

## Phytoplankton Monitoring in Prince Edward Island

### Background and Objectives

Phytoplankton forms the base of the marine food web, serving as a critical food source for grazing organisms. Phytoplankton communities are highly sensitive and indicative of changes in water conditions including nutrient availability, temperature, salinity, and local grazing pressures. Their abundance and community composition are critical factors affecting shellfish growth, however an overabundance of phytoplankton can also be detrimental to the local ecosystem (i.e., harmful algal blooms) if resulting in anoxic or biotoxin events.

The Prince Edward Island (PEI) Aquaculture Division began phytoplankton monitoring in oyster aquaculture and wild fishery areas in 2025. This was initiated to provide insight into food availability and composition for oyster growth,

and to monitor changes in phytoplankton in relation to oyster population declines due to the oyster pathogens *Haplosporidium nelsoni* (MSX) and *Perkinsus marinus* (Dermo).

### Methods

A total of 86 samples were collected at seven sites across PEI (Figure 1) from May to October 2025. Sites in Foxley River, Bideford River, Rustico Bay, and Orwell River were selected based on their pre-existing inclusion in the Oyster Monitoring Program (OMP) which includes annual monitoring of oyster larvae, oyster growth, and environmental conditions (see Tech Report #287). Sites in Dunk, Wilmot and Percival Rivers were added due to severe oyster mortalities resulting from MSX infections in 2024 and early 2025.

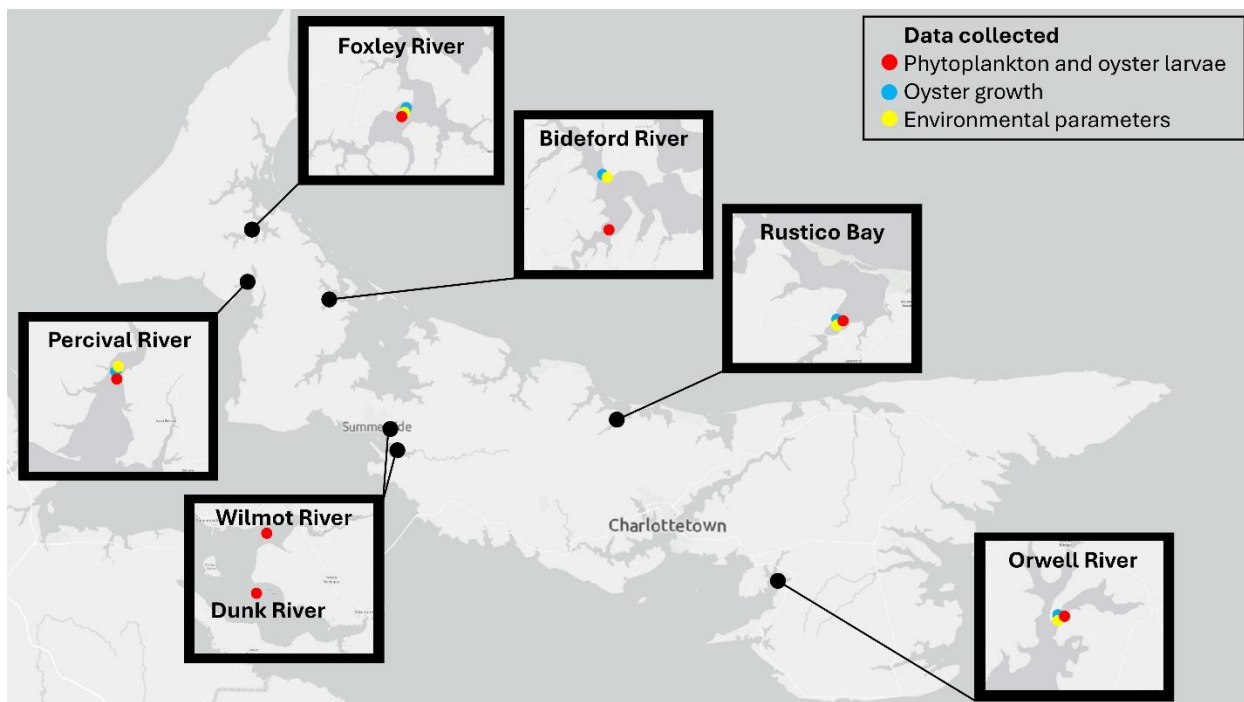
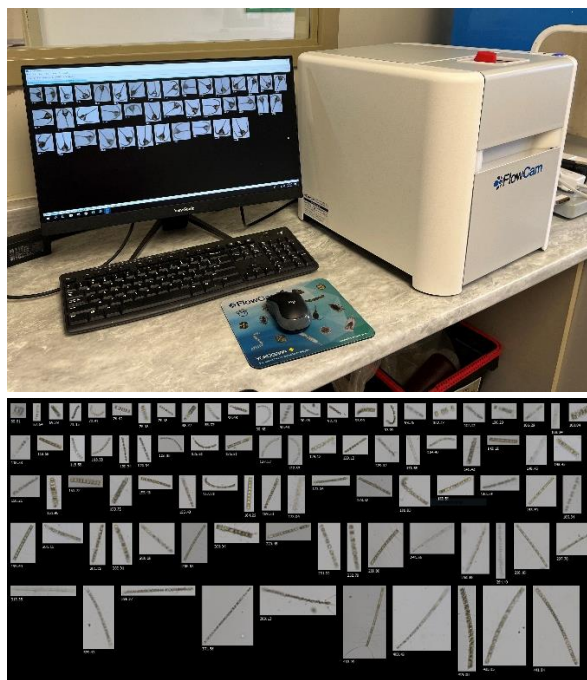


Figure 1. Phytoplankton sampling locations (red), as well as Oyster Monitoring Program (OMP) sites for oyster larvae (red), oyster growth (blue), and environmental parameters (yellow).

Clear plastic tubing (4.5 m long, 2 cm diameter) was used to collect water samples by lowering the tube into the water, keeping the bottom of the tube 0.5 m above the seafloor using a hanging weight. Once lowered, the top of the tube was sealed with a clamp, and the collected water was dispensed into a 5 L container. This method samples the entire water column, accounting for vertical differences in the distribution of phytoplankton. To minimize horizontal variability, sampling was repeated five times, and the water was gently mixed in the container. A 500 mL sample was stored on ice, in the dark, and returned to the lab where it was sieved into size fractions of 20 to 75  $\mu\text{m}$  and 75 to 250  $\mu\text{m}$  and preserved with 1% Lugol until analysis.

A 2 mL subsample of each size fraction was image-processed using a flow imaging microscopy system FlowCam 8100 (Figure 2), using a 4 $\times$  objective lens.



**Figure 2. FlowCam 8100 (top) used for phytoplankton imaging and sorting (bottom).**

All images were cleaned (i.e., removed images of debris and bubbles) and classified into the following functional groups: centric diatoms, pennate diatoms, unidentified diatoms, dinoflagellates, and unidentified phytoplankton. Phytoplankton abundance was reported as

individuals  $\text{m}^{-3}$ , with “individuals” representing images of individual cells, chains, or clumps. Phytoplankton abundance should therefore be interpreted as an estimate rather than an exact count of phytoplankton cells present in the water column. Additionally, many phytoplankton taxa can be as small as 0.2  $\mu\text{m}$ , however a minimum of 20  $\mu\text{m}$  was used in this study due to identification resolution using the 4 $\times$  objective lens on the FlowCam. It is therefore important to note that phytoplankton smaller than 20  $\mu\text{m}$  have important ecological and nutritional contributions that are not accounted for in this dataset.

### ***Phytoplankton abundance and community composition***

Phytoplankton abundance ranged from  $5 \times 10^4$  to  $2.4 \times 10^8$  individuals  $\text{m}^{-3}$ . Blooms of centric diatoms (primarily *Chaetoceros* spp., 20 to 75  $\mu\text{m}$ ) were observed in late June and mid-October in the Dunk and Wilmot Rivers, whereas they were observed in mid-September in Foxley River, Bideford River, and Rustico Bay (Figures 3 & 4). No significant blooms were captured in Percival River or Orwell River.

When food is abundant, bivalves can preferentially select plankton based on size, shape, and nutritional value. Phytoplankton community composition is therefore important to quantify in addition to total abundance. Figure 4 details seasonal variations in the dominant phytoplankton functional groups at each site.

### ***Ratio of centric diatoms to pennate diatoms***

The ratio of centric to pennate diatoms may be used as an indicator for water clarity/turbidity based on the vertical distribution of phytoplankton within the water column. This is because centric diatoms generally inhabit the upper water column, meanwhile many pennate diatoms live on the bottom or attached to substrate. Additionally, most freshwater diatom species are pennate, therefore areas or time periods experiencing greater freshwater input (i.e., spring melt) may see influxes of pennate diatoms.

Our results indicated a greater proportion of pennate diatoms in May, the only month to experience higher-than-average rainfall (Table

1). The ratio of centric to pennate diatoms varied between sites throughout June and July (Figure 5). Percival River and Orwell River were dominated by pennate diatoms, whereas the Dunk and Wilmot Rivers were dominated by centric diatoms, and the north shore sites (Foxley River, Bideford River, Rustico Bay) showed variation. All sites were dominated by centric diatoms from August to October, except for Orwell River.

**Table 1. Monthly rainfall (mm) recorded in Summerside, PEI ([Historical Data - Climate - Environment and Climate Change Canada](#)).**

	2014-2024	2025
<b>May</b>	62 ± 36	89
<b>June</b>	92 ± 45	50
<b>July</b>	57 ± 31	41
<b>August</b>	94 ± 40	22
<b>September</b>	96 ± 59	35
<b>October</b>	90 ± 27	66

#### ***Ratio of diatoms to dinoflagellates***

The ratio of diatoms to dinoflagellates may be used as an indicator of environmental and ecosystem changes affecting water quality and ecosystem dynamics. Diatoms have a faster growth rate and can outcompete dinoflagellates when there are abundant inorganic nutrients, such as nitrogen, in the water. Many dinoflagellates have the ability to graze on smaller plankton, in addition to photosynthesizing, therefore dinoflagellates tend to become more dominant when inorganic nutrient availability is limited. Our results indicate that most samples were dominated by diatoms (Figure 5), as expected in coastal PEI waters, which receive high nutrient inputs from agricultural activities. The few samples that showed greater proportions of dinoflagellates were collected in July or early August, indicating generally lower inorganic nutrient availability during that time.

It is unclear whether major declines in oyster populations (due to MSX and Dermo) may favor the growth of diatoms or dinoflagellates. Diatoms

may be favored due to increased availability of inorganic nutrients in the water column that are not filtered out during oyster feeding. However, water clarity is expected to decrease if these water systems are not being filtered by important bivalve populations, thereby favoring dinoflagellates that have a better ability to adjust their position in the water column for optimal grazing and photosynthesizing. Nevertheless, a significant decline in filter feeding can have negative effects on water quality and may result in increased phytoplankton biomass, with risks of proliferation of harmful phytoplankton and depletion of dissolved oxygen in bottom waters having damaging effects on ecosystem health.

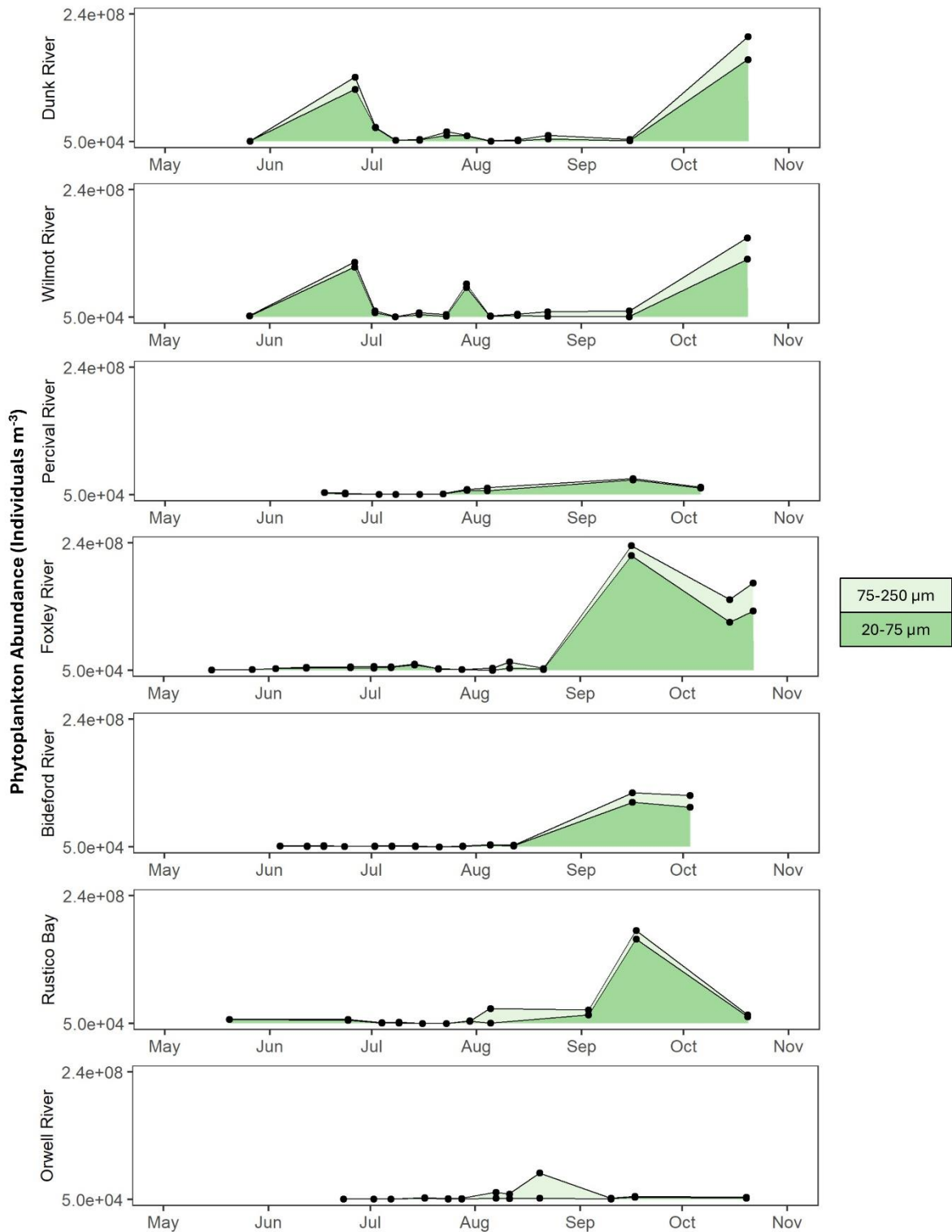
#### ***Baseline Data Collection***

2025 is the first year of sample collection, therefore there is no current baseline phytoplankton data to use for comparison under “typical” conditions, particularly considering that 2025 experienced less-than-normal rainfall (Table 1). The data presented in this report will serve as a foundation for long-term phytoplankton monitoring to capture changes in PEI waters.

#### ***Conclusion***

Phytoplankton monitoring is important for informing food availability for oyster growth as well as water quality for overall ecosystem health. The data presented in this report serves as a foundation for long-term phytoplankton monitoring to understand changes in PEI waters as a result of 1) inter-annual variation in environmental conditions, and 2) declines in important oyster populations due to MSX and Dermo.

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**Figure 3. Total phytoplankton (20 – 250 μm) abundance (individuals m<sup>-3</sup>) with “individuals” representing images of individual cells, chains, or clumps.**

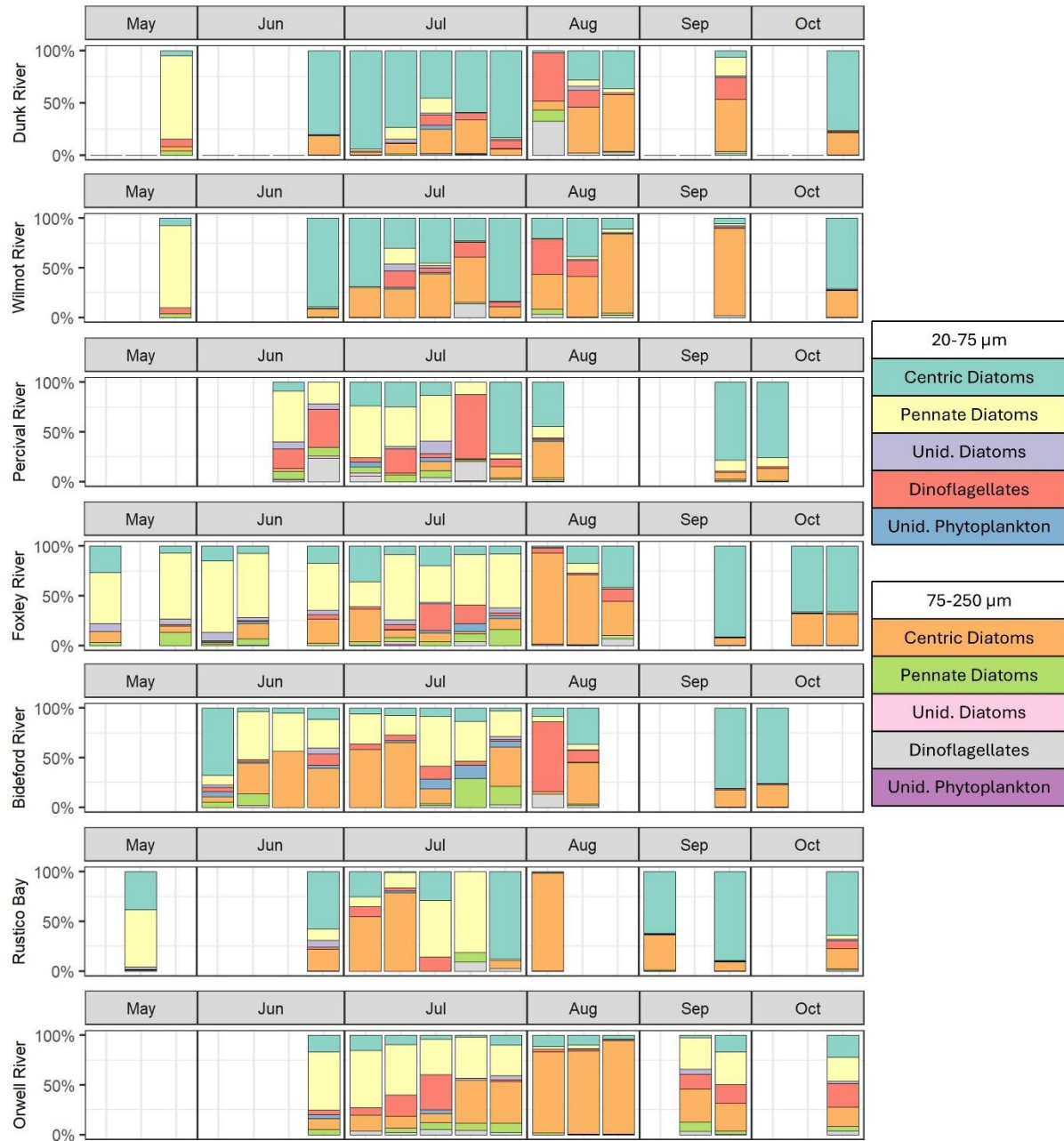
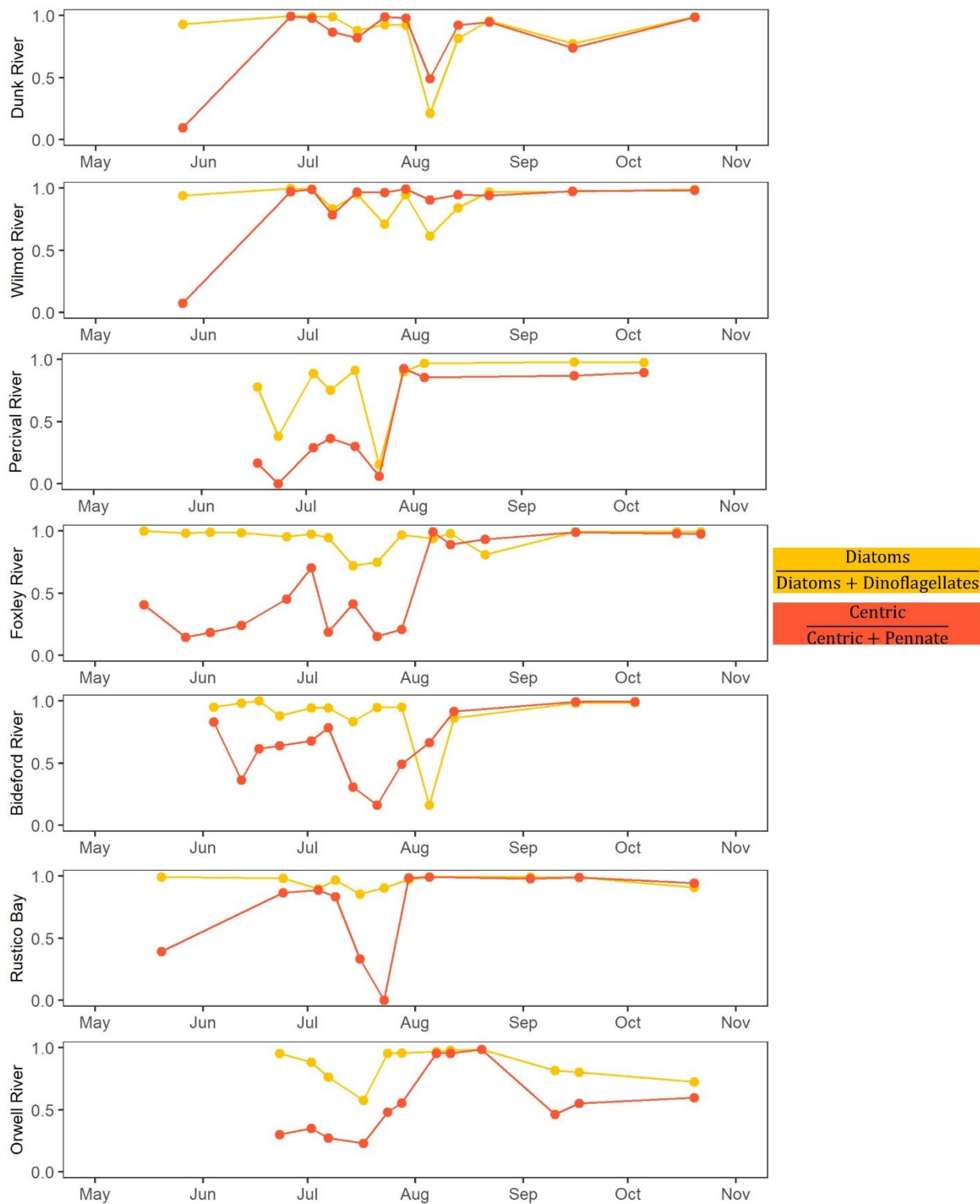


Figure 4. Relative contributions of major phytoplankton (20 – 250 μm) functional groups.



**Figure 5. Relative contributions of diatoms and dinoflagellates (yellow) and centric and pennate diatoms (red) for the total 20 – 250 μm size fraction.**