Biological Standards Update

Invertebrates and Fish

May 3, 2023

SONGS Mitigation Monitoring Project
Marine Science Institute, University of California Santa Barbara

- This presentation concerns the status of invertebrates and fish in San Dieguito Wetlands.

Performance Standards - Invertebrates

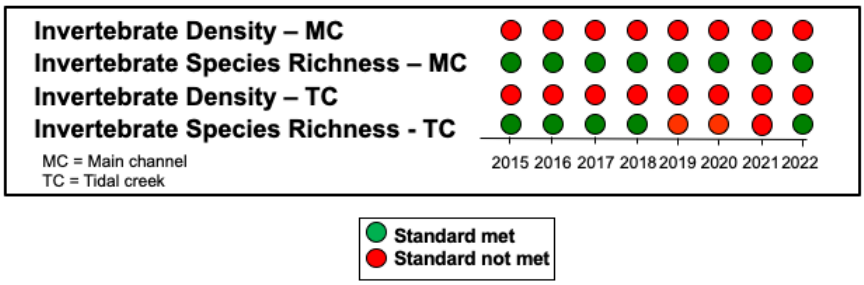
Relative Standards:

The total densities and number of species of macroinvertebrates shall be similar to the densities and number of species in similar habitats in the reference wetlands.

Evaluated separately for:

- Main channel
- Tidal creek

Performance 2015 – 2022 (based on 4 year running average):



- To review, this slide provides the relative standards for invertebrates.
- This standard requires that the total densities and number of species of macroinvertebrates in SDW be similar to the densities and number of species in similar habitats in the reference wetlands.
- The standard is evaluated separately for main channel and tidal creek.
- As presented by Rachel, the densities of invertebrates have consistently underperformed in both tidal creeks and main channels in San Dieguito Wetland relative to the reference wetlands.

Performance Standards - Fish

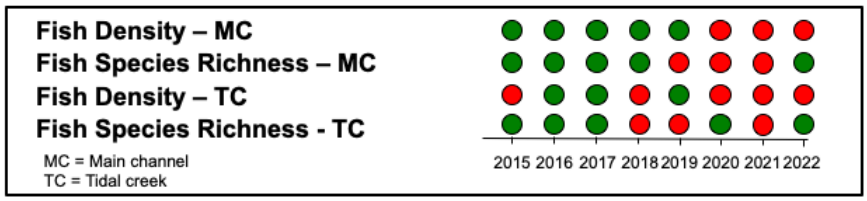
Relative Standards:

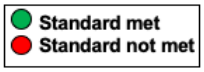
The total densities and number of species of fish shall be similar to the densities and number of species in similar habitats in the reference wetlands.

Evaluated separately for:

- Main channel
- Tidal creek

Performance 2015 – 2022 (based on 4 year running average):





- The relative standard requirement for fish is the same as that for invertebrates, i.e. the densities and number of species of fish shall be similar in San Dieguito to the reference wetlands.
- Fish have met the relative standard more consistently than invertebrates, but have failed the standard for density in tidal creeks, and richness in main channel, the past three years.
- Today, we would like to review of some of the data that we have collecting to understand and address the possible reasons for the underperformance of invertebrates and fish in tidal creeks.

Hypotheses explored pertaining to the underperformance of invertebrates and fish in San Dieguito Wetlands

Sediment properties hypothesis – characteristics of the sediments are contributing to invertebrate underperformance

- Grain size characteristics (e.g., % silt-clay, median particle size)
- Organic matter content

Topography hypothesis – aspects of the physical structure of the wetland (e.g., elevation of habitat) are contributing underperformance

- Over the past year, two hypotheses were evaluated pertaining to the underperformance in density of invertebrates in SDW tidal creeks relative to the reference sites.

Hypotheses explored pertaining to the underperformance of invertebrates and fish in San Dieguito Wetlands

Sediment properties hypothesis – characteristics of the sediments are contributing to invertebrate underperformance

- Grain size characteristics (e.g., % silt-clay, median particle size)
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Topography hypothesis – aspects of the physical structure of the wetland (e.g., elevation of habitat) are contributing underperformance

- The first hypothesis concerns sediment properties.
- This hypothesis proposes that some characteristics of the sediments are contributing to invertebrate underperformance.
- Sediment properties, for example % silt-clay or the amount of organic matter has been shown to influence invertebrate distribution and abundance at some wetlands.
- However, sediment properties in tidal creeks were similar across our wetlands, so today we'll focus on the second hypothesis that pertains to topography.

Hypotheses explored pertaining to the underperformance of invertebrates and fish in San Dieguito Wetlands

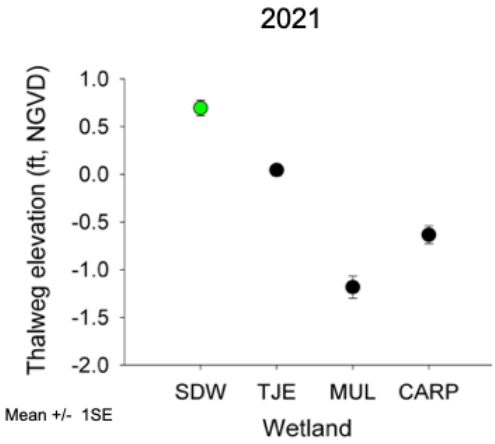
Sediment properties hypothesis – characteristics of the sediments are contributing to invertebrate underperformance

- Grain size characteristics (e.g., % silt-clay, median particle size)
- Organic matter content

Topography hypothesis – aspects of the physical structure of the wetland (e.g., elevation of habitat) are contributing underperformance

- This hypothesis proposes that an aspect or aspects of the physical structure of SDW tidal creeks is contributing to the deficit of invertebrates.
- As mentioned in Kat's presentation, Spartina has encroached into bottoms of SDW tidal creeks in some locations, suggesting that tidal creeks are at a higher elevation in SDW than the reference sites and this could affect invertebrate, as well as, fish abundance.

Variation in Elevation of Tidal Creeks Among Wetlands

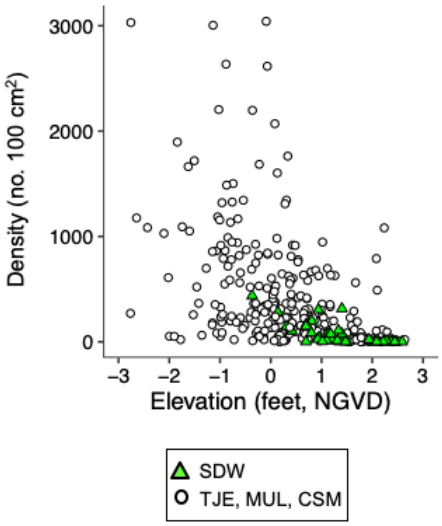


- Tidal creeks are at a higher elevation in SDW compared with the reference wetlands
- High elevation creeks of SDW are inundated by tidal waters less frequently than low elevation creeks of reference sites.

San Dieguito Wetlands tidal creeks
2020-2021

- Last year we reported that the elevations of the tidal creeks in SDW are higher than in the reference wetlands.
- In the figure on the left, each point represents the mean elevation of the thalweg, the lowest elevation in the tidal creeks sampled in SDW and the reference wetlands determined from measurements taken during our monitoring in 2021.
- Again, the sites are SDW=San Dieguito, TJE=Tijuana Estuary, MUL=Mugu Lagoon, and CARP=Carpinteria Salt Marsh.
- You will notice that the mean thalweg elevation in SDW is about 0.7 ft higher than the closest reference wetland, which is TJE and 1.3 to 1.8 ft higher than Mugu and Carpinteria, the other two reference wetlands.
- A consequence of this is that the high elevation creeks of SDW are inundated by tidal waters less frequently than low elevation creeks of reference sites.

Invertebrate Density vs. Elevation (2020-2021)



Trend of decreasing invertebrate density with increasing tidal elevation

Examples of sampled invertebrates retained on a 0.5 mm mesh sieve

- We also found a trend of decreasing invertebrate density with increasing tidal elevation across all the wetlands.
- This figure shows invertebrate density as #/100 cm2 on the y axis and elevation on the x axis for SDW, indicated by the green symbols, and the reference wetlands, indicated by the open symbols.
- Each point represents the elevation at a location where we sample invertebrates using small cores.
- You will notice, as illustrated in the earlier slide, that the elevations for the reference wetlands extend lower than those at SDW, which has few points below 0 ft NGVD.

Evaluation of the Topography Hypothesis

Sample the lower elevation creeks in the nearby 22nd Ag District restoration and in SDW to determine whether they have higher densities and species richness of invertebrates and fish than the monitored SDW creeks

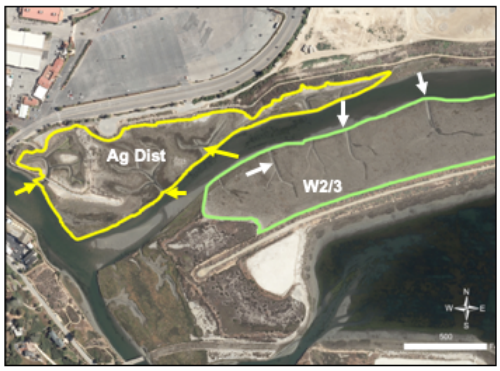
Lower elevation Ag District creeks located across the river channel from monitored creeks in SDW

- To evaluate the topography hypothesis, we proposed to sample invertebrates and fish in the tidal creeks of the 7 year old 22nd Ag District restoration located across the river channel from SDW modules W2/3, the location of three of our currently monitored creeks.
- In this image, you can clearly see that the Ag District creeks are filled with water in comparison to the empty SDW creeks on the other side of the river channel.
- The expectation is that invertebrate and fish densities would be higher in the Ag District creeks compared to those in SDW if elevation is contributing to the differences in invertebrate densities among wetlands.

Sampling Locations & Creek Elevations

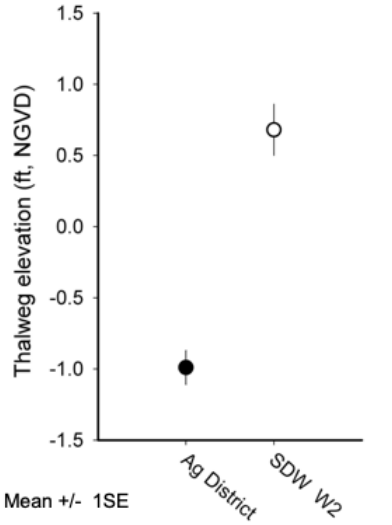
Monitored & Supplemental Creeks:
San Dieguito Wetlands (W2/3) & 22nd Ag District

Currently monitored creeks (white arrows) & supplemental creeks (yellow arrows)



- Supplemental creeks in the 22nd Ag District are lower in elevation than those currently monitored in W2/3

Creek elevation vs. location

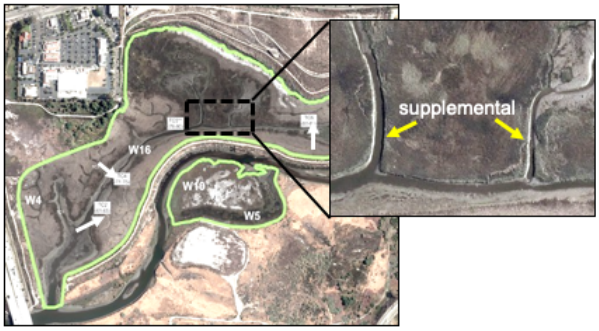


- This slide shows in more detail the creeks that were sampled in W2/3 as part of our performance monitoring 2022, indicated by the white arrows, and supplemental Ag District that were also sampled last year indicated by the yellow arrows.
- The figure on the right shows the mean elevation of the thalweg, the lowest elevation, of the sampled creeks.
- You can see that the mean thalweg elevation of the Ag District creeks is more than 1.5 ft feet lower than those in W2/3.

Sampling Locations & Creek Elevations

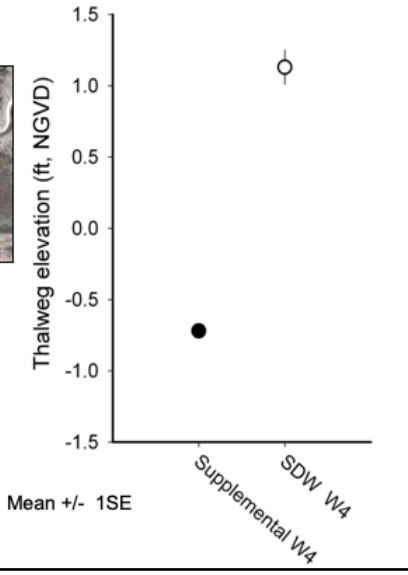
Monitored & Supplemental Creeks in SDW W4

Currently monitored creeks (white arrows) & supplemental creeks (yellow arrows)

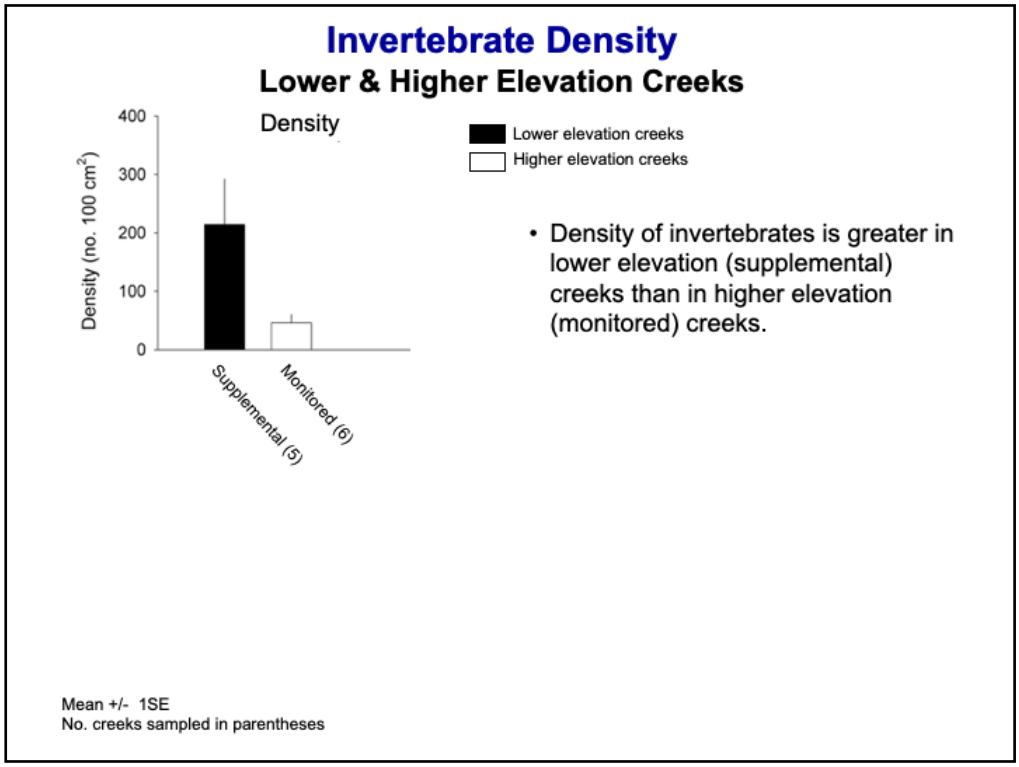


- Supplemental creeks in W4 are lower in elevation than those currently monitored in W4

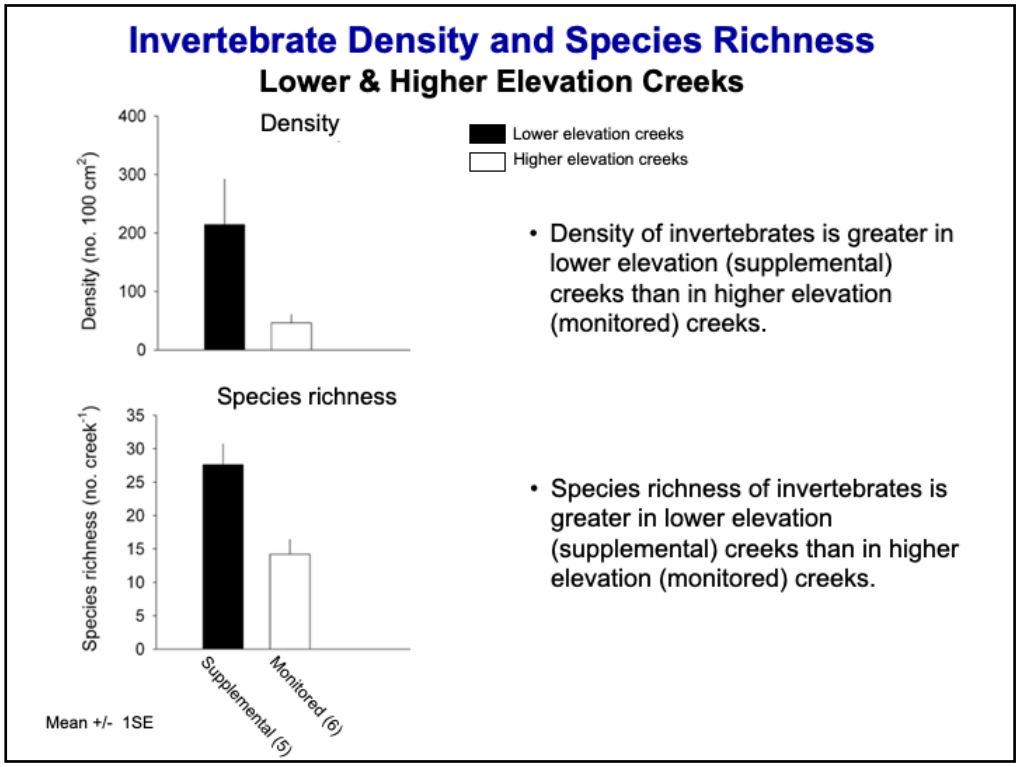
Creek elevation vs. location



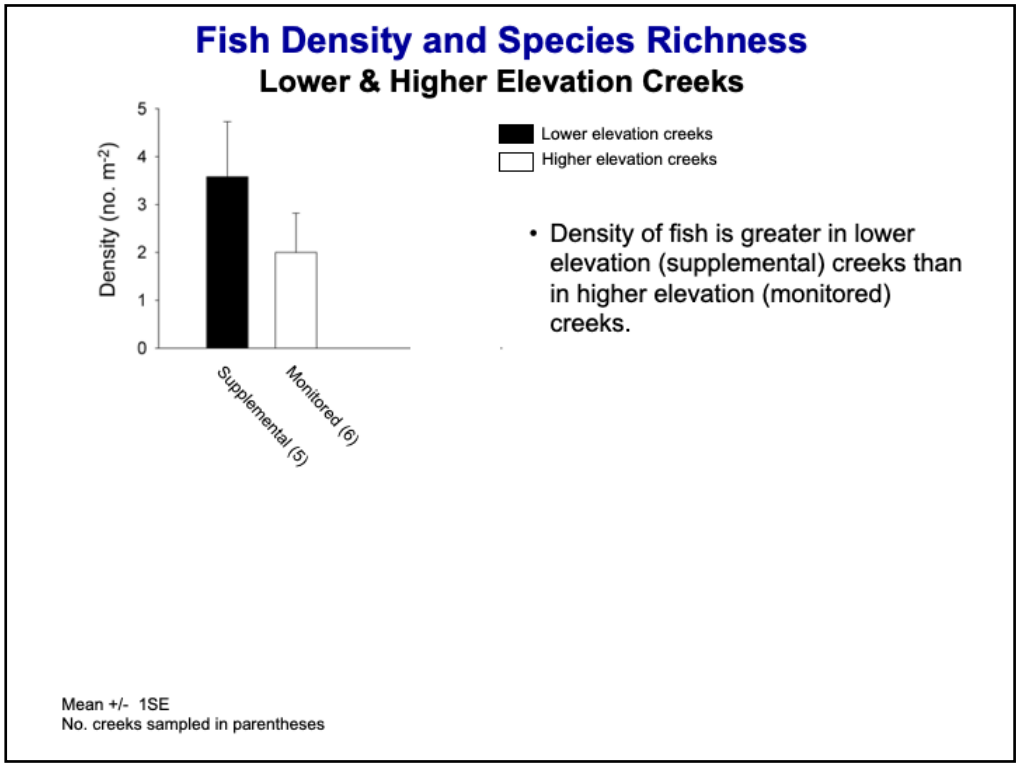
- We also took advantage of two lower elevation drainages that act as creeks entering mudflat areas in W4/16 on the east side of the freeway, shown by yellow arrows, and compared invertebrate and fish densities and richness at those locations to currently monitored creeks, indicated by the white arrows.
- The figure on the right shows the thalweg elevations of these supplemental creeks on the left and the currently monitored creeks on the right.
- You can see that the mean thalweg elevation of the supplemental creeks is over 1.5 feet lower than the currently monitored creeks.



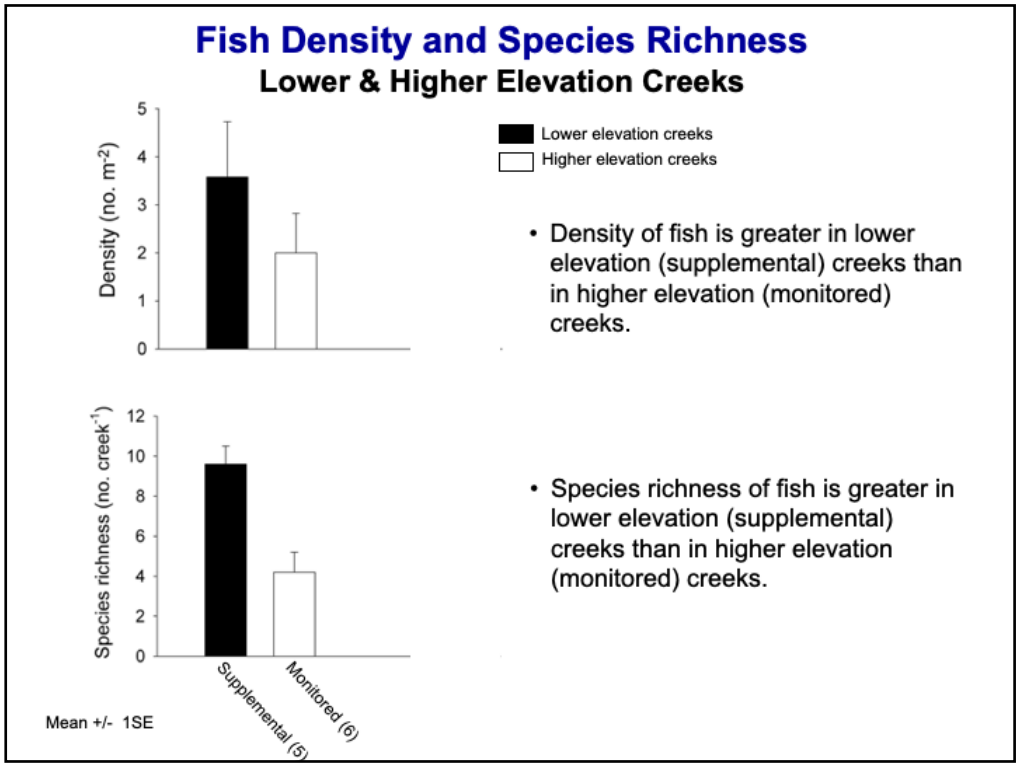
- We combined the data from the 5 lower elevation creeks for comparison to the 6 currently monitored creeks.
- Taking a look at the densities of invertebrates, we see that mean invertebrate density is greater in the lower elevation creeks, indicated by the dark bars, than in the creeks used in performance monitoring, indicated by the open bars.



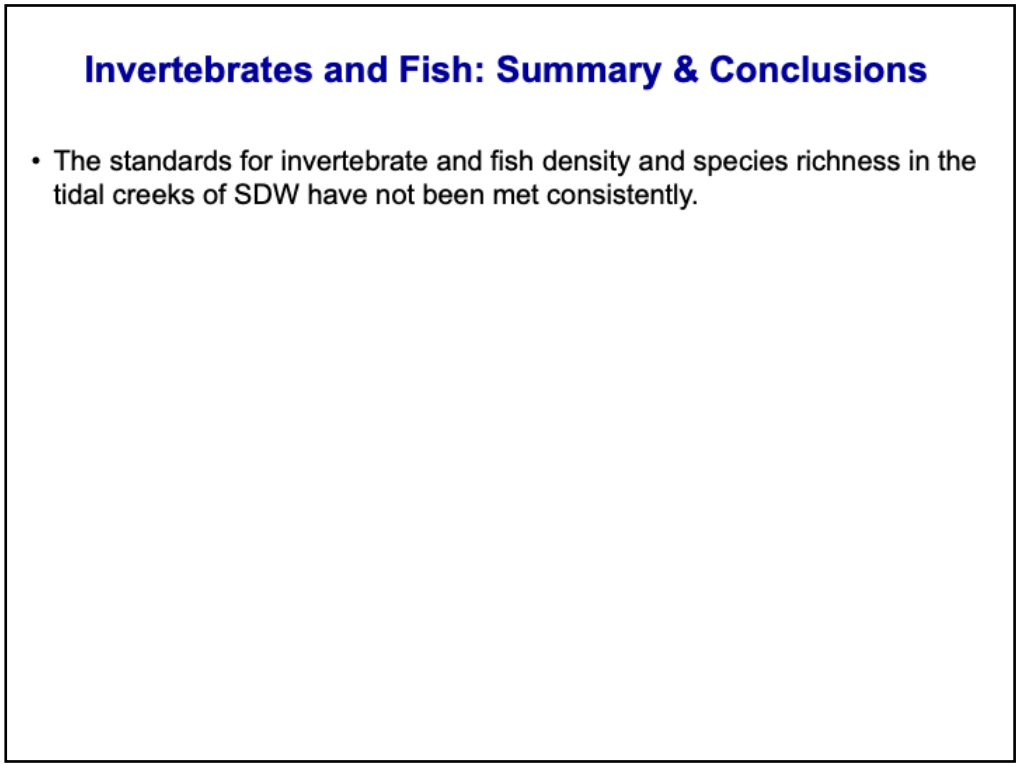
- Taking a look at invertebrate species richness in the lower figure, we see a similar pattern.
- Invertebrate species richness is greater in the low elevation creeks than in the creeks sampled in performance monitoring.



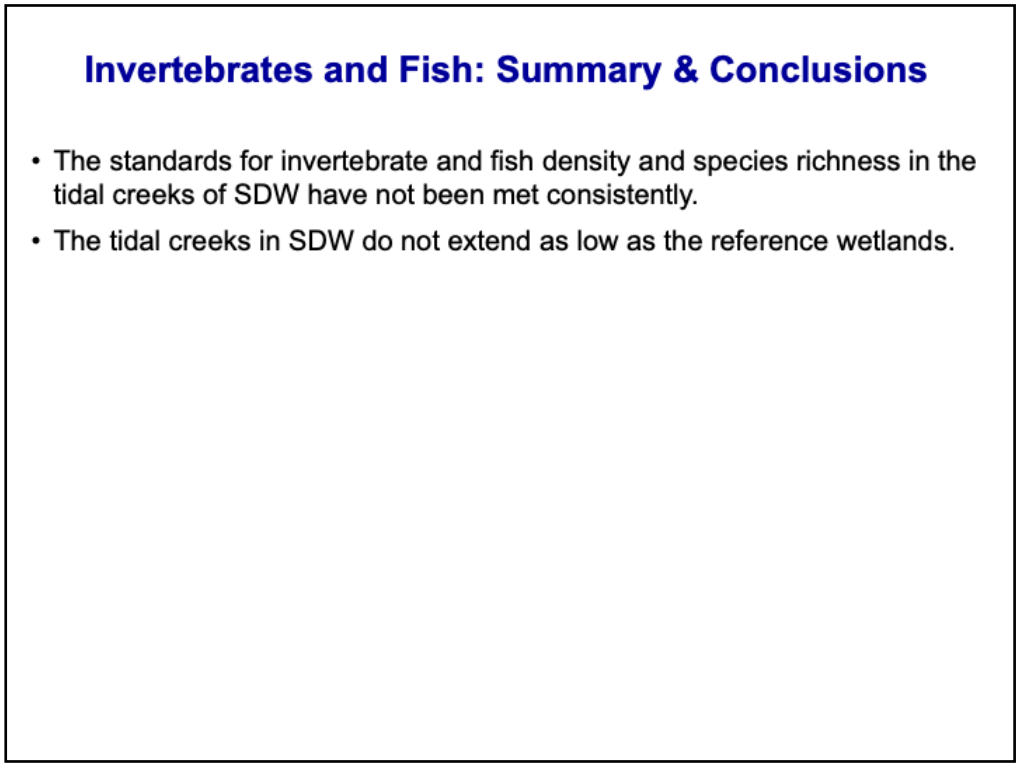
- Turning to fish, we see a similar pattern for fish density.
- Fish density is greater in the lower elevation supplemental creeks of the Ag District and W4, shown as solid bars, than in the creeks used in performance monitoring.



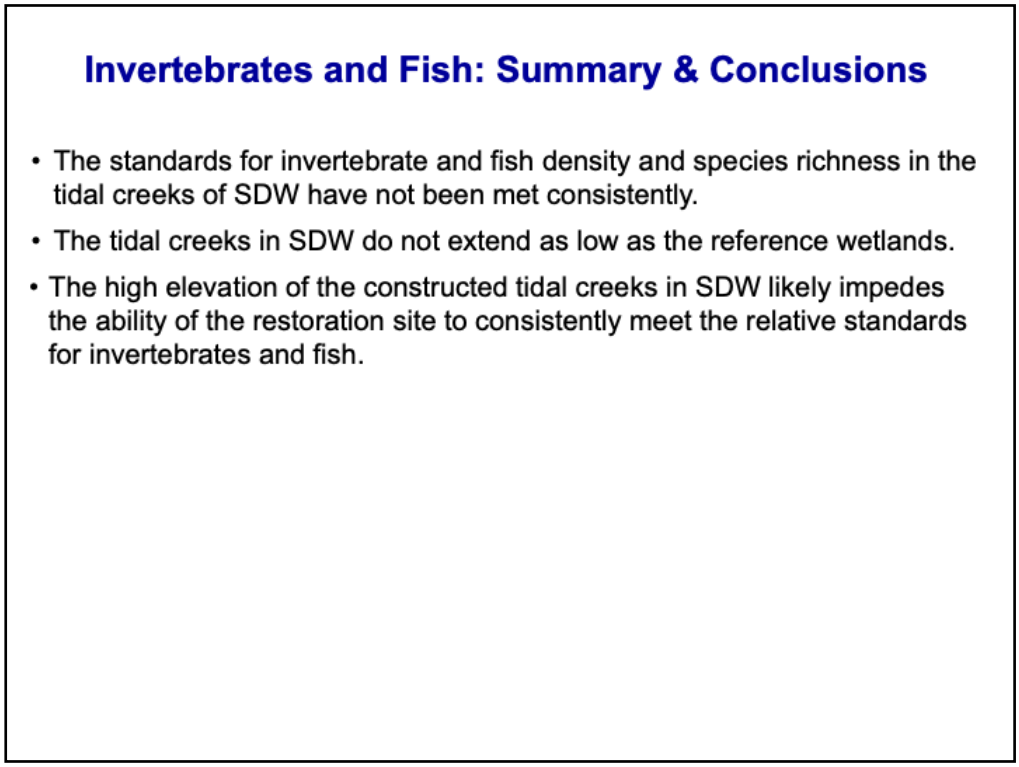
- A similar pattern is seen for fish species richness in the lower figure.
- Fish species richness is greater in the lower elevation creeks than in the creeks used in performance monitoring.



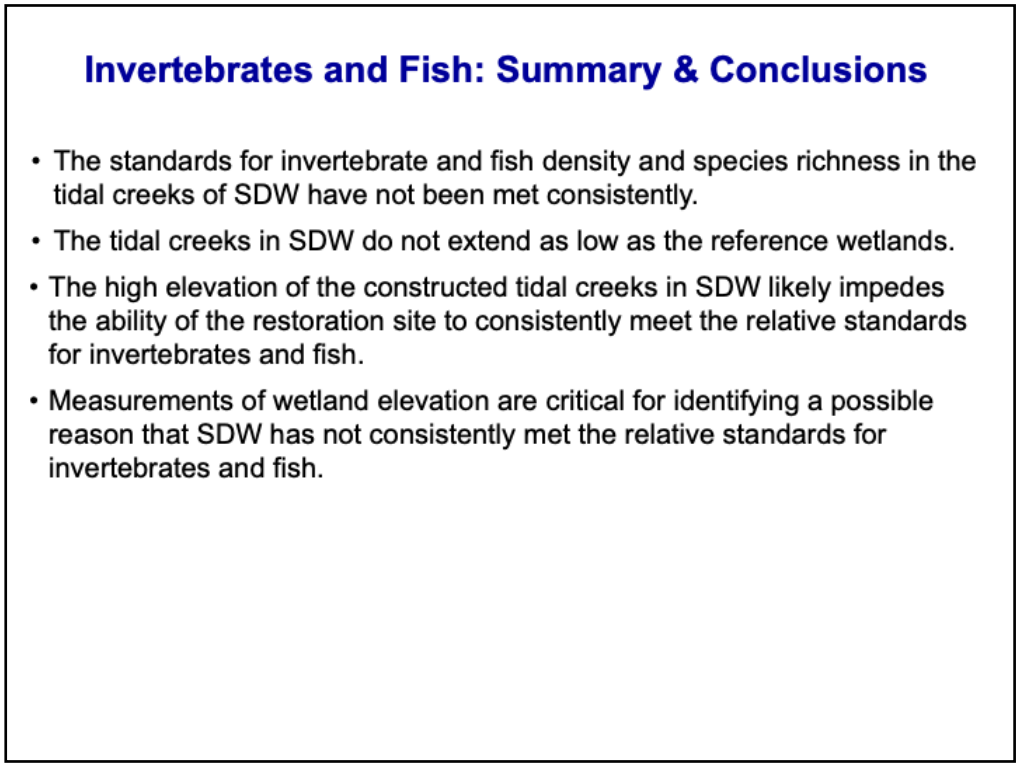
- To summarize, the standards for invertebrate and fish density and species richness in the tidal creeks of SDW have not been met consistently.



- The standards for invertebrate and fish density and species richness in the tidal creeks of SDW have not been met consistently.
- The tidal creeks in SDW do not extend as low as the reference wetlands.



- The standards for invertebrate and fish density and species richness in the tidal creeks of SDW have not been met consistently.
- The tidal creeks in SDW do not extend as low as the reference wetlands.
- The high elevation of the constructed tidal creeks in SDW likely impedes the ability of the restoration site to consistently meet the relative standards for invertebrates and fish.



- The standards for invertebrate and fish density and species richness in the tidal creeks of SDW have not been met consistently.
- The tidal creeks in SDW do not extend as low as the reference wetlands.
- The high elevation of the constructed tidal creeks in SDW may impede the ability of the restoration site to consistently meet the relative standards for invertebrates and fish.
- Measurements of wetland elevation are critical for identifying a possible reason why SDW has not consistently met the relative standards for invertebrates and fish.

Future Directions

- Continue to conduct on the ground elevation surveys and obtain a wetland wide digital elevation model (DEM) that will facilitate:
  - Geomorphological analysis to understand sediment inputs and processes (accretion, erosion)
  - Habitat evolution model analysis to determine areal extent and rate of habitat conversion over time

- Moving forward, we will continue to:
- Conduct on the ground elevation surveys and obtain a wetland wide digital elevation model (DEM) that will facilitate:
  - Geomorphological analysis to understand sediment inputs and processes (accretion, erosion)
  - Habitat evolution model analysis to determine areal extent and rate of habitat conversion over time
- The issues discussed in this presentation are related to those discussed by Kat in her talk on the disappearance of mudflat, and we will use the results of the proposed studies to inform any future remedial action related to tidal creeks, if necessary.

Agenda

Annual Public Workshop

San Onofre Nuclear Generating Station Wetland Mitigation Project

May 3, 2023

1:30 – 1:40	**Introduction and Overview – *Steve Schroeter, UCSB***
1:40 – 2:20	**Performance of the San Dieguito Wetlands Restoration Project – *Rachel Smith, UCSB***
2:20 – 2:35	**Salt Marsh Vegetation and Habitat Areas: Status Update – *Kat Beheshti, UCSB***
2:35 – 2:50	**Biological standards update: Invertebrates & Fish – *Mark Page, UCSB***
2:50 – ?	**General Discussion**

For more information go to: http://marinemitigation.msi.ucsb.edu/