Nutrient Concentrations (SOOE Extended)

Please note that this section contains both "Methods and Data Sources" as well as "Additional Discussion" and over 15 additional tables and figures.

Methods and Data Sources

Trend analysis for nitrogen and phosphorus species was performed at the following stations:

- GRBAP (Adams Point between Great Bay and Little Bay)
- GRBGB (Great Bay)
- GRBCL (Chapmans Landing in the Squamscott River)
- GRBSQ (Squamscott River at the railroad trestle)
- GRBLR (Lamprey River)
- GRBOR (Oyster River)
- GRBUPR (Upper Piscataqua River)
- GRBCML (Portsmouth Harbor)
- HHHR (Hampton River)
- GRBBR (Bellamy River)
- GRBCR (Cocheco River)

With regard to nitrogen species, this report focuses on total nitrogen and dissolved inorganic nitrogen; data are also available for ammonia, nitrate+nitrite, total dissolved nitrogen, and particulate nitrogen and can be obtained by querying the NHDES Environmental Monitoring Database or by contacting PREP staff. Total nitrogen is a calculated variable resulting from the summation of total dissolved nitrogen and particulate nitrogen. The phosphorus parameter for trend analysis was orthophosphate and is included in this report. Samples collected at low tide at the trend stations were identified and used for the trend analysis to control for the effects of tides and because historic datasets were collected exclusively at low tide. The data for each station were averaged by month (there was rarely more than one sample in the same month) and then the number of months with data in each year was counted. Only data from the months April through December were used. The only exception was the Adams Point station, which is monitored 12 months per year. Only years with at least seven data points were included in the analysis. This was done to minimize bias from years for which the data do not reflect at least half of the year. Linear regression was used to test for long-term trends between measured concentration and year of measurement. Trends were considered significant if the slope coefficient of the year variable was significant at the $p < 0.05$.

Data Sources

Data for this indicator were provided by the UNH and Great Bay NERR Tidal Water Quality Monitoring Programs for the years 1992 to present. Historic datasets from 1974 to 1981 (Norall et al. 1982; Loder et al. 1983) were also included in the trend analysis for station GRBAP. Additional trend monitoring stations were added in 2017 in the Bellamy and Cocheco Rivers and in Hampton-Seabrook Harbor by the PREP Tidal Water Quality Monitoring Program.

Additional Discussion

Trend analysis results for nitrogen species and orthophosphate showed varied responses across monitoring stations (Table 8.3). Concentrations of dissolved inorganic nitrogen (DIN) for individual monitoring stations are shown in Figures 8.2 through 8.12. Figures 8.13 through 8.23 display total nitrogen (TN) concentrations for individual monitoring stations and Figures 8.24 through 8.34 depict orthophosphate concentrations over time. *(Note that figure and table numbers are continued from the Printed Report.)*

For DIN, only two monitoring stations had a significant decreasing trend in concentrations over time, the Oyster River (Figure 8.8) and the Upper Piscataqua River (Figure 8.3, found in State of Our Estuaries Report). Recent (2016 – 2021) annual median concentrations at these two stations were comparable. The annual median concentration in 2021 was the highest of the last six years for both of these stations. One station exhibited a significant increasing trend in DIN concentrations, Chapman's Landing on the Squamscott River (Figure 8.4). The range in recent annual median concentrations was the highest at Chapman's Landing, spanning from 0.42 to 0.47 mg-N/L (Table 8.3).

The remaining monitoring stations did not have significant linear trends in DIN concentrations over time. At the Squamscott River monitoring station, annual median concentrations from 2019 to 2021 were lower than the previous six years (Figure 8.5). Both Great Bay Estuary and Hampton-Seabrook Estuary appear comparable in DIN concentrations with both the GRBGB (Figure 8.7) and HHHR (Figure 8.10) stations showing similar concentrations over time. Neither of those monitoring stations had annual median concentrations exceeding 0.20 mg-N/L. While there was no trend in DIN for the Cocheco River between 2016 and 2018 (Figure 8.12), median annual concentrations were higher than other nearby stations (Bellamy and Upper Piscataqua Rivers).

The Adams Point and Coastal Marine Lab stations were the only monitoring stations to exhibit a significant decrease in TN concentration over time (Figures 8.13 and 8.20). At Adams Point, TN concentrations were high in the early 2000s. From 2004 – 2010, only one year had annual median total nitrogen concentration below the EPA definition of low total nitrogen (0.31 mg-N/L). Between 2011 and 2021, five different years had annual medians of 0.31 mg-N/L or lower at the Adams Point station. Recent (2016-2017) annual median concentrations ranged from 0.21 to 0.24 mg-N/L at the Coastal Marine Lab station. Additionally, only 3 of the 15 monitoring years had annual medians in excess of 0.31 mg-N/L. Both monitoring stations on the Squamscott River (Chapman's Landing and Squamscott River) had increasing trends in total nitrogen concentration over time (Figures 8.14 and 8.15). These stations had the highest annual median concentrations out of all the monitoring stations, ranging from 0.63 to 1.04 mg-N/L across the two stations (Table 8.3).

The remaining monitoring stations did not exhibit trends in total nitrogen over time. Annual median total nitrogen concentrations at the Great Bay station exhibited a wider range (0.29 – 0.52 mg-N/L) than those at the Hampton River Station (0.38 – 0.47 mg-N/L) (Table 8.3). At the Lamprey River station, total nitrogen peaked in 2016 with an annual median of 0.63 mg-N/L (Figure 8.16). Following that peak, concentrations have ranged between 0.39 and 0.48 mg-N/L.

The Oyster River station exhibited a different pattern, reaching an all-time low in 2016 with an annual median of 0.42 mg-N/L (Figure 8.18).

Although nitrogen tends to dominate nutrient discussions in estuarine systems, phosphorus is also important and can be the "limiting nutrient" at specific times in the year (usually in the spring and fall, when nitrogen loading is highest) and in specific areas (often in medium salinity parts of the estuary) where algae growth is quite high. The sources of phosphorus are similar to the sources of nitrogen: wastewater treatment plants, atmospheric deposition, fertilizer and stormwater.

Temporal trends in orthophosphate (the species of phosphorus most often measured) concentrations occurred at three out of the eleven monitoring stations. At the Adams Point station, orthophosphate has decreased over time since the early 1970s (Figure 8.24). Recent annual medians at Adams Point ranged from 0.01 to 0.02 mg-P/L. Both the Squamscott (Figure 8.26) and Lamprey (Figure 8.27) Rivers exhibited increasing trends in orthophosphate concentrations over time. Annual median concentrations between 2016 and 2021 were higher in the Squamscott than in the Lamprey, with the Lamprey ranging between 0.01 and 0.03 mg-P/L (Table 8.3). The Lamprey River had higher intra-annual variability in orthophosphate. For example, in 2016 concentrations of orthophosphate reached a high of 0.15 mg-P/L in October and a low of 0.01 mg-P/L in May.

No other monitoring stations had linear trends for orthophosphate over time. Overall, concentrations were low across all sites. The highest annual median between 2016 and 2021 was 0.06 mg-P/L in the Oyster River (Table 8.3). These low concentrations are comparable to other estuaries, with a reported median phosphate concentration of 0.05 mg-P/L in the Choptank River Estuary in Maryland (2005-2008) (Whitall et al., 2010).

For orthophosphate, the EPA (2012) categories are: less than 0.01 mg/L is "good"; between 0.01 and 0.05 is "fair"; and above 0.05 mg/L is "poor". Based on annual median concentrations for each station's entire monitoring record (Figures 8.24 through 8.34), the majority of stations classify as "fair". The Lamprey River station oscillates the most between the "good" and "fair" categories with a number of individual observations falling well below the 0.01 mg-P/L threshold set by the EPA. Great Bay, relative to other stations, shows more results in the "good" category. Chapmans Landing, Lamprey River and Oyster River show results in both the "fair" and "poor" category. The above EPA thresholds are general values for the entire Northeast region of the country (EPA 2012).

Additional Data Tables and Figures

Table 8.3 Trends for nutrient species and recent annual median values for 10 stations in the Great Bay Estuary and one station in the Hampton-Seabrook Estuary.

Station	Parameter	Period	Range of Recent Median Values (2016-2021)	Long Term Trend
GRBAP (Adams Point)	Dissolved Inorganic Nitrogen	1974 – 2021	0.06 – 0.15	No
	Total Nitrogen	2004 – 2021	0.27 – 0.37	Yes (decreasing)
	Orthophosphate	1974 – 2021	0.01 – 0.02	Yes (decreasing)
GRBCL (Chapman's Landing)	Dissolved Inorganic Nitrogen	1992 – 2018	0.42 – 0.47	Yes (increasing)
	Total Nitrogen	2004 – 2018	0.90 – 1.04	Yes (increasing)
	Orthophosphate	1992 – 2018	0.04 – 0.05	No
GRBSQ (Squamscott River)	Dissolved Inorganic Nitrogen	2002 – 2021	0.19 – 0.42	No
	Total Nitrogen	2004 – 2021	0.63 – 1.04	Yes (increasing)
	Orthophosphate	2005 – 2021	0.04 – 0.05	Yes (increasing)
GRBLR (Lamprey River)	Dissolved Inorganic Nitrogen	1992 – 2021	0.12 – 0.21	No
	Total Nitrogen	2004 – 2021	0.39 – 0.63	No
	Orthophosphate	1992 – 2021	0.01 – 0.03	Yes (increasing)
GRBGB (Great Bay)	Dissolved Inorganic Nitrogen	2002 – 2021	0.06 – 0.15	No
	Total Nitrogen	2004 – 2021	0.29 – 0.52	No
	Orthophosphate	2002 – 2021	0.02 – 0.03	No
GRBOR (Oyster River)	Dissolved Inorganic Nitrogen	2005 – 2021	0.13 – 0.20	Yes (decreasing)
	Total Nitrogen	2004 – 2021	0.42 – 0.59	No
	Orthophosphate	2005 – 2021	0.02 – 0.06	No
GRBUPR (Upper Piscataqua River)	Dissolved Inorganic Nitrogen	2007 – 2021	0.14 – 0.20	Yes (decreasing)
	Total Nitrogen	2009 – 2021	0.37 – 0.48	No
	Orthophosphate	2007 – 2021	0.02 – 0.03	No
GRBCML (Coastal Marine Lab Portsmouth Harbor)	Dissolved Inorganic Nitrogen	2001 – 2017	0.07 – 0.12	No
	Total Nitrogen	2005 – 2017	0.21 – 0.24	Yes (decreasing)
	Orthophosphate	2002 – 2017	0.01 – 0.02	No
HHHR (Hampton River)	Dissolved Inorganic Nitrogen	2018 – 2021	0.09 – 0.12	No
	Total Nitrogen	2018 – 2021	0.38 – 0.47	No
	Orthophosphate	2018 – 2021	0.01 – 0.02	No
GRBBR (Bellamy River)	Dissolved Inorganic Nitrogen	2018	0.14	NA
	Total Nitrogen	2018	0.47	NA
	Orthophosphate	2018	0.02	NA
GRBCR (Cocheco River)	Dissolved Inorganic Nitrogen	2016 – 2020	0.22 – 0.25	No
	Total Nitrogen	2016 – 2020	0.50 – 0.57	No
	Orthophosphate	2016 – 2020	0.02 – 0.04	No

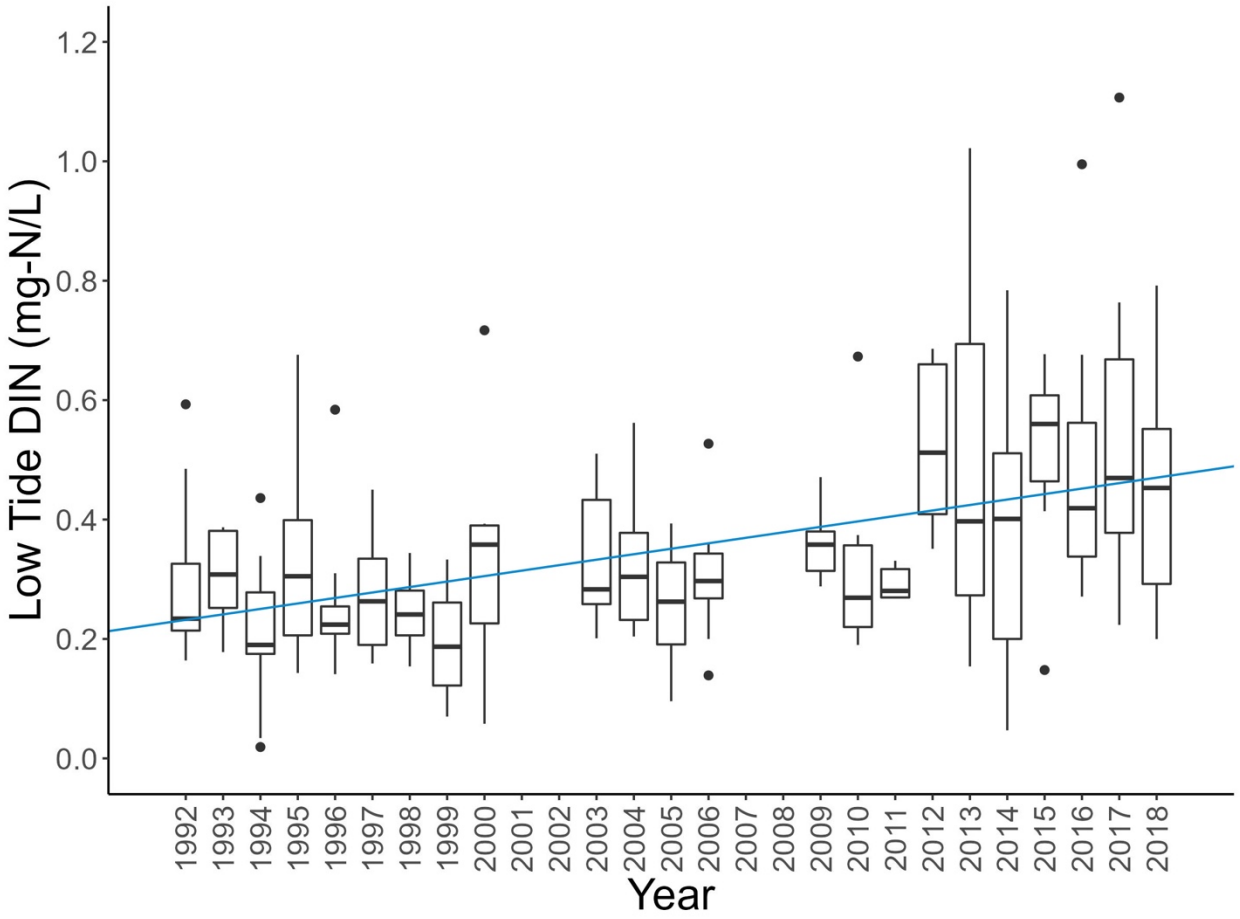

Figure 8.4: Dissolved inorganic nitrogen (DIN) at the Chapman's Landing Station (along the Squamscott River) shows an increasing trend based on data collected monthly at low tide between 1992 and 2018 and shown here as box and whisker plots. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. Blue line represents significant linear regression through all data points. *Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH*

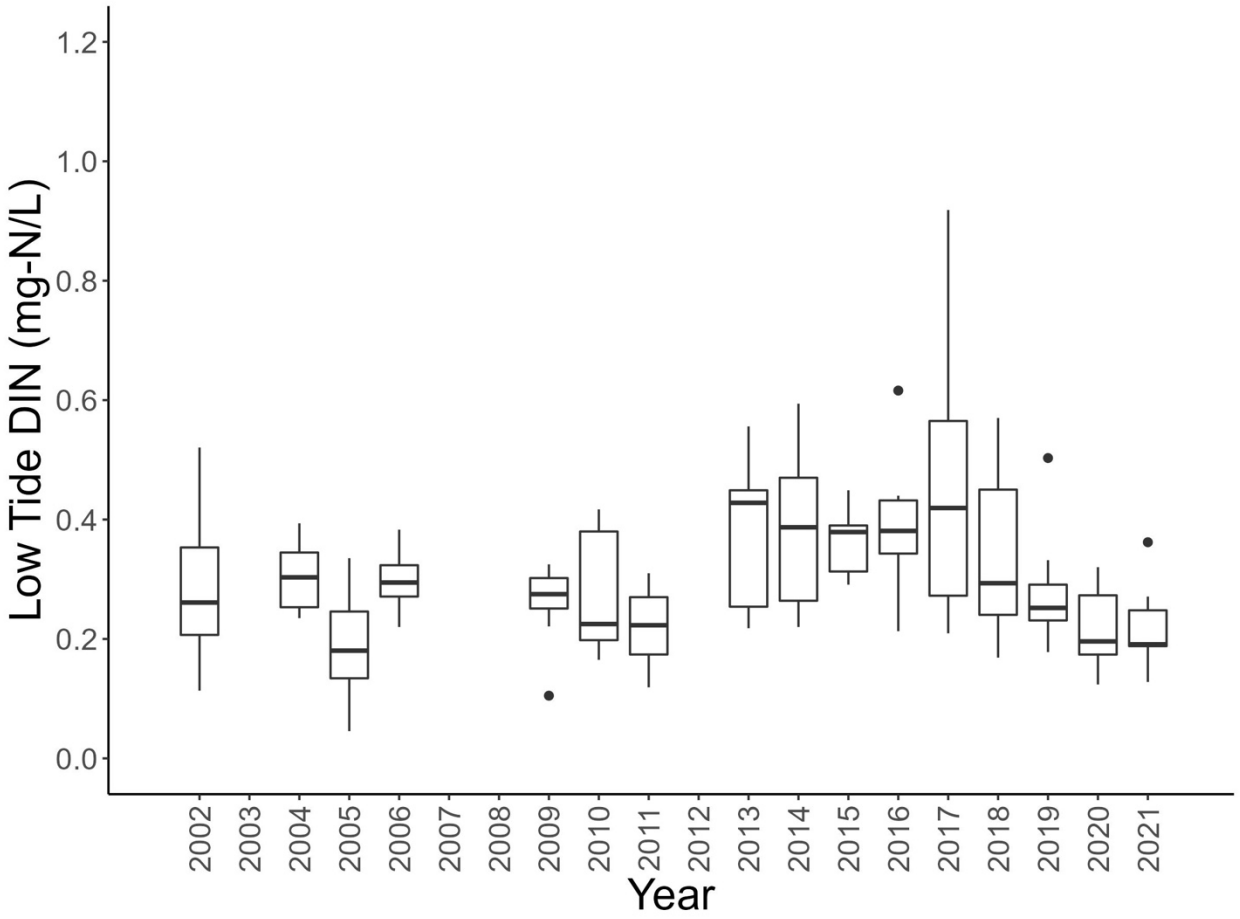

Figure 8.5: Dissolved inorganic nitrogen (DIN) at the Squamscott River Station. Box and whisker plots show DIN concentrations collected monthly at low tide between 2002 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

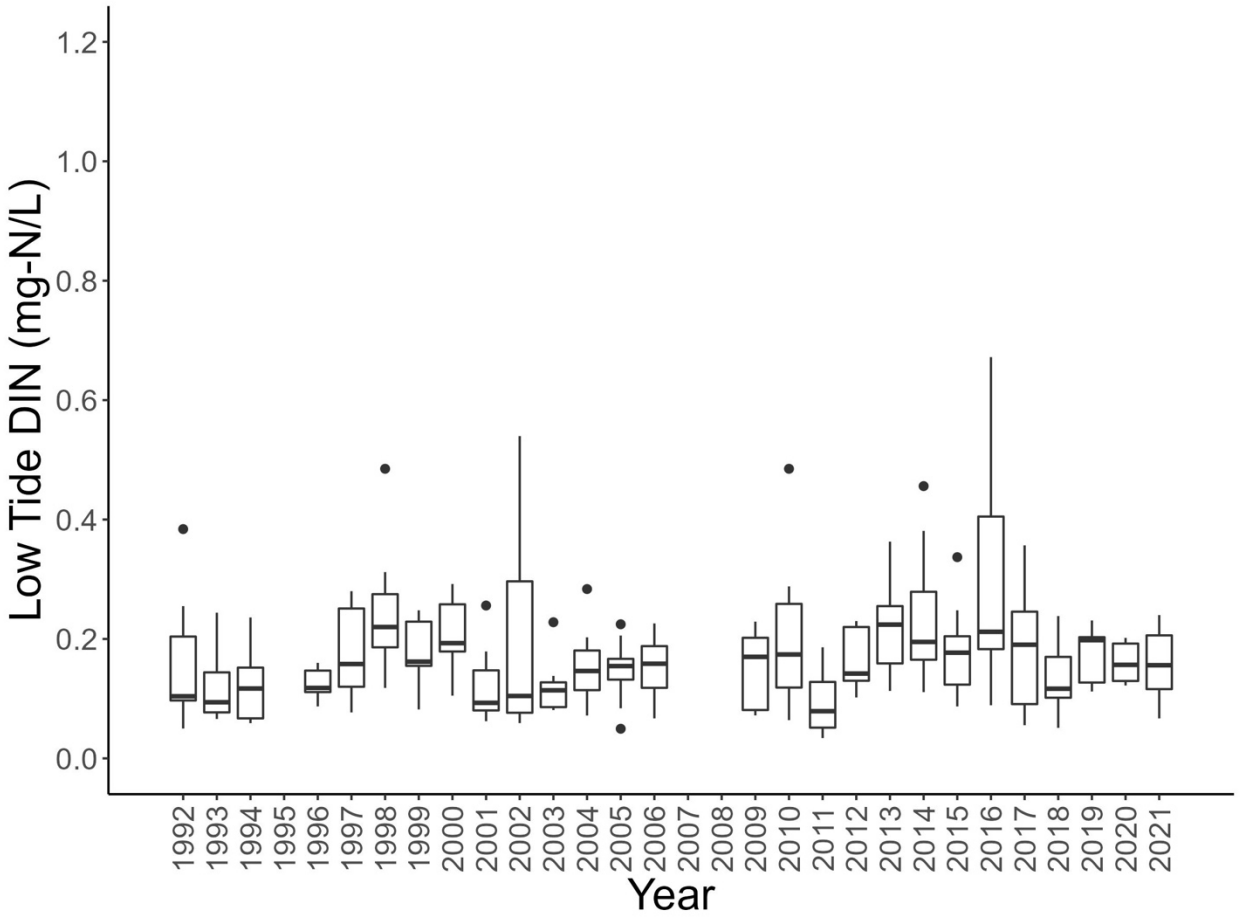

Figure 8.6: Dissolved inorganic nitrogen (DIN) at the Lamprey River Station. Box and whisker plots show DIN concentrations collected monthly at low tide between 1992 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

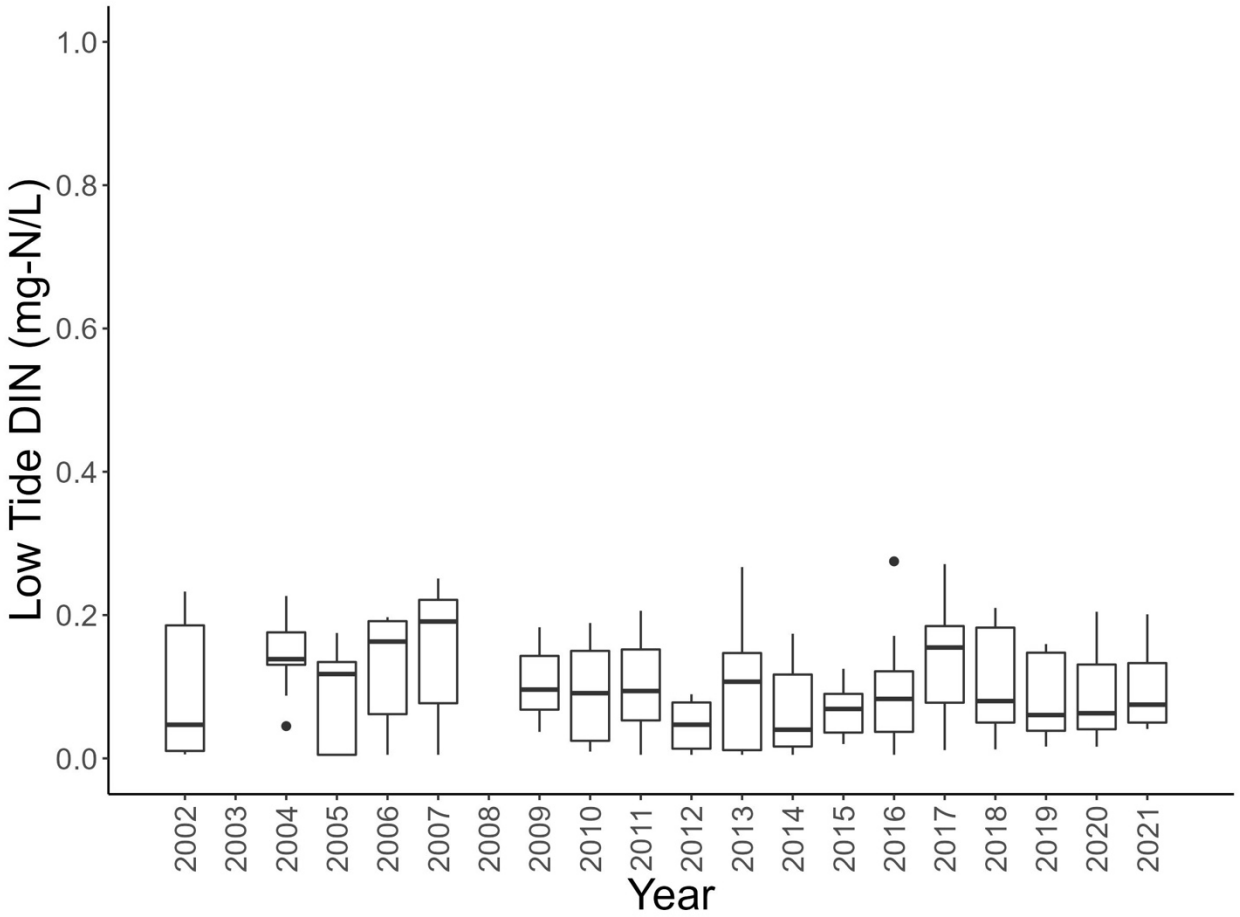

Figure 8.7: Dissolved inorganic nitrogen (DIN) at the Great Bay Station. Box and whisker plots show DIN concentrations collected monthly at low tide between 2002 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

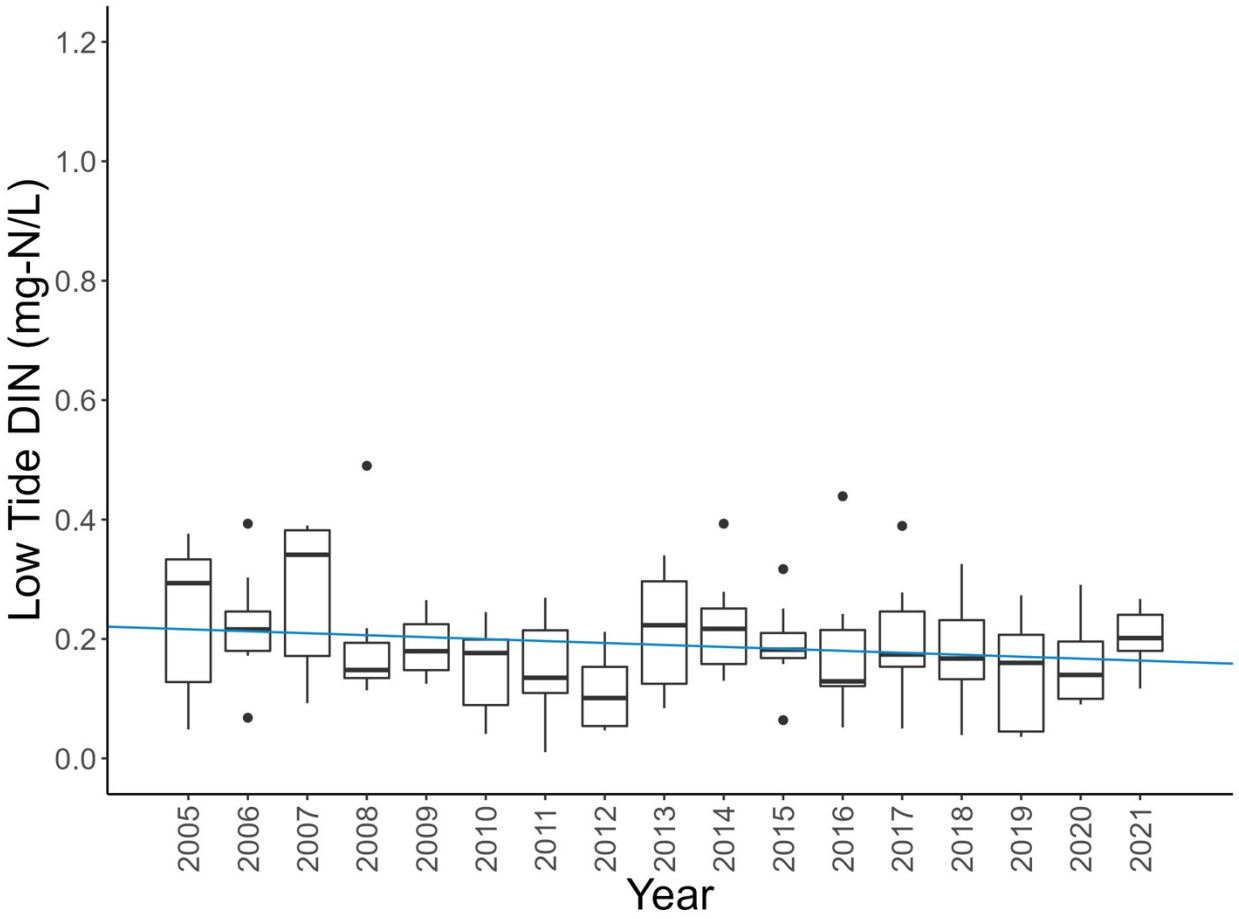

Figure 8.8: Dissolved inorganic nitrogen (DIN) at the Oyster River Station shows a decreasing trend based on data collected monthly at low tide between 2005 and 2021 and shown here as box and whisker plots. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. Blue line represents significant linear regression through all data points. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

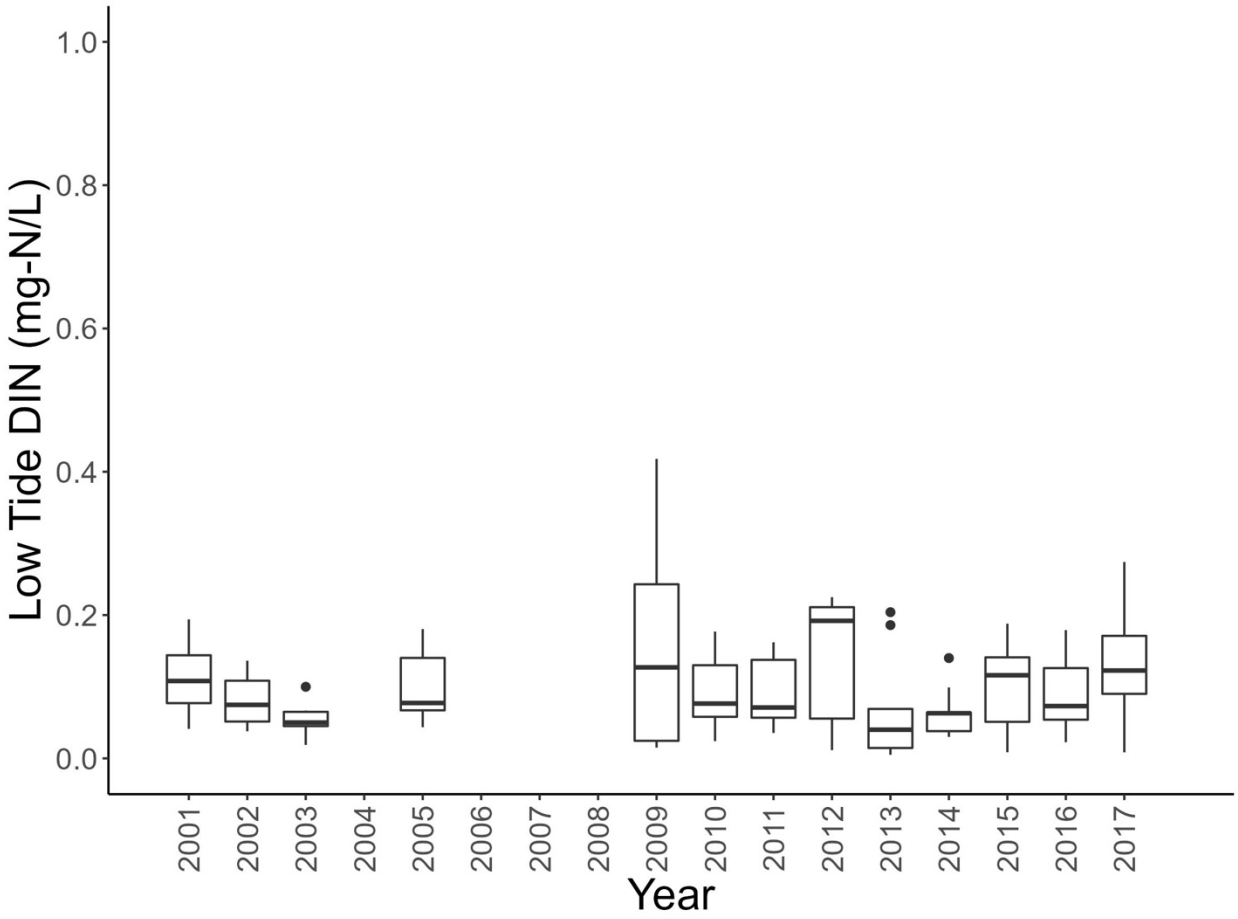

Figure 8.9: Dissolved inorganic nitrogen (DIN) at the Coastal Marine Lab (Portsmouth Harbor) Station. Box and whisker plots show DIN concentrations (ollected monthly at low tide between 2001 and 2017. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. *Data Source: Jackson Estuarine Laboratory, UNH*

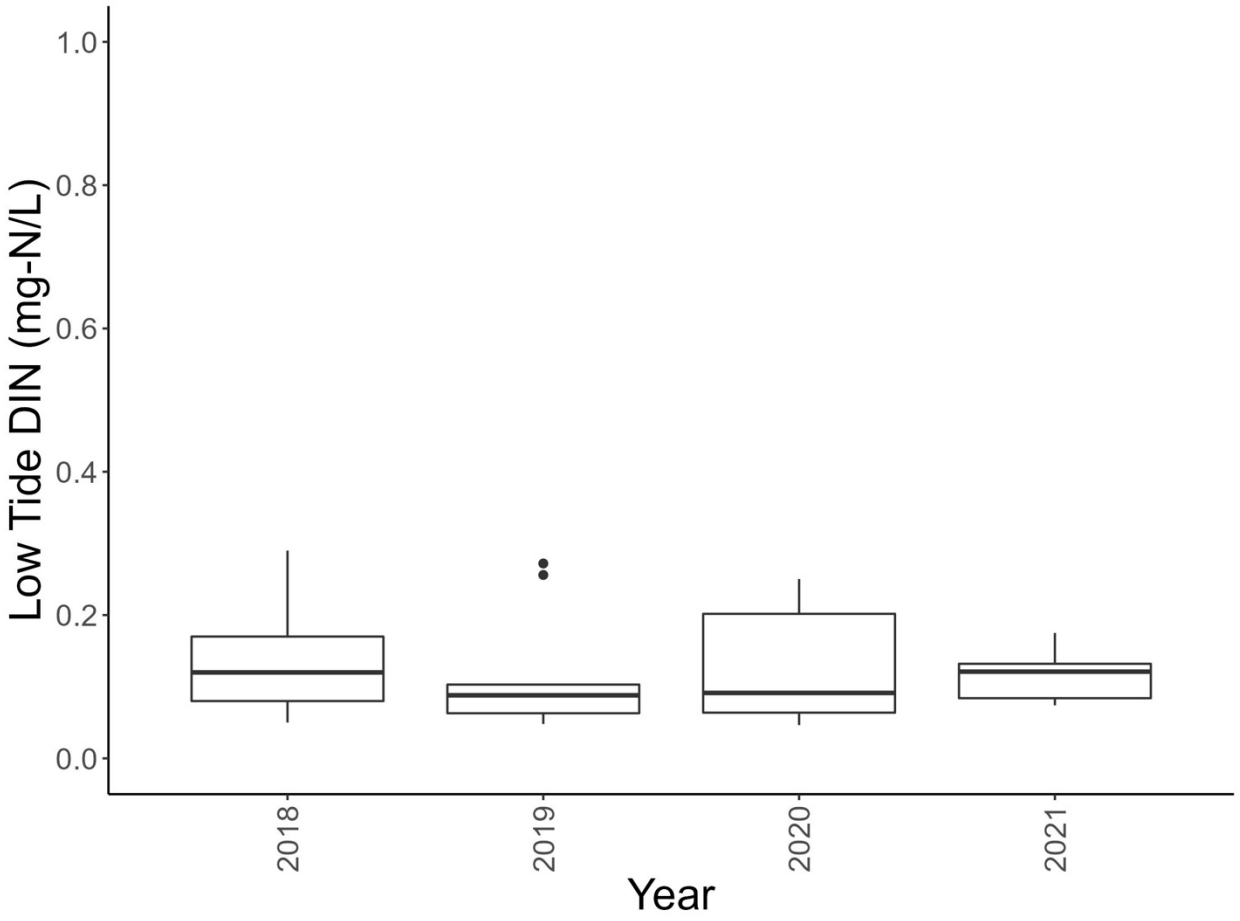

Figure 8.10: Dissolved inorganic nitrogen (DIN) at the Hampton River Station in the Hampton-Seabrook Estuary. Box and whisker plots show DIN concentrations collected monthly at low tide between 2018 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. ***Data Source: Jackson Estuarine Laboratory, UNH***

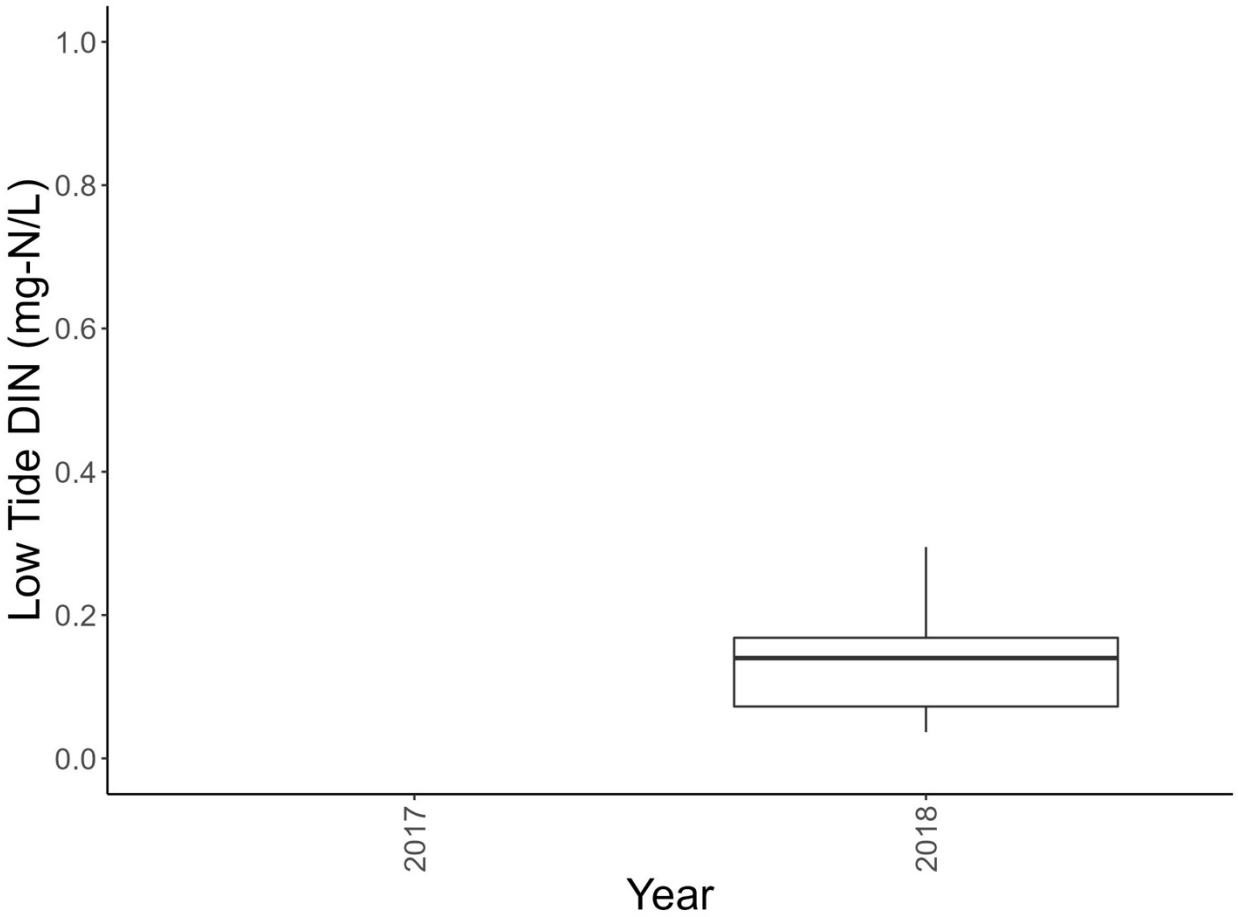

Figure 8.11: Dissolved inorganic nitrogen (DIN) at the Bellamy River Station. Box and whisker plots show DIN concentrations collected monthly at low tide in 2018. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Jackson Estuarine Laboratory, UNH***

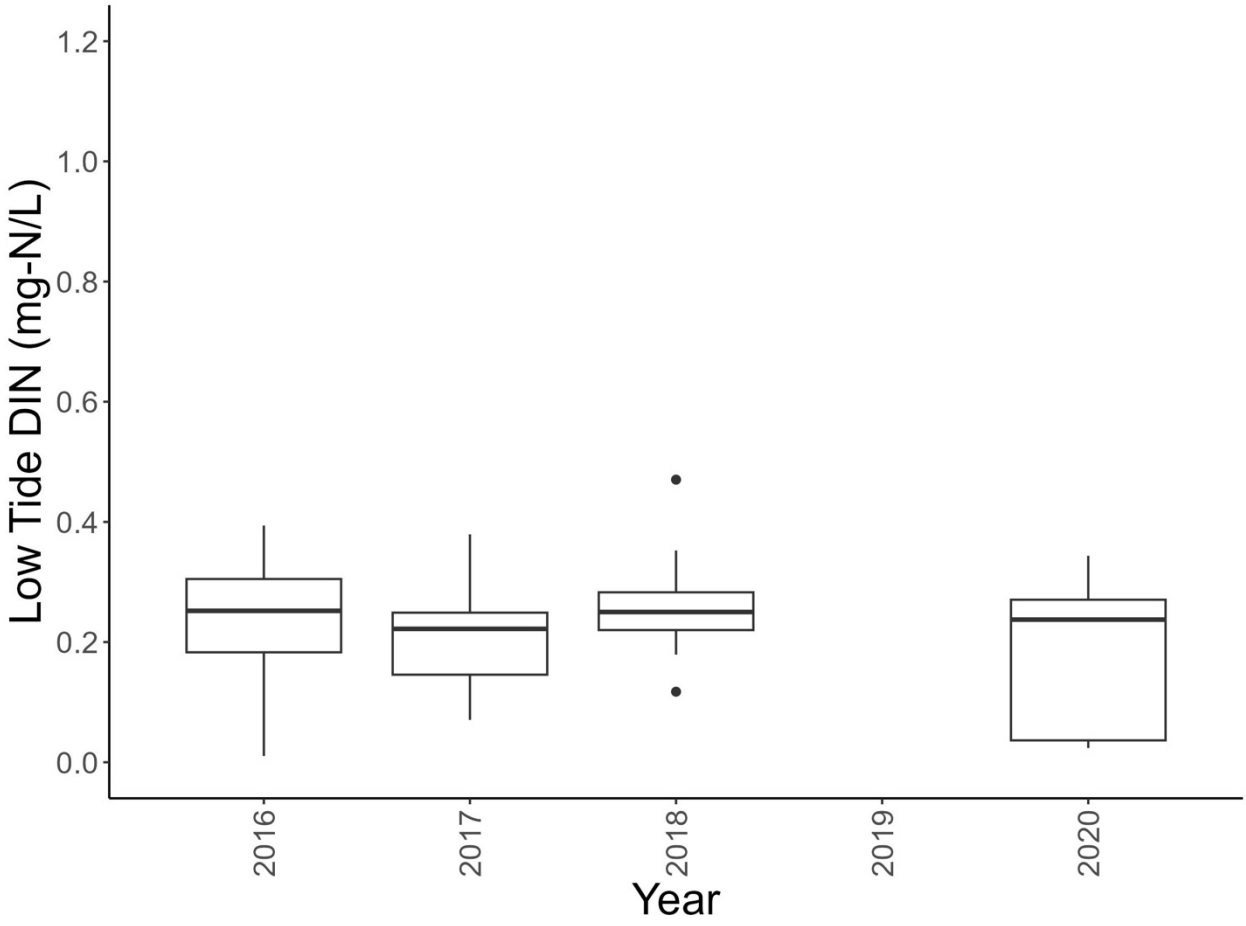

Figure 8.12: Dissolved inorganic nitrogen (DIN) at the Cocheco River Station. Box and whisker plots show DIN concentrations collected monthly at low tide between 2016 and 2020. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. *Data Source: Jackson Estuarine Laboratory, UNH*

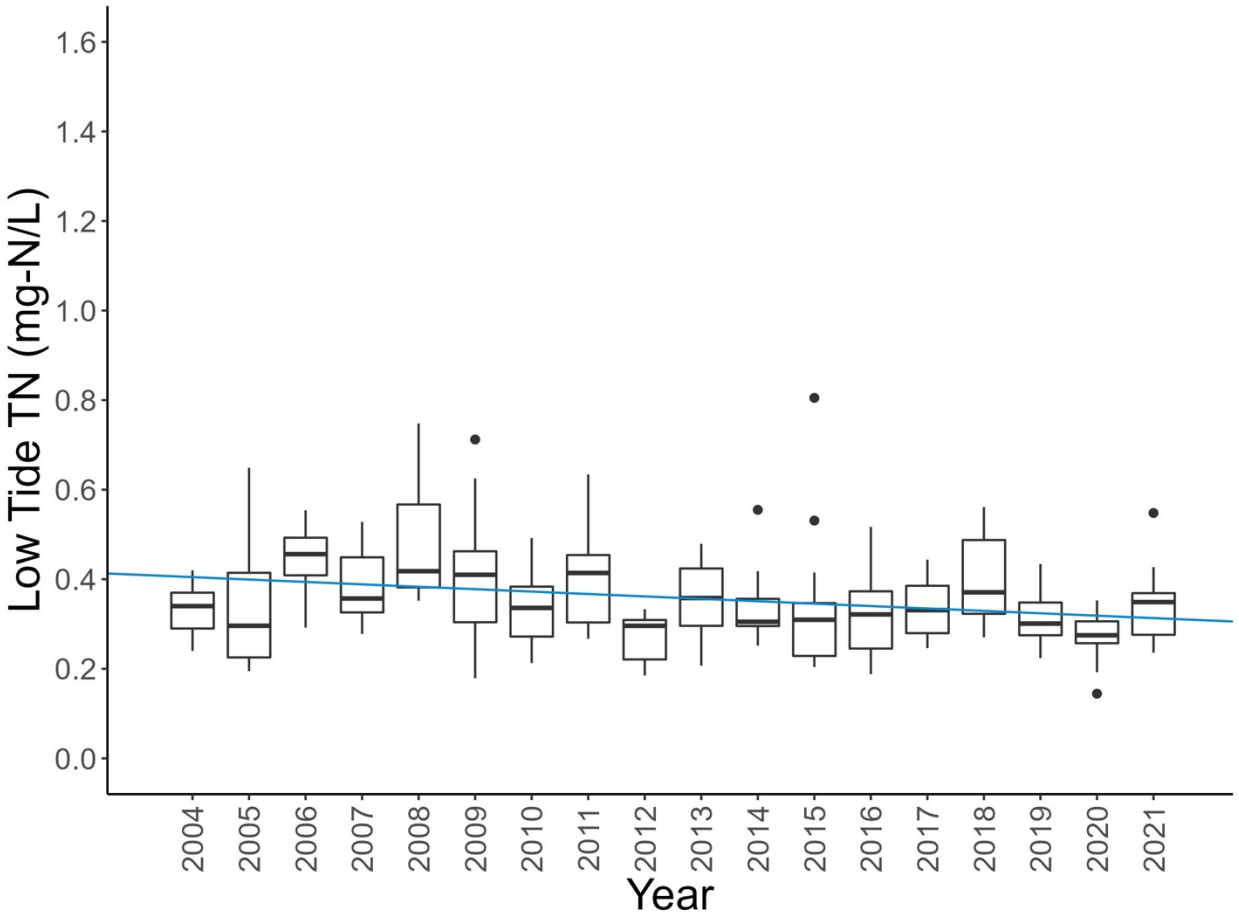

Figure 8.13: Total nitrogen (TN) at the Adams Point Station shows a decreasing trend based on data collected monthly at low tide between 2004 and 2021 and shown here as box and whisker plots. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. Blue line represents significant linear regression through all data points. ***Data Source: Jackson Estuarine Laboratory, UNH***

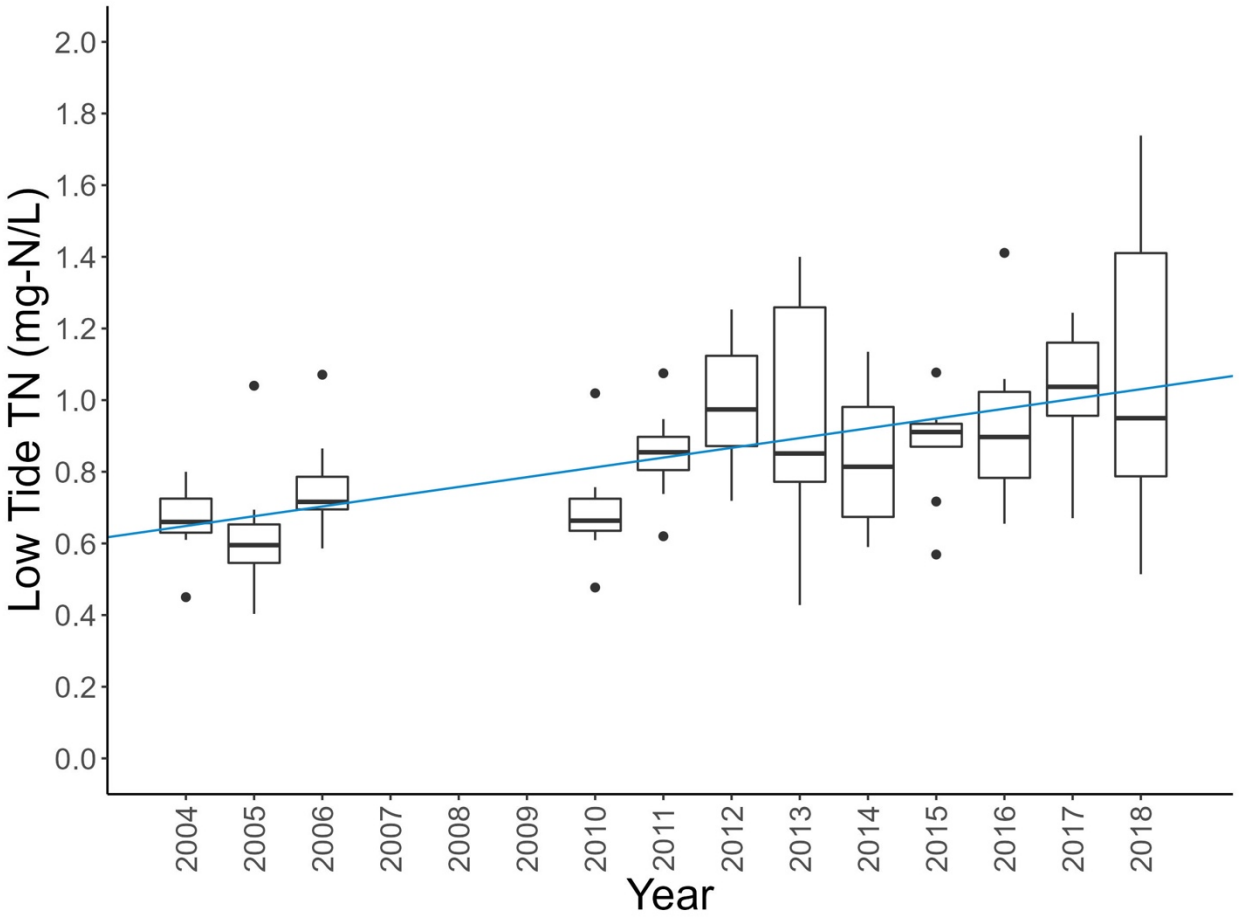

Figure 8.14: Total nitrogen (TN) at the Chapman's Landing Station (along the Squamscott River) shows an increasing trend based on data collected monthly at low tide between 2004 and 2021 and shown here as box and whisker plots. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. Blue line represents significant linear regression through all data points. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

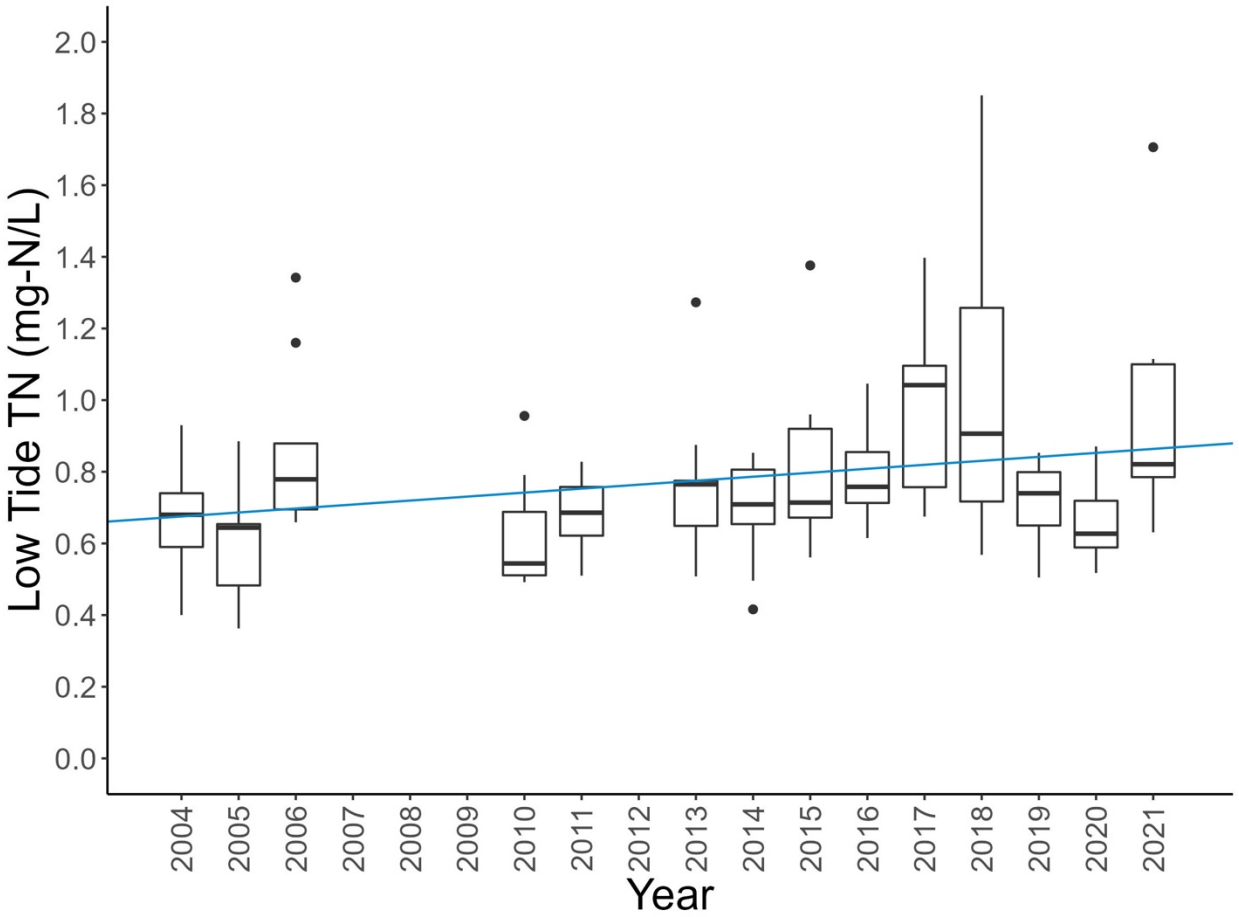

Figure 8.15: Total nitrogen (TN) at the Squamscott River Station shows an increasing trend based on data collected monthly at low tide between 2004 and 2021 and shown here as box and whisker plots. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. Blue line represents significant linear regression through all data points. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

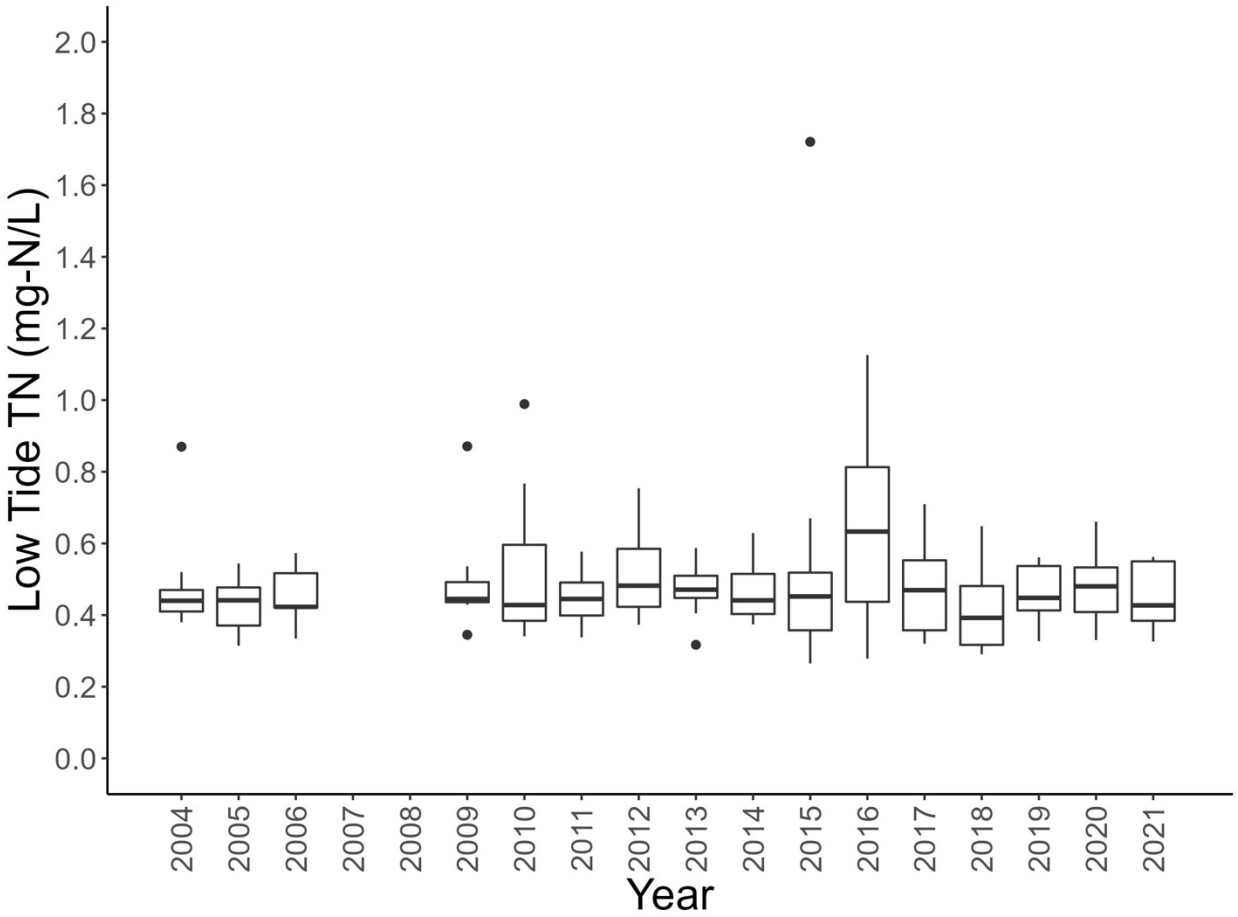

Figure 8.16: Total nitrogen (TN) at the Lamprey River Station. Box and whisker plots show TN concentrations collected monthly at low tide between 2004 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

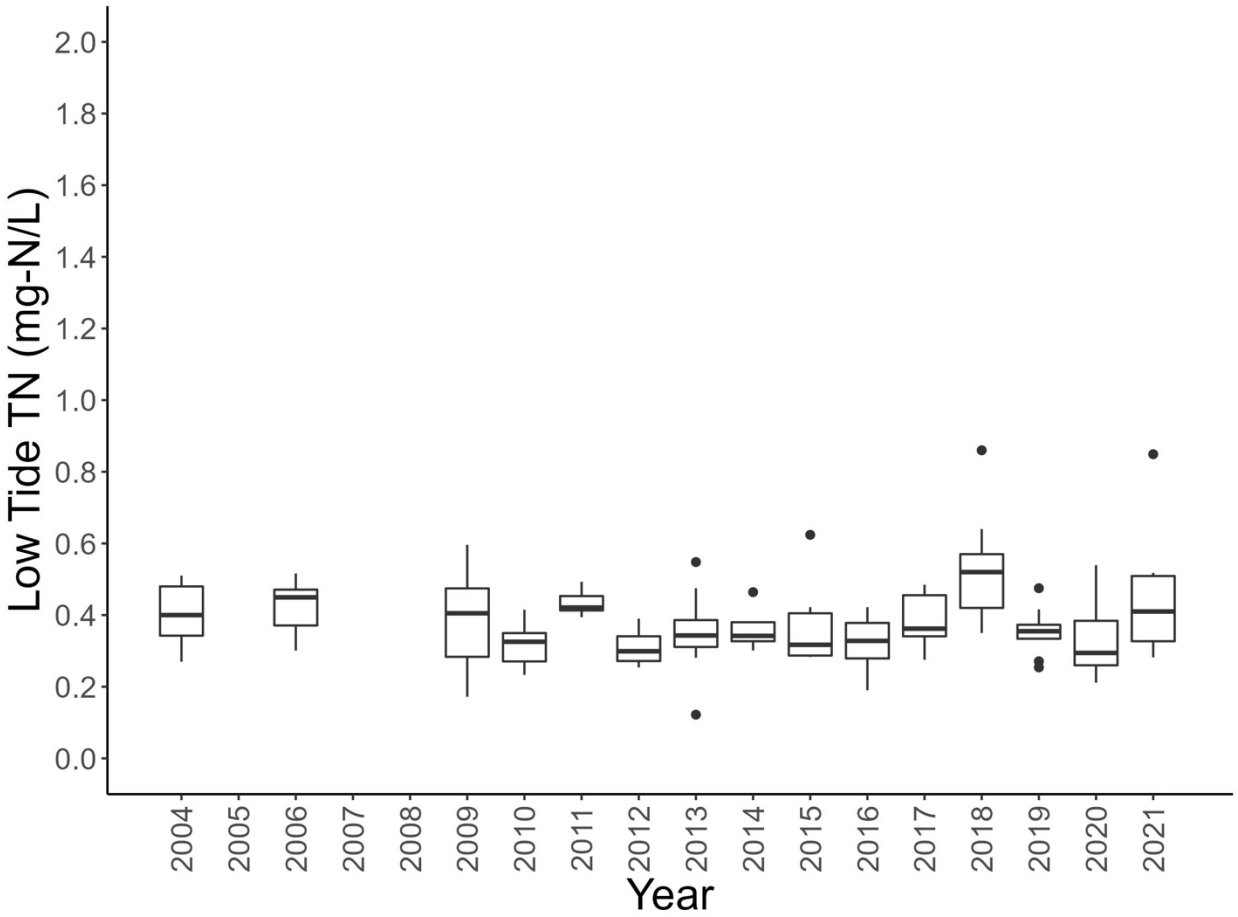

Figure 8.17: Total nitrogen (TN) at the Great Bay Station. Box and whisker plots show TN concentrations collected monthly at low tide between 2004 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

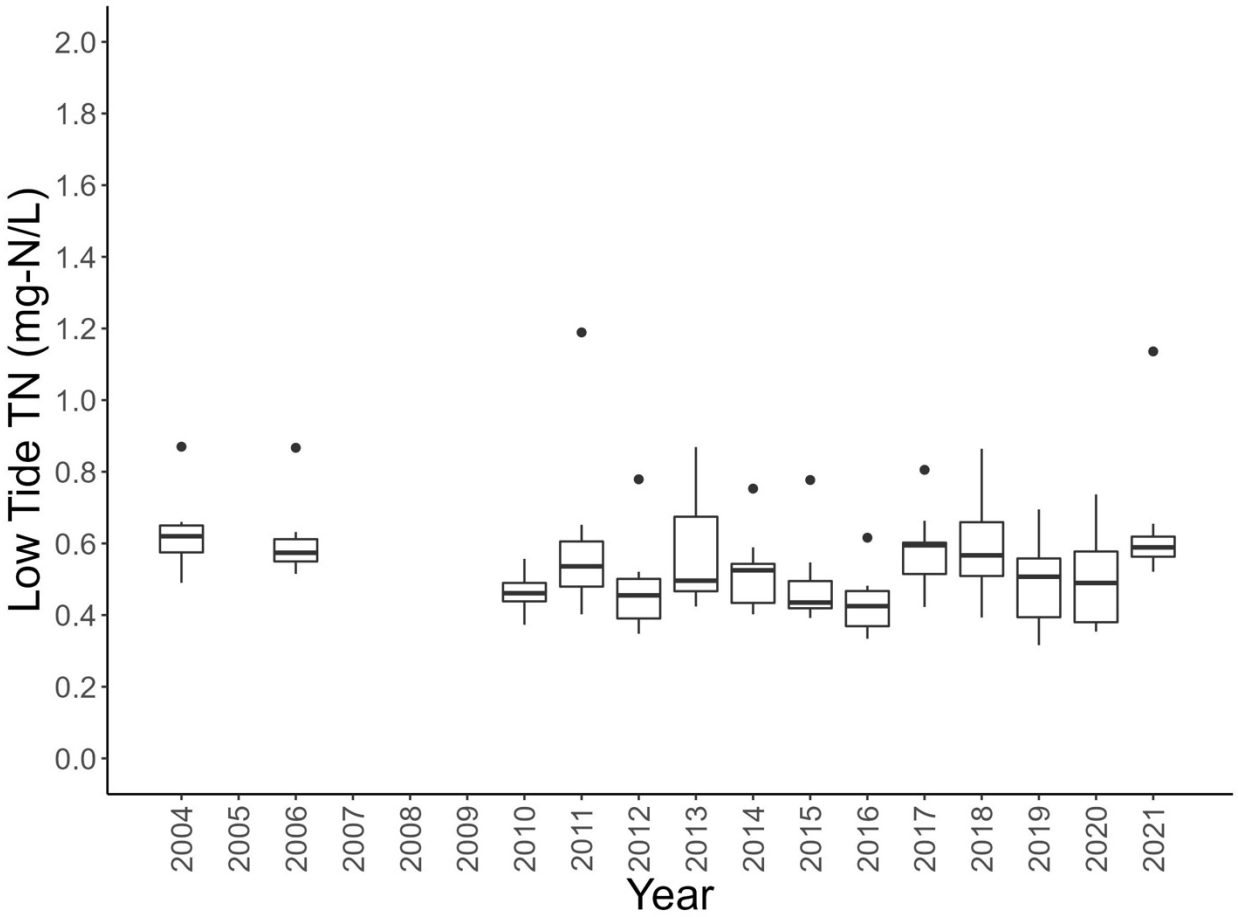

Figure 8.18: Total nitrogen (TN) at the Oyster River Station. Box and whisker plots show TN concentrations collected monthly at low tide between 2004 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

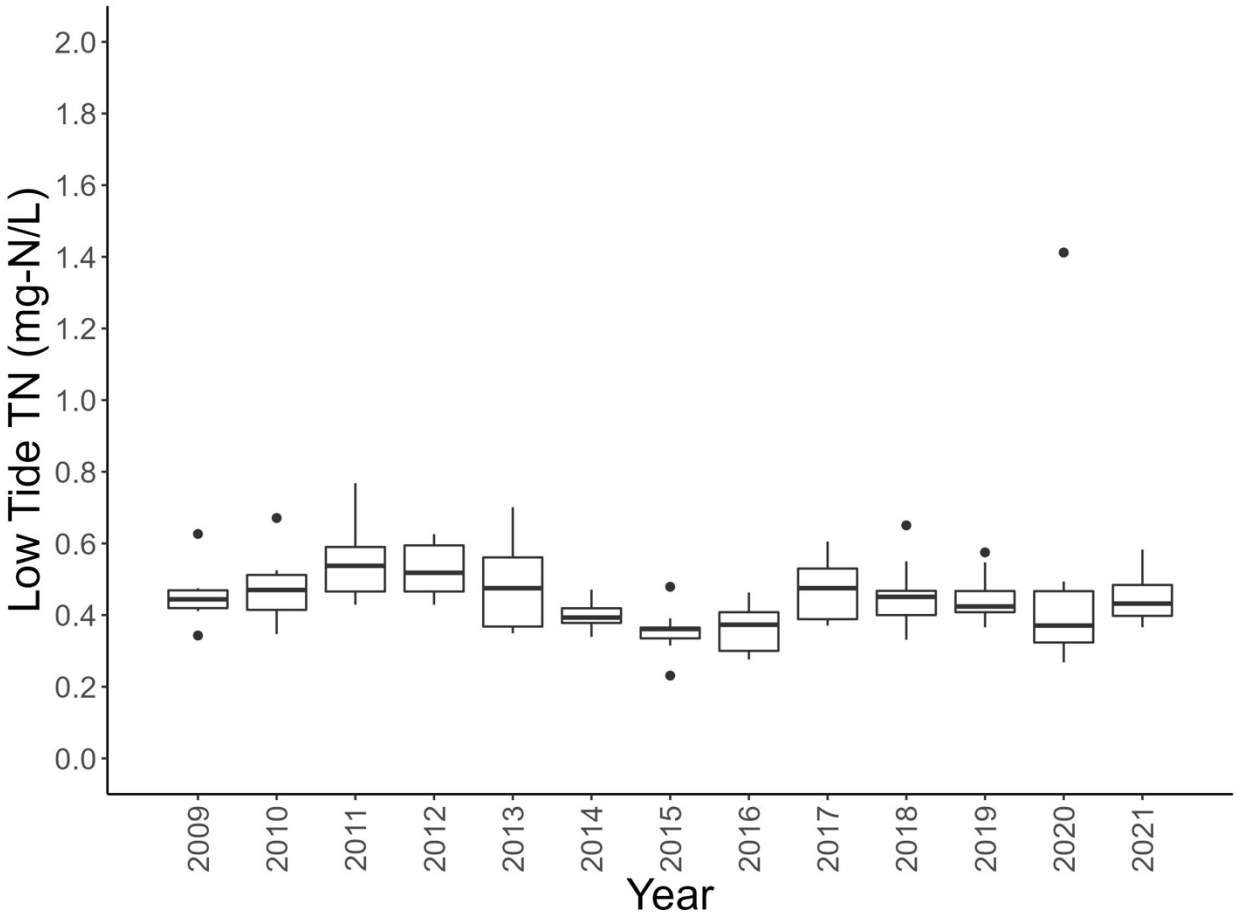

Figure 8.19: Total nitrogen (TN) at the Upper Piscataqua River Station. Box and whisker plots show TN concentrations collected monthly at low tide between 2009 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. *Data Source: the Jackson Estuarine Laboratory, UNH*

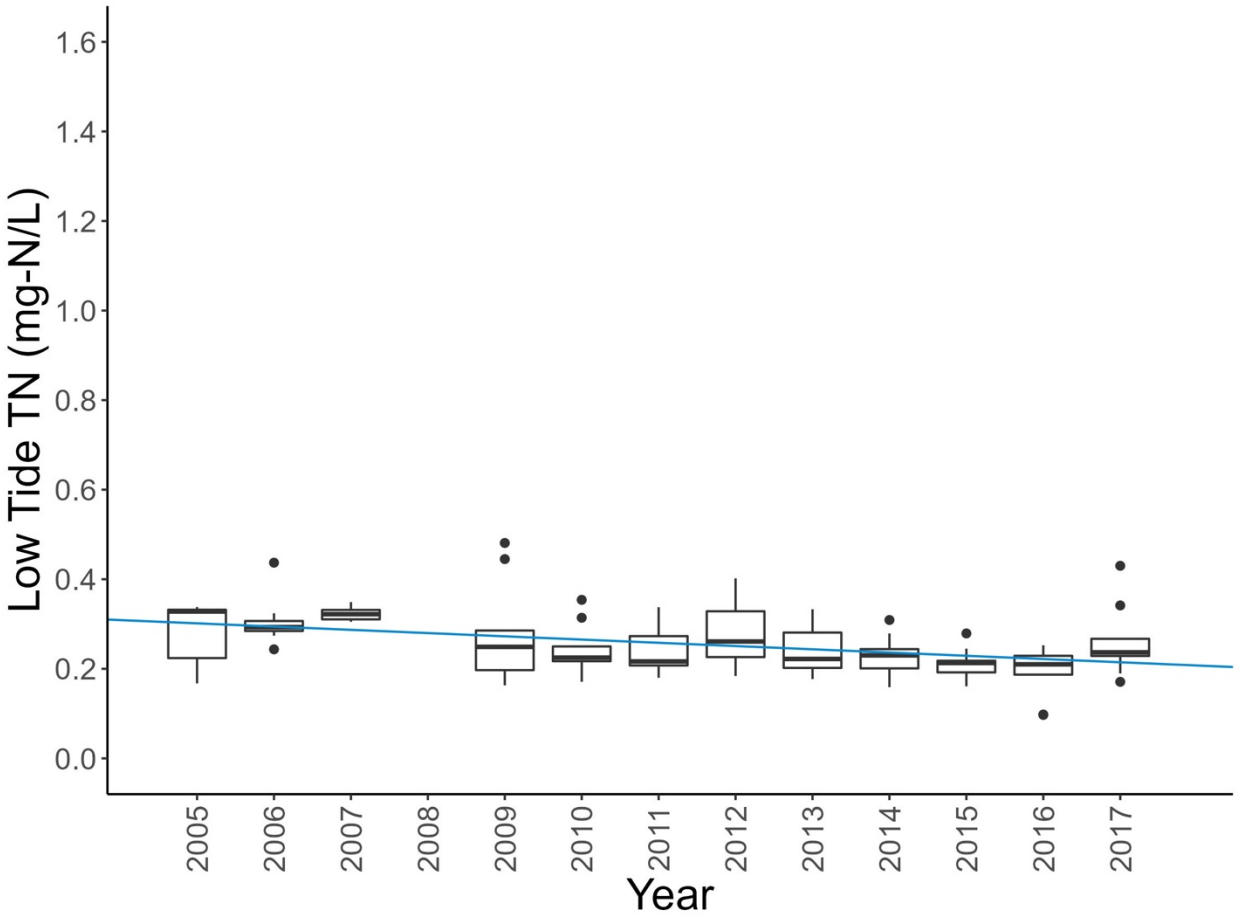

Figure 8.20: Total nitrogen (TN) at the Coastal Marine Lab (Portsmouth Harbor) Station shows a decreasing trend over time based on data collected monthly at low tide between 2005 and 2017 and shown here as box and whisker plots. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. Blue line represents significant linear regression through all data points. *Data Source: Jackson Estuarine Laboratory, UNH*

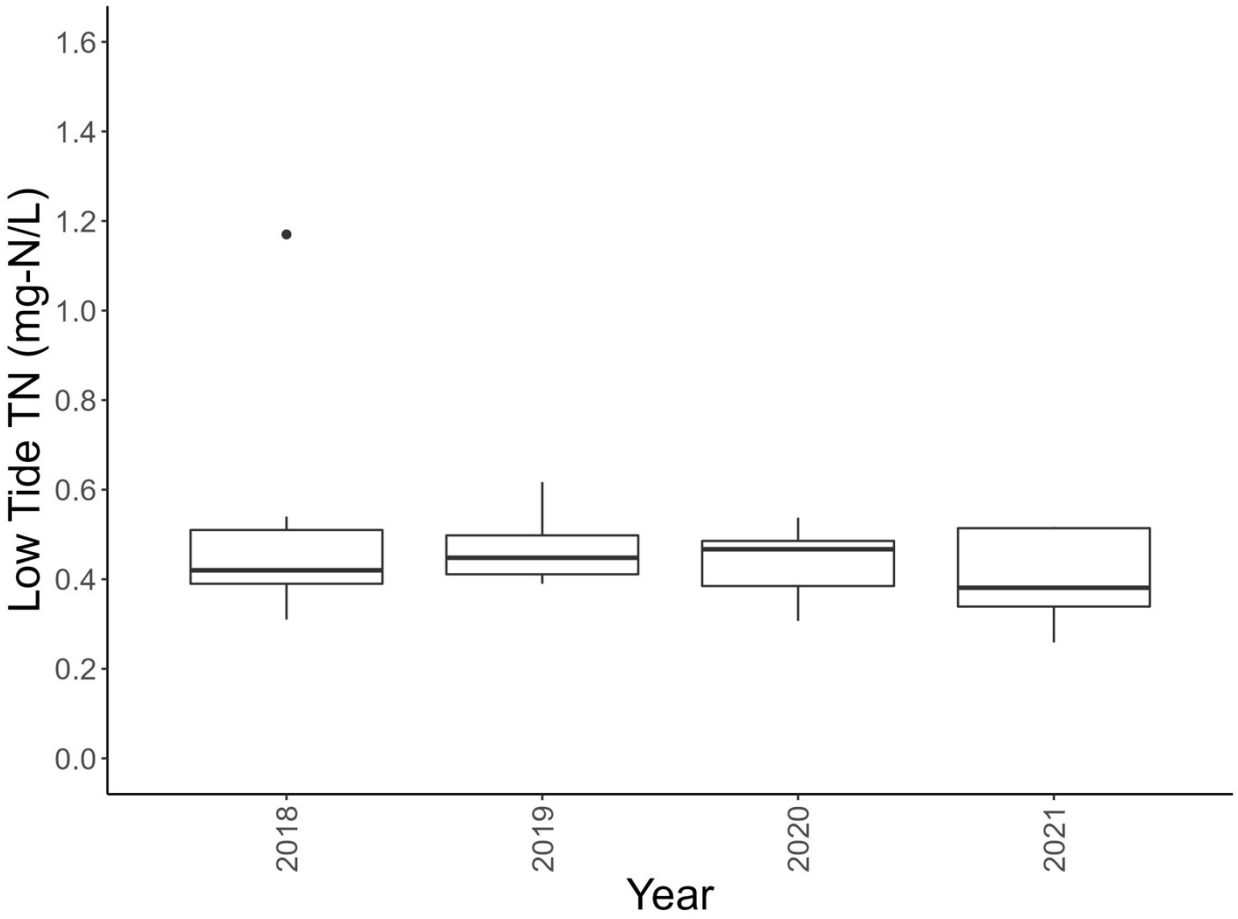

Figure 8.21: Total nitrogen (TN) at the Hampton River Station in the Hampton-Seabrook Estuary. Box and whisker plots show TN concentrations (collected monthly at low tide) between 2018 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Jackson Estuarine Laboratory, UNH***

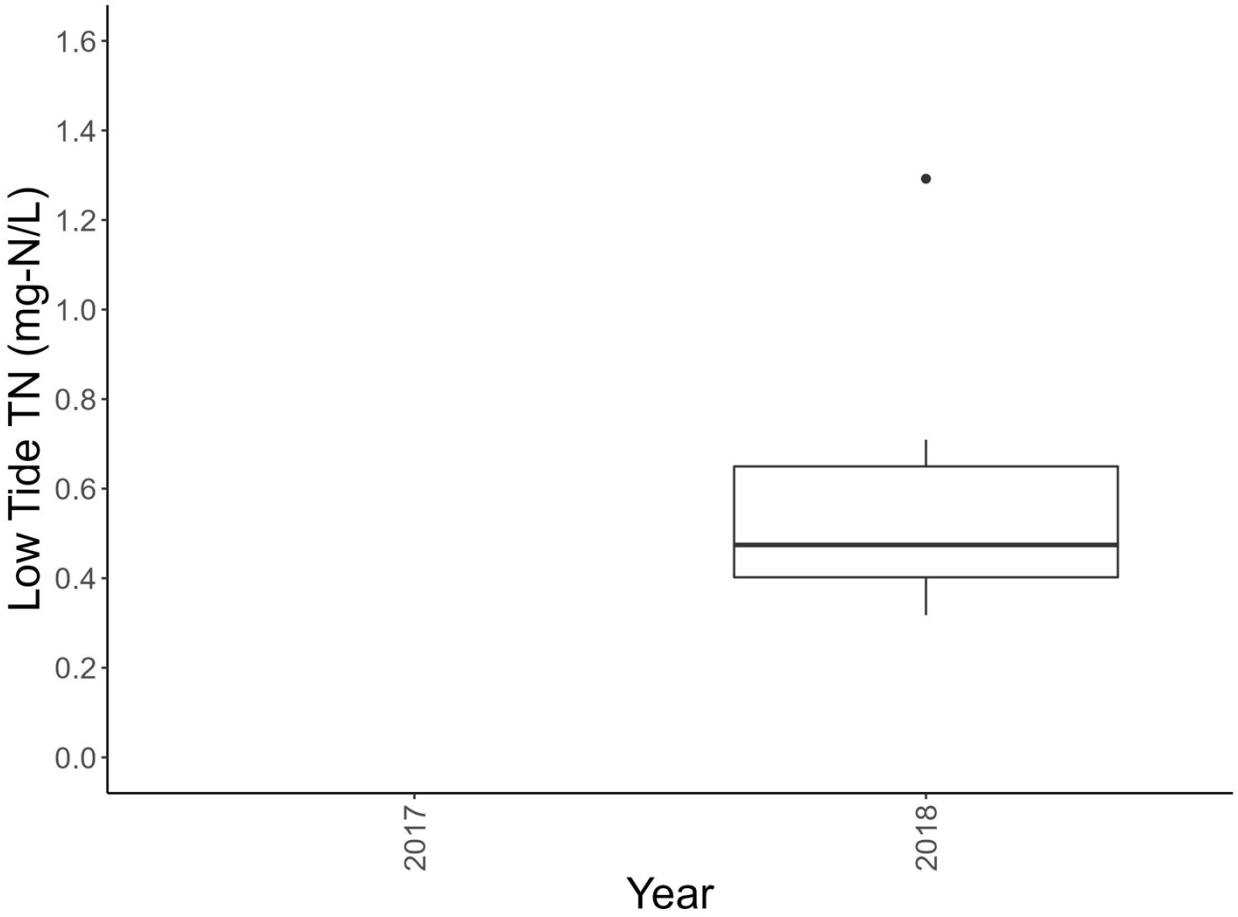

Figure 8.22: Total nitrogen (TN) at the Bellamy River Station. Box and whisker plots show TN concentrations collected monthly at low tide in 2018. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. *Data Source: Jackson Estuarine Laboratory, UNH*

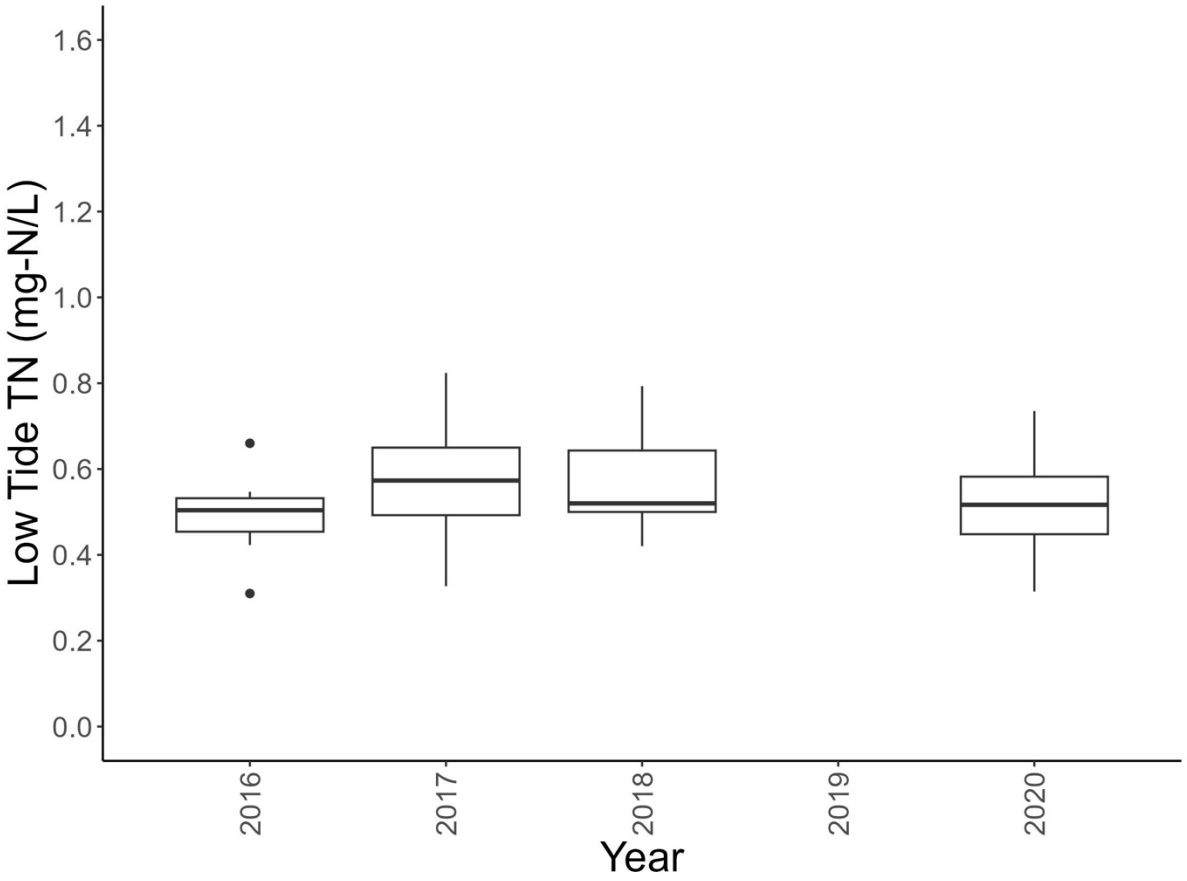

Figure 8.23: Total nitrogen (TN) at the Cocheco River Station. Box and whisker plots show TN concentrations collected monthly at low tide between 2016 and 2020. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Jackson Estuarine Laboratory, UNH***

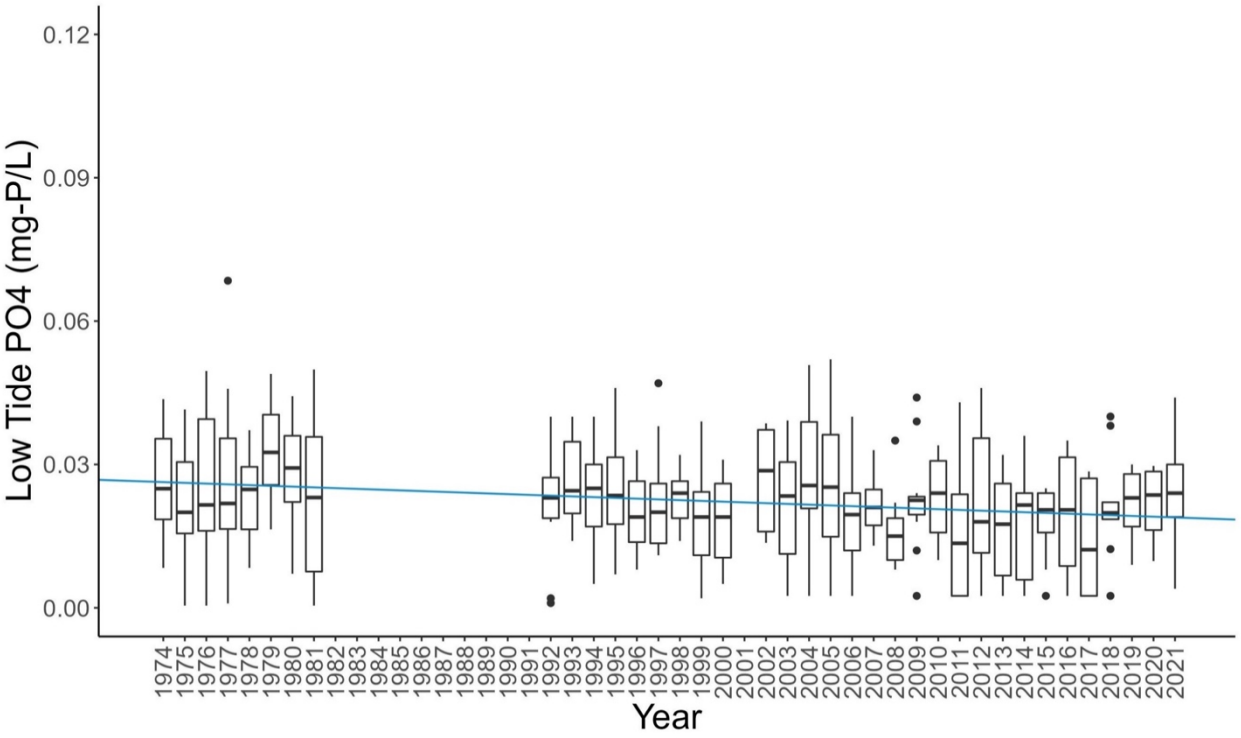

Figure 8.24: Orthophosphate (PO_4^{3-}) at the Adams Point Station shows a decreasing trend over time based on data collected at low tide between 1974 and 2021 and shown as box and whisker plots. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. Blue line represents significant linear regression through all data points. *Data Source: Jackson Estuarine Laboratory, UNH*

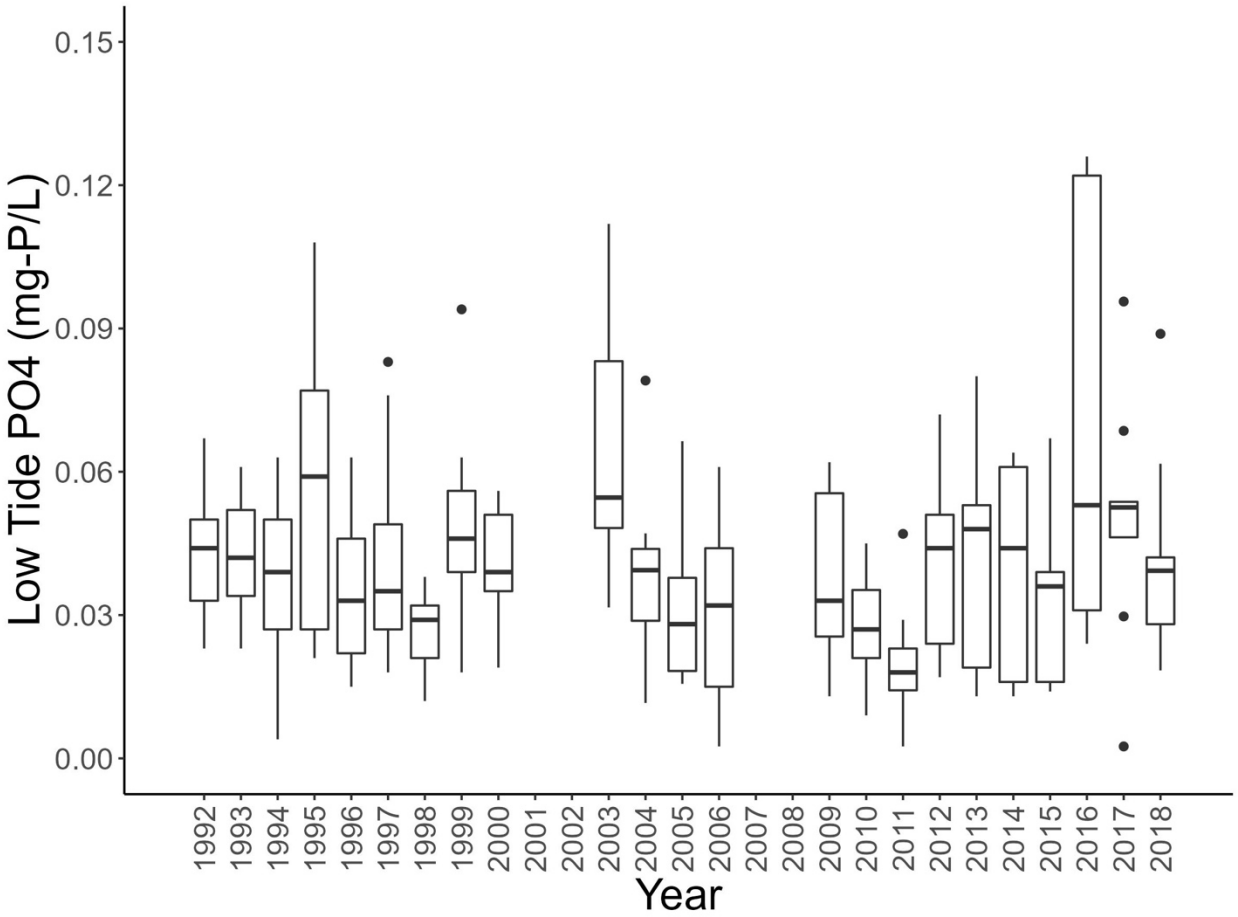

Figure 8.25: Orthophosphate (PO_4^{3-}) at the Chapman's Landing Station (along the Squamscott River). Box and whisker plots show concentrations based on data collected at low tide between 1992 and 2018. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

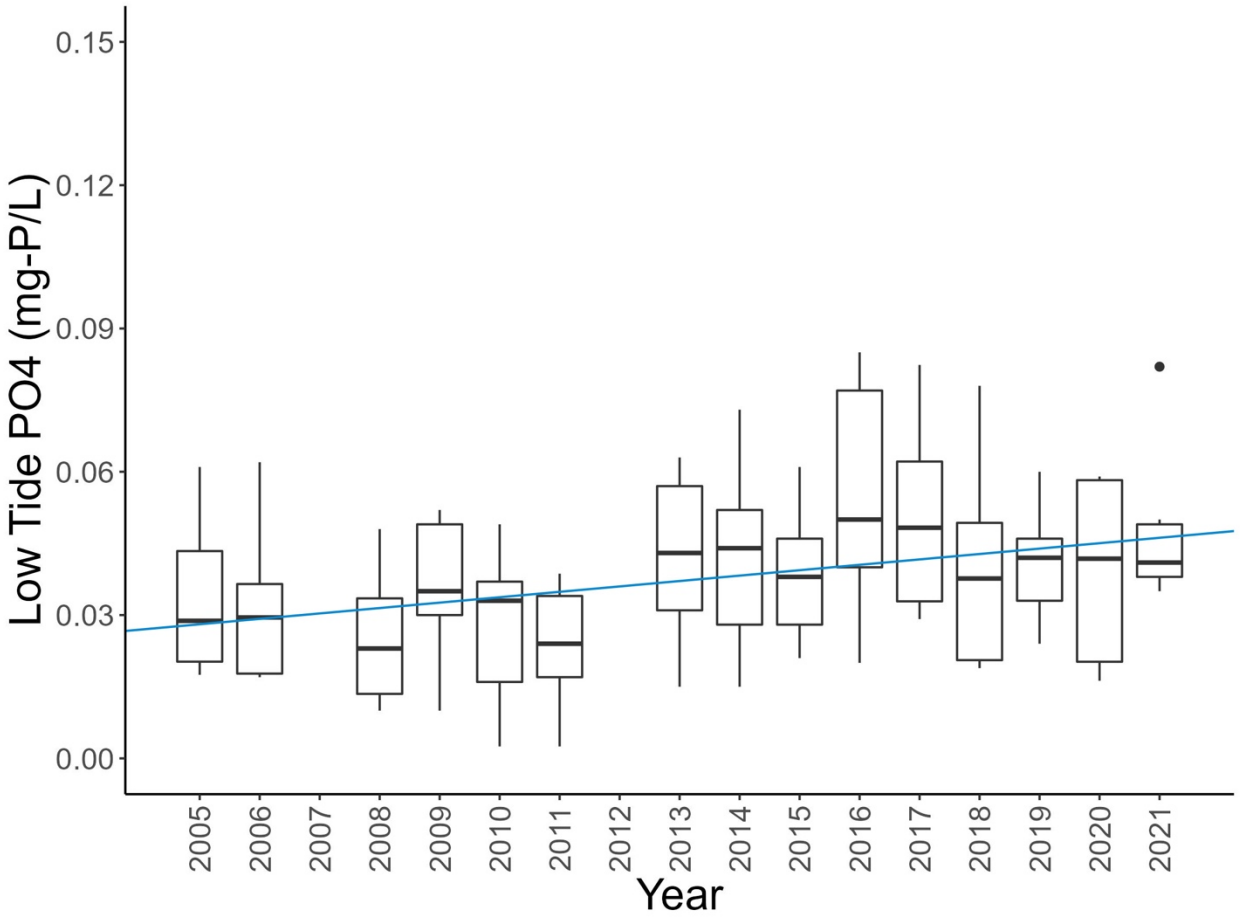

Figure 8.26: Orthophosphate (PO_4^{3-}) at the Squamscott River Station shows an increasing trend over time based on data collected at low tide between 2005 and 2021 and shown as box and whisker plots. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. Blue line represents significant linear regression through all data points. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

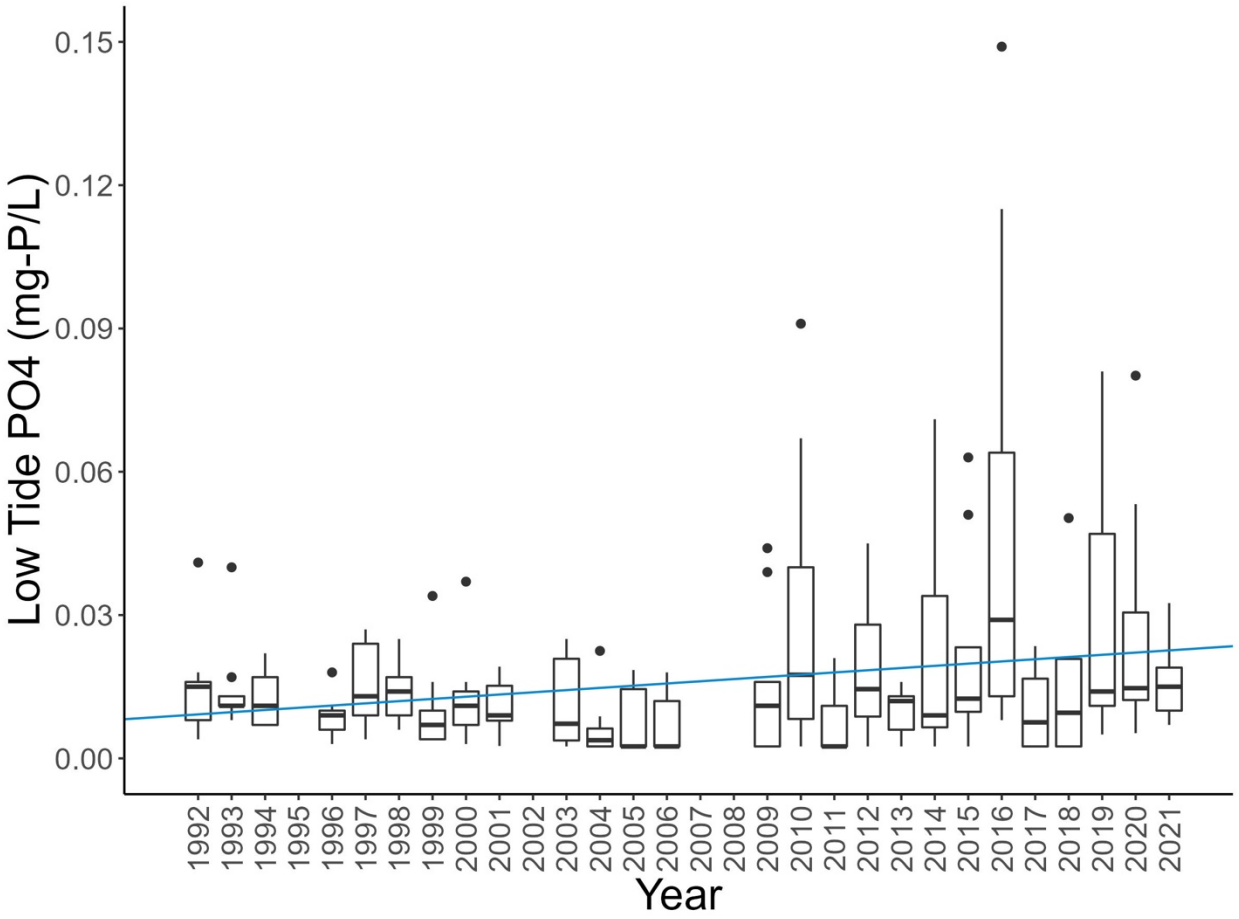

Figure 8.27: Orthophosphate (PO_4^{3-}) at the Lamprey River Station shows an increasing trend over time based on data collected at low tide between 1992 and 2021 and shown as box and whisker plots. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. Blue line represents significant linear regression through all data points. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

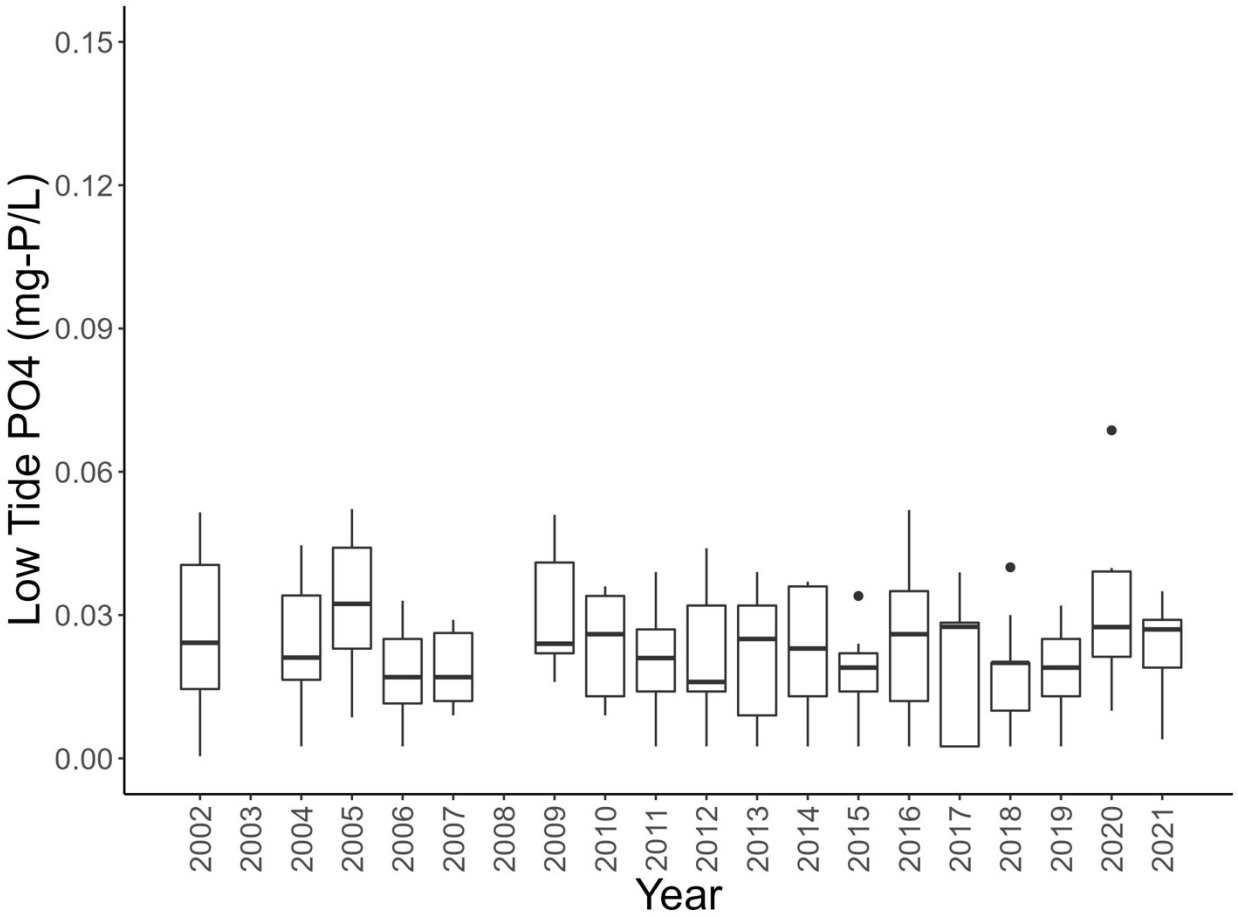

Figure 8.28: Orthophosphate (PO_4^{3-}) at the Great Bay Station. Box and whisker plots show PO_4 concentrations over time based on data collected at low tide between 2002 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. Blue line represents significant linear regression through all data points. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

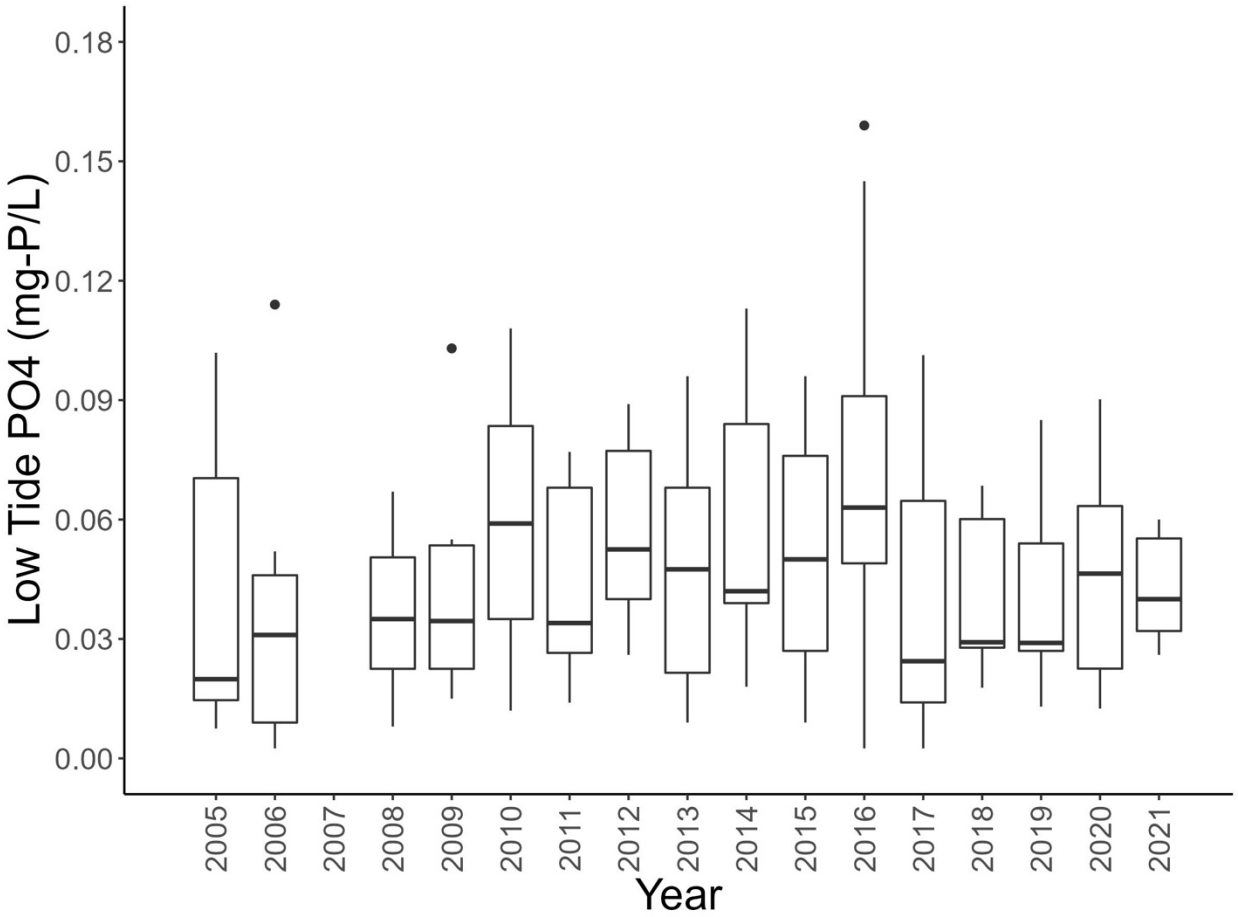

Figure 8.29: Orthophosphate (PO_4^{3-}) at the Oyster River Station. Box and whisker plots show PO_4 concentrations over time based on data collected at low tide between 2005 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Great Bay National Estuarine Research Reserve and the Jackson Estuarine Laboratory, UNH***

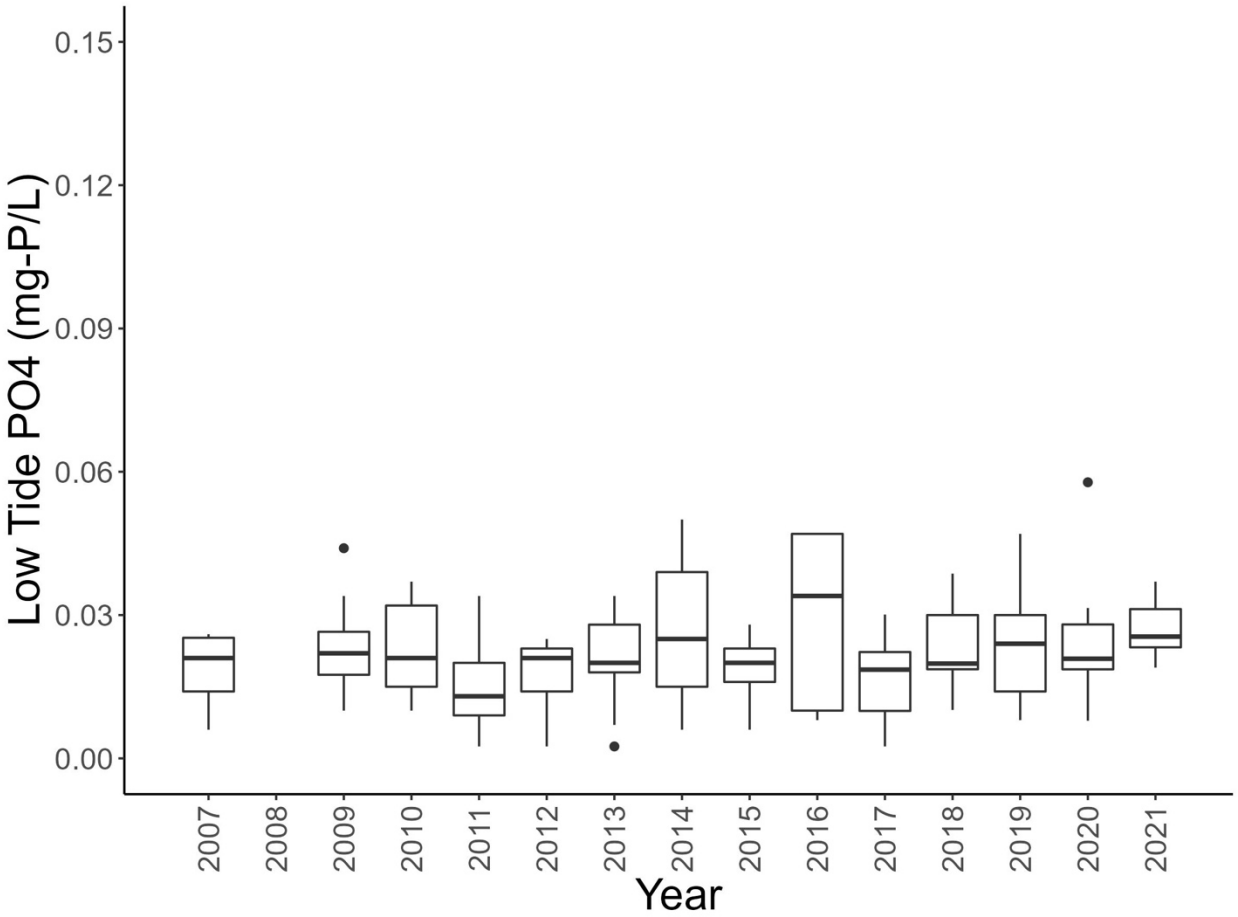

Figure 8.30: Orthophosphate (PO_4^{3-}) at the Upper Piscataqua River Station. Box and whisker plots show PO_4 concentrations over time based on data collected at low tide between 2007 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Jackson Estuarine Laboratory, UNH***

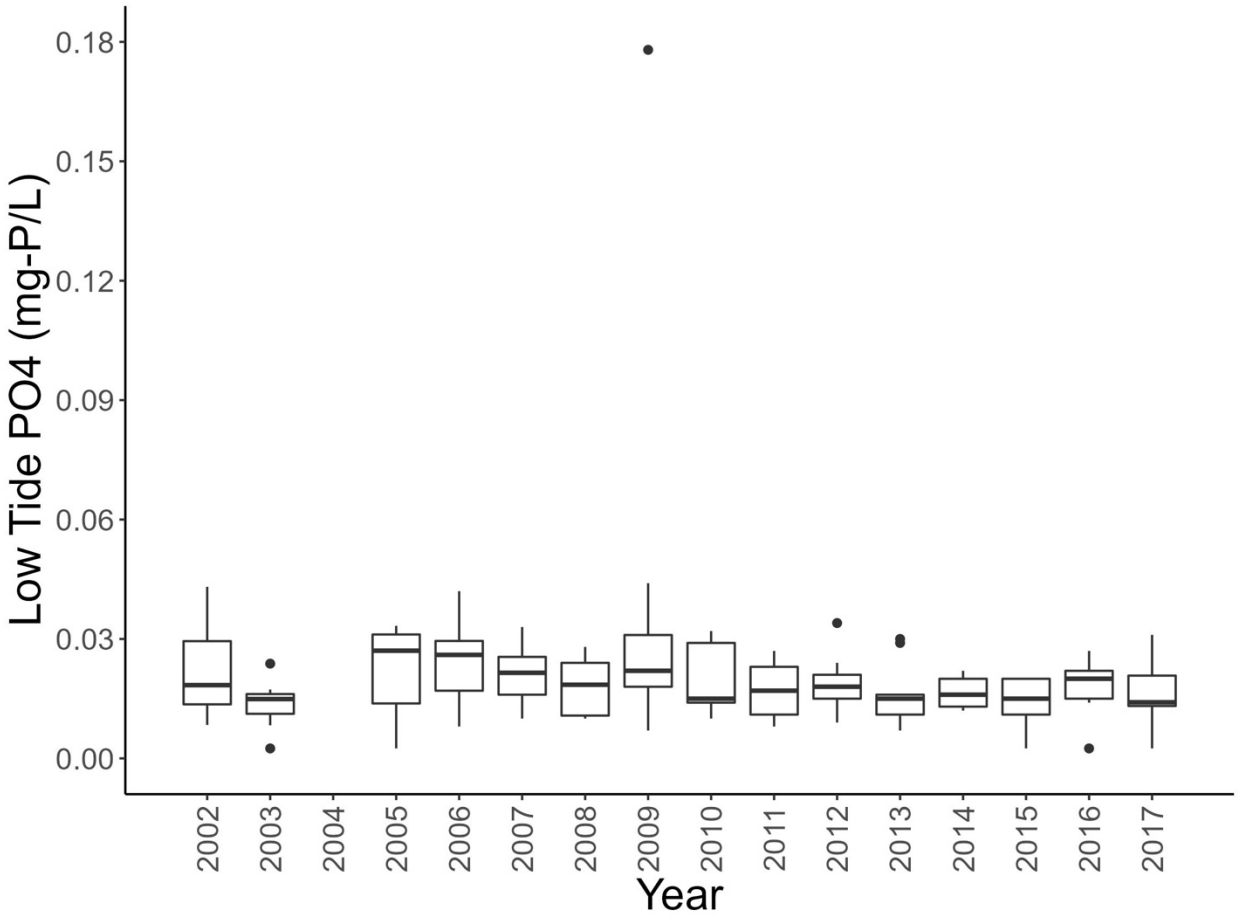

Figure 8.31: Orthophosphate (PO_4^{3-}) at the Coastal Marine Lab (Portsmouth Harbor) Station. Box and whisker plots show PO_4 concentrations over time based on data collected at low tide between 2002 and 2017. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. *Data Source: Jackson Estuarine Laboratory, UNH*

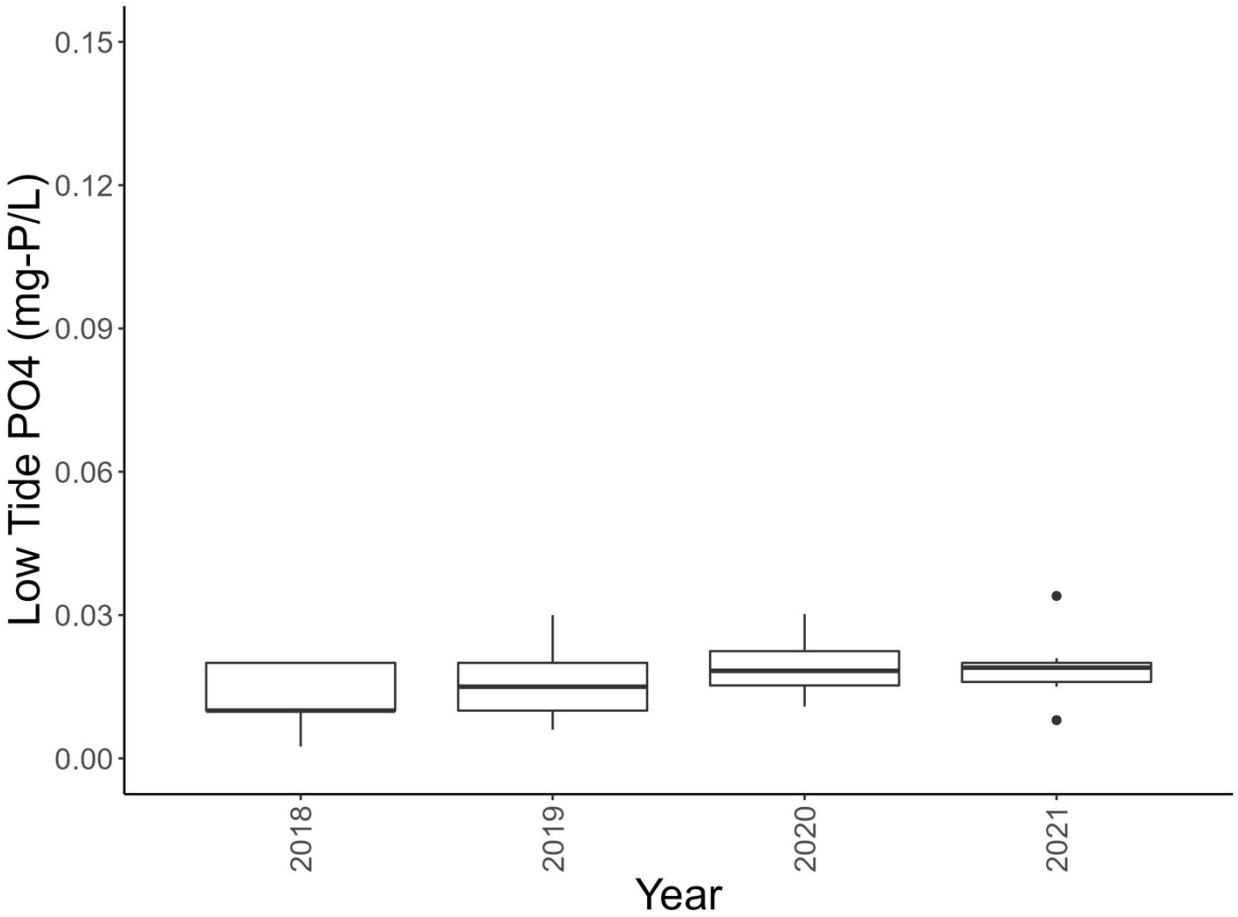

Figure 8.32: Orthophosphate (PO_4^{3-}) at the Hampton River Station in the Hampton-Seabrook Estuary. Box and whisker plots show PO_4 concentrations over time based on data collected at low tide between 2018 and 2021. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. *Data Source: Jackson Estuarine Laboratory, UNH*

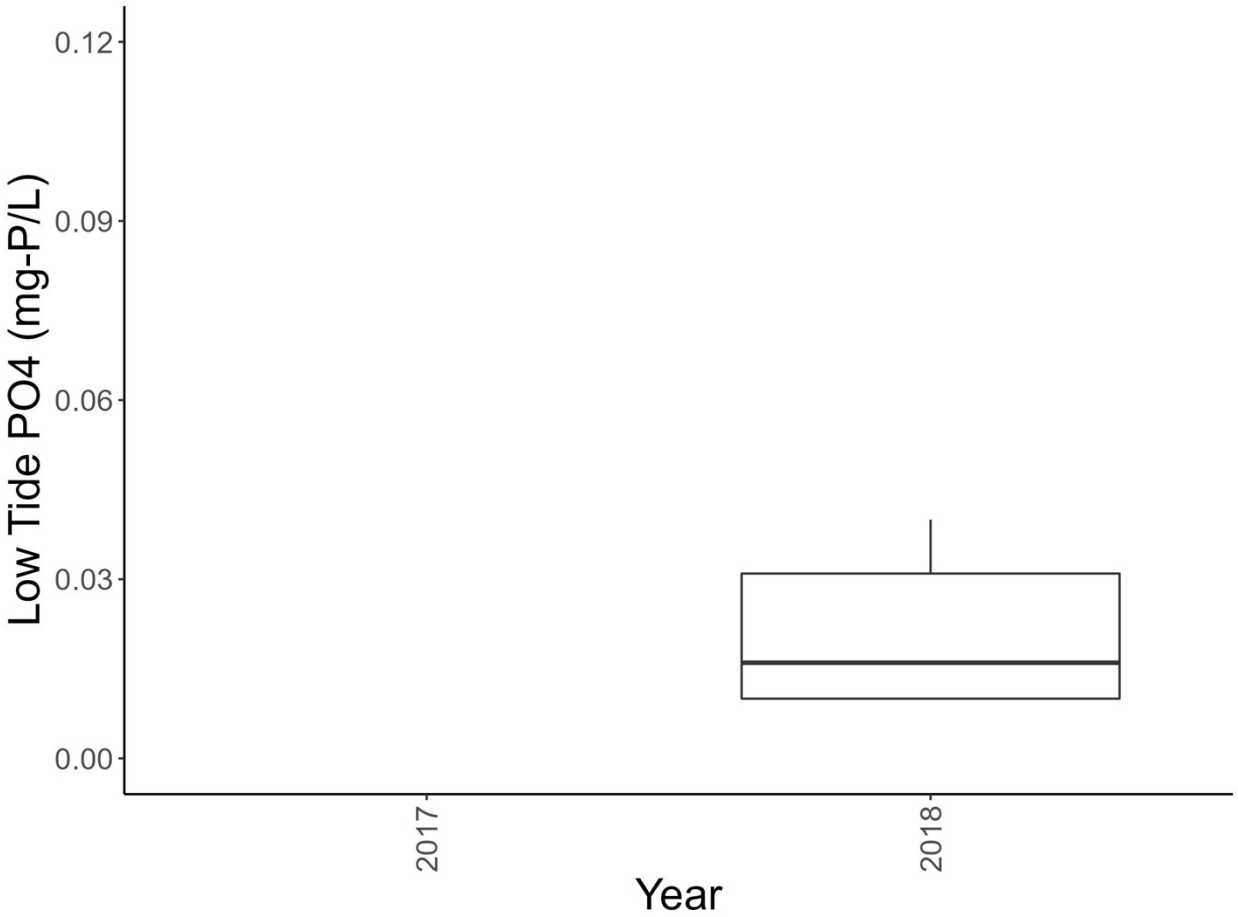

Figure 8.33: Orthophosphate (PO_4^{3-}) at the Bellamy River Station. Box and whisker plots show PO_4 concentrations over time based on data collected at low tide in 2018. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. *Data Source: Jackson Estuarine Laboratory, UNH*

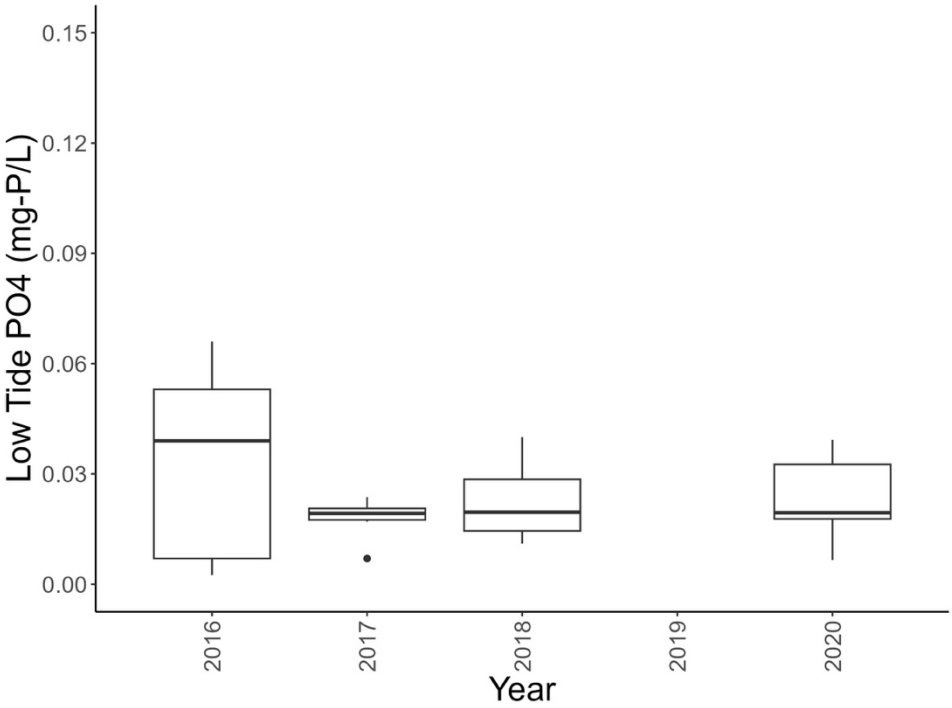

Figure 8.34: Orthophosphate (PO_4^{3-}) at the Cocheco River Station. Box and whisker plots show PO_4 concentrations over time based on data collected at low tide between 2016 and 2020. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). "Outliers" are shown as individual points. Some years are omitted due to missing data or an insufficient number of measurements that year. ***Data Source: Jackson Estuarine Laboratory, UNH***

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