# Supplementary Material

# Seasonal succession of the larval fish community from coastal areas of eastern Newfoundland, Canada

by

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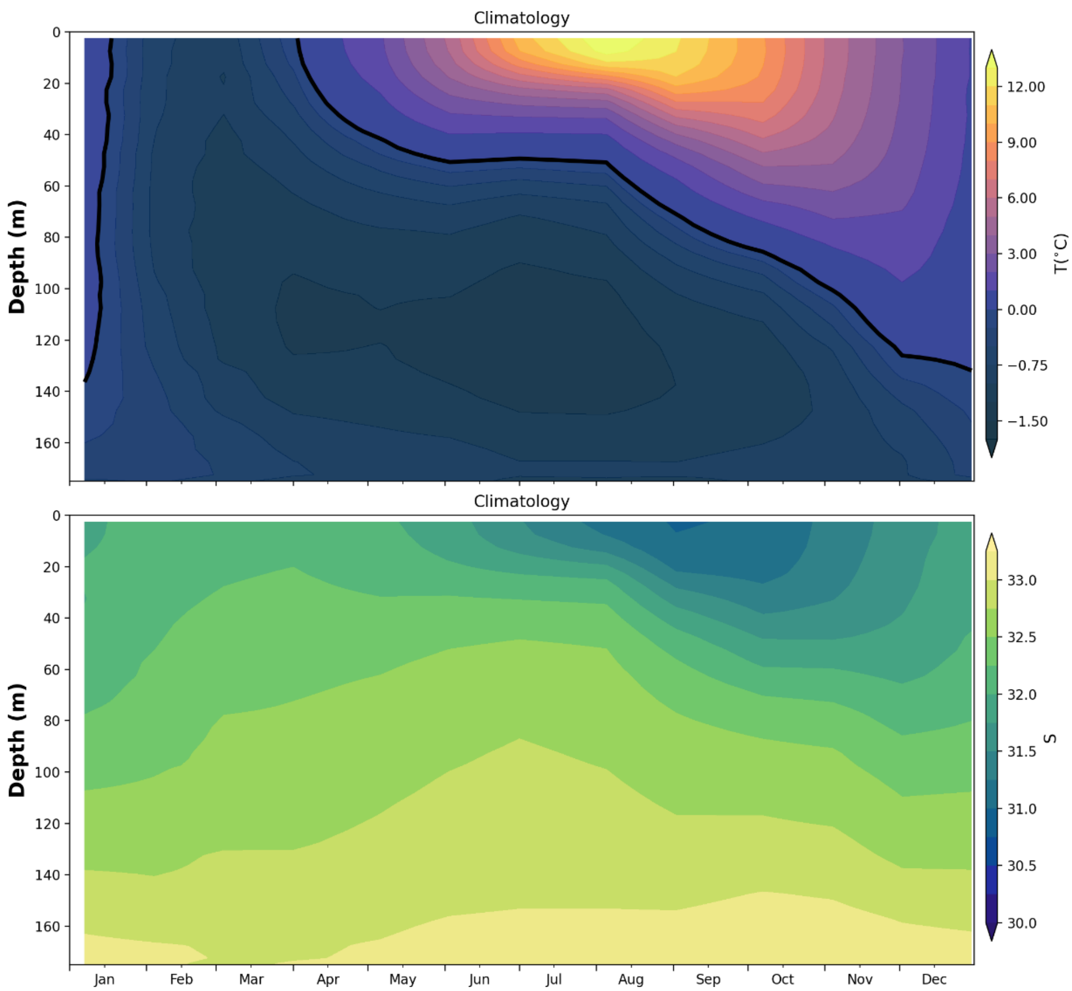
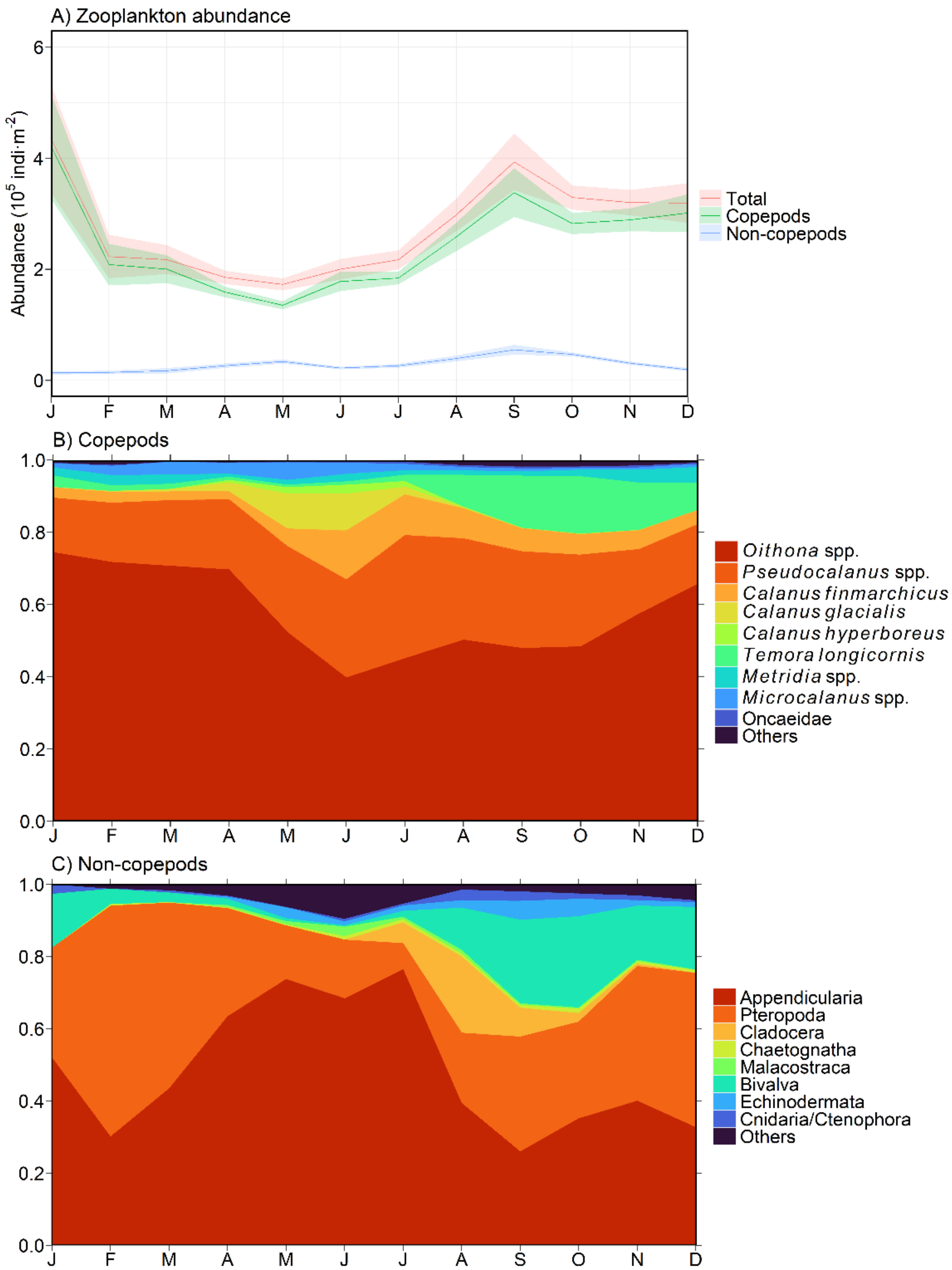
## Seasonal cycle in oceanographic conditions

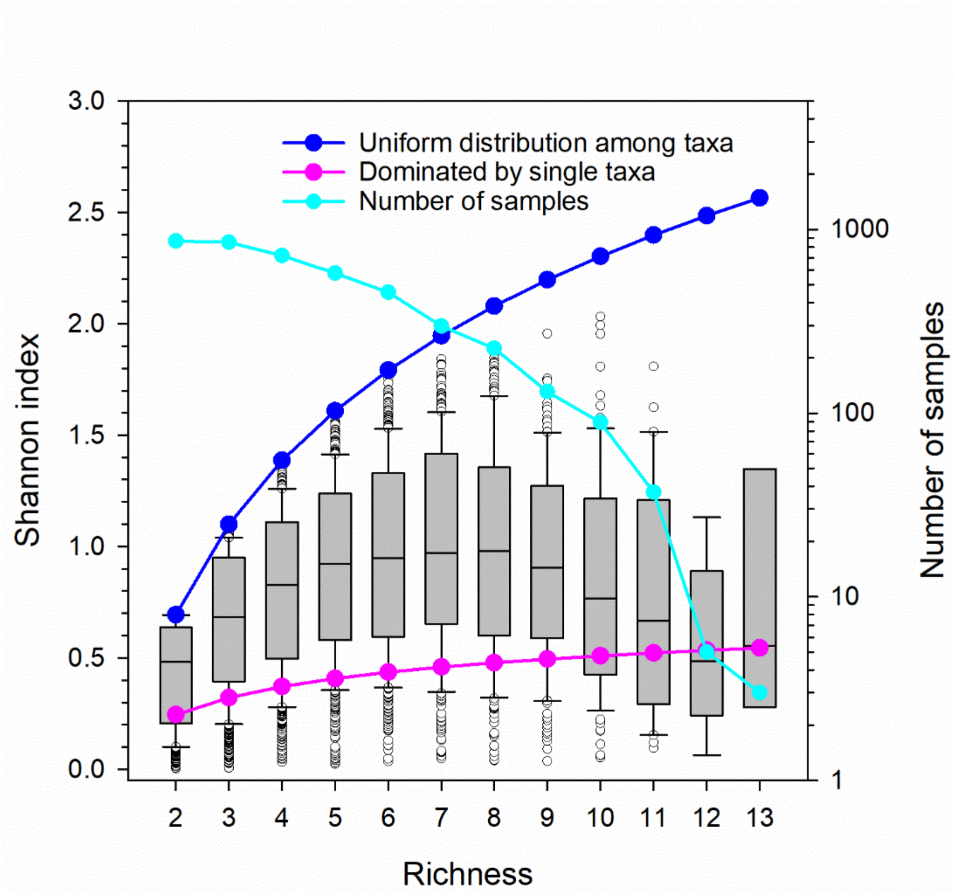



Supplementary Figure S1. Seasonal climatological (1990-2020) temperature (T°C – top panel) and salinity (S – bottom panel) depth profiles at Station 27, a high frequency sampling site of the Atlantic Zone Monitoring Program. Station 27 is located five nautical miles east of St John's harbour (47.55°N, 52.59°W), on the northwestern edge of the Grand Banks and has a 170 m water depth. The black line in the top panel represents the 0°Celcius isotherm.



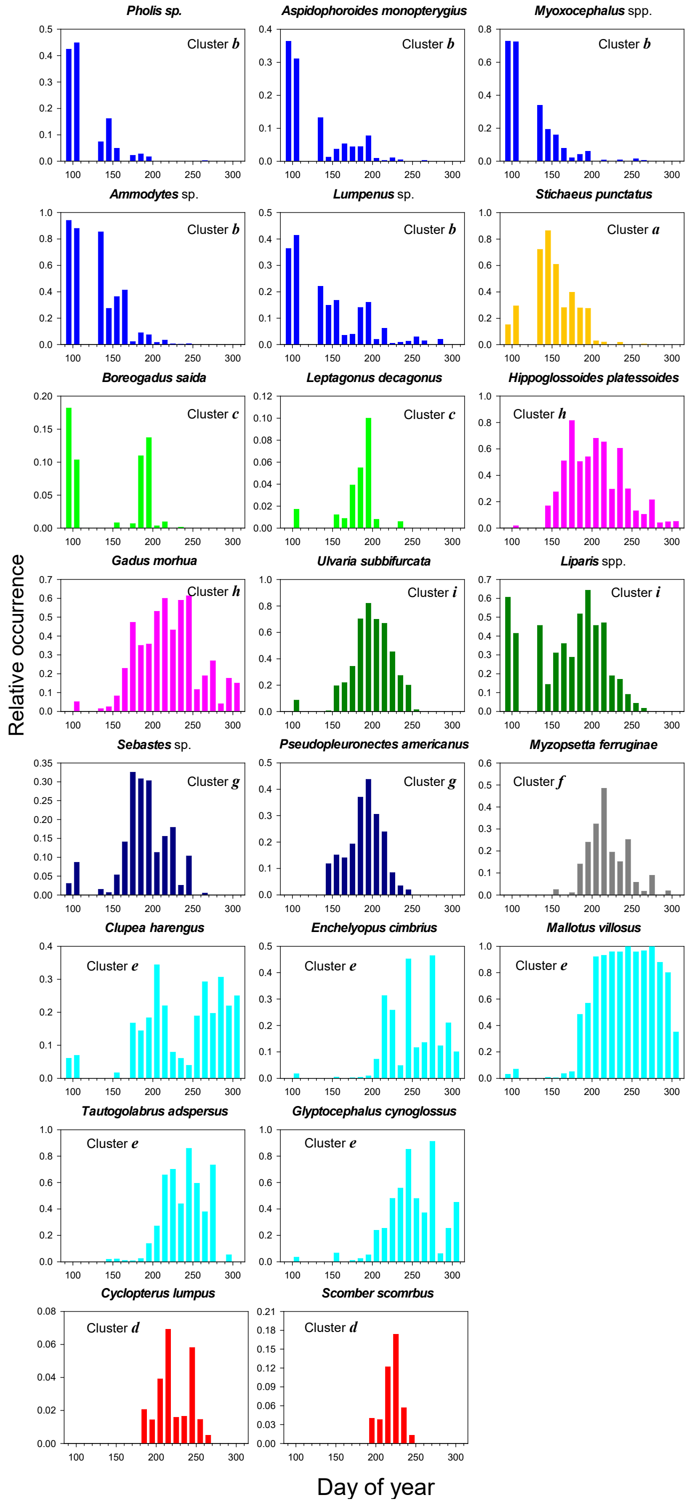

Supplementary Figure S2. (A) Climatological (1999-2020) average abundance ($10^5$ individuals·m$^{-2}$) of copepodite copepods and non-copepods (± standard deviation), and relative numerical taxonomic composition of (B) copepodites, and (C) non-copepods at Station 27, a high frequency sampling site of the Atlantic Zone Monitoring Program. The patterns of variation are estimated from data obtained using integrated vertical tows (0-160 m) of a 202 µm mesh net (see Mitchell et al. (2002) and Maillet et al. (2022) for details of sampling, sorting, and analytical protocols).

## Species richness and entropy



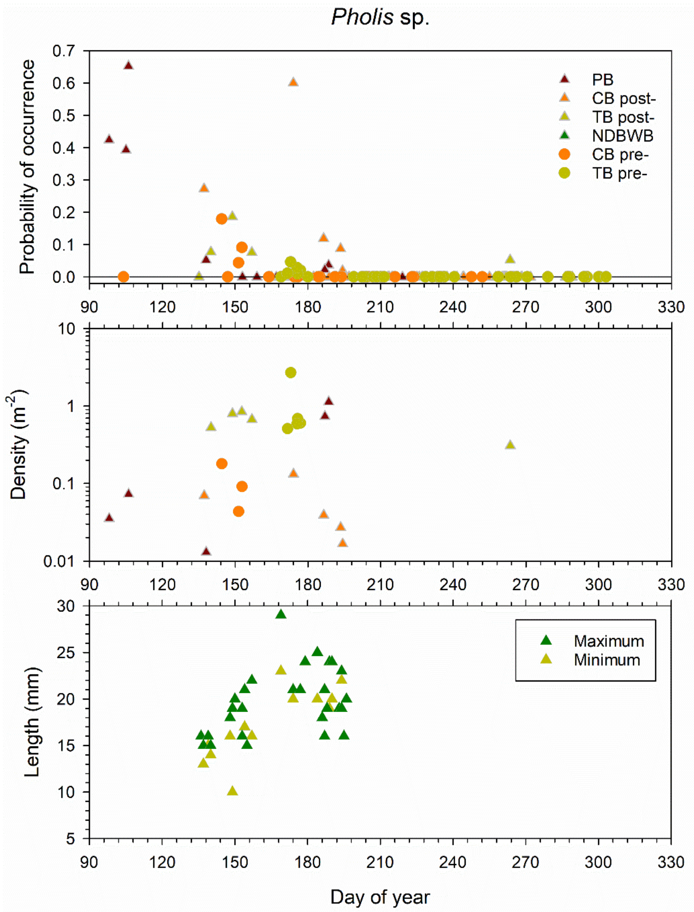

Supplementary Figure S3. Distribution of Shannon's entropy index in relation to the species richness recorded for each sample of this study. Grey bars represent the interquartile (25th, 50th, 75th percentiles), error bars represent the 10th and 90th percentiles, and open circles represent outliers of the data from this synthesis. The number of samples of each level of species richness is indicated by the teal line – 766 samples had only one taxon present. The maximum expected Shannon index occurs if all taxa for a given level of richness have equal abundance in the sample (blue line). The pink line represents the theoretical circumstances in which one taxa accounts for 90% of all fish larvae in a sample while all other taxa, for a given level of species richness, are equally abundant in the remaining 10% of fish larvae.

## Seasonal cycle in larval fish occurrence




Supplementary Figure S4. Relative occurrence, across all bays, during 10-day intervals based on the number of samples in which each taxon occurs relative to the total number of samples collected during each interval. Each panel is labelled and colour-coded with the clusters identified in Figure 7.

## Species specific cycles

<table>
<tr>
<td rowspan="2">Pholis sp. – The highest occurrence of Pholis sp. occurred during April in Placentia Bay, with somewhat lower occurrences in May in Conception and Trinity Bays (Supplementary Figure S5). Densities were highest in Trinity Bay and at limited locations in Placentia Bay, and similar during pre- and post-collapse periods. Minimum lengths indicate that specimens captured in May were considerably larger than length at hatch, suggesting that spawning occurred in winter months, consistent with the summary presented by Scott and Scott (1988).</td>
<td>
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<tr>
<td>Supplementary Figure S5. Probability of occurrence, average density (m<sup>-2</sup>), and minimum and maximum lengths of larvae of Pholis sp., estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay.</td>
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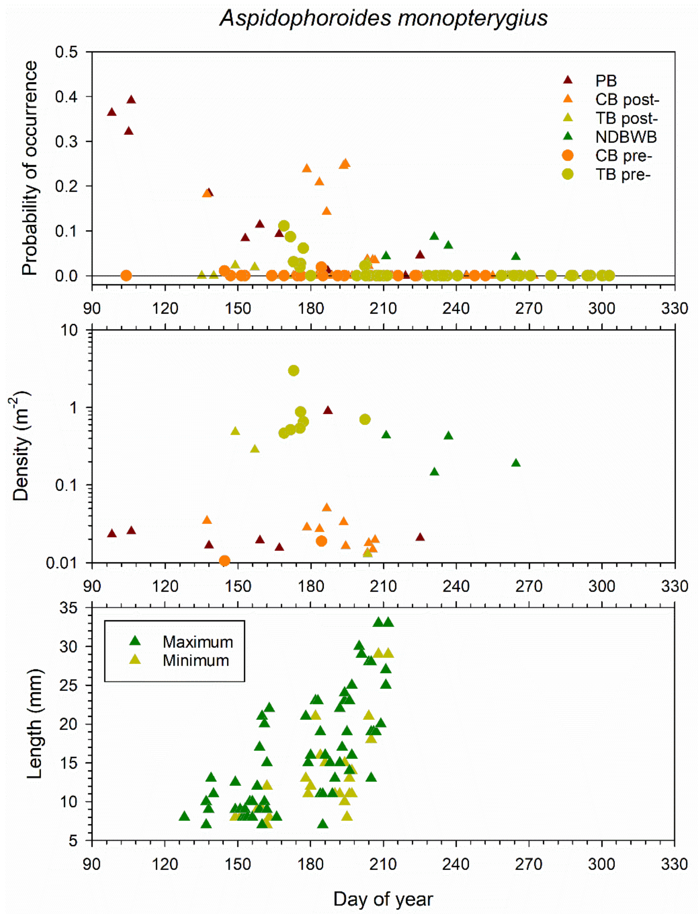
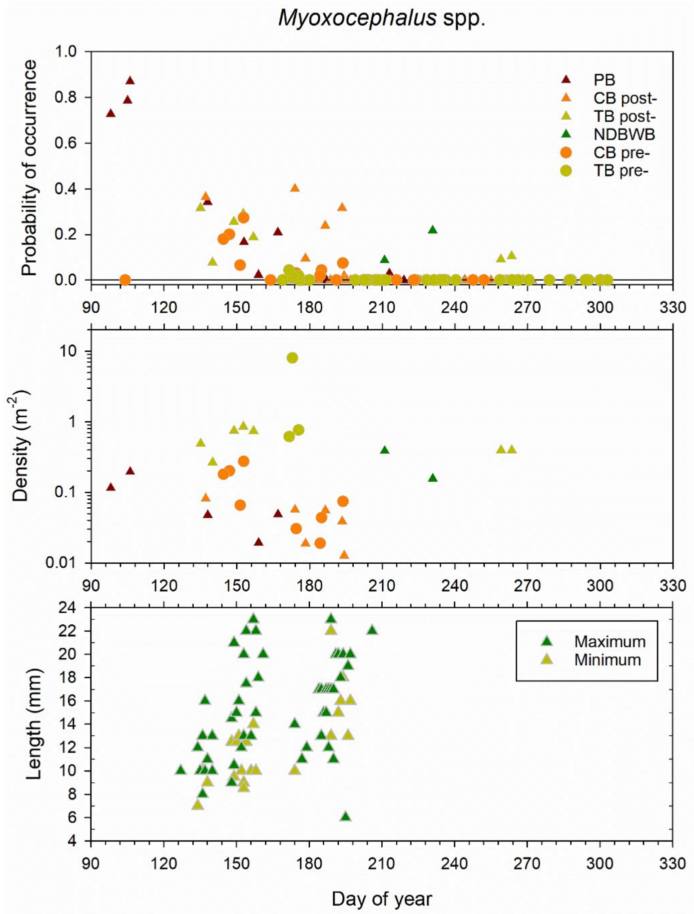
</table>

*Aspidophoroides monopterygius* –
Although highest occurrences of *A. monopyterygius* were in April in Placentia Bay, this species occurs frequently in all bays until September (Supplementary Figure S6). It is most frequent in Placentia and Conception Bays but occurs in highest densities in Trinity, Notre Dame, and White Bays. Small larvae < 10 mm standard length were present from May to July, possibly indicating continued spawning during this period, similar to that observed in Passamaquoddy Bay in southwestern New Brunswick (Scott and Scott, 1988). Maximum lengths from Conception Bay increased progressively from early April until late July, after which the larvae apparently settled out of the plankton. Larvae occurred frequently in the plankton of Notre Dame and White Bays in August and September.




Supplementary Figure S6. Probability of occurrence, average density (m$^{-2}$), and minimum and maximum lengths of larvae of *Aspidophoroides monopterygius*, estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay.

*Myoxocephalus spp.* – Highest occurrences in Placentia Bay were in April but this taxon persisted with a high level of variability in all bays into September, although sculpin larvae were frequent from May to July (Supplementary Figure S7). Densities were greatest in Trinity Bay, and similar during pre- and post-collapse periods in all bays where they occur. Length data from Conception Bay indicate that small larvae, indicative of recent hatch, were only present in May, although if hatchlings remain in the nest following emergence that may delay introduction to the plankton. The distribution of lengths may indicate different production cycles among the species included in this group. The presence of large larvae (> 20 mm) in late May likely indicates that spawning occurred in winter or early spring. The pattern of occurrence and size of larvae is generally consistent with current knowledge about the spawning of *Myoxocephalus scorpius* in Newfoundland, the most frequently identified species from our data (Pepin, unpublished data), although the presence of hatch-size larvae in May indicate a longer spawning and brooding period than previously known (Scott and Scott, 1988).




Supplementary Figure S7. Probability of occurrence, average density (m$^{-2}$), and minimum and maximum lengths of larvae of *Myoxocephalus* spp., estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay.

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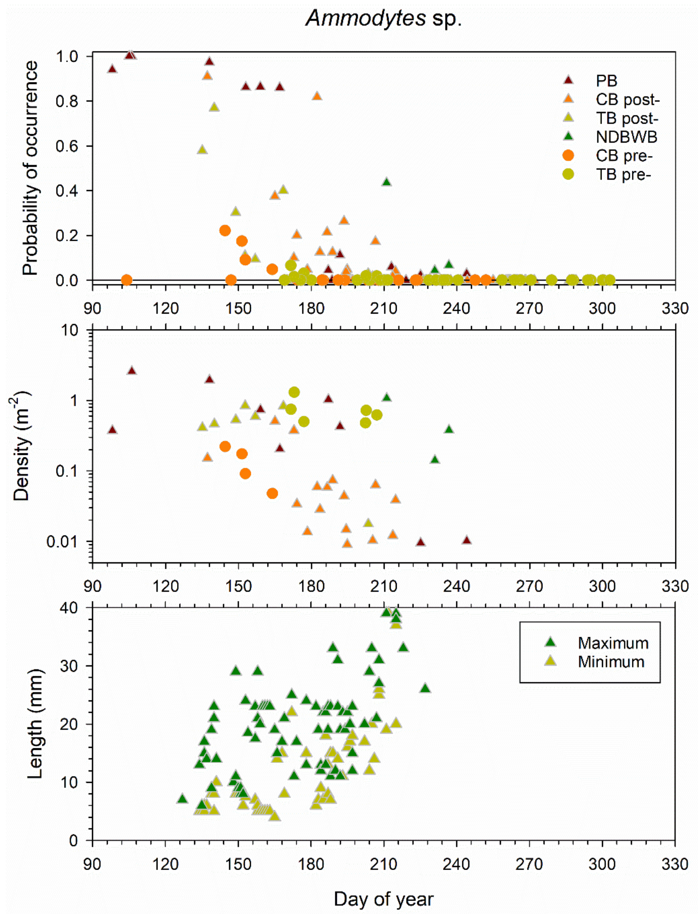
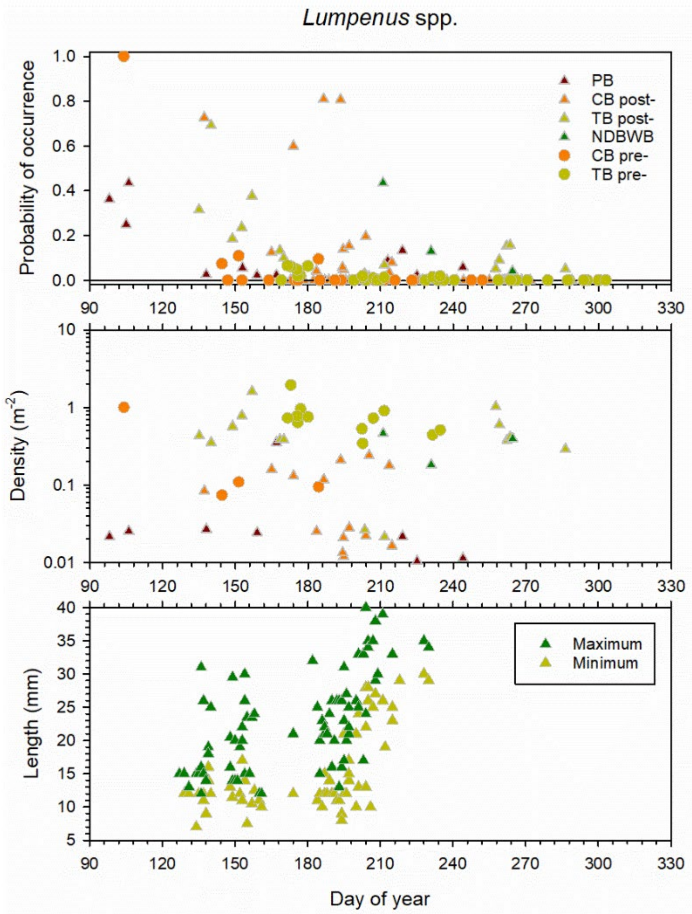
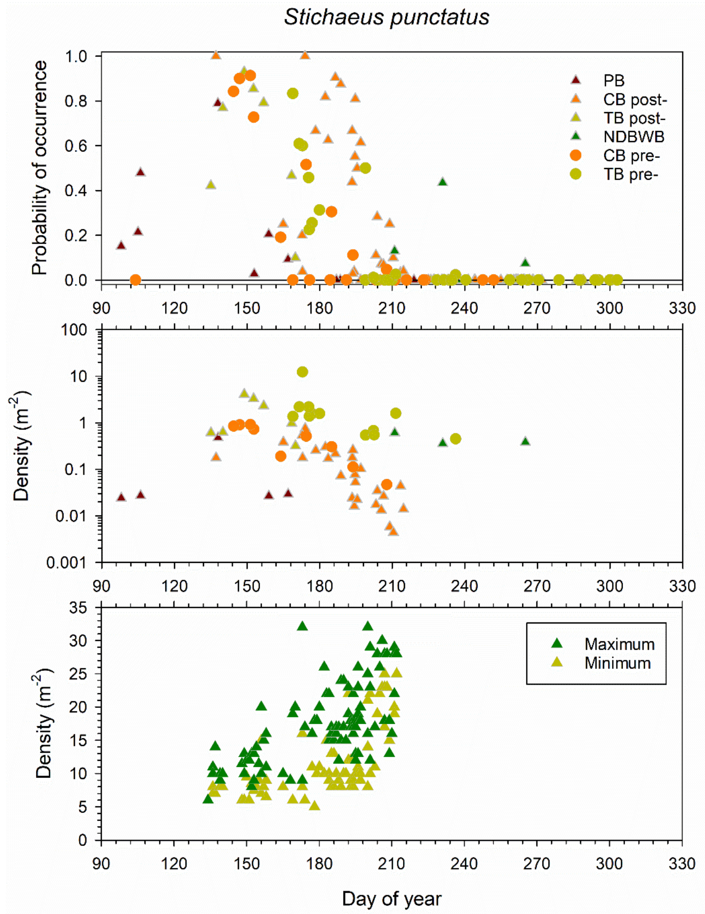
| *Ammodytes sp.* – Occurrence was high in Placentia, Trinity, and Conception Bays from April to June, and reached a minimum in July although they did occur in Notre Dame and White Bays in August (Supplementary Figure S8). Occurrence appeared to be higher during the post-collapse periods although at densities comparable to the pre-collapse state. Densities were comparable in Trinity, Notre Dame, and White Bays. Small larvae occurred in the plankton of Conception Bay during May and into early July, after which only post-flexion larvae seemed to occur, which is later than the apparent spawning patterns observed on the Scotian Shelf (Scott and Scott, 1988). | <br>Supplementary Figure S8. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Ammodytes* sp., estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay. |

*Lumpenus spp.* – High but variable occurrences of blenny occurred in Conception Bay (Supplementary Figure S9) from April to July, with somewhat lower probabilities of occurrence in Placentia and Trinity Bays, and lower still in Notre Dame and White Bays. However, densities were highest in Trinity Bay and northern Bays, exceeding those in Conception Bay by ~1 order of magnitude and ~2 orders of magnitude relative to Placentia Bay, although similar prior and after the collapse. Small larvae, less than 10 mm standard length, and indicative of recent hatching or emergence, occurred from May until the end of July, which is longer than current inferences regarding spawning activity for the most frequently identified species (*Leptoclinus macculatus*) from Conception Bay (Scott and Scott, 1988). However, individuals > 25 mm occurred in May, likely indicative of winter spawning.



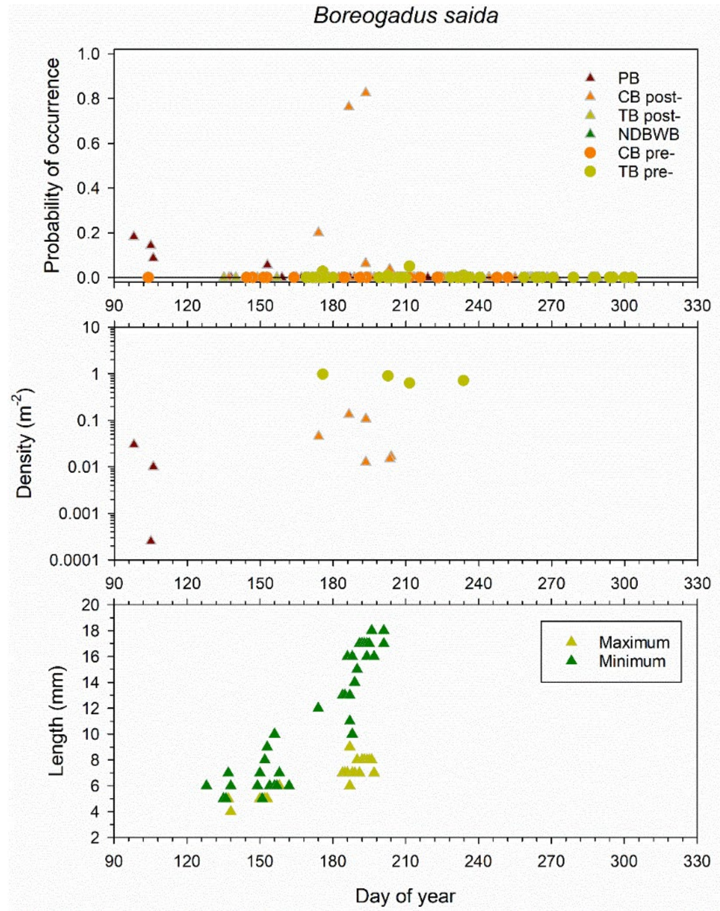

Supplementary Figure S9. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Lumpenus* spp., estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay.

*Stichaeus punctatus* – This species occurred in Placentia Bay in April and was highly frequent in Conception and Trinity Bays from May to July, after which their larvae disappeared from the plankton, with the exception of Notre Dame and White Bays (Supplementary Figure S10). Densities were slightly greater in Conception Bay than in Trinity Bay, with apparently limited differences between the pre- and post-collapse periods. Small larvae (5-8 mm) occurred in Conception Bay from May to July, which is later than previously inferred in waters of Newfoundland (Scott and Scott, 1988), but they co-occurred with larvae > 15 mm from early May onwards, suggesting that spawning occurred in April or earlier.



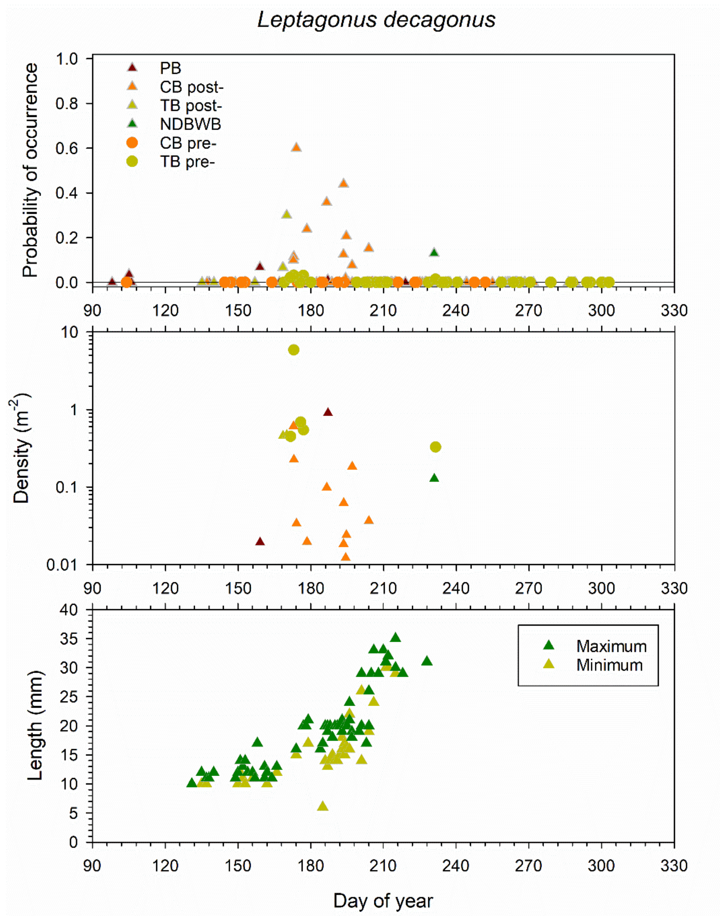

Supplementary Figure S10. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Stichaeus punctatus*, estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay.

*Boreogadus saida* – Arctic cod, a cold-water species of great ecological importance in Arctic seas and ecosystems (Herbig et al., 2023), occurred infrequently (Supplementary Figure S11). Densities were low and small larvae close to the size at hatch were sometimes present from May to July, consistent with the timing of larval production in Arctic polynyas located further north (Michaud et al., 1996), and potentially indicative of transport of pelagic eggs from other areas of the Newfoundland and Labrador shelves.



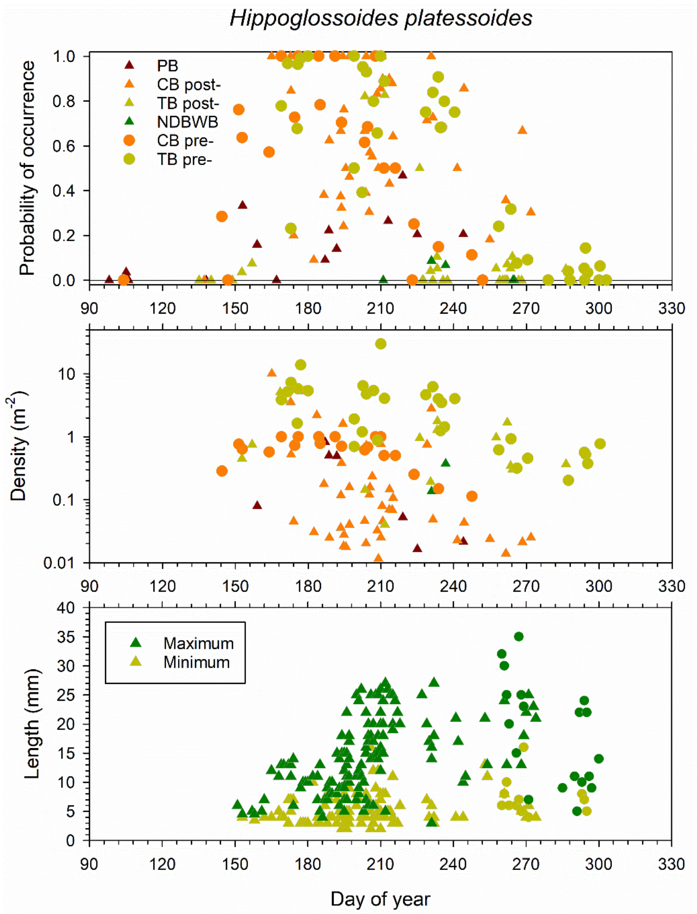

Supplementary Figure S11. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Boreogadus saida*, estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay.

*Leptagonus decagonus* – This species occurred relatively infrequently, though more frequently in Conception and Trinity Bays than other bays, particularly during the post-collapse period (Supplementary Figure S12). However, greater average densities occurred in Trinity Bay during the pre-collapse period, suggesting a localized distribution in that system. Small larvae, ~10-11 mm standard length, were most frequent in May and early June, consistent with other limited evidence of reproductive activity from the northwest Atlantic (Scott and Scott, 1988), with a gradual progression to larger sizes (>30 mm) by early August. This species occurred in only one survey of Notre Dame and White Bays.




Supplementary Figure S12. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Leptagonus decagonus*., estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay.

*Hippoglossoides platessoides* – American plaice larvae were present for an extended period, with first, albeit low, occurrence in Placentia Bay in April, high prevalence (>0.6) at the end of May that persisted into September in Conception and Trinity Bays, and residual presence at the end of October at lower frequencies (Supplementary Figure S13). Occurrences in Notre Dame and White Bays were limited. Densities were approximately 5-10 time greater in Trinity than in other locations, and higher during the pre-collapse than in the post-collapse period. Small larvae, with the range of lengths at hatch reported by Fahay (1992b), were present from late-May into October, a range later than the spawning activity reported for the Scotian Shelf (Scott and Scott, 1988).




Supplementary Figure S13. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Hippoglossoides platessoides*, estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay.

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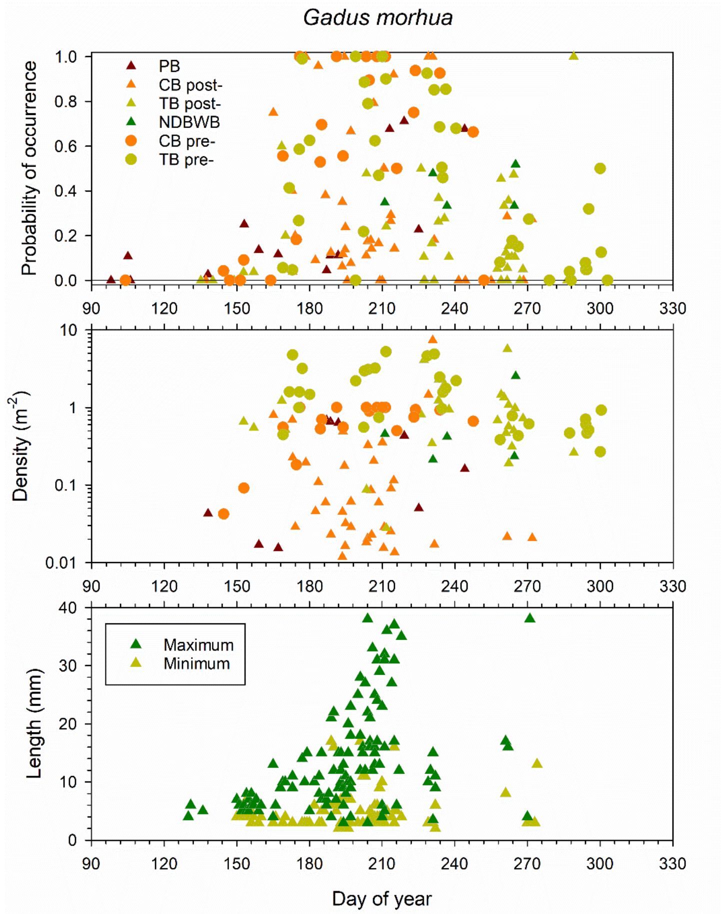
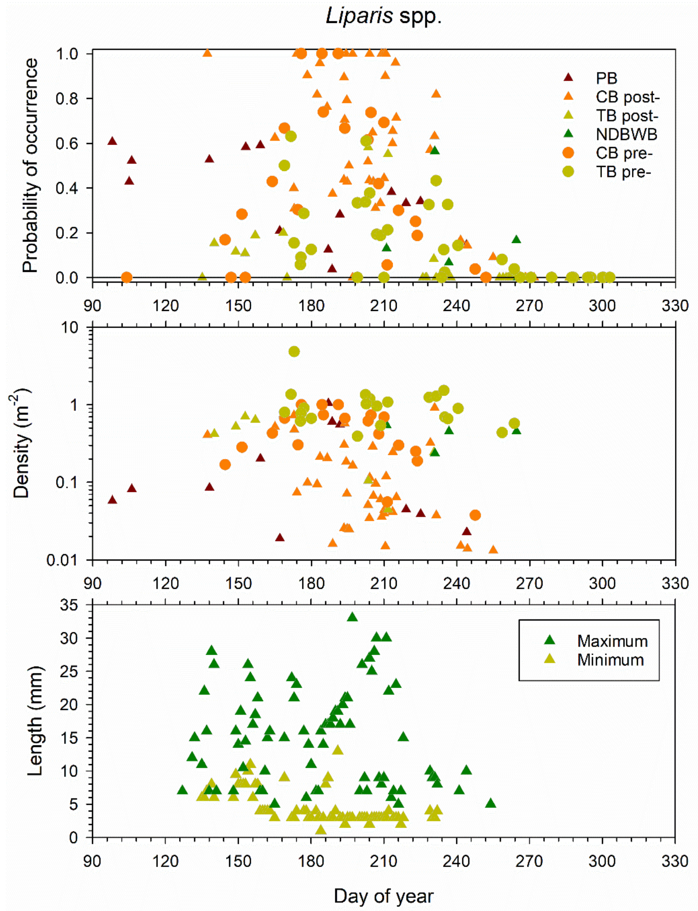
| *Gadus morhua* – Atlantic cod larvae were present from April until October in all bays (Supplementary Figure S14). Probabilities of occurrence > 0.2 started in late-May and continued into the fall, with highest densities in Conception and Trinity Bays. A substantial decline in the probability of occurrence followed post-collapse but with a probability of occurrence of ~0.5 from Placentia Bay to White Bay during that period. Pre-collapse densities were at least one order of magnitude greater than post-collapse, noting post-collapse densities in Notre Dame and White Bays were comparable to those of Conception Bay prior to the collapse. Despite considerable increase in the maximum size of larvae from the spring onward, small larvae, close to the size at hatch (3-4 mm), occurred from May to the end of September suggesting that spawning continued into the fall, considerably later than suggested for Newfoundland but consistent with spawning patterns in the Gulf of St. Lawrence (Scott and Scott, 1988). | <br>Supplementary Figure S14. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Gadus morhua*, estimated as described in the analysis section. Circles represent pre-collapse observations, triangles represent post-collapse observations. Maximum length is reported when minimum and maximum are equal. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; NDBWB – Notre Dame Bay/White Bay. |

*Liparis spp.* – Snailfish occurred frequently in Placentia, Conception, and Trinity Bays, with the highest probabilities of occurrence from late-June to August in Conception Bay (Supplementary Figure S15). Densities in Conception and Trinity Bays were comparable, and apparently greater during the pre-collapse period. *Liparis* spp. occurred in the northern bays but with a lower overall probability of occurrence, although at densities, when present, comparable to other regions. Small larvae (~3-4 mm) occurred in Conception Bay from June to August but large individuals > 20 mm occurred in May, indicating that egg production likely starts in early spring or earlier, but the persistence of small larvae until later in the summer suggests more protracted spawning than reported by Scott and Scott (1988).




Supplementary Figure S15. Probability of occurrence, average density (m$^{-2}$), and minimum and maximum lengths of larvae of *Liparis* spp., estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay.

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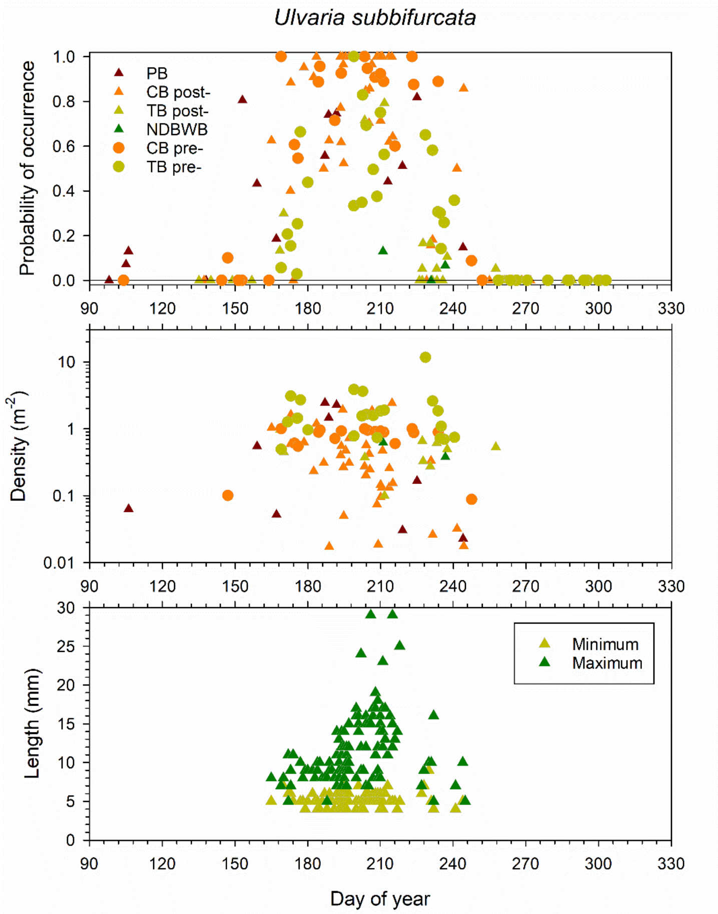
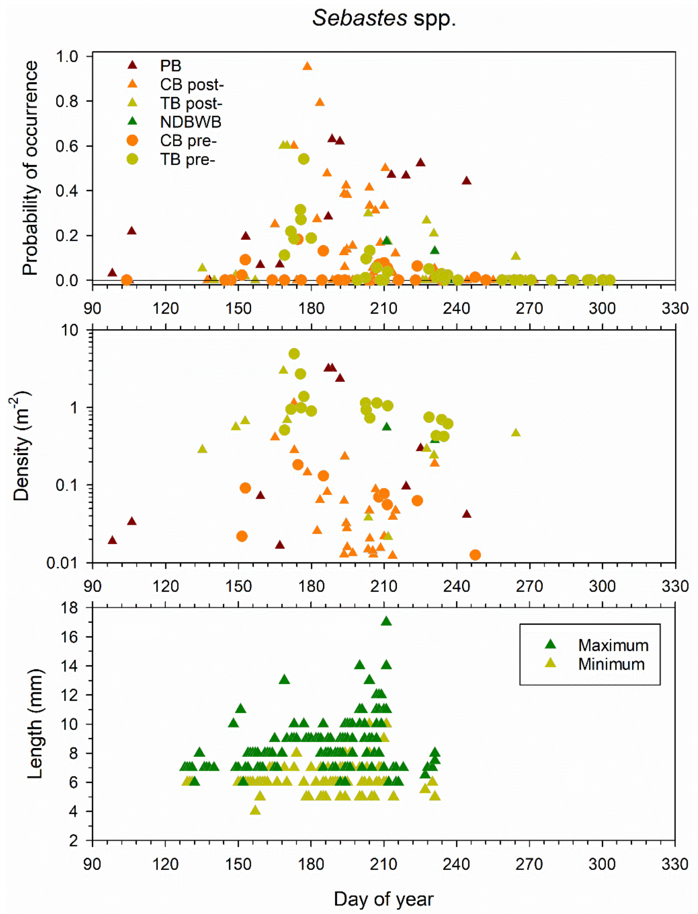
| *Ulvaria subbifurcata* – The annual cycle for radiated shanny (Supplementary Figure S16) generally resembled that of winter flounder. They first appeared in late-May and were absent in the plankton after mid-September, with peaks in occurrence in July and August, although some larvae appeared in Placentia Bay samples as early as mid-April. Occurrence was apparently higher in Conception Bay relative to Trinity and Placentia Bays, with modest likelihood of occurrence in Notre Dame and White Bays. Densities were generally comparable among bays, although greater during the pre-collapse period. Small larvae (~5-6 mm) were always present in the plankton throughout the period of occurrence, a longer time span than the spawning activity described in Scott and Scott (1988). The largest larvae occurred at the end of July. | <br><br><br>Supplementary Figure S16. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Ulvaria subbifurcata*, estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay. |

*Sebastes spp.* – Redfish probability of occurrence was moderate to low in all bays (Supplementary Figure S17) at frequencies generally higher in the post-collapse period. Larvae occurred from the end of May to early September, after which they essentially disappeared from the surveys. Individuals 5-7 mm were present throughout the period when larvae occurred, suggesting that the extrusion of larvae follow a pattern more consistent with spawning activity of *S. fasciatus* and *S. mentella* reported in Scott and Scott (1988) than that of *S. norvegicus*. Their disappearance from the plankton may indicate the cessation of spawning activity or possibly the result of transport from the bays onto the continental shelf. Densities were high and variable in all bays with the exception of Conception Bay, where abundances were generally lower.




Supplementary Figure S17. Probability of occurrence, average density (m$^{-2}$), and minimum and maximum lengths of larvae of *Sebastes* spp., estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay.

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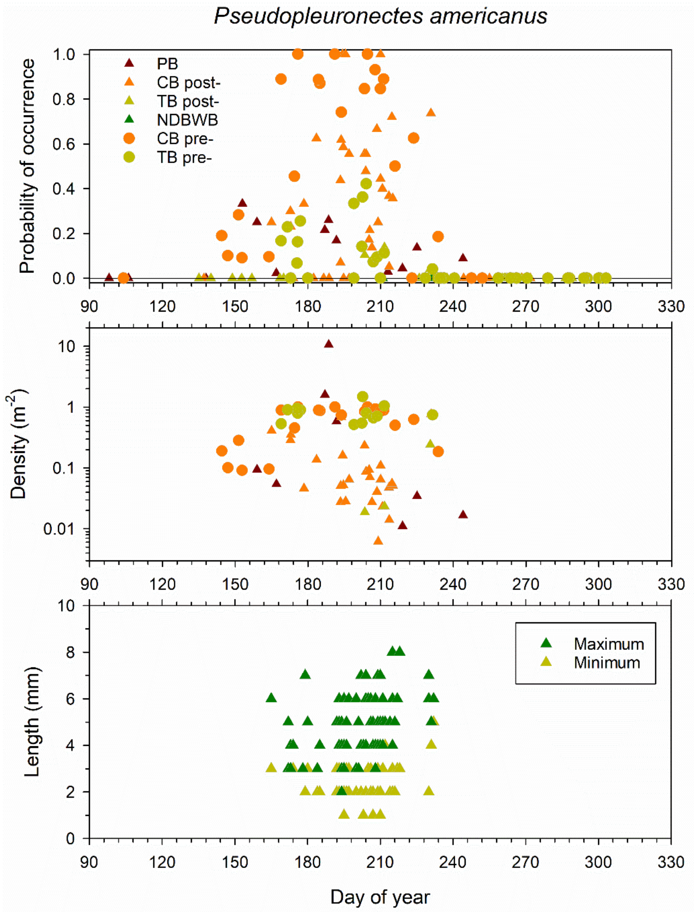
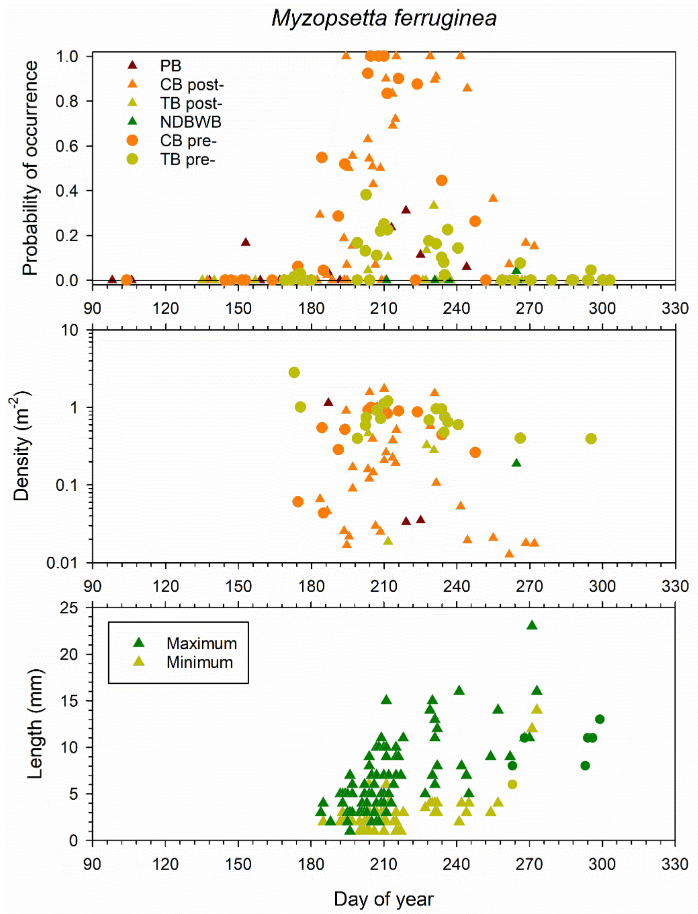
| *Pseudopleuronectes americanus* – Winter flounder larvae occurred from mid-May to the end of August (Supplementary Figure S18), peaking in July. This species was more likely to occur in Conception Bay relative to Trinity or Placentia Bays, although at comparable densities among bays when caught. Pre-collapse abundances appeared higher. The presence of small larvae from mid-June until the end of August was later than Scott and Scott (1988) reported for Newfoundland waters. Noting potential extrusion of small hatchlings (2.4 mm) through the mesh of many plankton nets, our numbers may underestimate their presence. No winter flounder were observed in Notre Dame and White Bays. |   |
| | Supplementary Figure S18. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Pseudopleuronectes americanus*, estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay. |

*Myzopsetta ferruginea* – Witch flounder larvae were abundant and frequent from late June until late September (Supplementary Figure S19). Probability of occurrence was much higher in Conception Bay than Trinity or Placentia Bays, and the timing of occurrence did not differ between pre- and post-collapse periods. We observed only one occurrence in the northern Bays. At stations where larvae occurred, densities were similar between Conception and Trinity Bays and generally lower in Placentia Bay, although they appeared to vary more during the post- than pre-collapse period. Small larvae occurred in the plankton from the end of June and into mid-September, reflecting a somewhat longer than previously reported spawning activity (Scott and Scott, 1988), and development times expected from regional variations in surface temperatures (Petrie et al., 1991; Petrie et al., 1992); only larger individuals occurred from late September and October.




Supplementary Figure S19. Probability of occurrence, average density (m$^{-2}$), and minimum and maximum lengths of larvae of *Myzopsetta ferruginea*, estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; and NDBWB – Notre Dame Bay/White Bay.

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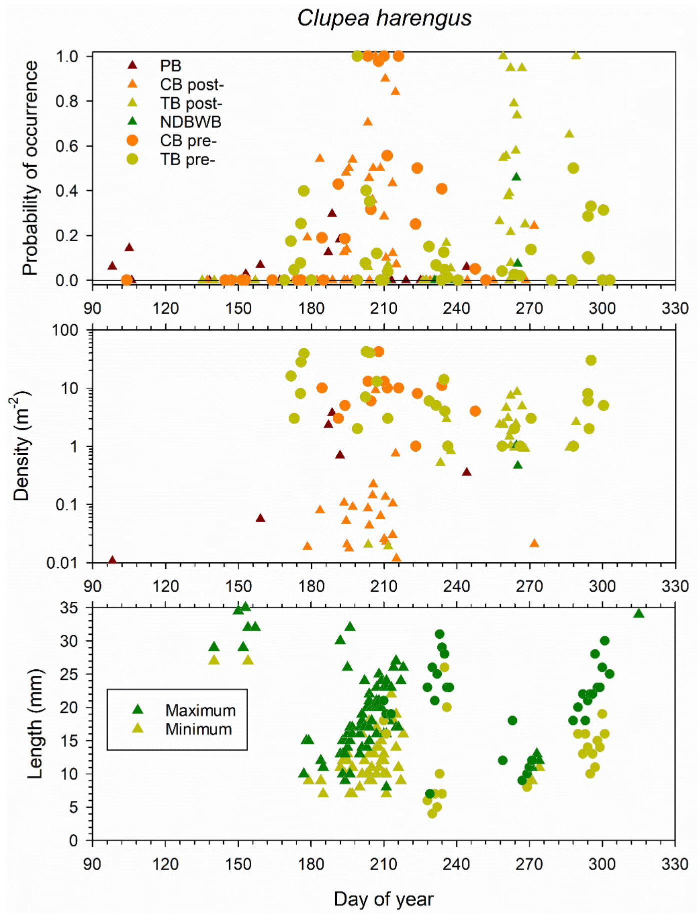
| *Clupea harengus* – Atlantic herring larvae occurred from April to October, with peak occurrence in Conception Bay at the end of July (Supplementary Figure S20) and high levels of occurrence in Trinity Bay in June/July and at the end of September. These occurrences were consistent with the spawning patterns of spring and fall spawners of local herring stocks (Bourne et al., 2023). Herring larvae occurred in Placentia, Notre Dame, and White Bays but relatively infrequently. Large individuals in the water column during April and May likely represented pelagic juveniles from the previous year. Pre-collapse densities were high in Conception and Trinity Bays, and remained so in the fall in the latter, but essentially declined by close to two orders of magnitude in Conception Bay. The presence of larvae with lengths similar to those of hatchlings (4-10 mm; Fahay (1992a)) extended from the end of June and into October. However, once in the plankton the minimum and maximum lengths increased rapidly. |  Supplementary Figure S20. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Clupea harengus*, estimated as described in the analysis section. Circles represent pre-collapse observations, triangles represent post-collapse observations. Maximum length is reported when minimum and maximum are equal. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; NDBWB – Notre Dame Bay/White Bay. |

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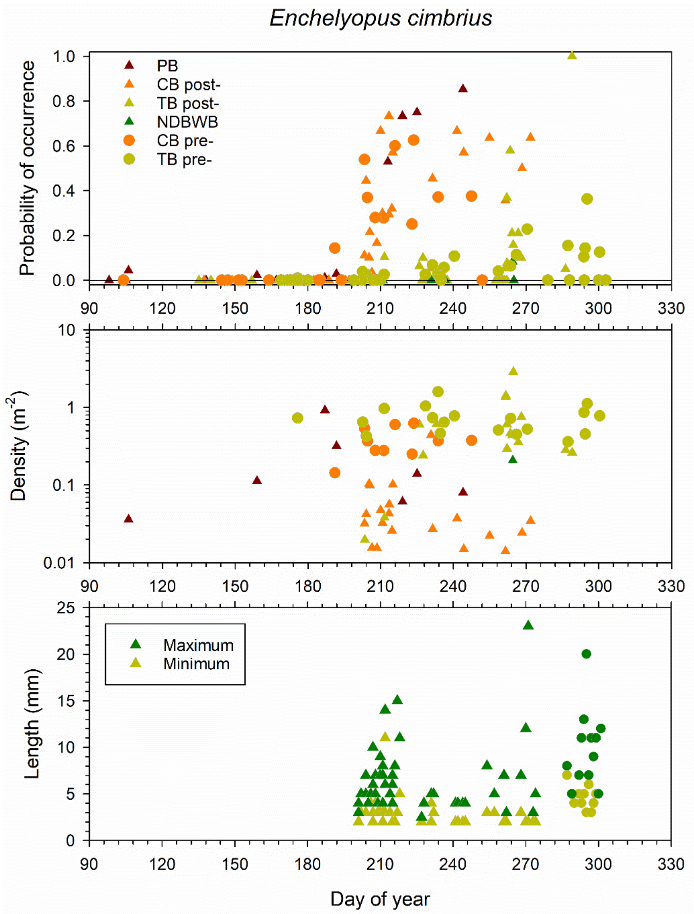
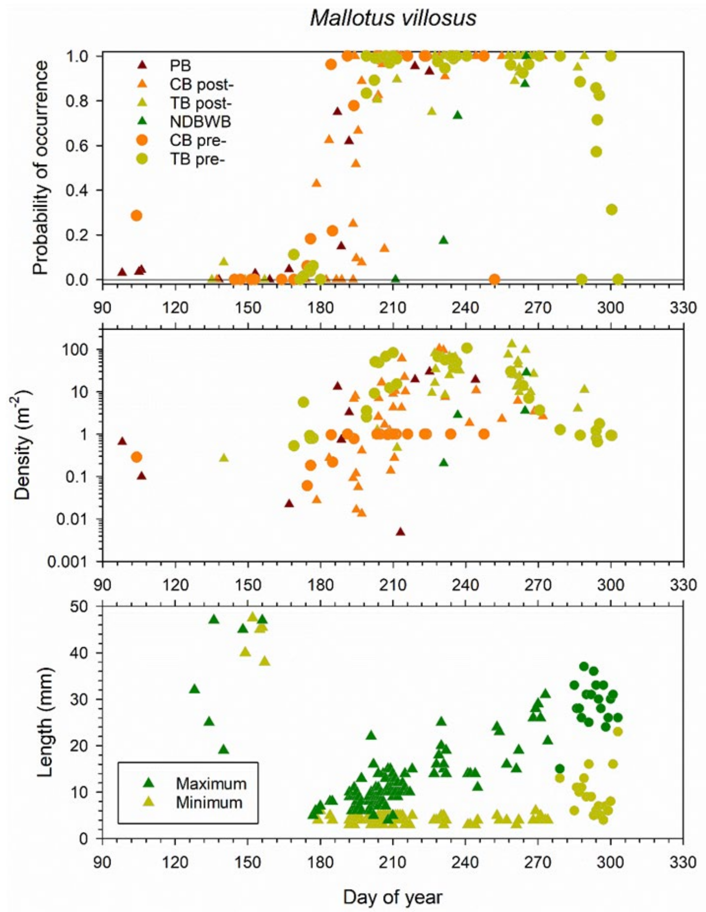
| *Enchelyopsus cimbrius* – Fourbeard rockling larvae occurred in moderate densities starting in late July until mid-October (Supplementary Figure S21), with higher probabilities of occurrence in Placentia and Conception Bays and lower probabilities in Trinity Bay later in the seasonal production cycle. Densities in pre-collapse Conception and Trinity Bays resembled post-collapse Placentia Bay. However, post-collapse densities in Conception Bay were approximately 10-fold lower relative to the pre-collapse period. The presence of recently hatched larvae (1.5-4 mm), produced from small pelagic eggs that develop in the upper water column, indicates late July until late October spawning, consistent with observations from the Bay of Fundy (Scott and Scott, 1988). |  |
| | Supplementary Figure S21. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Enchelyopus cimbrius*, estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; NDBWB – Notre Dame Bay/White Bay. |

*Mallotus villosus* – Capelin dominated the ichthyoplankton from July until October (Supplementary Figure S22). Larger larvae (>20 mm), which likely represented remnants from the previous year's larval production, contributed to their presence in April and May. Low probability of occurrence in June from Placentia to Trinity Bays preceded a steep increase starting in early July that remained high until mid-October. Occurrence in Notre Dame and White Bays increased starting in August, reflecting the latitudinal gradient in spawning activity along the coast of Newfoundland. Despite a dramatic decline in the biomass of the capelin stock (Buren et al., 2014; Buren et al., 2019) the pre- to the post-collapse period apparently had no substantial effect on the maximum probability of occurrence. However, the sharp increase in probability of larval occurrence in Conception and Trinity Bays in July was apparently delayed by 10-30 days in the post-collapse period, consistent with observations of delayed spawning timing following the collapse of the stock (Murphy et al., 2018; Buren et al., 2019). This delay in occurrence was more apparent in the rise in densities of capelin larvae in those two systems, although peak abundance during the post-collapse period appeared higher in Conception Bay and similar in Trinity Bay relative to pre-collapse densities. Furthermore, densities in Placentia, Notre Dame, and White Bays in the post-collapse period appeared to reach levels similar to that of the other bays in the region. Densities in Trinity Bay appeared to decline ~10 to 100-fold between the end of September and the end of October. We note the presence of small capelin larvae, of a length consistent with recent hatching, from the end of June until late October. Although spawning activity generally subsides in August, larvae emerging from subtidal spawning locations subjected to lower temperatures during development (Tripp et al., 2023; Tripp et al., 2024), likely contributed to the continued presence of small larvae in coastal Newfoundland.




Supplementary Figure S22. Probability of occurrence, average density (m$^{-2}$), and minimum and maximum lengths of larvae of *Mallotus villosus*, estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; NDBWB – Notre Dame Bay/White Bay.

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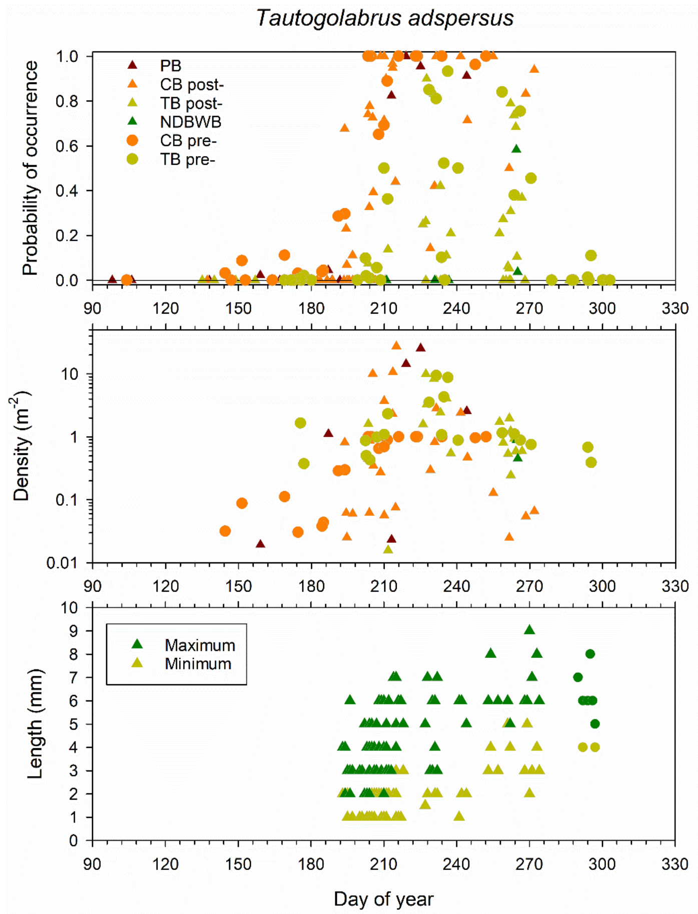
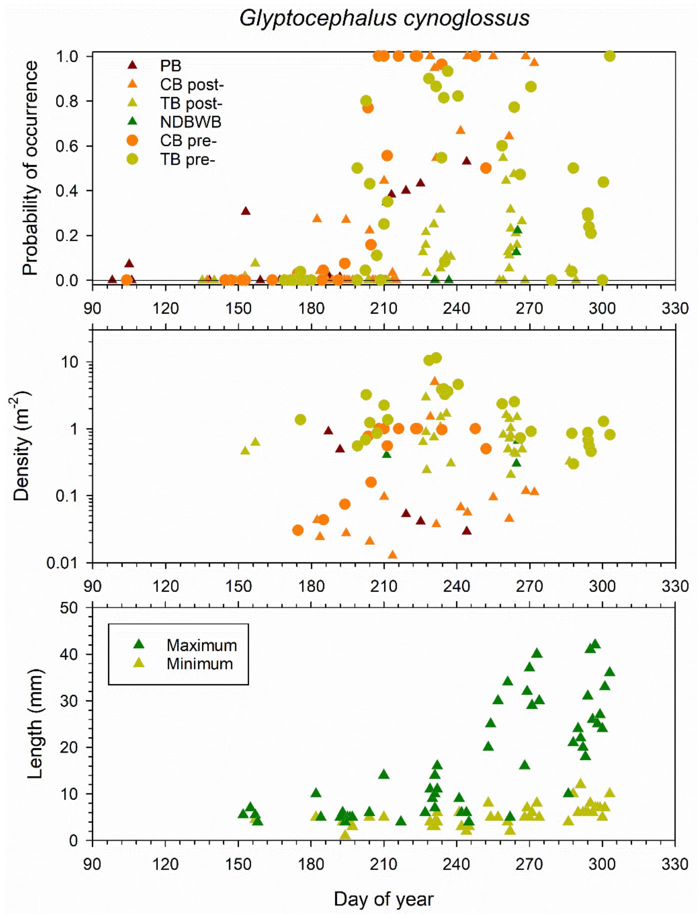
| *Tautogolabrus adspersus* – Probability of occurrence of cunner was low in June but they became more important from July to the end of September (Supplementary Figure S23). The onset of their occurrence was notably earlier in Conception and Placentia Bays relative to Trinity Bay and the northern bays, with little evidence of pre- and post-collapse period differences. Densities varied greatly but were comparable between periods of different ecosystem states and among the four areas we considered. The occurrence of larvae shortly after hatch (1-2 mm) in Conception Bay was limited to July and August, consistent with knowledge of spawning activity in the region, after which minimum length increased at a rate similar to that of the largest larvae. | <br><br><br>Supplementary Figure S23. Probability of occurrence, average density (m$^{-2}$), and minimum and maximum lengths of larvae of *Tautogolabrus adspersus*, estimated as described in the analysis section. Circles represent pre-collapse observations, triangles represent post-collapse observations. Maximum length is reported when minimum and maximum are equal. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; NDBWB – Notre Dame Bay/White Bay. |

*Glyptocephalus cynoglossus* – Witch flounder are the latest spawning flatfish (Pleuronectidae) in the region (Scott and Scott, 1998). Probabilities of occurrence were generally low from May into July, after which their presence sharply increased from Placentia to Trinity Bays (Supplementary Figure S24). Witch flounder were particularly prevalent in Conception and Trinity Bays during the pre-collapse period, and remained relatively frequent in Conception Bay in the post-collapse period in contrast to a decline in the probability of occurrence in Trinity Bay by half, or possibly more. Very low probability of occurrence characterized Notre Dame and White Bays. Although the probability of occurrence declined substantially in Trinity Bay, larval densities at sites where they do occur appeared to remain similar during the two periods of ecosystem state. Similar densities between the pre- and post-collapse periods also characterized Placentia, Notre Dame, and White Bays. However, although the probability of occurrence in Conception Bay remained relatively constant, densities during the post-collapse period were approximately 10-fold lower on average than pre-collapse. The presence of small larvae, close to the length at hatch (4-6 mm; Fahay (1992b)), persisted from June to the end of October, a pattern consistent with spawning activity of more southerly stocks (Scott and Scott, 1988). Because the pelagic eggs occur near the surface, the presence of recently hatched larvae suggests a prolonged spawning period.




Supplementary Figure S24. Probability of occurrence, average density (m$^{-2}$), and minimum and maximum lengths of larvae of *Glyptocephalus cynoglossus*, estimated as described in the analysis section. Circles represent pre-collapse observations, triangles represent post-collapse observations. Maximum length is reported when minimum and maximum are equal. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; NDBWB – Notre Dame Bay/White Bay.

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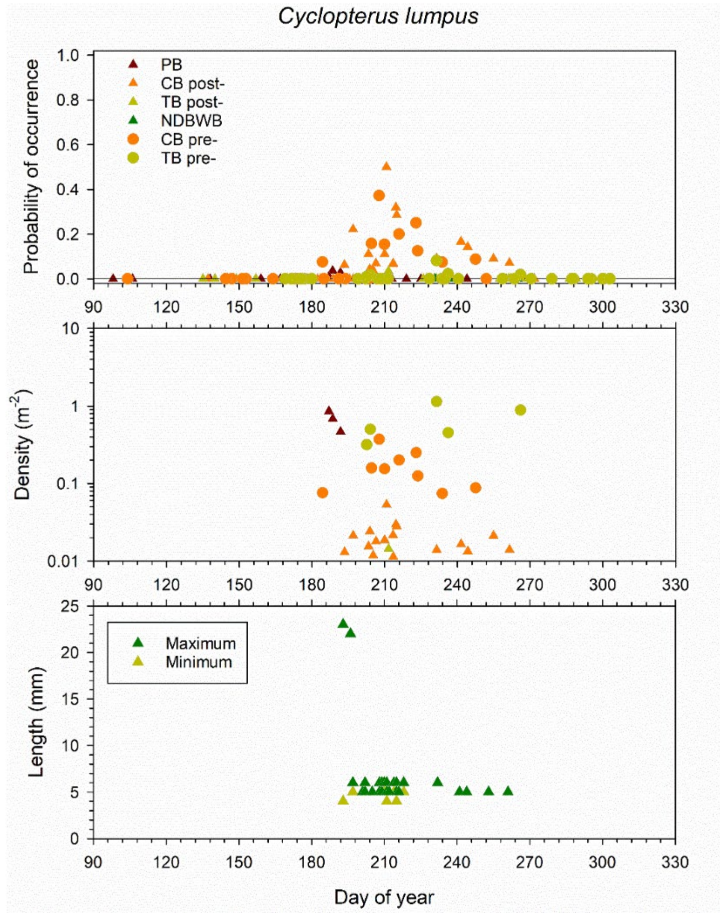
| *Cyclopterus lumpus* – Lumpfish larvae had an overall low probability of occurrence (Supplementary Figure S25), starting in July until the end of September, principally in Conception Bay relative to Trinity Bay. Despite a few occurrences in Placentia Bay, larvae were absent after mid-July. No lumpfish occurred in the northern bays. Densities were generally low and considerably greater prior to the collapse in both Conception and Trinity Bays, noting densities in Placentia Bay were comparable to those in the other two bays prior to the collapse. Larvae were almost always small (~4-6 mm), close to the size at hatch, suggesting their occurrence likely did not reflect consistent emergence from the demersal environment into the plankton for dispersal because we seldom observed larger individuals. |   |
| | Supplementary Figure S25. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Cyclopterus lumpus*, estimated as described in the analysis section. Circles represent pre-collapse observations, triangles represent post-collapse observations. Maximum length is reported when minimum and maximum are equal. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; NDBWB – Notre Dame Bay/White Bay. |

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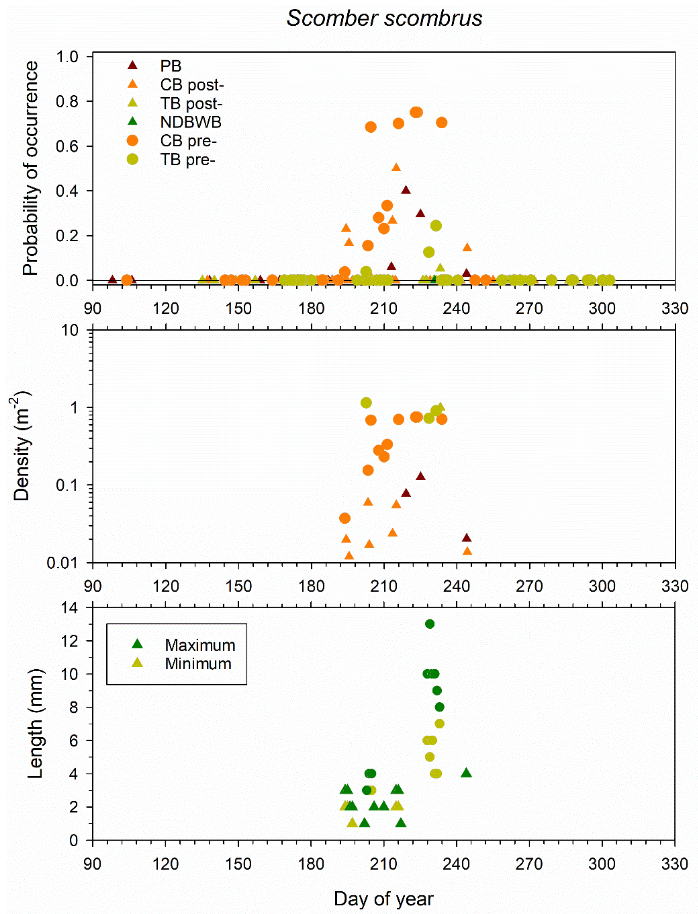
| *Scomber scombrus* – The highly migratory adults of Atlantic mackerel occur in Newfoundland water during the warmer summer months (Scott and Scott, 1988), with much more limited occurrence of eggs and larvae than in other parts of Atlantic Canada (van Beveren et al., 2023). The probability of larval occurrence was generally below 0.5, and greater in Conception Bay during the pre-collapse period than at other times or in other locations (Supplementary Figure S26). High densities only occurred from mid-July to the end of August, were greater during the pre-collapse period, and were generally well below 1 individual $m^{-2}$. Larvae with lengths consistent with that of hatchlings were only present from mid-July to mid-August, after which minimum and maximum lengths increased rapidly. | <br>Supplementary Figure S26. Probability of occurrence, average density ($m^{-2}$), and minimum and maximum lengths of larvae of *Scomber scombrus*, estimated as described in the analysis section. Maximum length is reported when minimum and maximum are equal. Circles represent pre-collapse observations, triangles represent post-collapse observations. PB – Placentia Bay; CB – Conception Bay; TB – Trinity Bay; NDBWB – Notre Dame Bay/White Bay. |

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