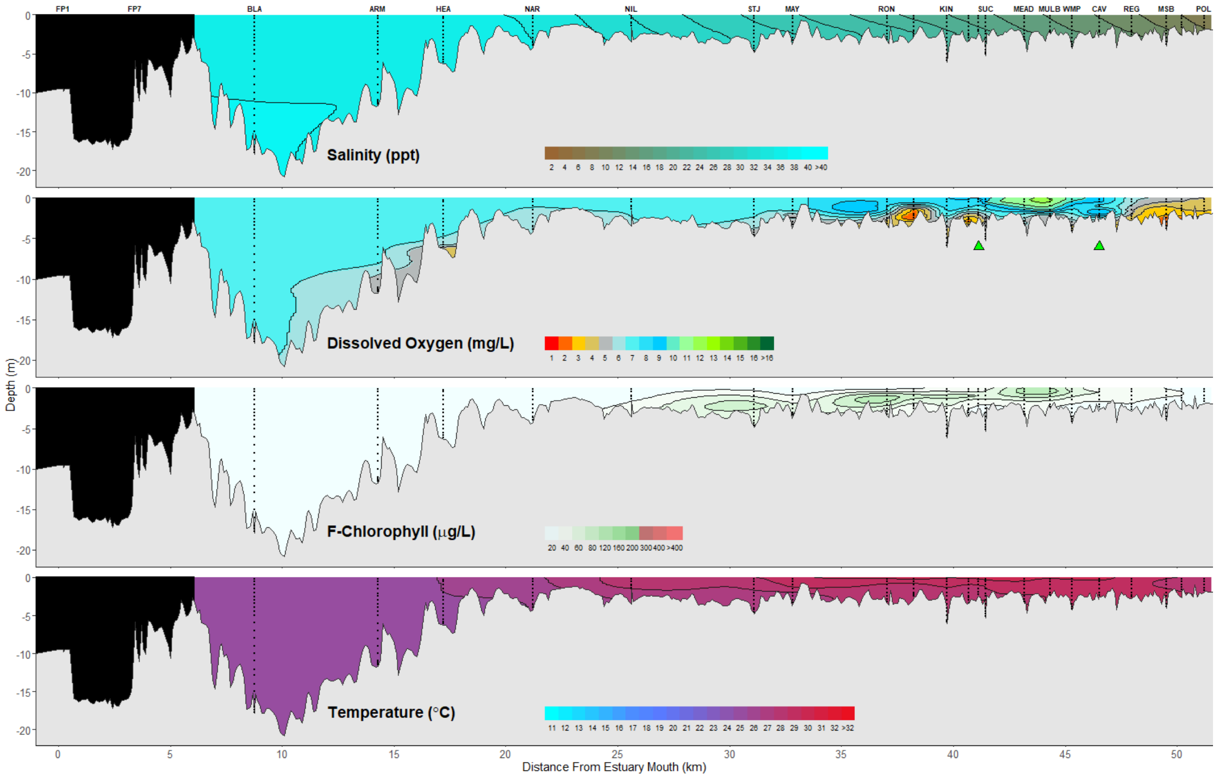


Appendix (ix). A representative selection of vertical contour plots of salinity (ppt), dissolved oxygen concentrations (mg/L), Chlorophyll fluorescence (µg/L) and water temperature (°C) measured at monitoring stations along the length of the Swan Canning Estuary (see map) on occasions throughout the summer to autumn period of fish community sampling. Prepared by the Department of Biodiversity, Conservation and Attractions (https://www.dbca.wa.gov.au/science/riverpark-monitoring).

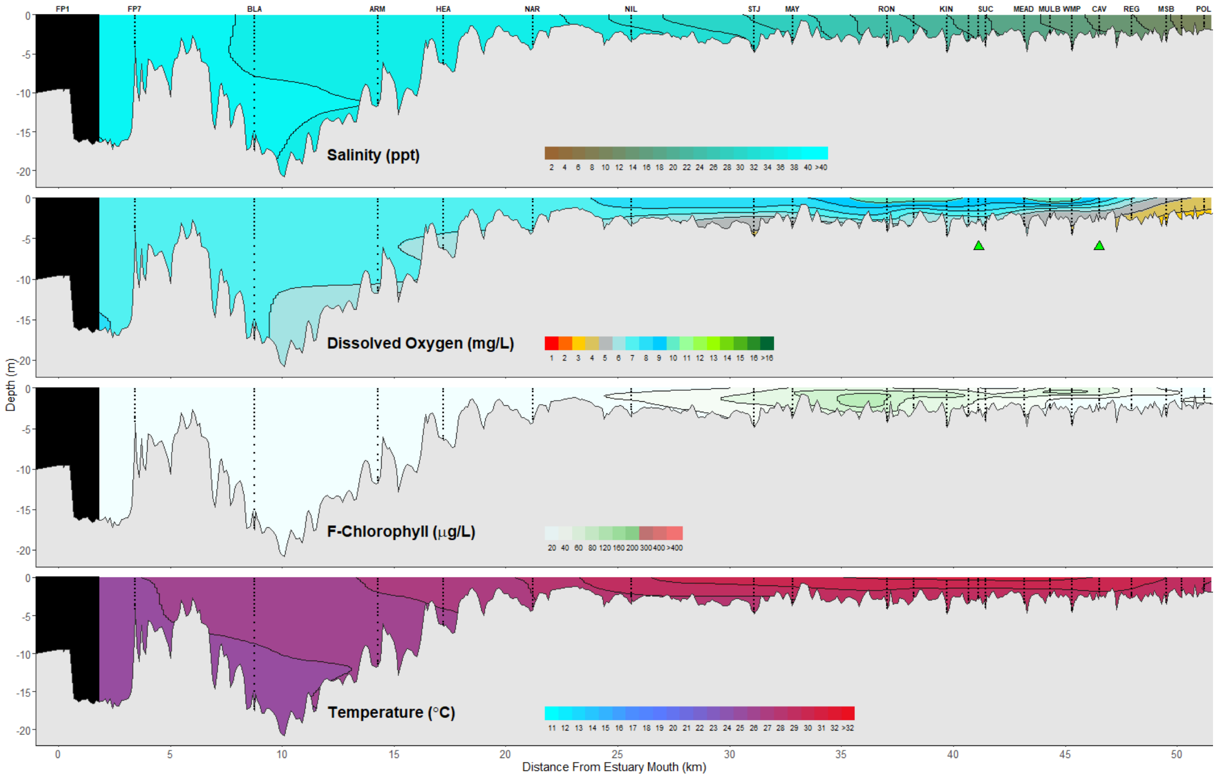


LSCE, MSE and USE zones in summer through autumn 2025

6 January 2025



13 January 2025



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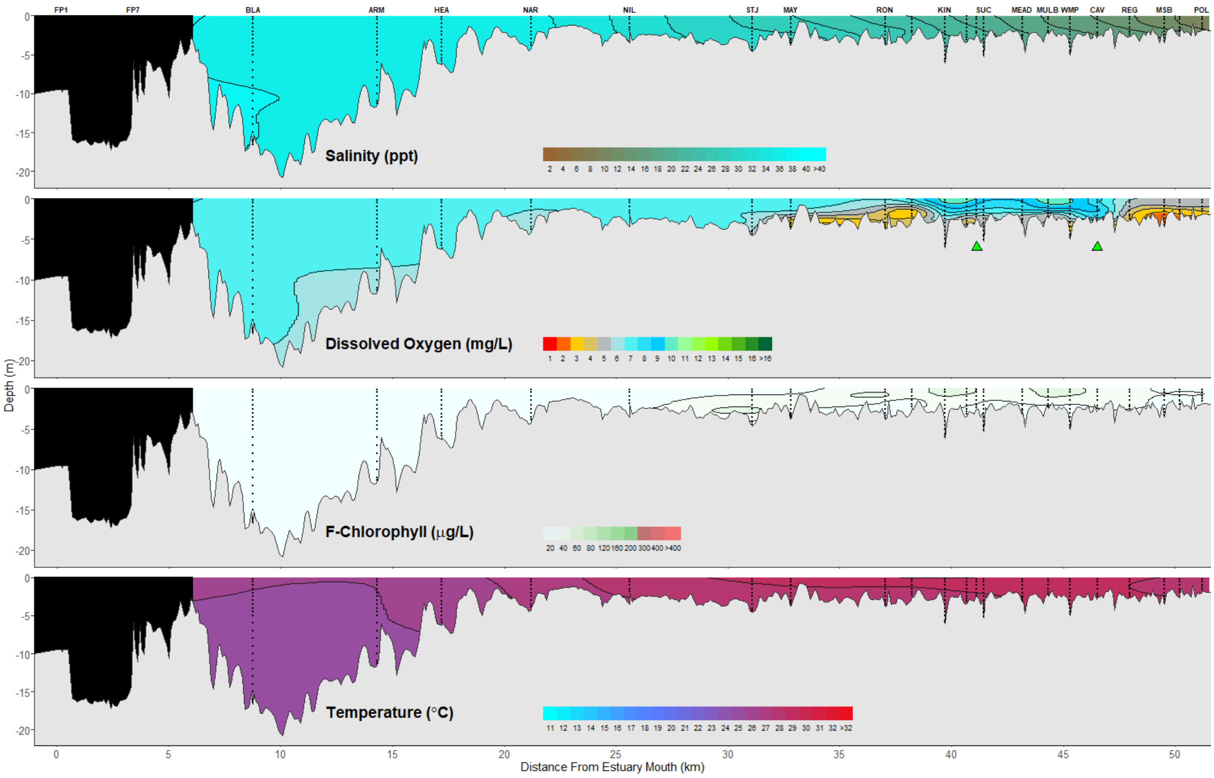
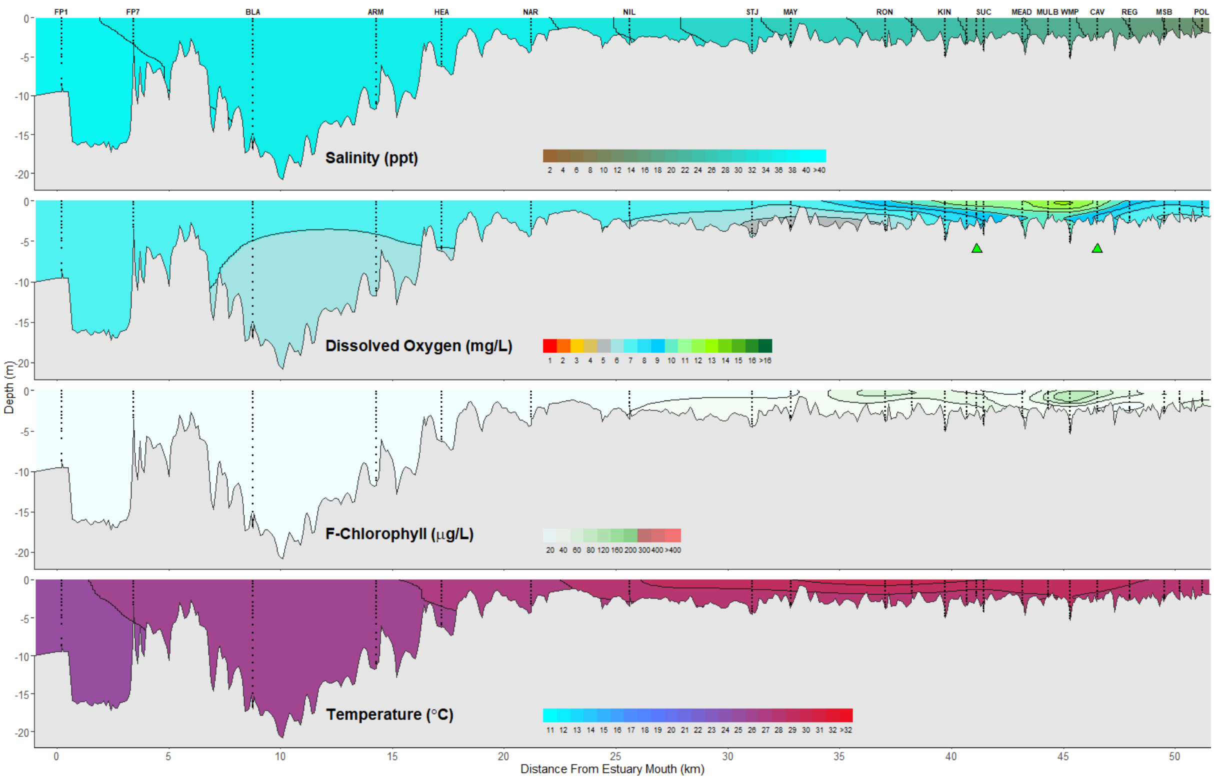
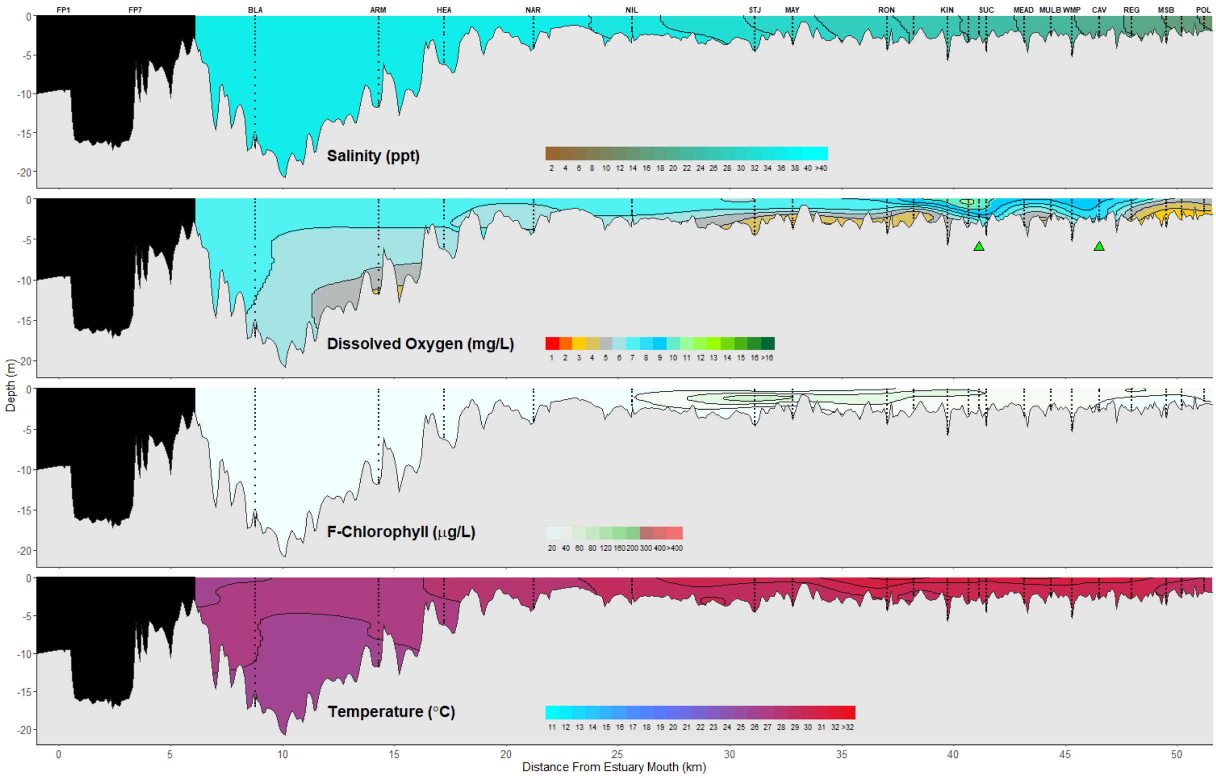


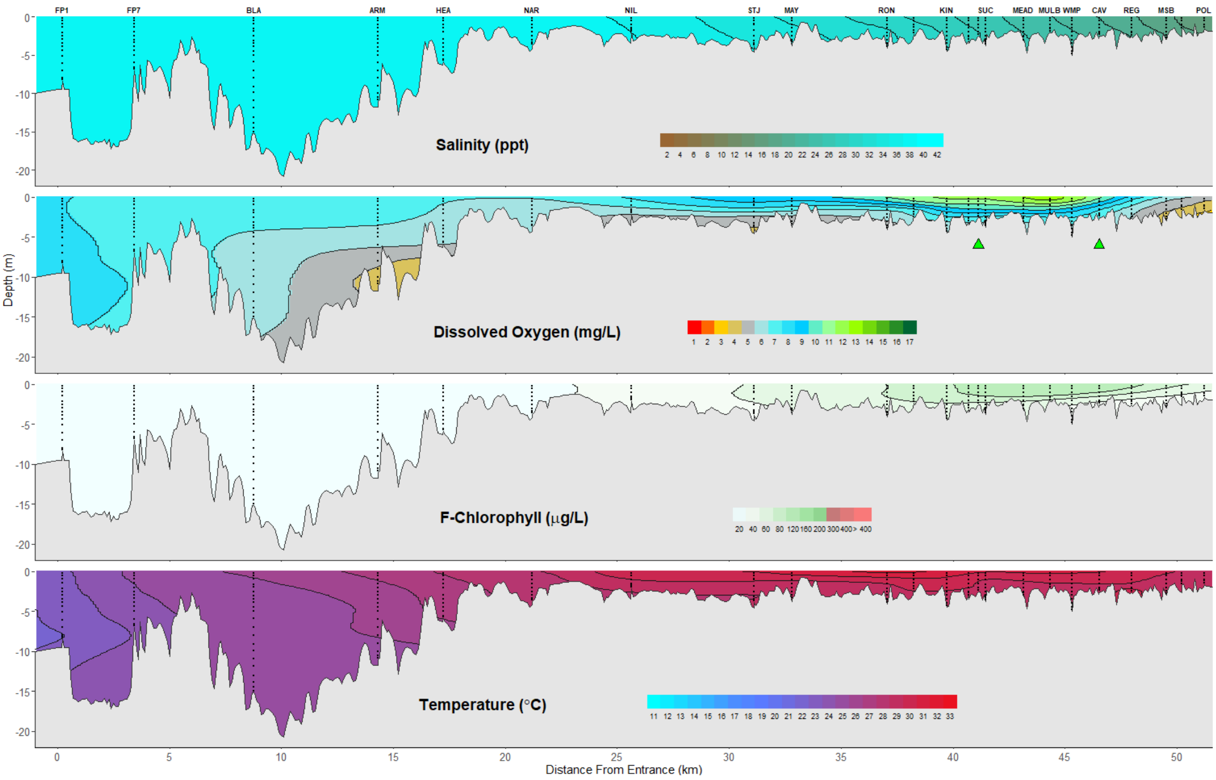
27 January 2025



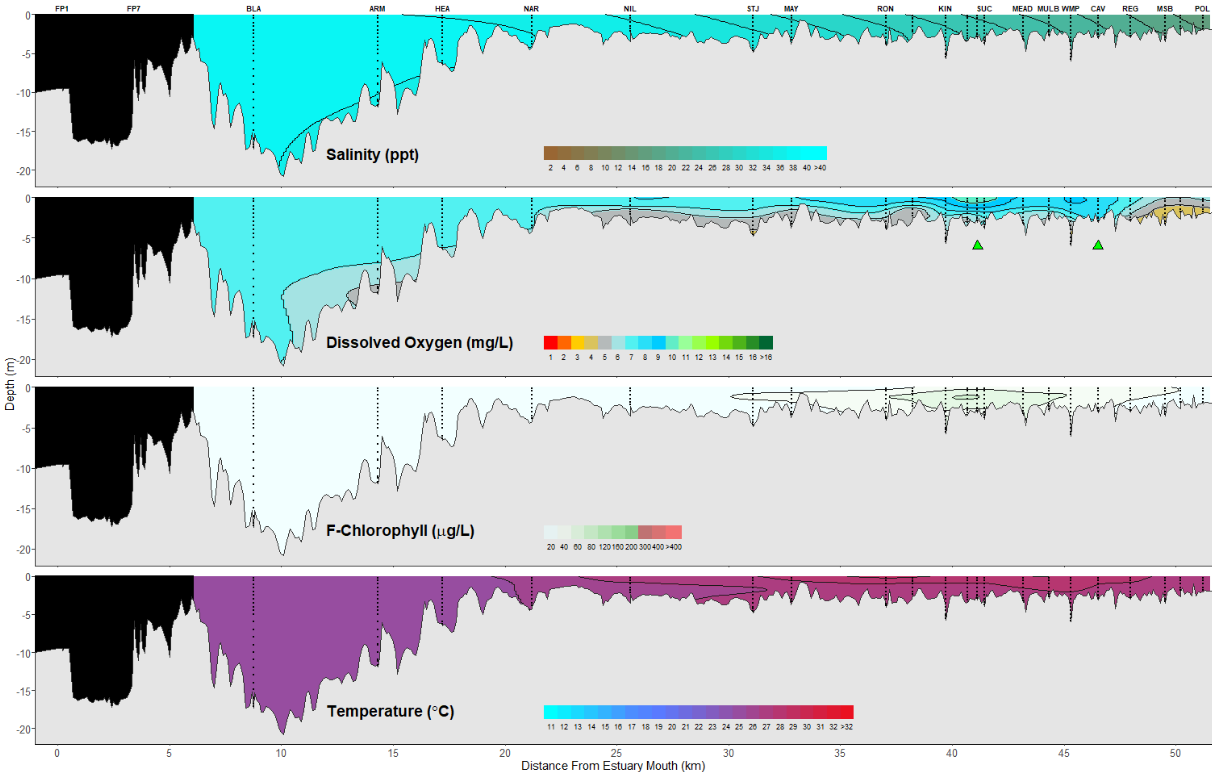
3 February 2025



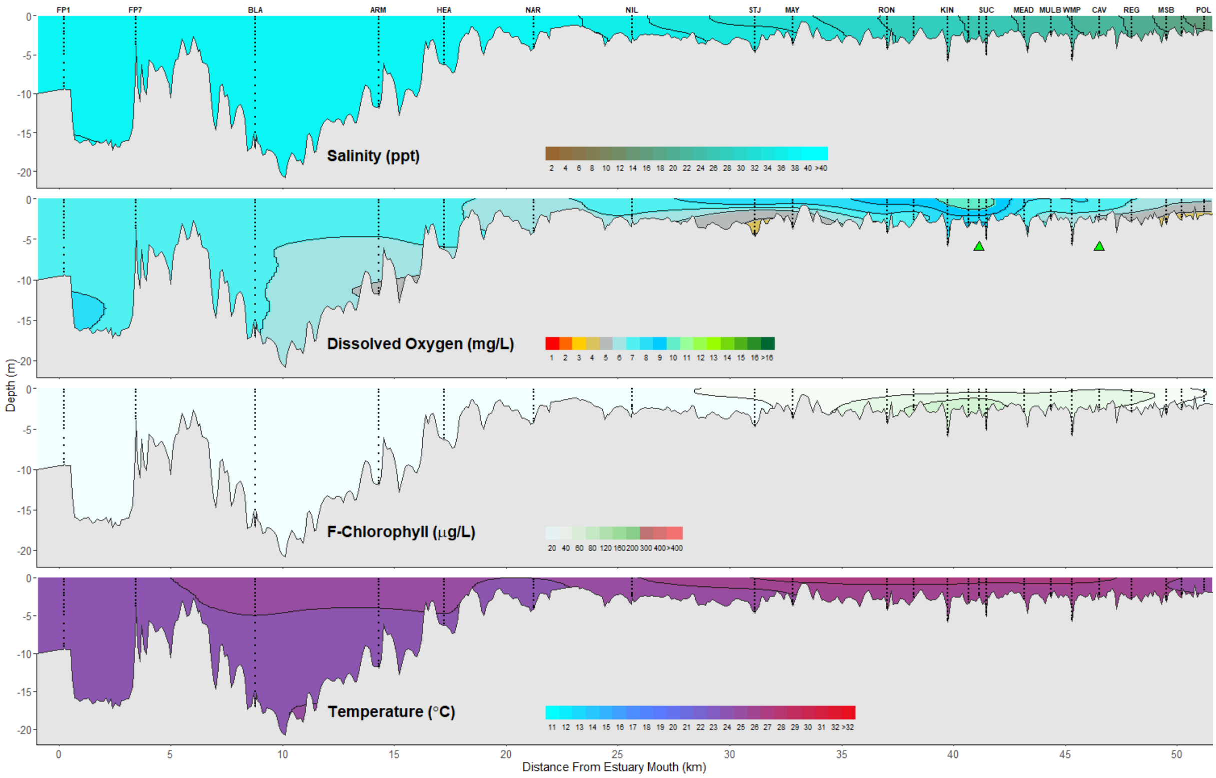
10 February 2025



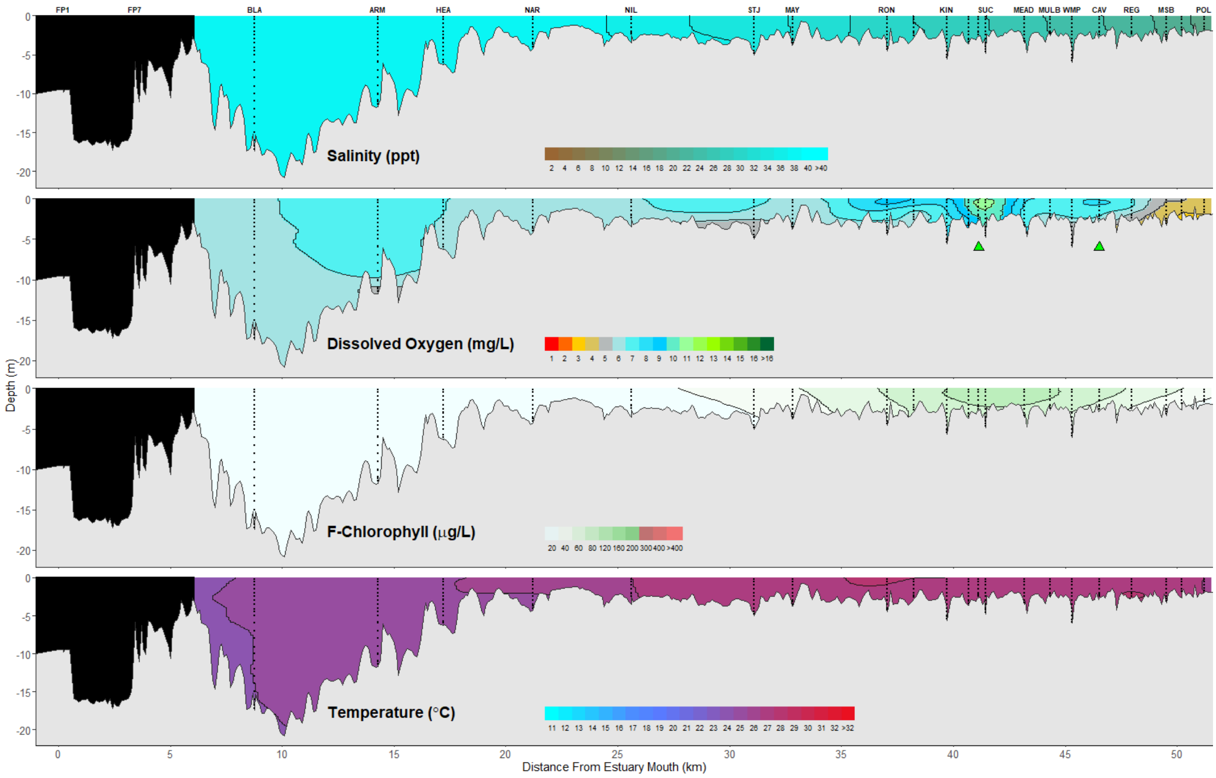
17 February 2025



24 February 2025



4 March 2025



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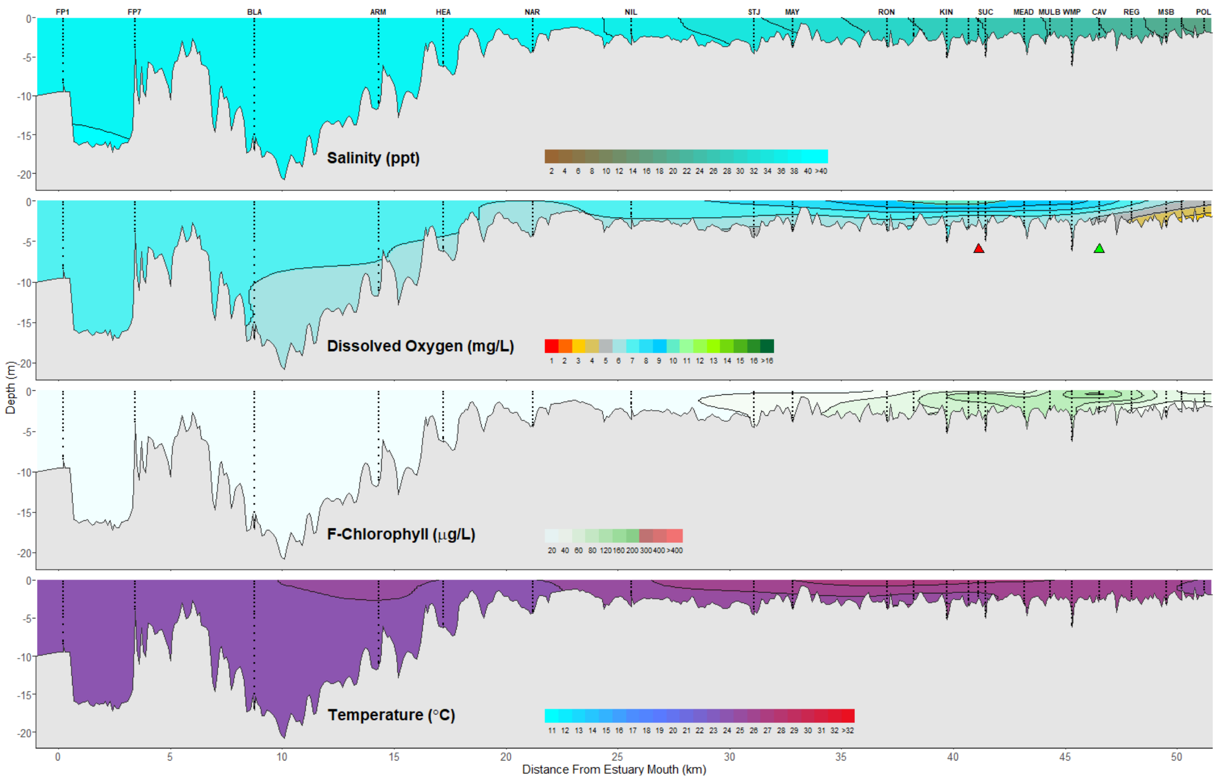

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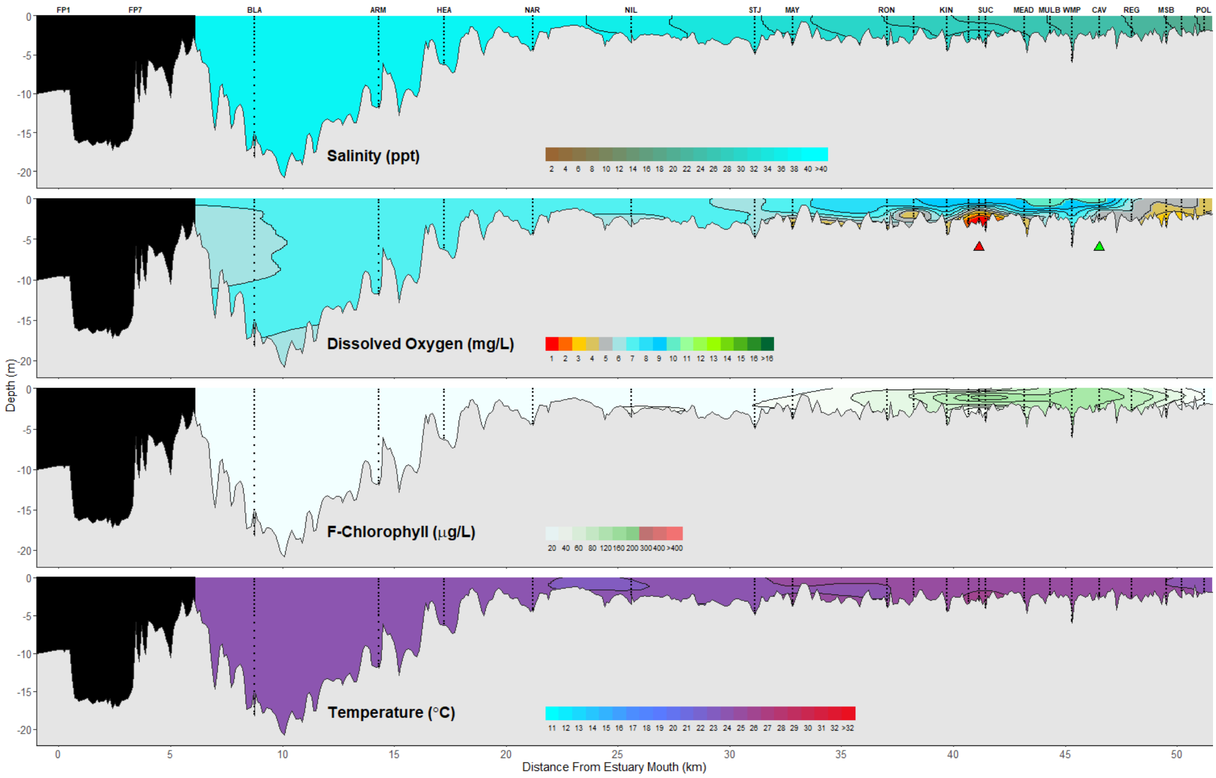
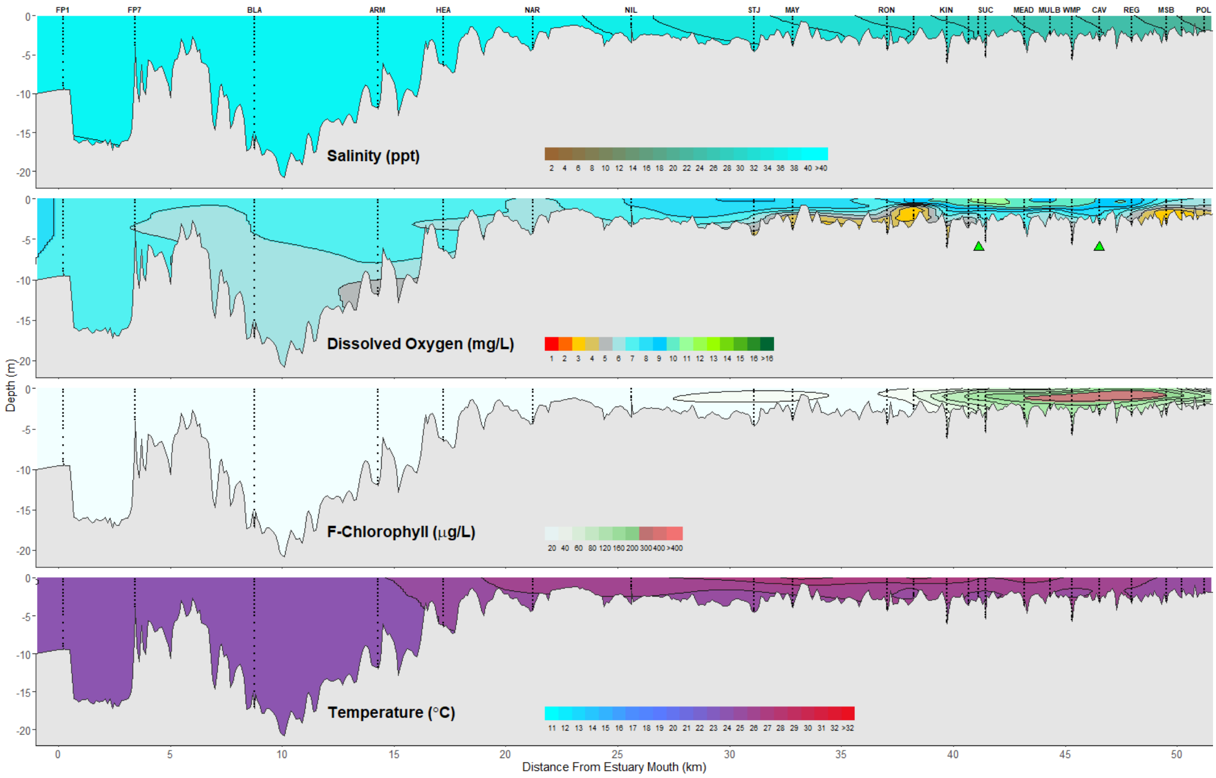
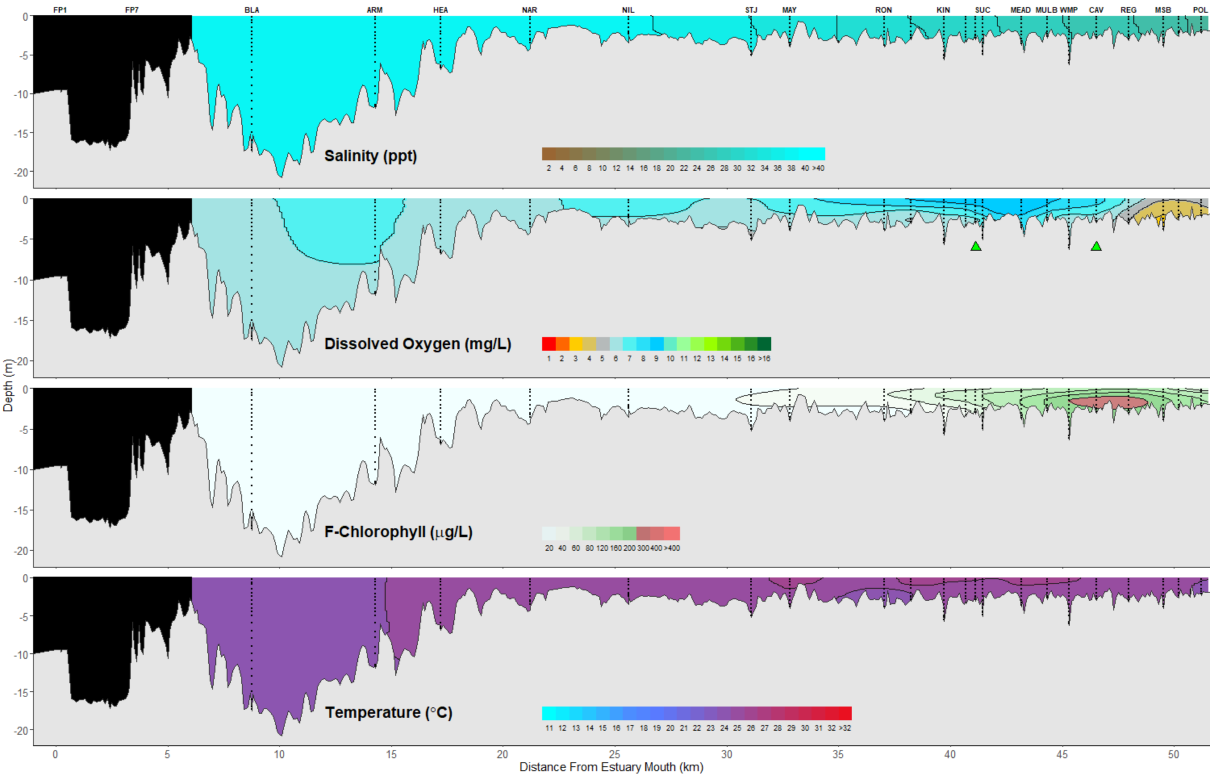


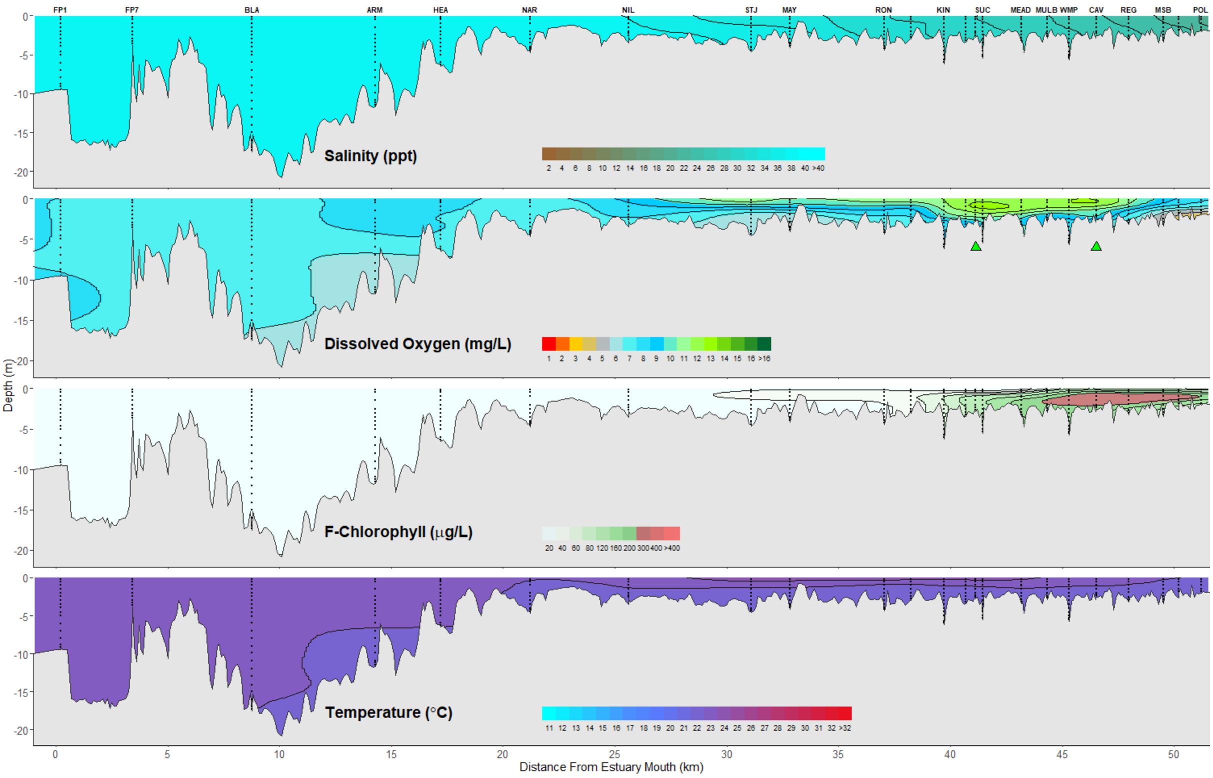
24 March 2025



31 March 2025



7 April 2025



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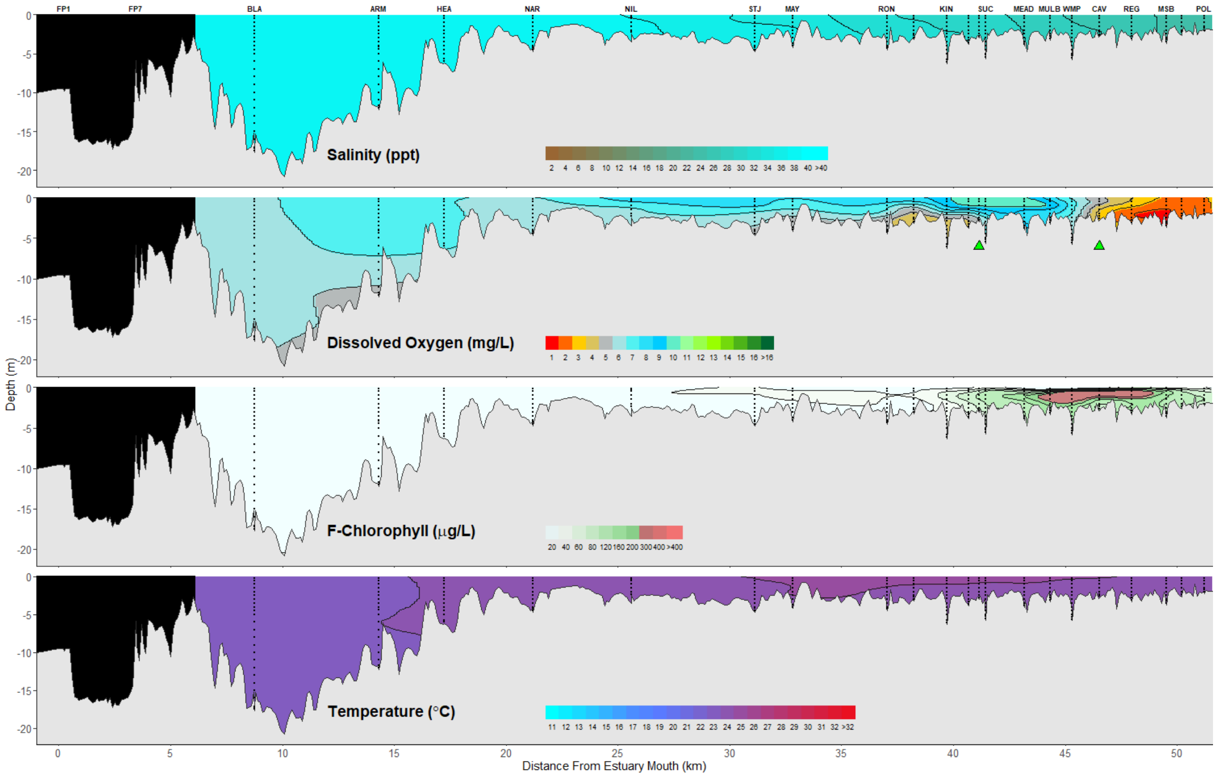

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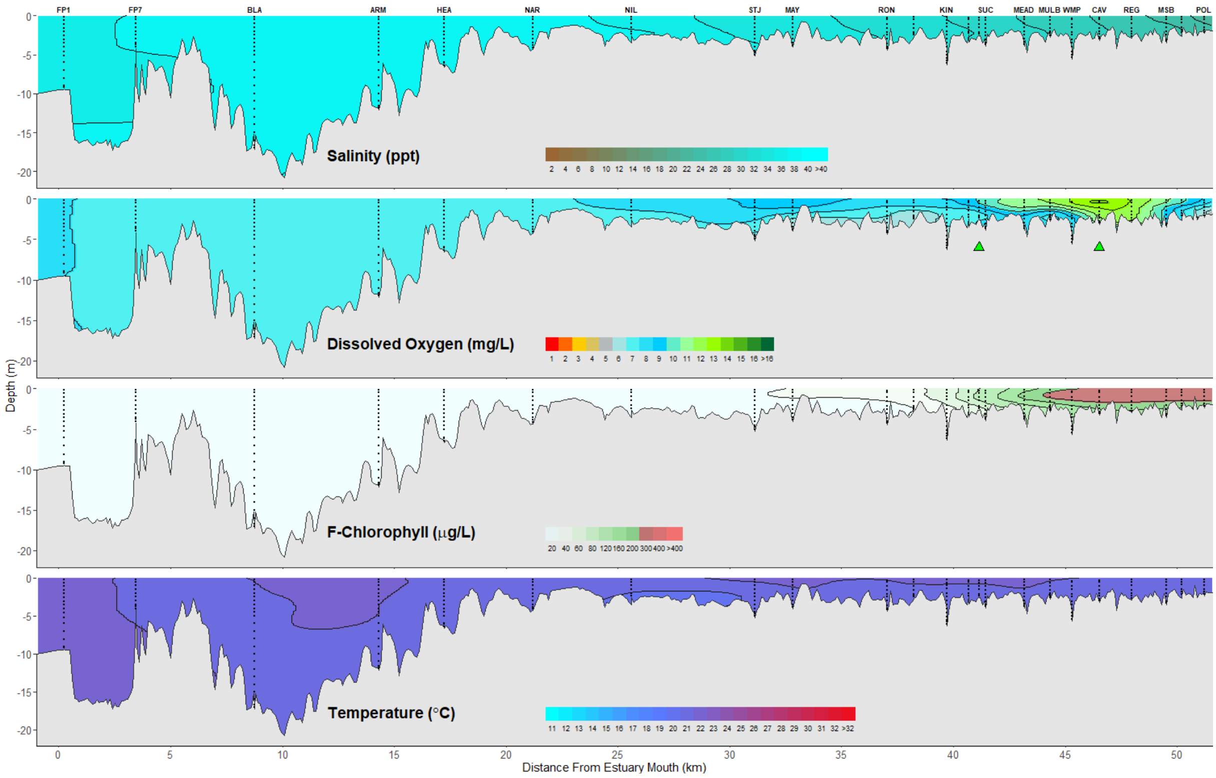

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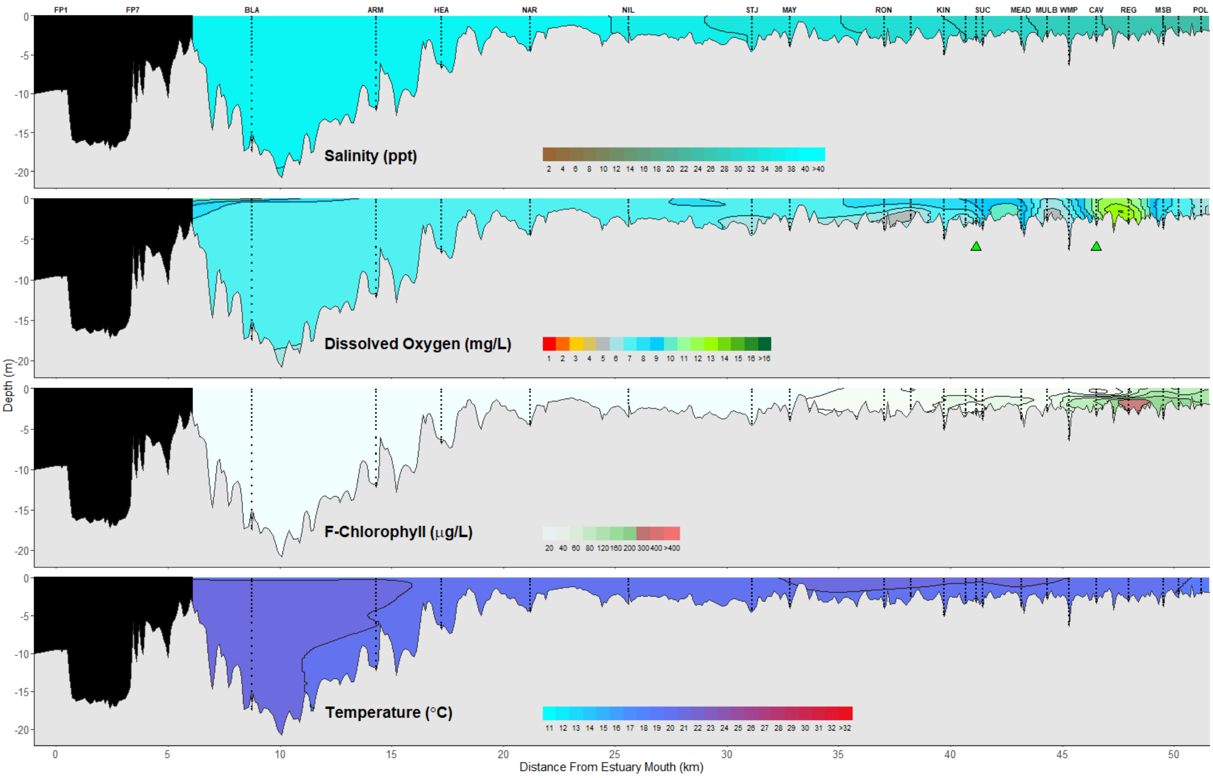

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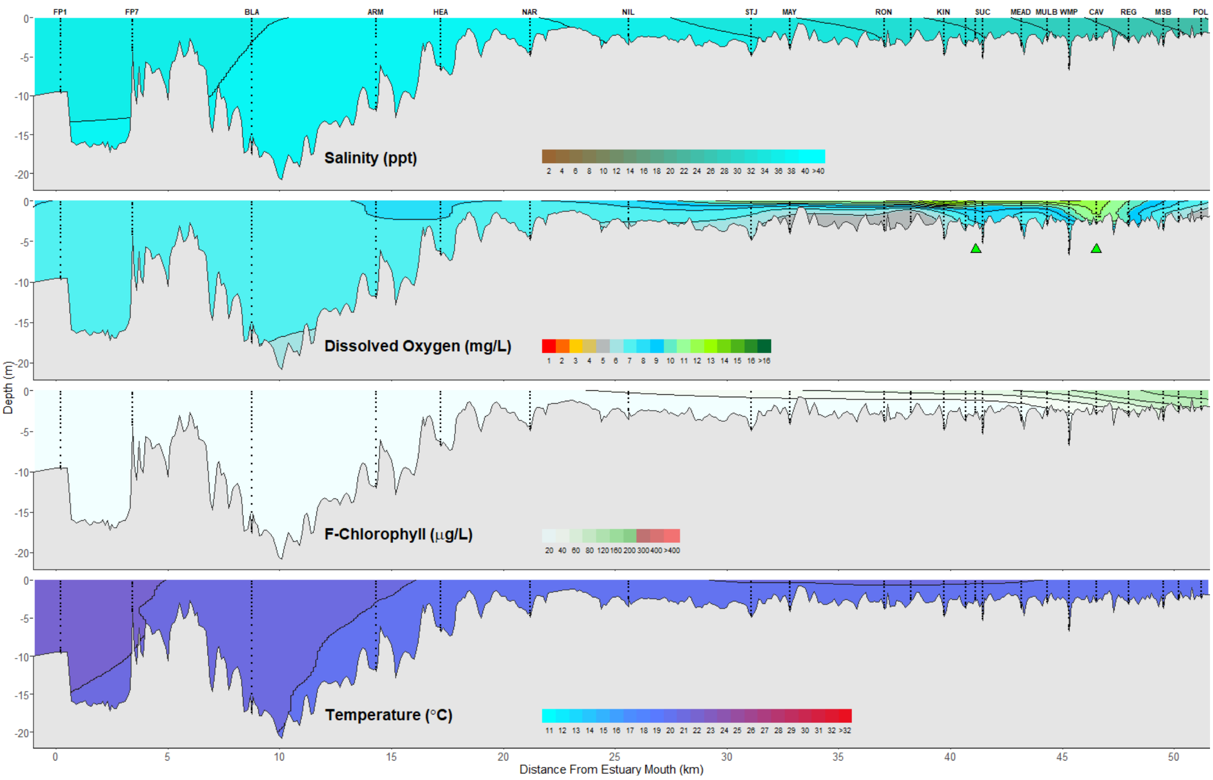

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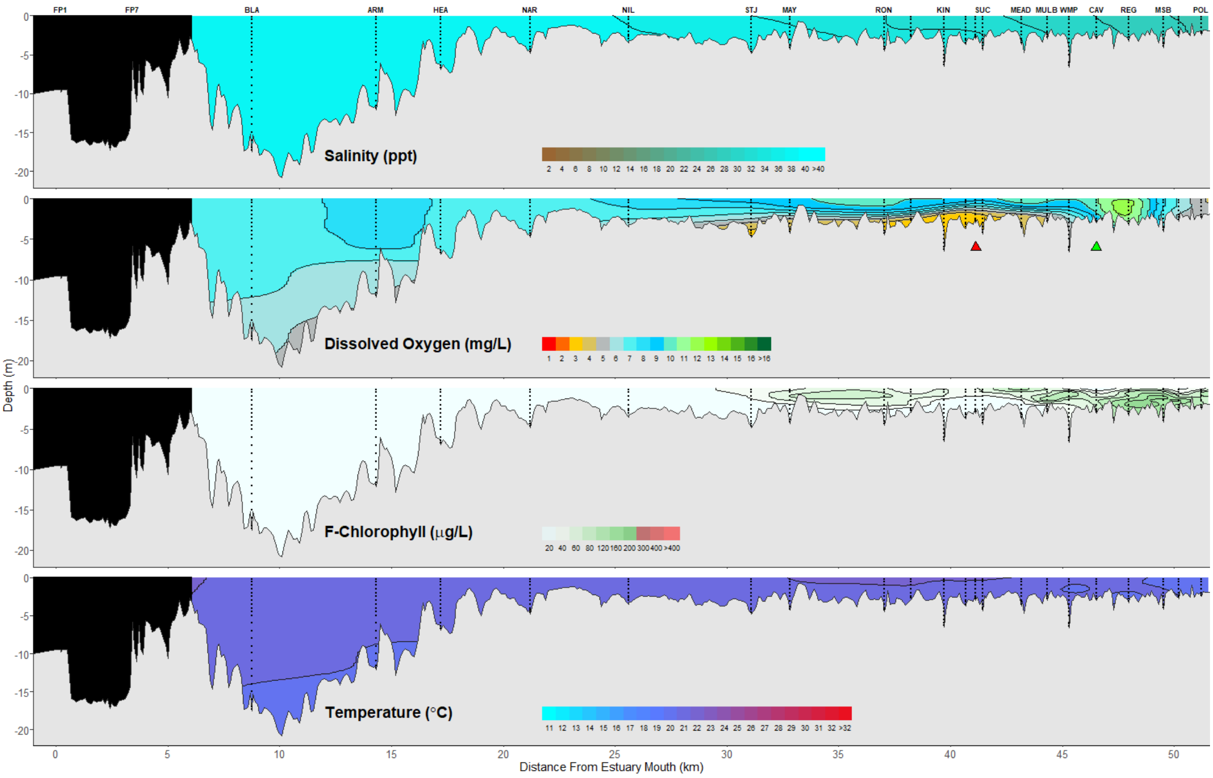

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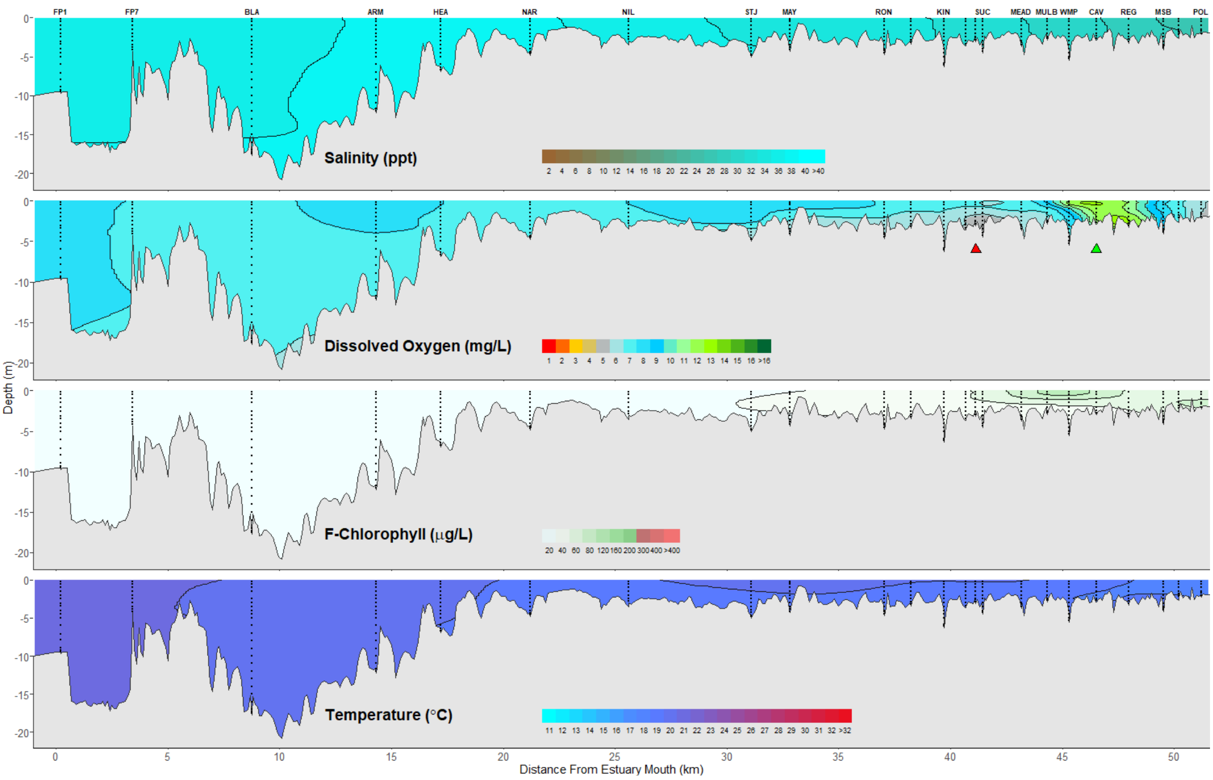

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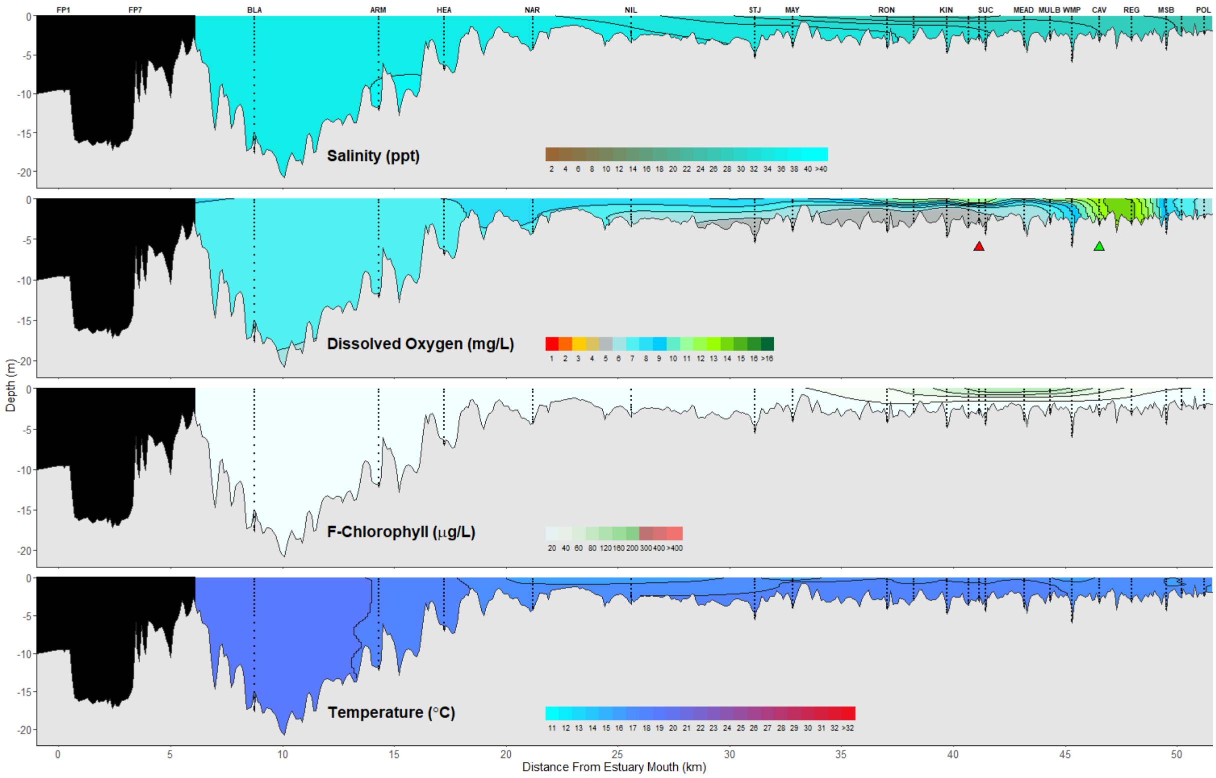
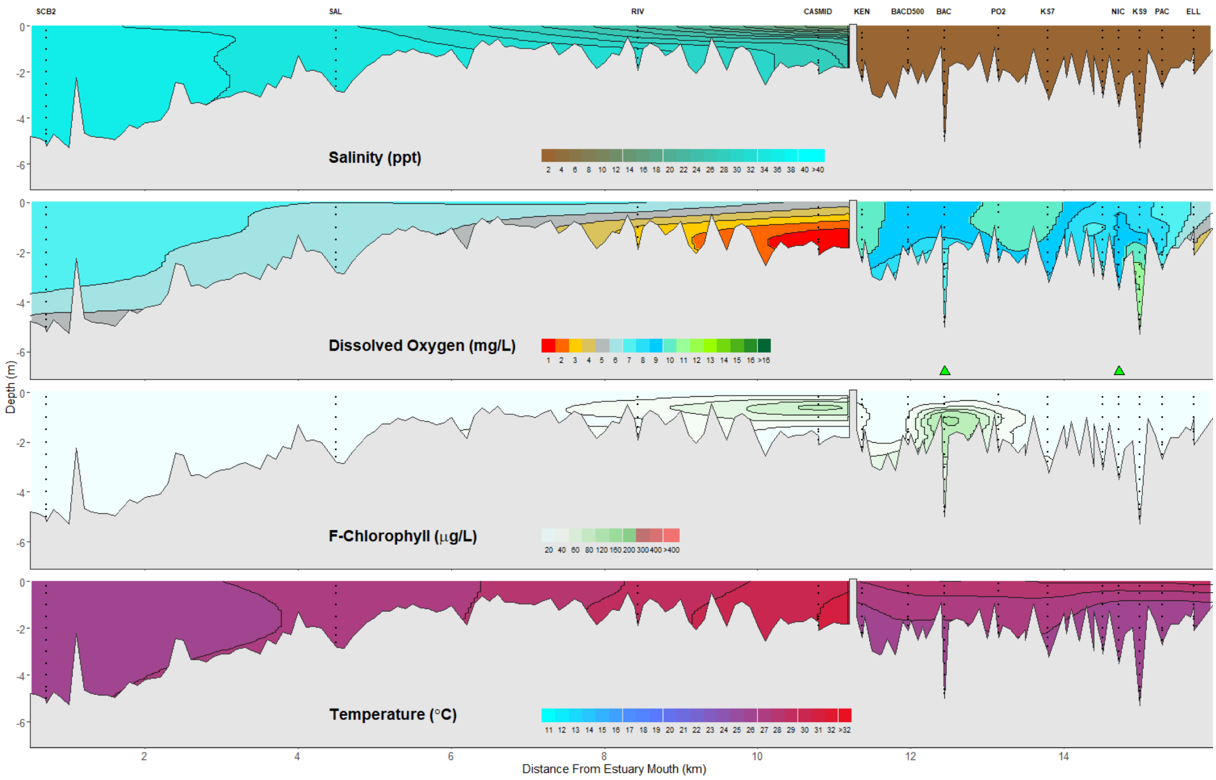


CE zone in summer through autumn 2025

7 January 2025



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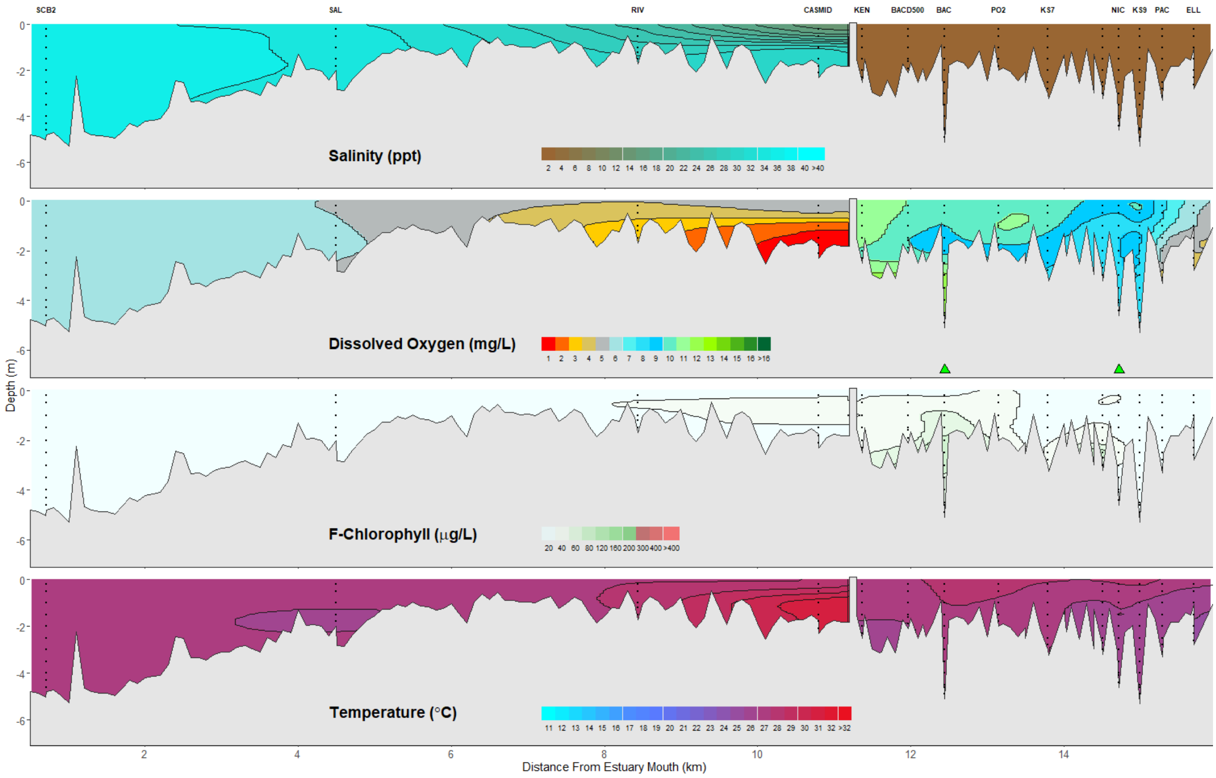

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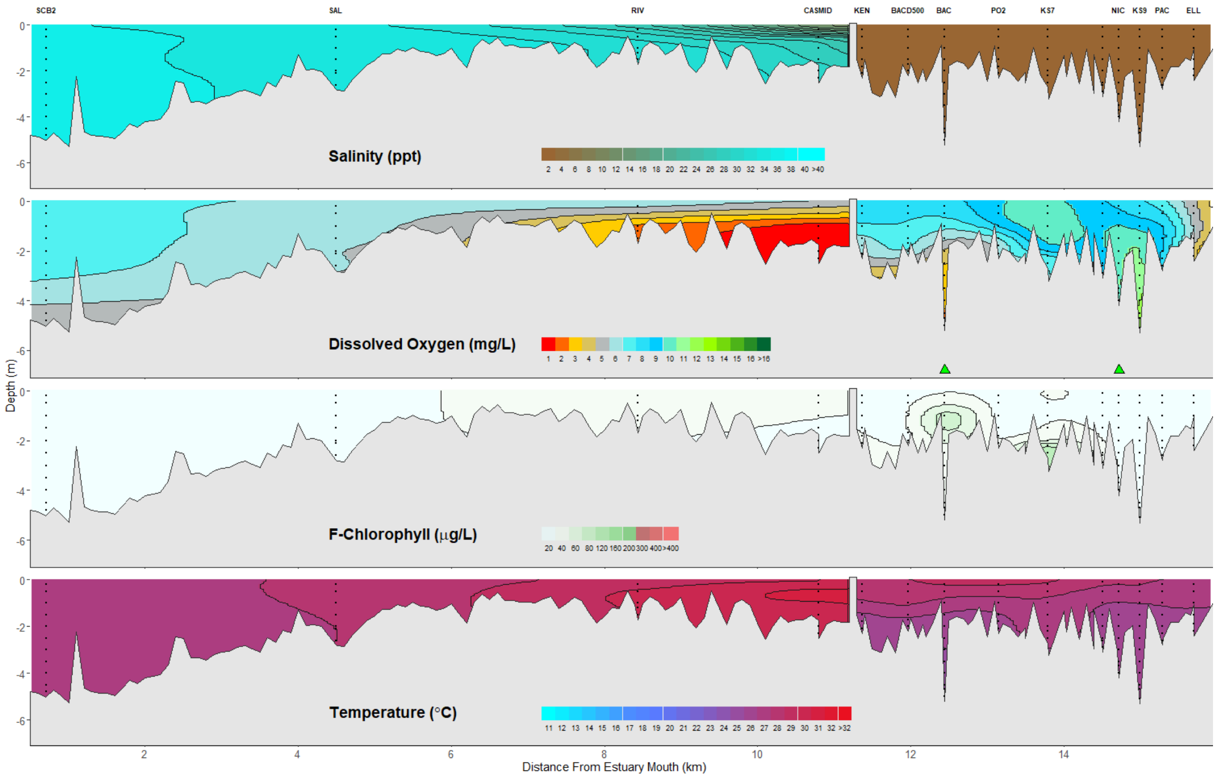

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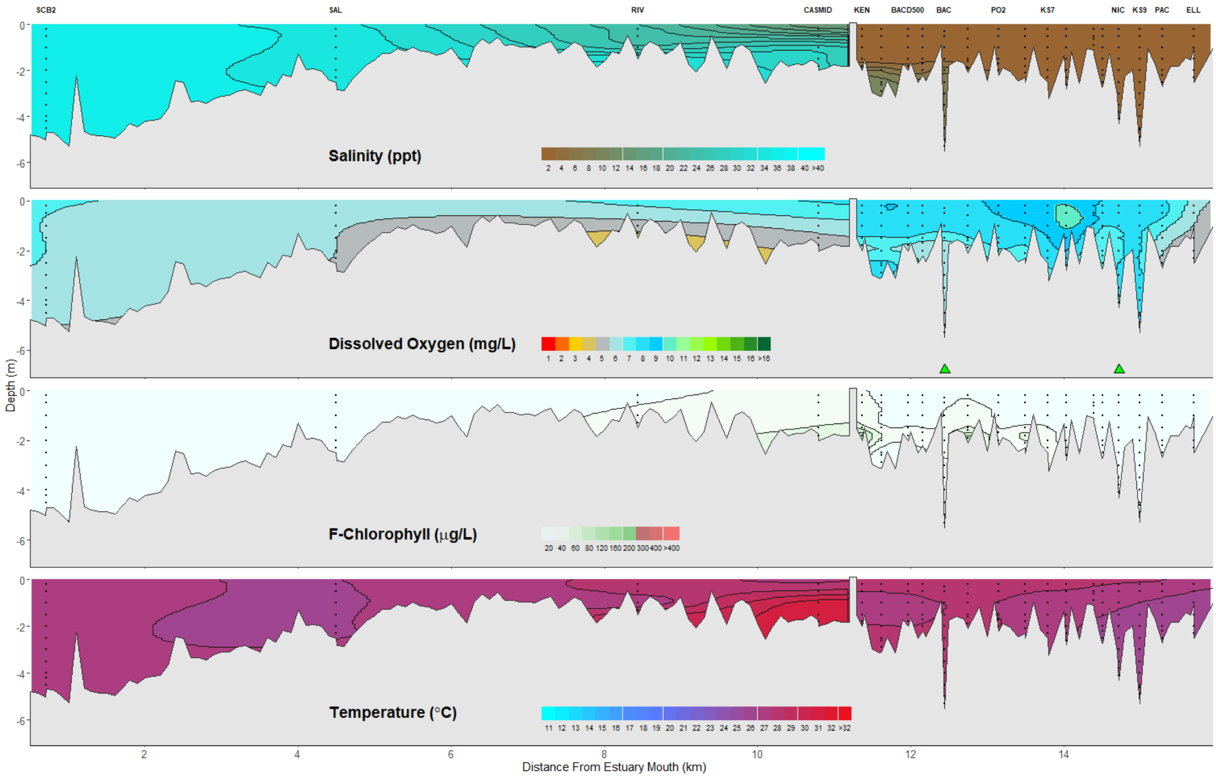

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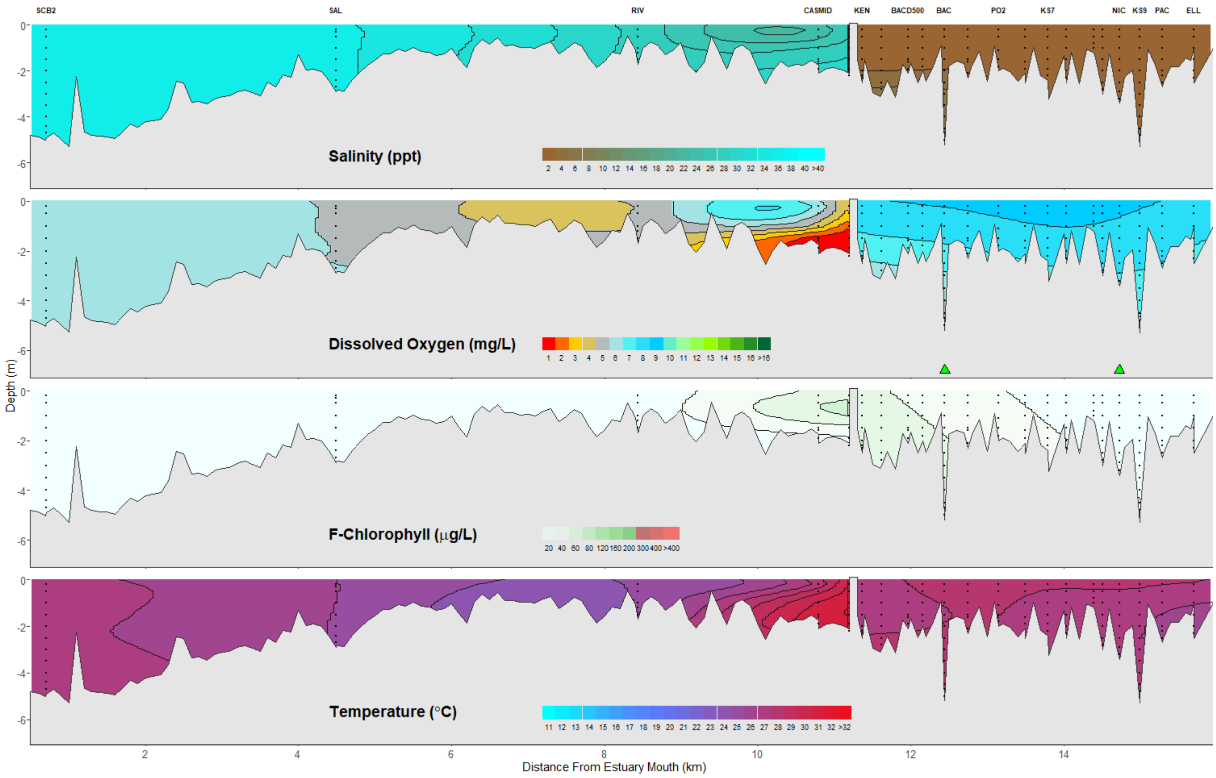

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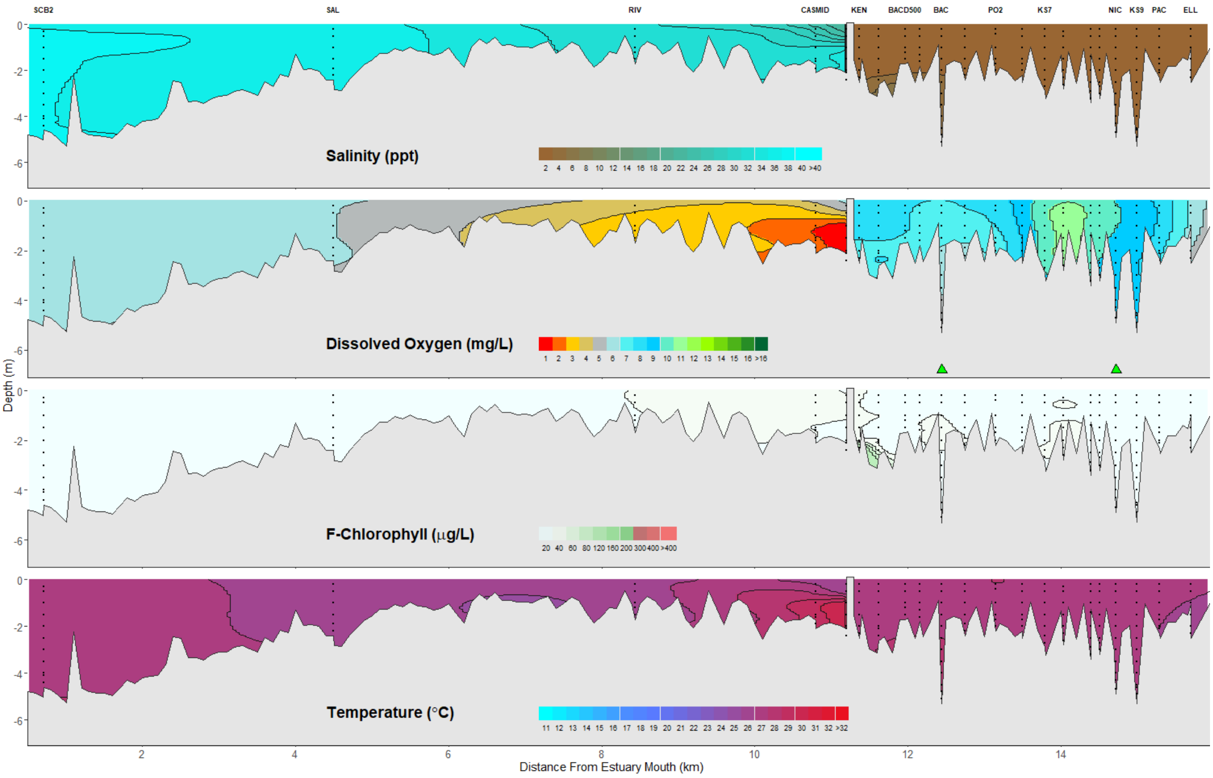

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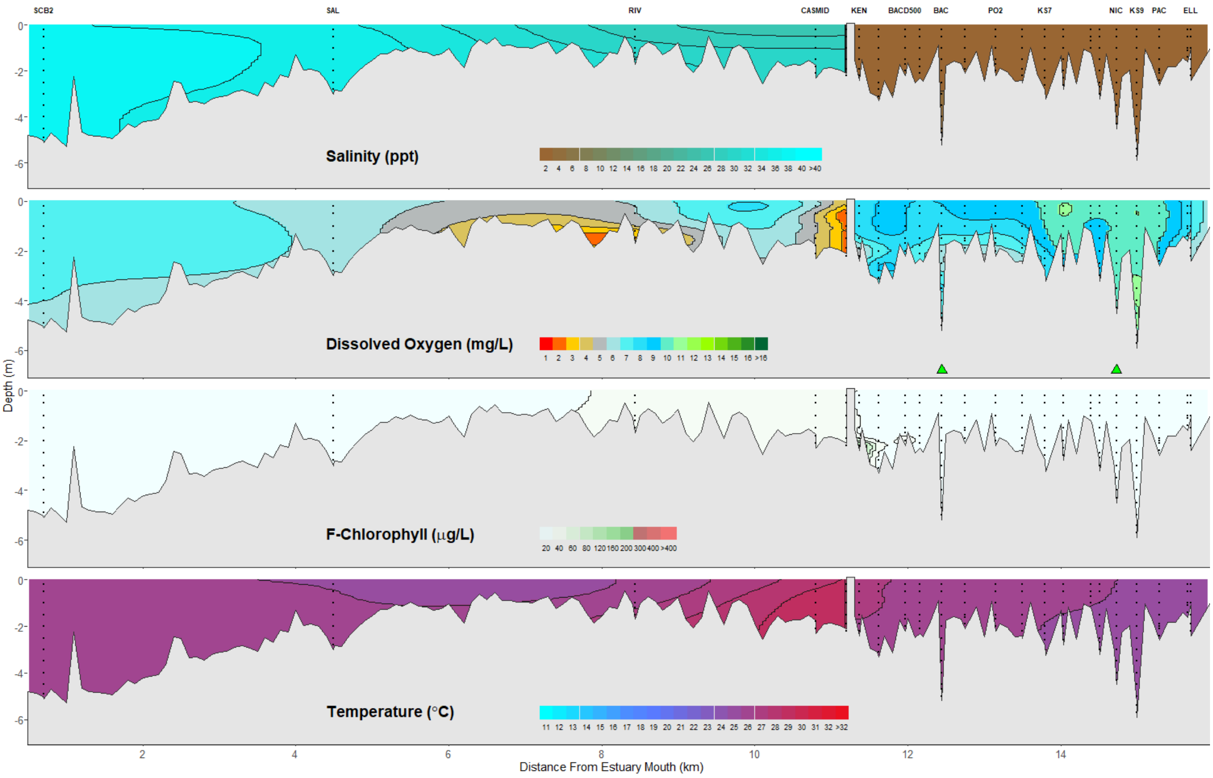

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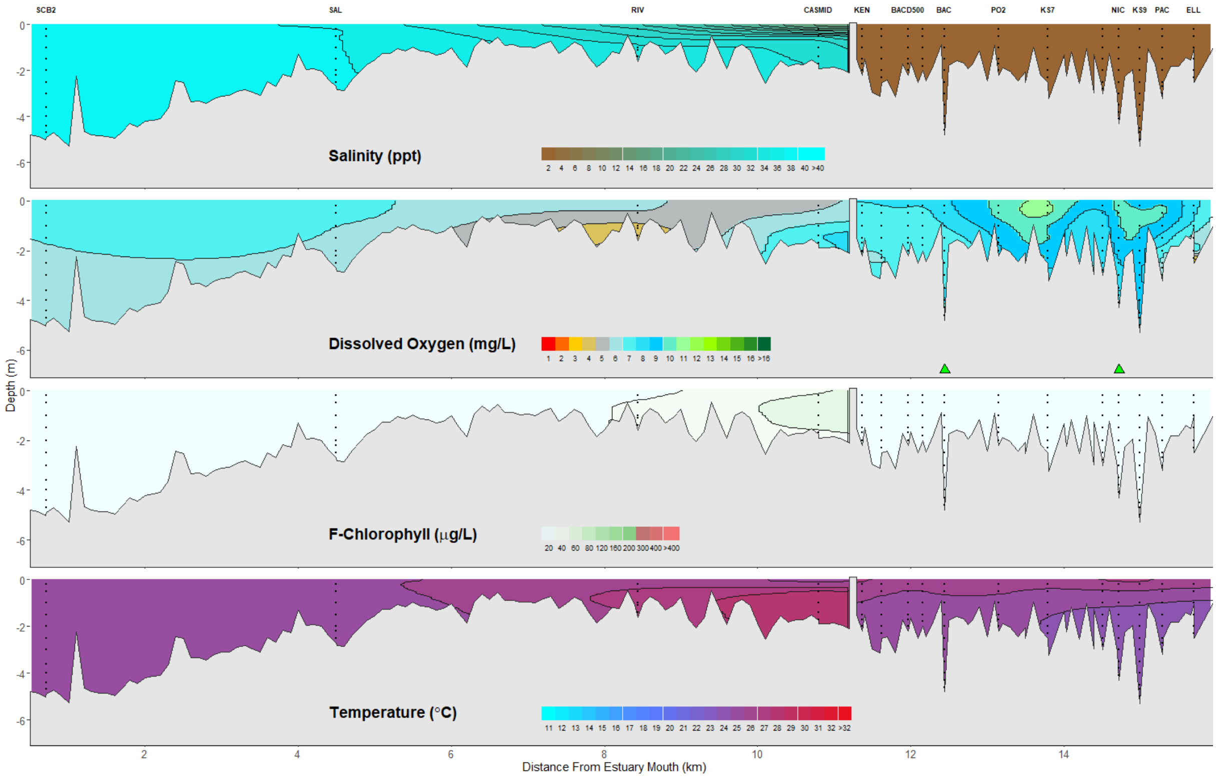

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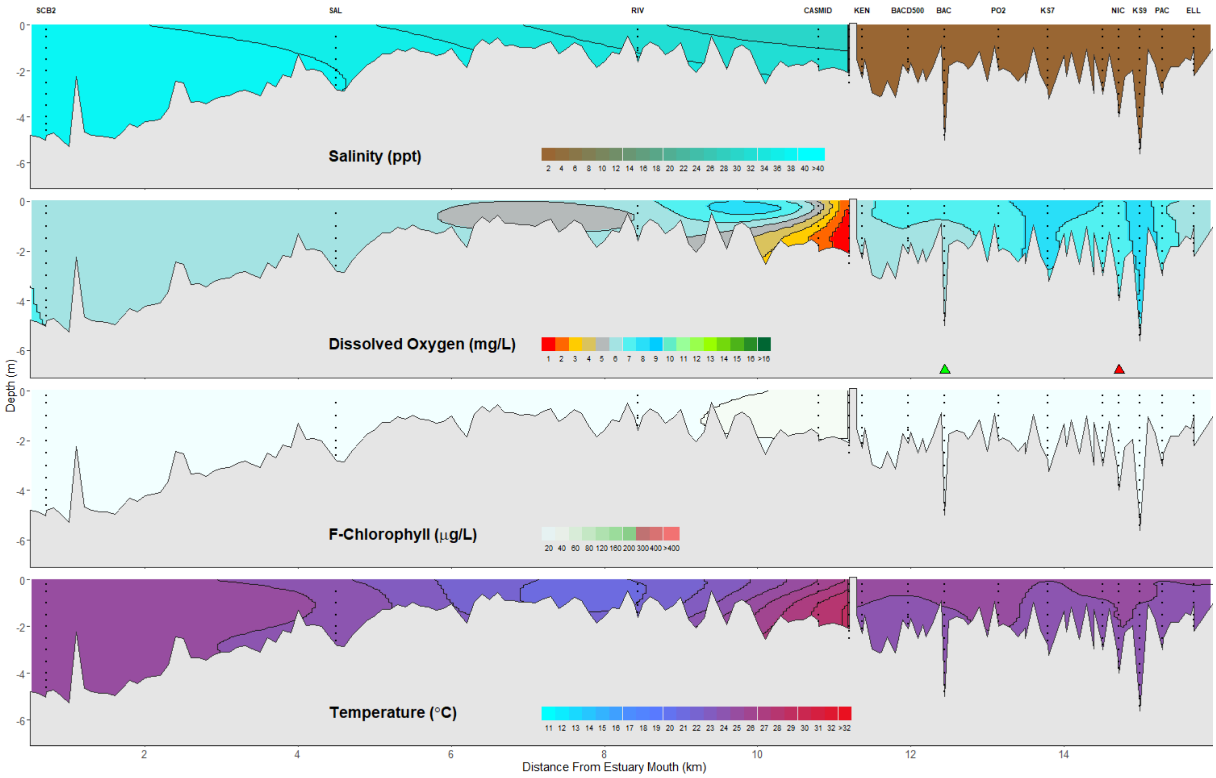

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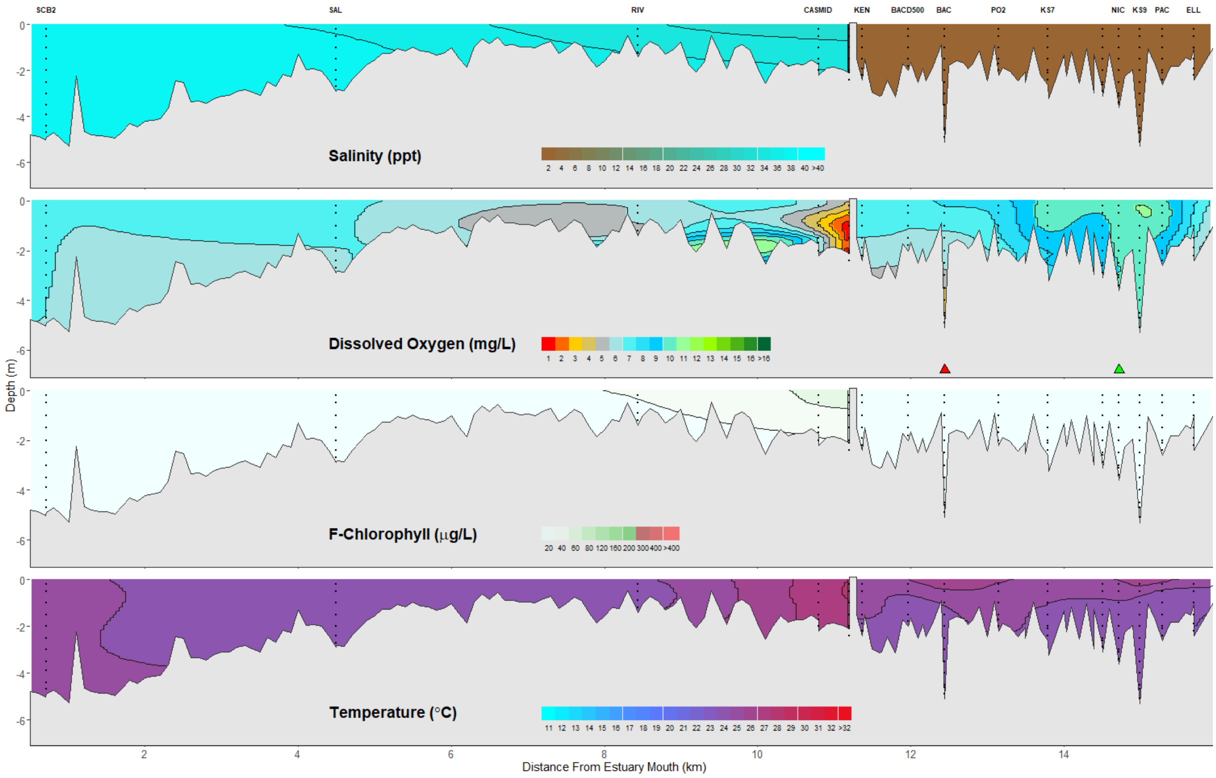

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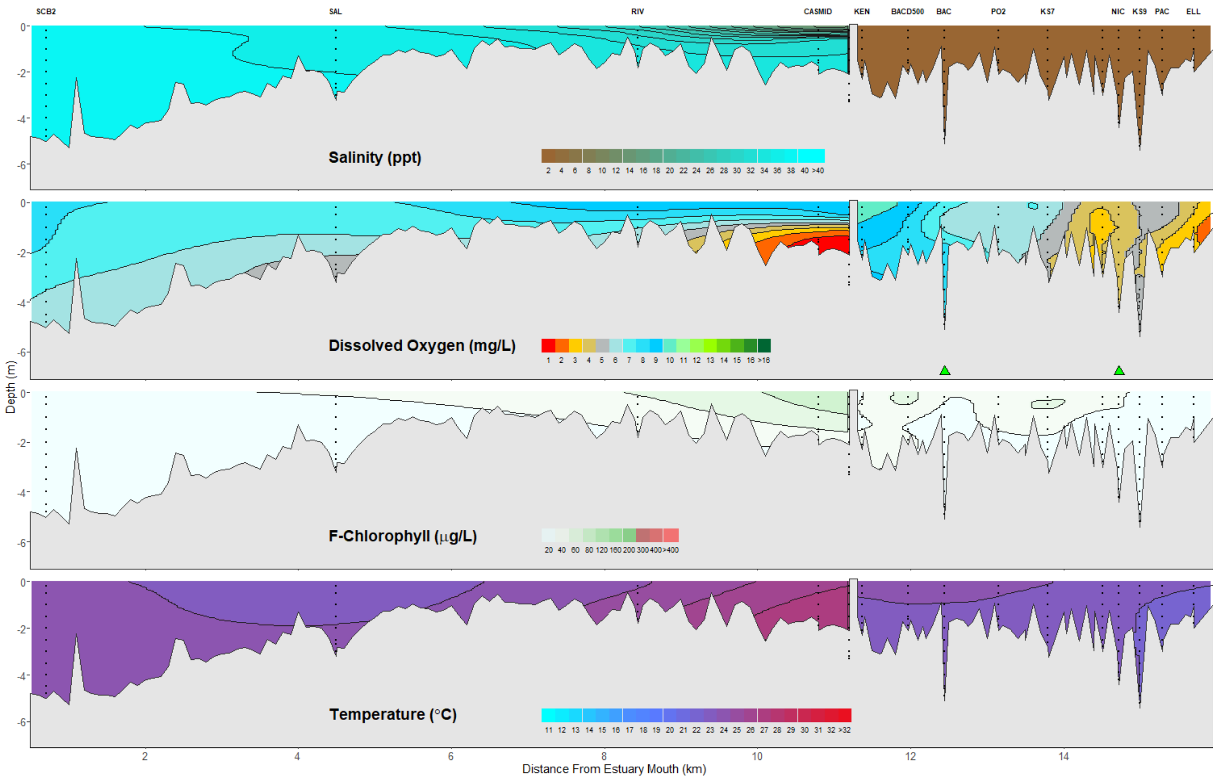

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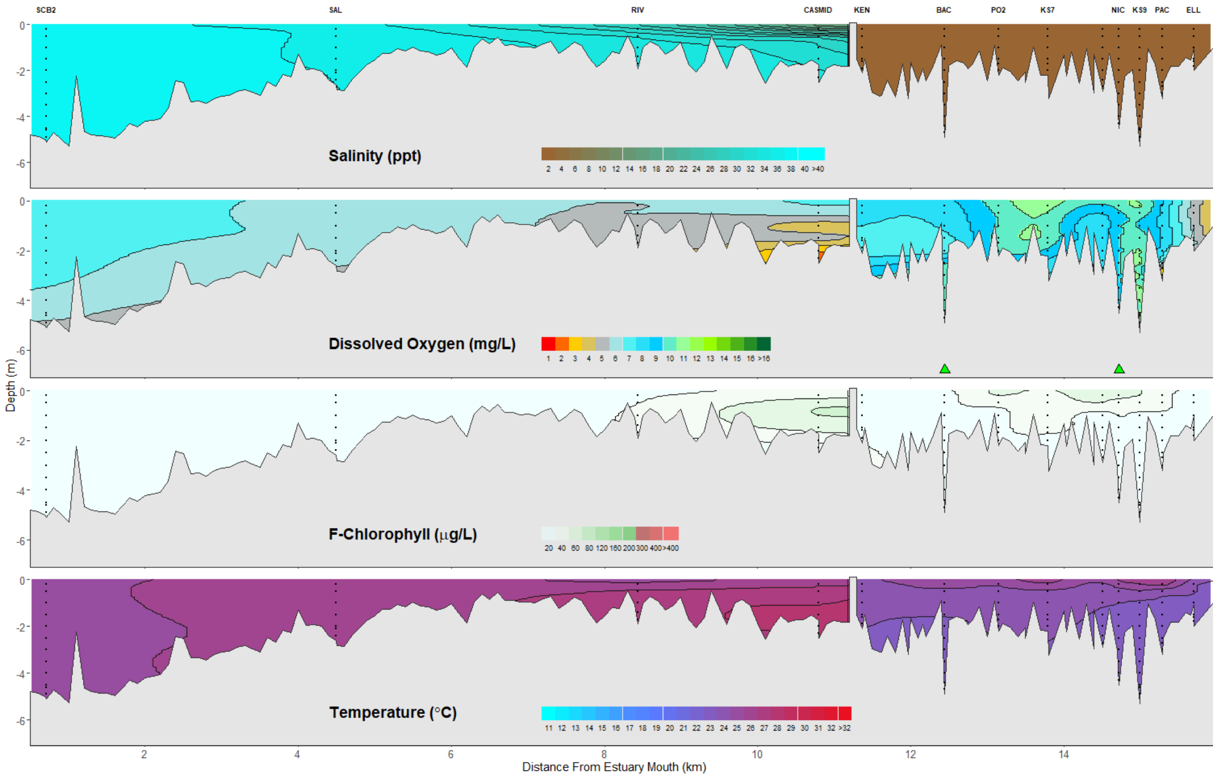
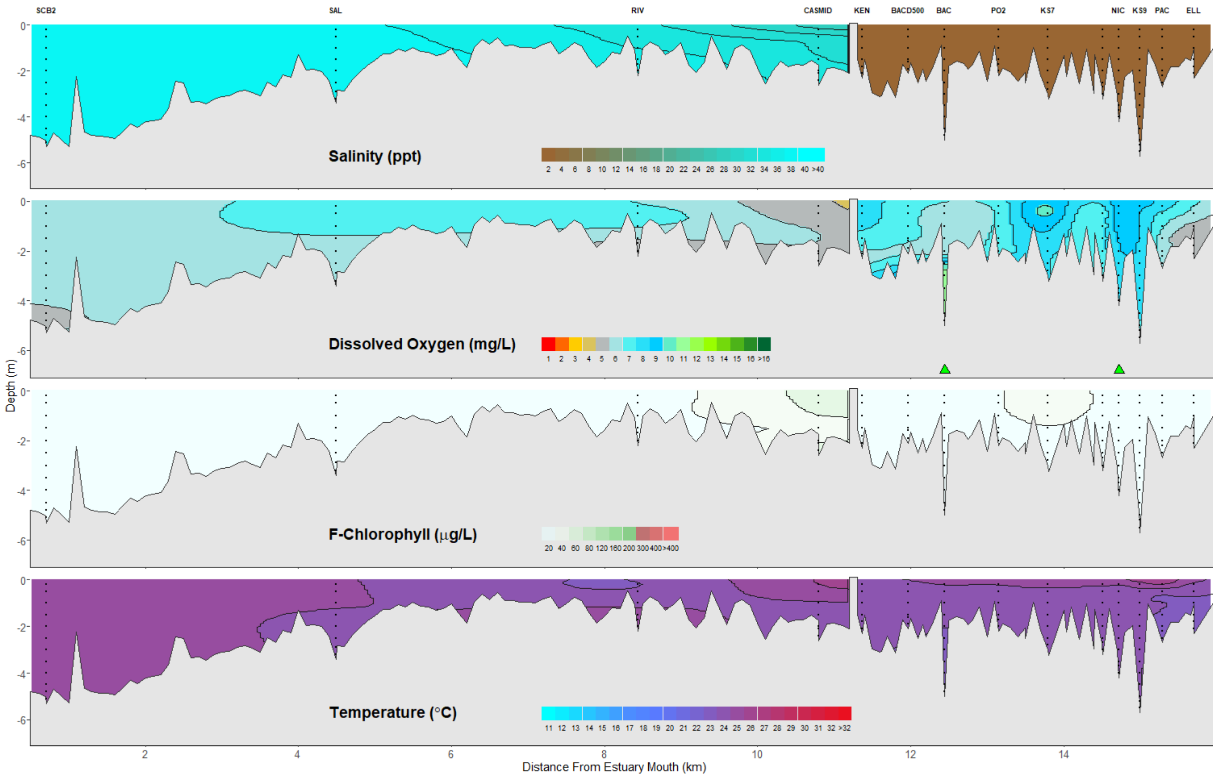
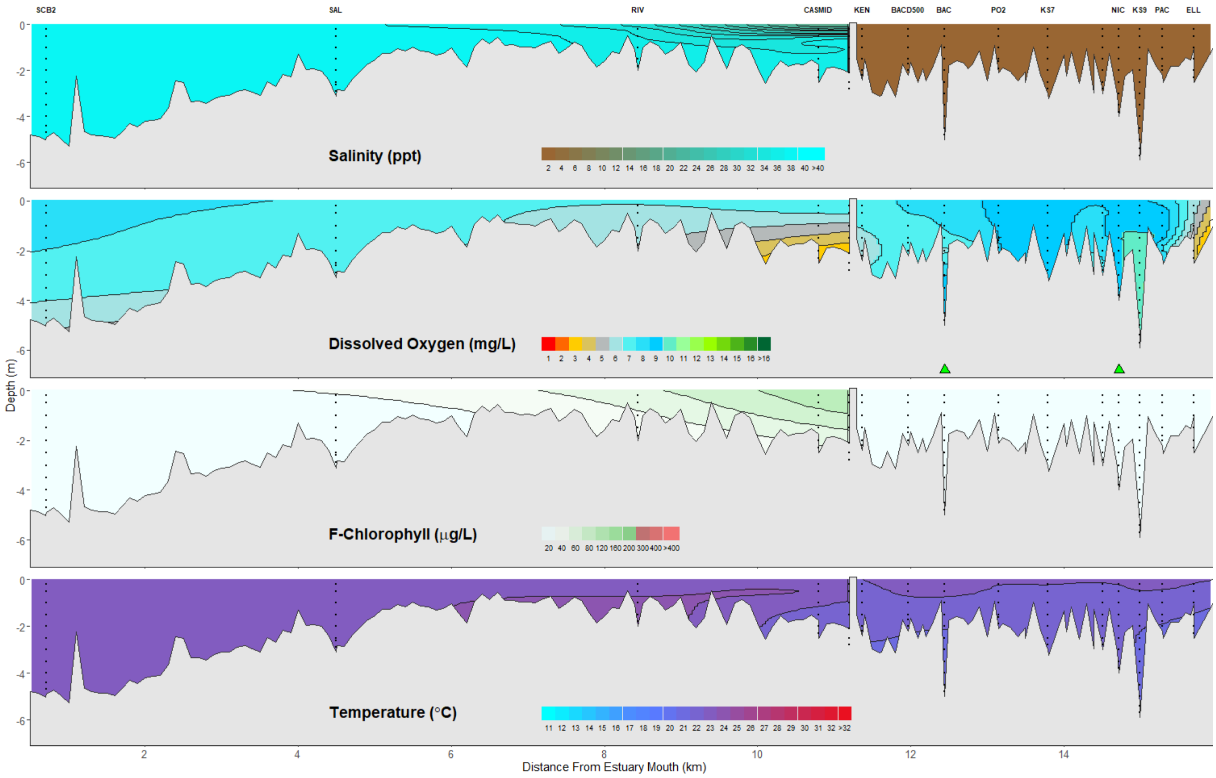


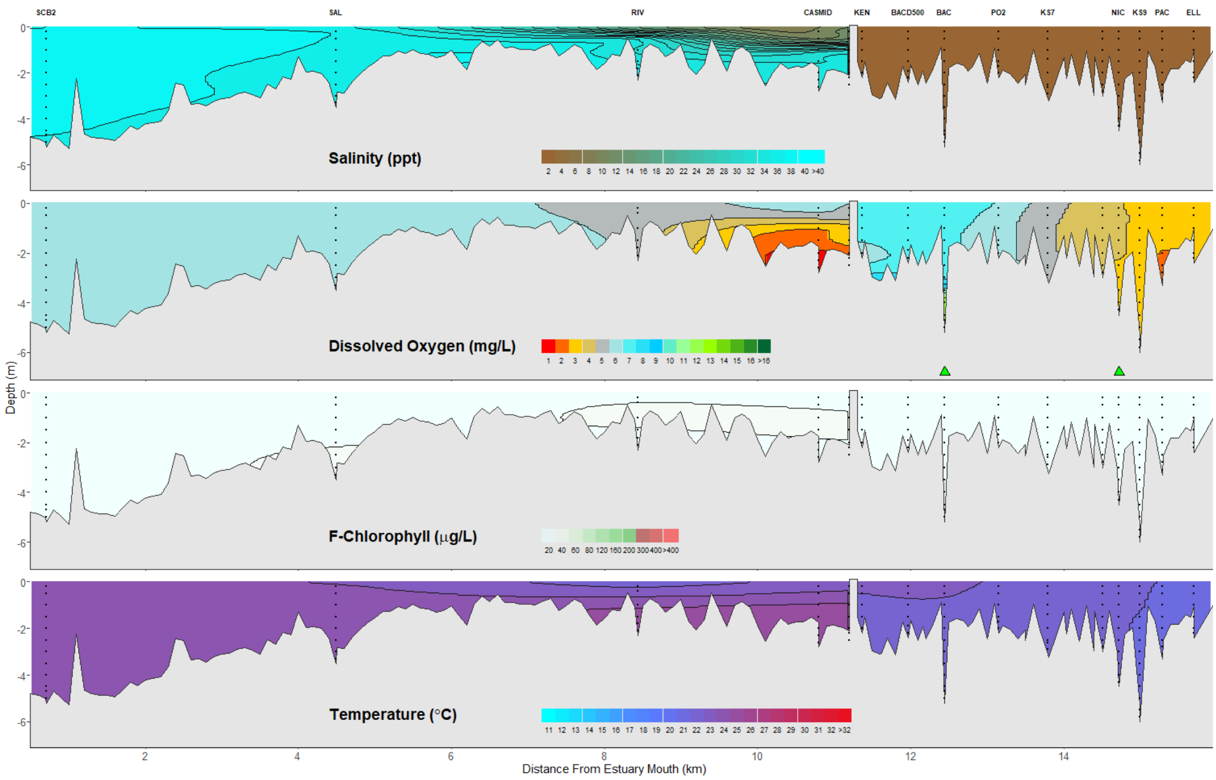
1 April 2025



8 April 2025



15 April 2025



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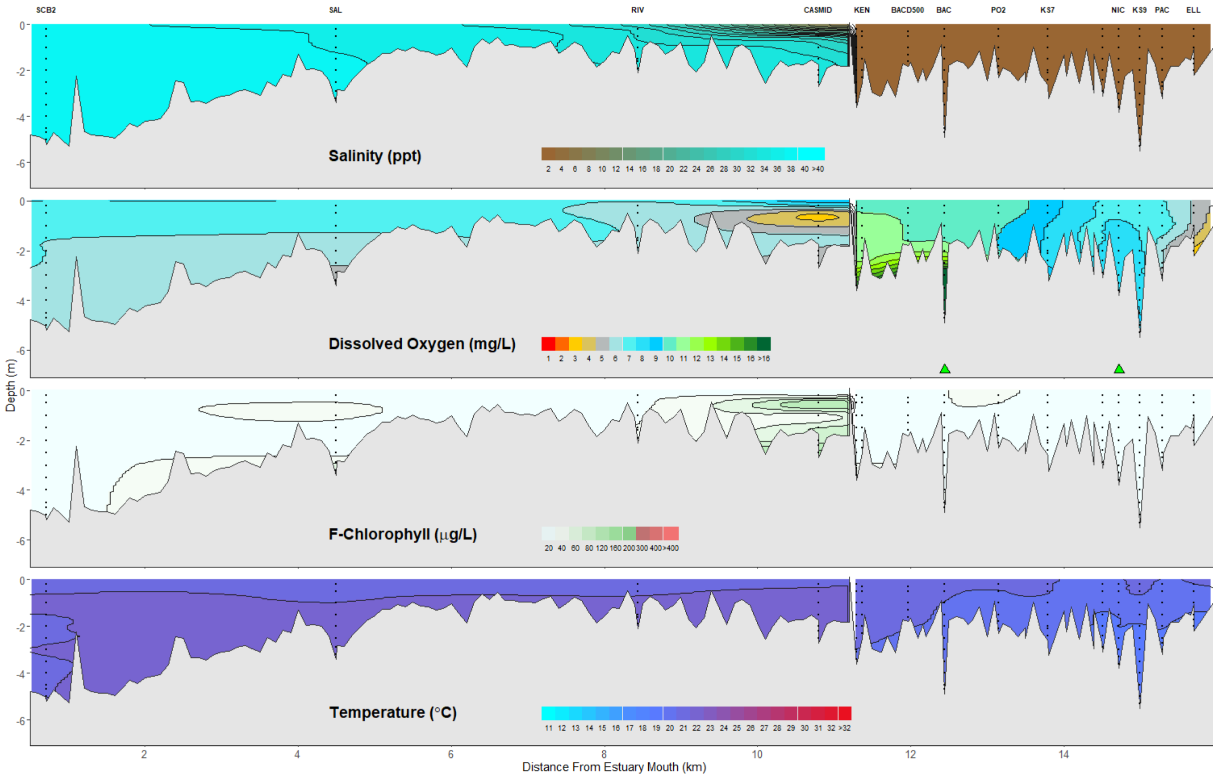

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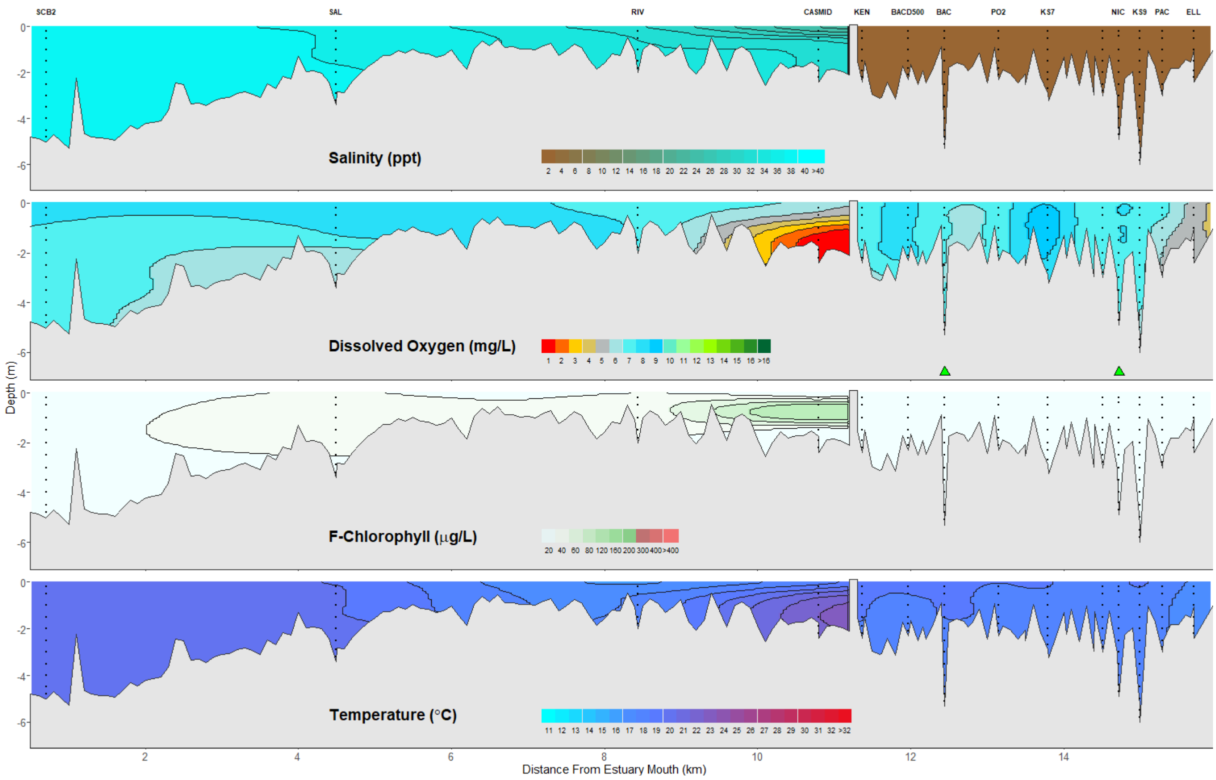
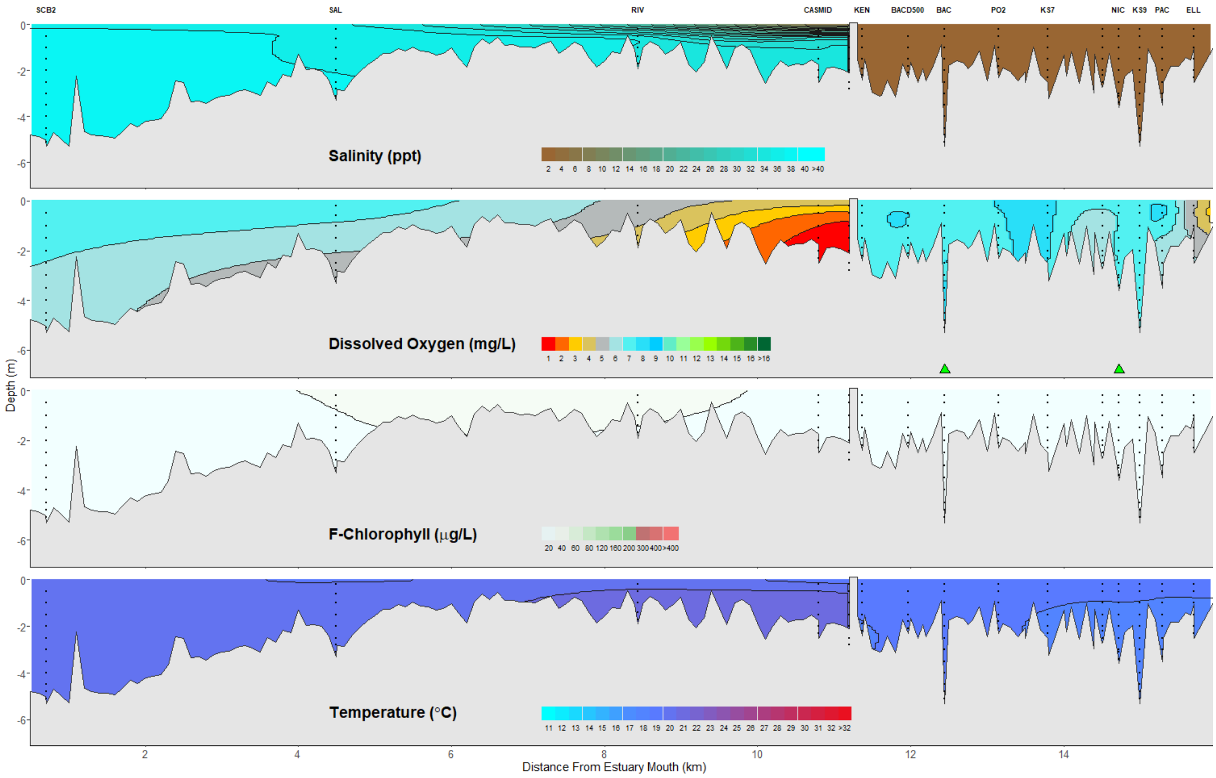
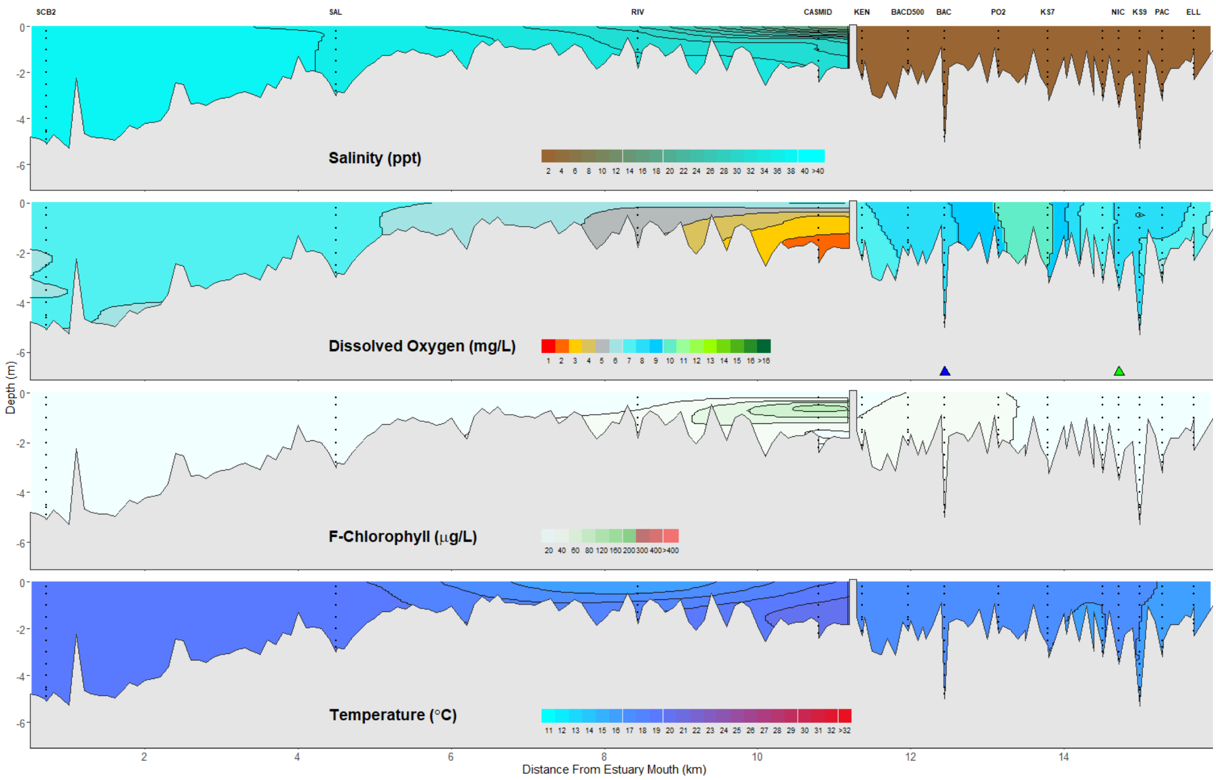


6 May 2025



13 May 2025



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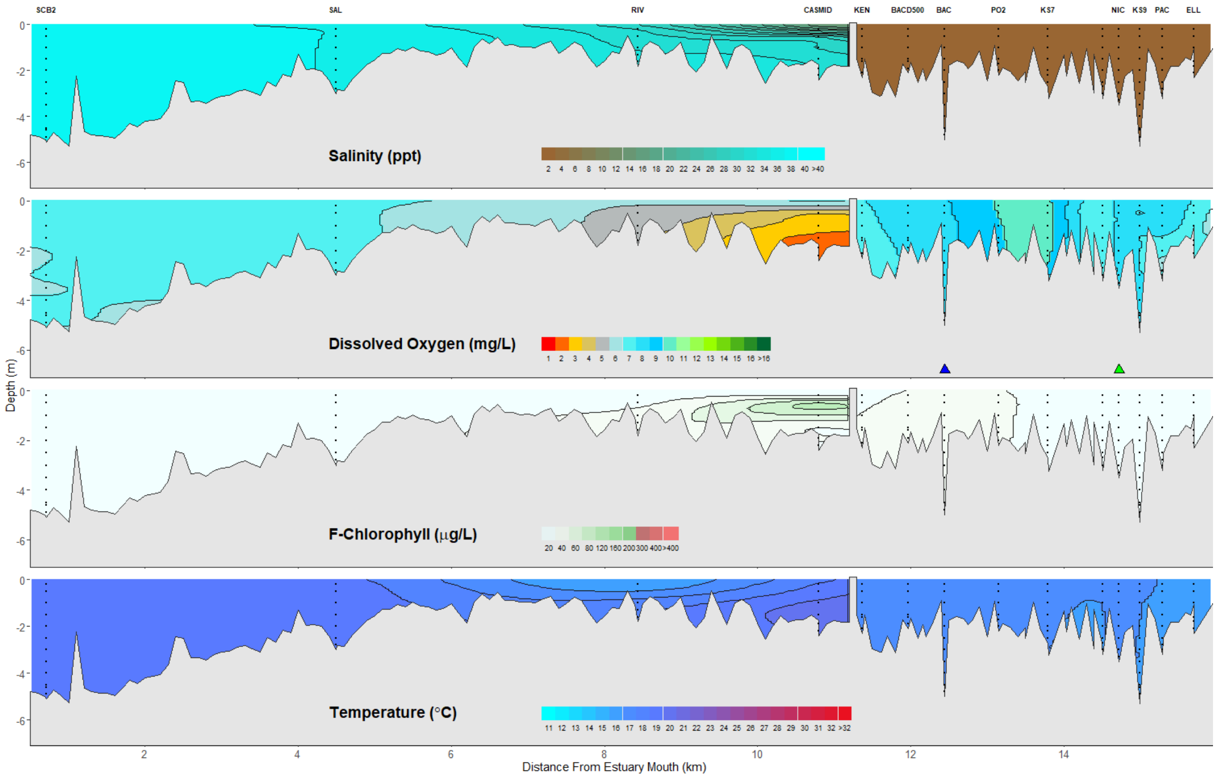
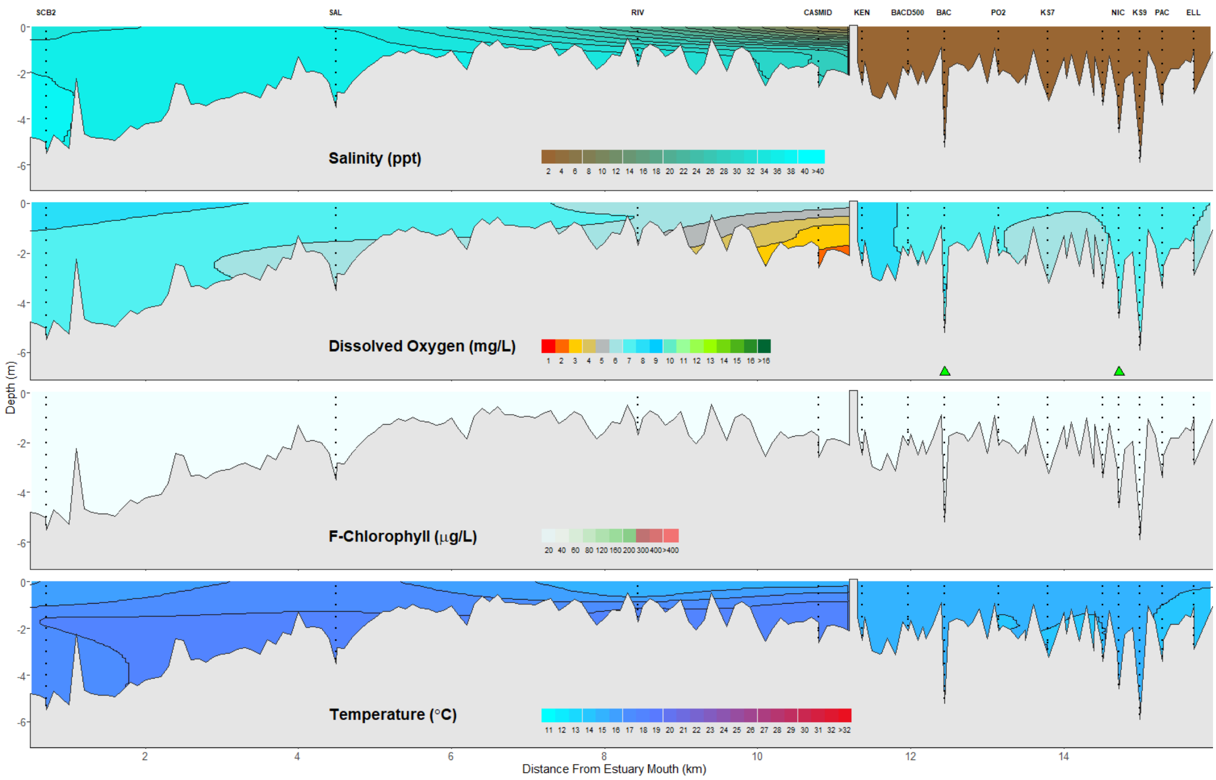


27 May 2025



Appendix (x). Spot measurements of salinity (ppt), temperature (°C) and dissolved oxygen (DO; mg/L) at the surface and, for offshore sites, also the bottom of the water column collected at the same time as the samples of the fish community. – denotes no data were recorded.

Nearshore		Summer						Autumn					
		Surface			Bottom			Surface			Bottom		
Zone	Site Code	Sal	Temp	DO	Sal	Temp	DO	Sal	Temp	DO	Sal	Temp	DO
LSCE	LSCE3							-	-	-			
	LSCE4							36.8	24.9	-			
	LSCE5							37.6	23.4	-			
	LSCE6							-	-	-			
	LSCE7							-	-	-			
	LSCE8							-	-	-			
CE	CE1							-	-	-			
	CE2							-	-	-			
	CE5							36.7	25.1	7.3			
	CE6							36.6	24.8	7.3			
	CE7							36.0	25.0	9.6			
	CE8							16.4	23.1	10.8			
MSE	MSE2							36.3	21.3	7.3			
	MSE4							35.4	21.8	9.0			
	MSE5							34.5	21.2	9.5			
	MSE6							-	-	-			
	MSE7							32.1	23.2	6.8			
	MSE8							31.0	23.0	6.3			
USE	USE1							-	-	-			
	USE3							-	-	-			
	USE4							26.3	25.7	10.6			
	USE5							25.7	25.2	9.4			
	USE6							25.2	25.3	9.7			
	USE7							-	-	-			

Offshore		Summer						Autumn					
		Surface			Bottom			Surface			Bottom		
Zone	Site Code	Sal	Temp	DO	Sal	Temp	DO	Sal	Temp	DO	Sal	Temp	DO
LSCE	LSCE1G	36.9	25.9	6.1	37.0	26.4	6.0	37.1	22.9	-	37.1	22.8	-
	LSCE2G	36.9	26.3	6.6	36.9	26.3	6.6	36.9	23.2	-	36.9	23.3	-
	LSCE3G	36.9	26.0	6.1	36.9	26.0	6.0	37.4	22.7	-	37.5	22.2	-
	LSCE4G	36.9	26.5	6.0	36.9	26.5	6.0	37.4	23.7	-	37.6	23.0	-
	LSCE5G	-	-	-	-	-	-	37.4	23.2	-	37.5	22.4	-
	LSCE6G	-	-	-	-	-	-	37.5	24.6	-	37.5	34.6	-
CE	CE1G	36.1	24.4	6.8	36.1	24.4	6.8	-	-	-	-	-	-
	CE2G	35.9	24.3	6.1	35.9	24.4	6.0	-	-	-	-	-	-
	CE3G	-	-	-	-	-	-	-	-	-	-	-	-
	CE4G	35.4	27.6	6.6	35.3	27.7	6.3	-	-	-	-	-	-
	CE5G	35.0	27.4	6.6	35.5	27.7	6.4	36.8	24.7	7.6	36.8	24.7	7.5
	CE6G	35.0	27.7	6.5	35.1	27.7	6.0	36.7	24.7	7.7	36.6	24.7	7.3
MSE	MSE1G	35.8	26.9	6.6	36.0	26.7	5.9	37.4	21.2	7.4	37.5	21.0	7.3
	MSE2G	34.0	28.0	6.8	34.1	28.0	6.3	35.4	21.6	8.8	36.0	21.1	6.4
	MSE3G	33.1	28.1	7.1	33.4	28.4	7.2	34.8	21.3	9.1	35	21.2	7.4
	MSE4G	31.8	25.4	6.1	32.8	25.6	4.7	34.1	23.5	6.9	34.5	23.3	6.0
	MSE5G	28.9	26.0	7.0	29.0	26.4	3.4	31.5	22.9	7.7	32.2	23.2	7.1
	MSE6G	27.7	26.4	7.2	27.6	26.5	7.0	30.8	22.9	7.4	31.7	22.8	5.8
USE	USE1G	26.5	26.3	7.7	26.8	26.3	5.6	-	-	-	-	-	-
	USE2G	24.2	26.1	8.2	25.0	27.1	6.1	-	-	-	-	-	-
	USE3G	23.7	26.8	6.2	23.7	26.9	6.2	-	-	-	-	-	-
	USE4G	21.2	29.9	6.8	21.4	30.0	5.3	26.1	25.0	9.3	26.4	24.7	7.8
	USE5G	18.9	30.3	6.5	19.1	30.1	5.5	24.5	25.3	8.3	24.9	25.0	7.3
	USE6G	18.5	30.3	7.6	30.3	18.7	6.3	21.6	25.7	9.3	24.3	24.9	6.0

<u>Appendix (xi).</u> Average density fish (100 m^{-2}) observed across all nearshore sites sampled in Swan Canning Estuary during the summer and autumn of 2025 and in each year between 2012 and 2024. An average (Avg) and standard deviation (SD) in provided for the previous years (2012-2024). The difference (fish 100 m^{-2}) between 2025 and the previous average (Diif) are provided for each species caught in 2025 together with the percentage change (% Change; increase = green shading; decrease = red shading).

Common name	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Avg	SD	2025	Diff	% Change
Southern Eagle Ray		0.02	0.02			0.02								>0.01	0.06			
Hawaiian Giant Herring			0.08											0.01	0.14	0.79	0.79	11,505%
Australian Sardine				0.04				9.34						0.71	17.82			
Blue Sprat				0.36								0.02		0.03	0.69			
Sandy Sprat			0.07			0.29				3.52	3.86	0.05	0.04	0.59	6.49	0.02	-0.02	-97%
Perth Herring	2.83	51.56	87.09	16.94	14.04	1.24	33.48	1.04	12.02	12.59	11.91	9.25	5.71	20.13	161.37	14.01	8.30	-30%
Australian Anchovy	0.11	0.83	8.64	9.84	8.78			1.33	0.23	57.31	7.42		0.50	7.25	106.21	0.45	-0.05	-94%
Western Galaxias							0.02							>0.01	0.03			
Estuary Cobbler					0.02		0.04					0.02		0.01	0.08			
Eastern Gambusia	21.62	3.72	0.63	11.17	2.26	29.33	12.84	7.90	2.08	0.93	19.61	0.50	1.29	8.84	64.61	9.93	8.64	12%
Silver Fish	26.44	2.23		1.62	41.85	4.40	16.59	6.73	25.59	25.88	4.36	1.76	38.42	15.10	108.25	83.67	45.26	454%
Common Hardyhead	2.08	31.70	4.87	6.63	2.66	0.43	44.79	2.19	13.09	17.96	14.26	17.89	20.64	13.63	79.45	6.65	-13.99	-51%
Elongate Hardyhead	12.63	97.09	133.35	66.54	37.72	21.84	36.24	12.75	62.10	6.12	33.49	43.80	20.47	45.05	239.76	3.68	-16.79	-92%
Western Hardyhead	88.87	54.65	53.03	100.14	65.64	152.96	101.87	205.37	124.41	62.90	324.25	172.18	32.63	117.79	419.48	8.73	-23.90	-93%
Spotted Hardyhead	208.92	168.18	72.58	83.14	65.86	28.83	160.96	45.82	90.86	47.07	167.17	137.55	35.45	101.84	283.51	79.20	43.75	-22%
West Australian Seahorse						0.20								0.01	0.38			
Hairy Pipefish					0.11									0.01	0.21			
Spotted Pipefish			0.05		0.11			0.04		0.02				0.02	0.18			
Pugnose Pipefish			0.02				0.04		0.02					0.01	0.07			
Soldier					0.09	0.07	0.11	0.07	0.02	0.29	0.22			0.07	0.70			
Yellowtail Flathead	0.05	0.07	0.05		0.05	0.05	0.04		0.05	0.02	0.05	0.20		0.05	0.38			
Yellowtail Grunter	3.74	6.90	11.29	6.16	6.54	1.47	3.14	5.03	1.42	8.78	6.50	6.30	3.81	5.48	16.73	7.49	3.68	37%
Western Striped Grunter	11.10	19.86	5.16	6.72	13.78	31.16	4.97	2.57	4.62	1.31	85.06	22.11	1.83	16.07	112.76	1.51	-0.32	-91%
Sea Trumpeter	0.03		0.02											>0.01	0.06	0.05	0.05	1,219%
Western Gobbleguts	3.29	1.19	4.95	7.87	18.30	3.09	2.23	3.74	9.81	3.70	3.52	0.81	0.50	4.83	34.86	1.49	0.99	-69%
Whiting spp.																0.07	0.07	
King George Whiting	0.05					0.02	0.05	0.20		0.02				0.03	0.39			
Southern School Whiting						0.04						0.22		0.02	0.42			
Western Trumpeter Whiting	1.17	0.48	3.77	0.65	0.32	0.41	0.99	0.50	1.53	2.30	11.62	10.94	1.72	2.79	12.74	7.36	5.64	164%
Yellowfin Whiting	0.24	0.09	0.03		0.04		0.11	0.05	0.07	0.13	0.77	1.13	0.31	0.23	1.27	2.14	1.83	840%
Western School Whiting								0.04				0.22		0.02	0.31	0.31	0.31	1,501%
Tailor		0.29							0.02	0.61	0.29		0.02	0.09	0.75			
Skipjack Trevally											0.02			>0.01	0.03			
Queenfishes																0.02	0.02	
Australian Herring					0.02									>0.01	0.03			
Western Butterfish									0.04			0.04		0.01	0.10			
Common Silverbiddy	7.79	4.81	8.57	1.19	1.13	0.18	4.24	1.31	0.47	1.10	3.61	9.88	8.57	4.12	13.67	7.92	-0.65	92%
Black Bream	3.40	5.62	26.08	8.55	18.50	3.34	9.84	4.36	4.11	7.78	7.35	1.40	2.98	7.99	19.46	1.90	-1.08	-76%
Tarwhine	0.18		0.03	0.04	0.07	0.11	0.05			0.09	0.41	0.47		0.11	0.80	0.04	0.04	-68%
Pearl Cichlid			0.10	1.08	0.22	0.34	0.16	0.07	0.38	0.75	0.92	0.09		0.31	2.89	0.25	0.25	-19%
Yelloweye Mullet	7.44	13.31	5.36	0.90	2.55	1.99	1.38	5.48	16.85	11.39	6.05	19.47	2.44	7.27	30.89	10.70	8.26	47%
Sea Mullet	21.55	2.01	1.94	0.95	1.62	0.34	1.22	0.40	1.90	0.90	2.28	4.56	0.40	3.25	24.17	2.82	2.42	-13%

Common name	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Avg	SD	2025	Diff	% Change
Striped Barracuda				0.02										>0.01	0.03			
Little Weed Whiting					0.13	0.18						0.02		0.02	0.42			
Longray Weed Whiting							0.02				0.02			>0.01	0.05			
Blue Weed Whiting	0.02	0.02	0.05		0.38		0.14		0.02	0.05	0.14			0.06	0.59			
Wavy Grubfish			0.02											>0.01	0.03			
Flathead Sandfish			0.02											>0.01	0.03			
Germain's Blenny							0.04							>0.01	0.05			
False Tasmanian Blenny							0.05							>0.01	0.08			
Painted Stinkfish		0.02												>0.01	0.03			
Southern Longfin Goby	1.04	0.88	1.91		0.38	1.87	2.48	2.35	1.44	1.89	3.20	2.78	0.65	1.60	5.60	1.45	0.81	-9%
Bridled Goby	0.32	0.34	7.62	0.41	0.95	3.54	1.35	2.86	3.02	0.79	0.88	1.89	5.39	2.26	11.58	1.13	-4.26	-50%
Bluespot Goby	6.31	10.34	19.47	5.03	2.91	33.82	29.80	38.47	15.73	10.29	21.98	15.36	19.18	17.49	61.20	3.09	-16.09	-82%
Dusky Frillgoby										0.02	0.07	0.02		0.01	0.15			
Yellowspotted Sandgoby	16.00	19.83	45.30	5.89	22.47	17.28	35.27	6.66	11.94	9.57	24.87	26.01	14.96	19.78	46.99	12.95	-2.01	-35%
Southwestern Goby	0.67	0.34	0.44		0.41	1.98	2.48	12.86	3.50	2.30	1.98	1.89	1.71	2.32	13.96	0.63	-1.08	-73%
Largemouth Goby									0.04		0.40	0.83	0.13	0.10	1.37	0.18	0.05	71%
Smalltooth Flounder			0.05						0.04	0.04		0.04		0.01	0.10			
Longsnout Flounder		0.07			0.02									0.01	0.14			
Elongate Flounder	0.03						0.02							>0.01	0.08			
Spinytail Leatherjacket					0.02									>0.01	0.03			
Rough Leatherjacket							0.02	0.07			0.02			0.01	0.15			
Fanbelly Leatherjacket													0.02	>0.01	0.03			
Bridled Leatherjacket					0.13									0.01	0.24			
Weeping Toadfish	4.96	18.32	18.39	9.14	6.03	1.08	1.76	9.00	0.27	5.19	2.51	3.68	1.78	6.36	27.60	5.41	3.63	-15%
Prickly Toadfish										0.02	0.04			>0.01	0.08			

Appendix (xii). Average catch rate (fish/net set) observed across all nearshore sites sampled in Swan Canning Estuary during the summer and autumn of 2025 and in each year between 2012 and 2024. An average (Avg) and standard deviation (SD) in provided for the previous years (2012-2024). The difference (fish/net set) between 2025 and the previous average (Diif) are provided for each species caught in 2025 together with the percentage change (% Change; increase = green shading; decrease = red shading).

Common name	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Avg	SD	2025	Diff	% Change
Port Jackson Shark				0.04						0.02				>0.01	0.09			
Bull Shark		0.08	0.02	0.04	0.02		0.11	0.06	0.13	0.13	0.02	0.04	0.06	0.05	0.25	0.21	-0.15	285
Southern Eagle Ray	0.28	1.63	1.06	0.88	1.08	0.58	1.13	1.35	2.92	2.42	3.19	1.75	3.38	1.65	5.83	1.15	0.51	-31
Hawaiian Giant Herring	0.02	0.25	0.13	0.31	0.13	0.21	0.13	0.10	0.42	0.10	1.02	0.65	1.77	0.40	1.49	1.60	-1.21	302
Perth Herring	21.11	27.48	22.48	35.00	25.58	10.52	18.36	22.63	22.56	33.35	31.92	23.65	39.75	25.69	31.32	30.54	-4.85	19
Scaly Mackerel		1.00	0.81	1.21	0.27		0.17							0.26	2.91			
Australian Anchovy	0.06	0.13	0.10	0.54	0.06	0.25	0.28	0.02	0.19	0.21	0.29	0.04	0.06	0.17	0.63	0.02	0.15	-88
Estuary Cobbler	0.04	0.04	0.04	0.08	0.06		0.11	0.17	0.19	0.08	0.15	0.10	0.19	0.10	0.51	0.06	0.03	-34
Common Hardyhead											0.02			>0.01	0.04			
Western Spiny Seahorse		0.02	0.02						0.02					>0.01	0.07			
West Australian Seahorse											0.02			>0.01	0.04			
Rock Flathead						0.02								>0.01	0.04			
Yellowtail Flathead	0.85	0.88	1.00	0.92	0.60	0.56	0.66	0.48	0.63	0.54	1.00	1.21	0.98	0.79	1.76	1.73	-0.94	118
Yellowtail Grunter	6.00	0.90	3.94	3.81	4.33	4.83	6.91	2.69	8.69	11.13	10.81	16.29	20.15	7.71	27.70	20.06	-12.35	160
Silver Perch						0.02								>0.01	0.04			
Western Striped Grunter	0.98	0.58	0.29	0.60	0.63	0.23	0.47	0.71	7.54	1.02	0.29	0.71	0.48	1.12	7.05	0.29	0.83	-74
Western Gobbleguts	0.02					0.02				0.04				0.01	0.10	0.02	-0.01	228
Western Trumpeter Whiting	0.35	0.27	0.13	0.77	0.17	0.10	0.23	0.04	0.13	0.13	0.31	0.38	0.25	0.25	1.17	0.15	0.11	-42
Yellowfin Whiting	0.04	0.06						0.06	0.06	0.08	0.10	0.10	0.29	0.06	0.41	0.15	-0.08	135
Western School Whiting								0.15						0.01	0.24			
Tailor	1.52	2.02	1.10	0.75	1.00	1.31	1.70	0.88	2.25	3.13	3.29	3.17	2.40	1.88	3.11	3.17	-1.28	68
Yellowtail Scad					0.71									0.05	1.17			
Silver Trevally						0.60		0.04					0.02	0.05	0.98	0.04	0.01	-18
Skipjack Trevally	0.04		0.15	0.04						0.13	0.02	0.04		0.03	0.37	0.04	-0.01	31
Australian Herring					0.02					0.02	0.19	0.17	0.02	0.03	0.42			
Common Silverbiddy	0.81	1.52	0.69	0.31	1.94	0.54	0.53	0.25	0.63	0.79	0.29	0.77	2.13	0.86	3.27	2.04	-1.18	137
Black Bream	8.31	0.21	0.31	0.29	0.77	1.67	0.87	1.83	0.90	4.58	1.65	2.56	2.58	2.10	8.40	2.46	-0.35	17
Tarwhine	0.52	0.17	0.17	0.38	1.17	0.42	0.04	0.04	0.06		0.31	0.63	1.81	0.44	3.01	1.31	-0.87	198
Mulloway	0.07	0.04	0.23	0.38	0.35	0.06	1.00	0.33	0.17	0.06	1.10	0.48	0.44	0.36	1.06	0.81	-0.45	126
Pearl Cichlid										0.02				>0.01	0.04			
Yelloweye Mullet		0.02	0.02						0.02	0.54			0.15	0.06	0.71			
Sea Mullet	2.31	0.73	0.54	0.02	0.23	1.46	0.53	0.67	0.23	2.40	1.33	3.56	3.21	1.34	6.26	0.65	0.69	-52
Snook	0.06	0.06												0.01	0.13			
Striped Barracuda											0.06			>0.01	0.09	0.02	-0.02	337
Smalltooth Flounder				0.02		0.02					0.08		0.02	0.01	0.12	0.02	-0.01	87
Weeping Toadfish	0.17	0.21	0.13		0.08					0.19	0.19	0.06	0.02	0.08	0.48	0.08	0.00	3