We thank Dr. Costello his kind comments regarding our analysis. Responses to comments are given below, with comments italicized and responses in plain text.

*This paper has brought forward data from an important long-term citizen effort to document specific water quality parameters in Buzzards Bay. The paper should be published subject to the author's satisfactory revisions as recommended in the review process.*

*The paper innovatively characterizes the several different, but complementary physical inputs to the Buzzards Bay over a long period of summer season monitoring. The paper effectively states the need for continued monitoring to further differentiate the causes and extent of the different stressors to the Buzzards Bay ecosystem.*

*Specific Comments*

*1. The monitoring effort described in the paper should be continued and extended over a longer window in the calendar year.*

We agree with Dr. Costello regarding this comment as changing in phenology of phytoplankton blooms may be aliasing our results. For example, if blooms occurred regularly during September of each year are now occurring in August, they would be captured in our data, and could perhaps be interpreted as a worsening of water quality. As such, in partnership with the Buzzards Bay Coalition, we have begun to expand their sampling to June and September to capture some of the seasonal variability in water quality.

*2. Other parameters such as the measurement of light attenuation should be included in the monitoring protocols.*

Secchi depth is monitored though the citizen-science program; however, we did not include these data in our analysis as most commonly samples are collected during low tide, at shallow sites. As such, most sites do not record a Secchi depth as frequently the sediment surface is visible. We have updated lines 184-187 with the following text to clarify this:

"Volunteers performed Secchi disk measurements; however, Secchi depth data were not analyzed because a large number of measurements of Secchi depth came from shallow sites at low tide where the sediment surface was visible and thus Secchi depth did not characterize water clarity."

*3. The climatic factors (temperature and precipitation) described in the paper are important elements in the analysis of the reasons for the continued degradation of the Buzzards Bay coastal systems, but climate change-related conditions shouldn't interfere (or delay) efforts to reduce the unsustainable inputs of N into the system.*

We agree with Dr. Costello on this point as well. The purpose of this work is not to suggest that efforts to reduce nitrogen inputs should be stopped because climate change may be impacting water quality in Buzzards Bay, but rather to acknowledge that there are other factors involved in addition to nutrient loading that may be exacerbating the eutrophication problem.

*4. Unlike Buzzards Bay's neighboring regional system, Cape Cod, there is still time and much undeveloped open space in the Buzzard's Bay Watershed to implement future sustainable development policies and remediation efforts. Wise policy action using the data and concepts introduced in this paper and future monitoring efforts will be needed to prevent further water quality degradation and loss of natural systems.*

We agree with the reviewer on this point as well.

*List of specific comments*
*1. In many places in the paper the term "normalized" was used. I was confused with what that meant and how it might effect the data.*

The term normalized refers to the factor scores reported. To fit on comparable axes as the factor loadings, factor scores have been scaled by the largest factor loading. This does not alter the interpretation of the factor scores; rather, it only rescales the values such that the scores fall between -1 and 1. We have updated line 201 with the following text to clarify this point:

"Reported factor scores have been normalized by the largest factor loading to scale from -1 to 1."

The initial plots for Figs 3 and 4 contained factor loadings and scores that were rescaled such that the largest value of the first factor was given a positive value. While this does not impact our interpretation of the data, we thought this may have caused some confusion as the factor loadings reported in Table 2 were the raw loadings, and the plot (Fig. 3) showed the loadings with the altered signs. We have updated the plots to contain the actual factor loadings rather than the resigned factor loadings for clarity.

*2. There didn't seem to be a definition of TN in the paper and I found the analysis referencing TN and N to be confusing.*

We have added a definition of TN and DIN to the manuscript where TN is the sum of all nitrogen species ($NO_3^-$ + $NO_2^-$ + $NH_4^+$ + DON+PON), while DIN is the sum of the inorganic nitrogen species ($NO_3^-$ + $NO_2^-$ + $NH_4^+$). We have also clarified our references to nitrogen in general as "nitrogen", rather than "N". We have added the following text to lines 147-149:

"Total nitrogen (TN) is defined as the sum of TDN and PON and dissolved organic nitrogen (DON) is defined as the difference between TDN and DIN ($NO_3^-$ + $NO_2^-$ + $NH_4^+$)."

*3. Little mention of light availability was present in the analysis. Light is an important component for life in and under the water column and should be considered as an important element of future monitoring efforts.*

We agree that light availability is a critical factor in determining ecosystem responses to reduced water quality (e.g., eelgrass loss, etc.). Although we do not have reliable direct measurements (see above response to Secchi depth), we have added the additional text below to the discussion (lines 290-296) to reflect potential changes in light attenuation as a result of increased chlorophyll.

"Higher Chla concentration in most embayments implies increasing water column light attenuation and decreasing light reaching the benthos that can have strong impacts on ecosystem functioning. Loss of eelgrass is common when less than 20% of incident light reaches the sediment surface (e.g. Dennison et al. 1993). Although we do not have direct measurements of light attenuation, the widespread rate of increase in Chla (4% $yr^{-1}$) across Buzzards Bay was consistent with declines in bay-wide eelgrass extent (loss of 3.5 % $yr^{-1}$, Costello and Kenworthy 2011)."

*4. In the Conclusion of the paper I found the statement that a "five-fold reduction in nitrogen load might be required to mitigate the effects of nitrogen enrichment in some embayments" confusing and in need of explanation.*

We agree that this statement was confusing. We have removed this statement from the text.

Reviewer #2

Responses to comments are given below, with comments italicized and responses in plain text.

*General Comments:*
*This paper is well-written analysis of a 22-year citizen science water quality monitoring program in Buzzards Bay. By using principal component analysis and factor analysis, the authors present evidence of climate change (increasing summer temperatures), the dependence of water quality on geomorphology (riverine-fed systems decreased water quality), and ecosystem shifts (Chl response to nutrient loading increased). The paper is innovative in that the citizen science program provided consistent data over 22 years to find significant trends and shed some light on long-term drivers of water quality. This paper presents data and findings that are potentially useful to coastal managers in terms of offering recommendations about nutrient reductions as well as longer term impacts of climate change on these systems. As such, the paper is topical, timely, and of sufficient quality to be accepted with minor (very minor) revisions.*

We thank reviewer #2 for their kind comments regarding our analysis.

*Specific Comments:*
*It is very difficult to determine if a symbol is a triangle or a circle in Fig 1. Coastline is too faint. #s of estuaries and lat/lon is hard to read. The figure can be improved with changes in font and symbol.*

We thank the reviewer for pointing out these issues. We have updated the figure to include larger and bold font for the embayment numbers, increase the size of the font on the axes, and increase the line width of the coastline. We also have improved the quality of the figure by increasing the dpi and changing the file format.

*Figure 5: The caption states that color and symbols indicate trend and direction? This is confusing for this first figure of this type (Figure 5) in that there is no negative slopes in the figure. I would suggest removing "and direction" from the Figure 5 caption. The captions are fine for Figures 6-8 as written.*

We have updated the figure caption to improve clarity. The text now reads (lines 618-621):

"**Fig. 5** Slopes from long-term trend analysis for (A) temperature (°C $yr^{-1}$), (B) chlorophyll (Chla) ($log_{10}$ (mg $m^{-3}$)) $yr^{-1}$), and (C) total nitrogen (TN) (μM $yr^{-1}$). Red triangles indicate statistically significant increasing trends and black circles indicates no statistical trend. The size of the triangles indicates the magnitude of the slopes."

*–Can you please clarify why a river-fed embayment is defined as having a standard deviation of >5 salinity units? Can some rivers have fairly constant flow so that salinities do not vary that much? Could tidal ranges lead to characterizing a site as river-fed? In general higher salinity sites have lower SD so are*

*groundwater-fed systems simply farther downstream from freshwater sites? This definition has implications for water quality so the definition deserves further description/definition.*

We used the variability of embayment mean salinity across many sampling locations within each estuary as an indication of geomorphology and freshwater input. Embayments with high standard deviations in salinity contained a classical estuarine gradient with riverine input, while embayments with low standard deviations were more lagoonal in structure with largely similar salinity across sampling locations, and thus low surface water inputs. However, this method may also be biased by sampling location if no sampling sites were contained in fresh or brackish water areas. In response to this comment, we have to redefined embayments as river vs. groundwater fed based on surface water inflows to the embayments. This new definition does not change the embayments designated as groundwater-fed or river-fed. We have updated lines 174-179 such that:

“Embayments were classified as “river-fed” (Fig. 1, triangles) if the embayments had large surface water inputs, and otherwise were classified as “groundwater-fed” (Fig. 1, circles). Embayments classified as “river-fed” tended to have higher variability in mean salinity across the embayment, consistent with sampling across a classical estuarine gradient (Table S1).”

*–Could the citizen volunteers be thanked by name in the Supplement (or a few key volunteers selected by # of samples or # of years) or Acknowledgements?*

While we would love to thank the volunteers by name, there have been more than 1074 volunteers over the history of this program, and we believe thanking this many people would be an inefficient use of space. However, we have added to the Acknowledgements the specific number of volunteers who have participated in the program (line 47). The volunteers are thanked by name each year in the Buzzards Bay Coalition’s Annual Reports.

*–Introduction Line 23-29: These conclusions are described in the Abstract and Conclusions, but do not really belong in the Introduction.*

We thank the reviewer for pointing out this issue. We have moved this text to the conclusion section as a summary of our findings (lines 382-386).

*Technical Corrections –Abstract, line 10: “...little correlation between inorganic nutrients, organic matter, and chlorophyll a ...”*

We thank the reviewer for pointing out this confusing sentence. We have updated this clause to read (lines 29-30): “little correlation between inorganic nutrients and organic matter or chlorophyll a”.

*–While I can find the definitions of POC and PON, I do not see the definitions of DIN and TN*

We have added definitions to the text of DIN and TN also as a response to Reviewer #1. Regarding this point, our response to Reviewer #1 reads:

We have added a definition of TN and DIN to the manuscript where TN is the sum of all nitrogen species ($NO_3^-$ + $NO_2^-$ + $NH_4^+$ + DON+PON), while DIN is the sum of the inorganic nitrogen species ($NO_3^-$ + $NO_2^-$ + $NH_4^+$). We have also clarified our references to nitrogen in general as “nitrogen”, rather than “N”. We have added the following text to lines 147-148:

“Total nitrogen (TN) is defined as the sum of TDN and PON and dissolved organic nitrogen (DON) is defined as the difference between TDN and DIN.”