



Evaluating the impact of the Sewage Treatment Plant's effluent discharge in the Peconic River on bird biodiversity

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Abstract

The Long Island Central Pine Barrens region is a unique ecosystem that boasts high levels of biodiversity. Brookhaven National Laboratory (BNL), a multipurpose national research facility, is located within this region and researchers on site monitor wildlife populations continuously. The Sewage Treatment Plant (STP) at BNL has historically discharged effluent into the upstream reaches of the Peconic River, and in 2011, the Environmental Assessment (EA) recognized the negative impacts on the ecosystem. To remain in accordance with the permits issued through the State Pollutant Discharge Elimination System and to accommodate the EA, BNL stopped the discharge of effluent into the river, installed a new post-aeration filtration system at the STP, and constructed recharge basins on nearly 5 acres of the former WW I era sand filter beds. The goal of these actions is to decrease the concentration of heavy metals in the ecosystem and to maintain the biodiversity in the area. Avian point count surveys are a monitoring technique in place and have been conducted annually since 2000 on multiple transects throughout the laboratory. BNL is part of the Atlantic Flyway and provides habitat for hundreds of migratory bird species. The present study examined if stopping the STP's effluent discharge in 2014 has impacted bird biodiversity on the Peconic River transect. Statistical analysis revealed that there is no substantial, immediate impact on bird species richness, diversity, or evenness in the 4 sites studied along the Peconic River. Although there may not be an immediate impact, future monitoring is needed to determine if there is a long term impact on bird biodiversity. Ultimately, an adaptive management technique should be adopted to respond to any negative changes in wildlife populations at BNL.

Introduction

The STP has historically treated and discharged about one million gallons of effluent each day into the upstream reaches of the Peconic River (Greenberg 2016). These discharges have resulted in high levels of heavy metals and other harmful concentrations (BNL 2012). The EA highlighted numerous detrimental environmental impacts and made recommendations for alternative strategies for handling the effluent.

Actions taken by BNL (BNL 2011):

- Stopped discharging STP effluent into the Peconic River (2014)
- Installed a new post-aeration filtration system at the STP
- Constructed recharge basins on former WWI sand-filter beds
- Redirected effluent from discharging to the Peconic River to the discharge basins
- Planted native grasses and forbs at the former sand filter beds

Ceasing the discharge of effluent into the Peconic river essentially caused the upstream reaches to dry up. BNL is located within the Atlantic Flyway and is an important host for hundreds of migratory bird species (Audubon 2014). Birds are often considered to be effective indicators of the health of an ecosystem. They are impacted by the physical and chemical influences of their environments. The Environmental Protection Division has been monitoring bird populations through avian point count surveys since 2000.

Goal: Determine what the impacts are of STP effluent discharge in the Peconic River on bird biodiversity

Objective: To complete a biodiversity analysis of bird populations before and after the STP stopped the effluent discharge in the Peconic river (2014) and determine if further action is needed.

Methods

Study Site: Brookhaven National Laboratory, Long Island, New York

Study Period: 2000-2015

Transect: Peconic River x 4 stations (PRB-1, PRB-2, PRB-3, PRB-4)

- Every station is ~150m apart, no 2 stations are adjacent

Data Collection: Avian point count surveys

- Each station is observed for a 5-minute period
- All birds seen or heard by observers is recorded
- Weather data is recorded (temperature, precipitation, DP, wind speed/direction, RH)

Biodiversity Analysis:

- For each site, 2000—2014 and 2015, the following variables were calculated:
 - Species richness (S), Simpson's Index (D), Simpson's Diversity Index (1-D), Shannon-Weiner Index (H), and Shannon-Weiner Index of Evenness (E)

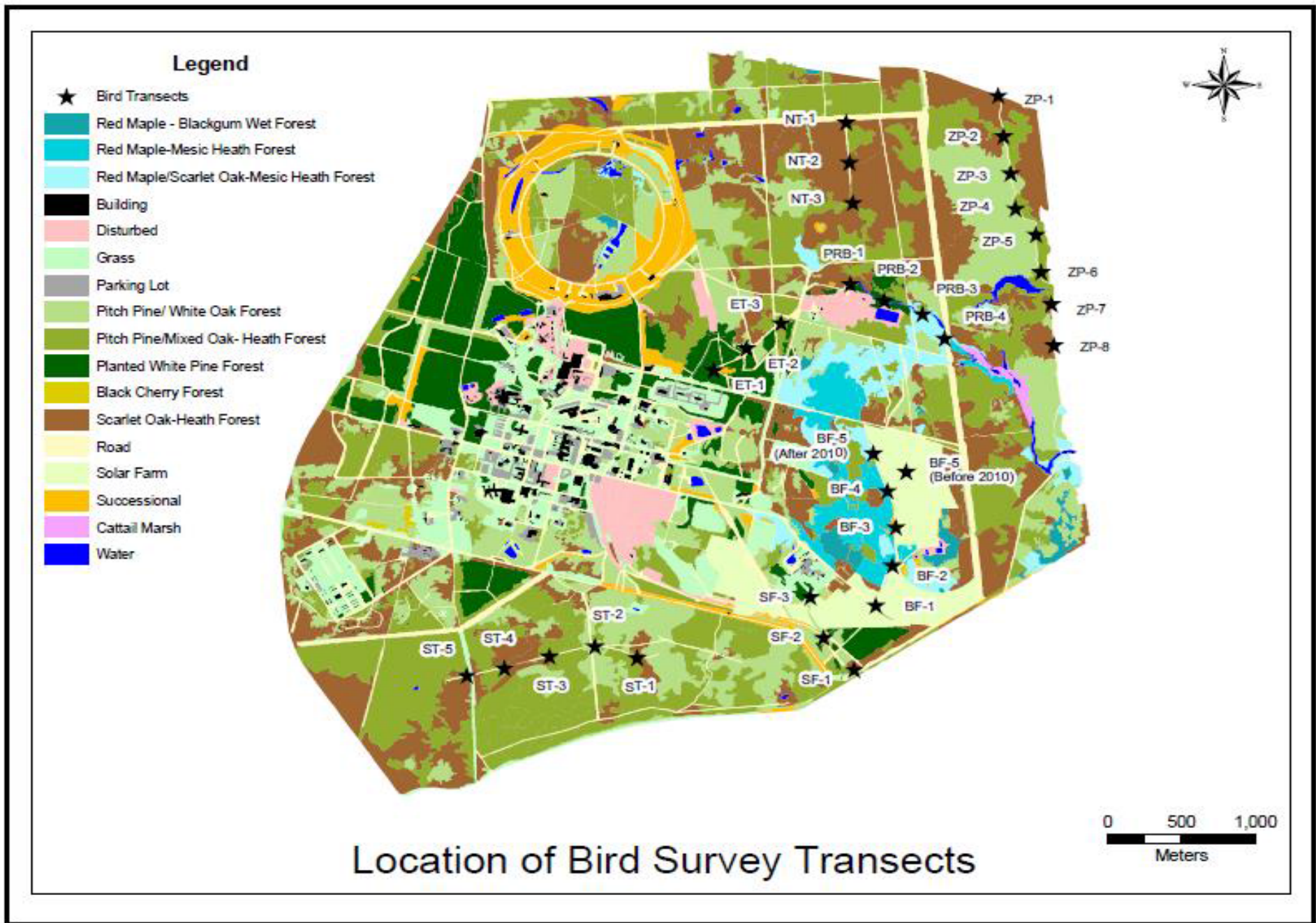


Figure 1: The locations and distribution of the bird point count survey transects and stations after 2010 across several habitats at Brookhaven National Laboratory in Suffolk County, New York.

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Results

- Species richness (S)**- the number of species in the study area during the survey.
- The Simpson's Index (D)**- the probability that 2 individuals randomly selected from the sample will be of the same species.
- The Simpson's Index of Diversity (1-D)**- the probability that 2 individuals randomly selected from the sample will be of different species.
- The Shannon-Weiner Index (H)**- the number of individuals observed for each species in the sample plot.
- The Shannon-Weiner Index of Evenness(E)** is a measure of how similar the abundance of different species is.

Time	Site #	S	D	1-D	H	E
2000-2014	PRB-1	22.3	0.0620	0.9380	3.2276	0.7704
2015	PRB-1	29	0.0552	0.9448	3.0073	0.8931
2000-2014	PRB-2	22.3	0.0528	0.9472	3.2863	0.8164
2015	PRB-2	28	0.0579	0.9421	2.9507	0.8855
2000-2014	PRB-3	24.6	0.0610	0.9390	3.2254	0.7755
2015	PRB-3	29	0.0479	0.9521	3.0810	0.9150
2000-2014	PRB-4	25.1	0.0703	0.9297	3.1315	0.7712
2015	PRB-4	25	0.0745	0.9255	2.7741	0.8618

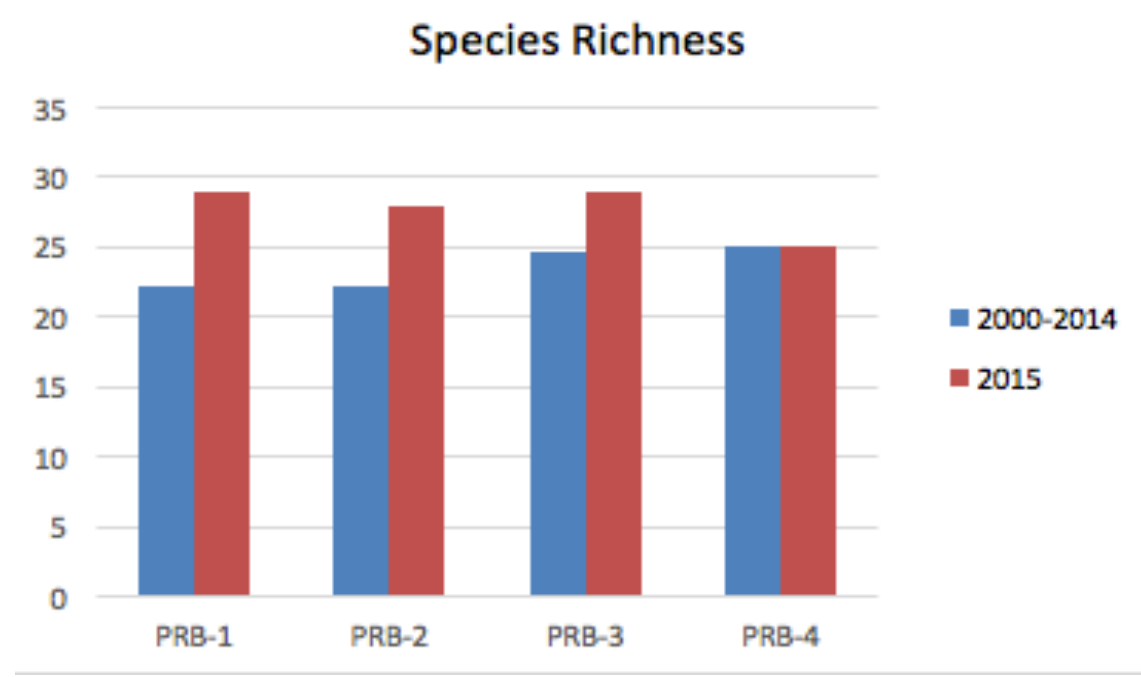


Figure 2: A comparison of species richness (S) values from 2000-2014 and 2015 along the Peconic river transect

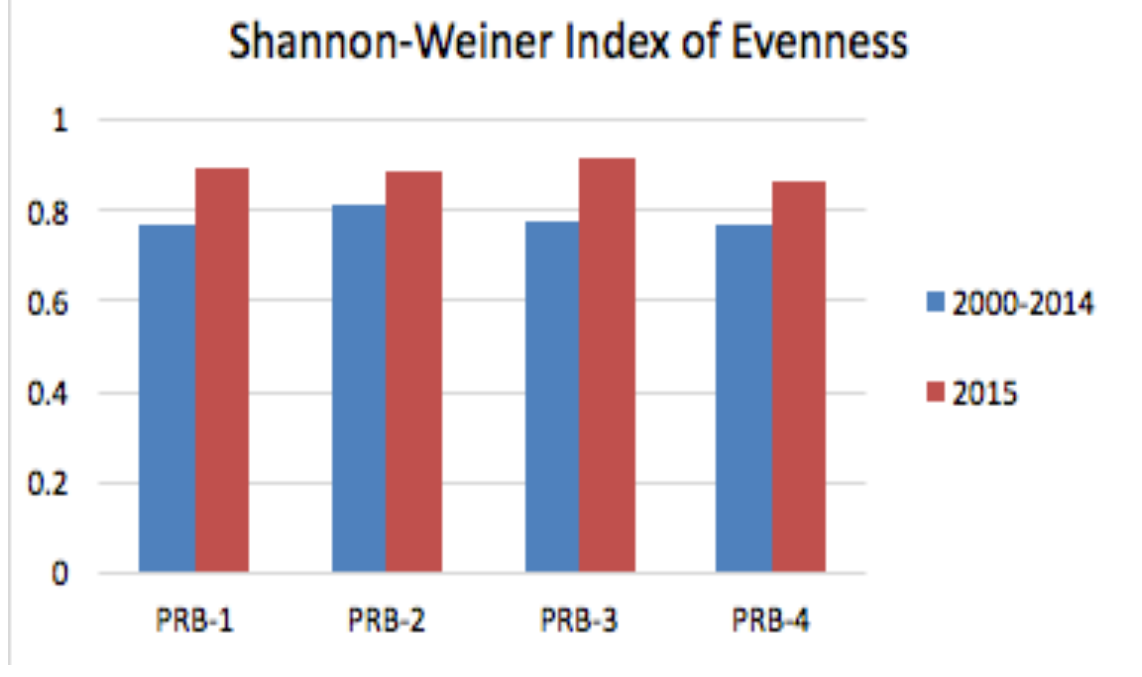


Figure 3: A comparison of Evenness (E) values from 2000-2014 and 2015 along the Peconic river transect

- Species richness was greater in 2015 than the average species richness from 2000-2014 for sites PRB-1, PRB-2, and PRB-3 (Fig. 2)
- The Shannon-Weiner Index of Evenness (E) was greater at all sites in 2015 than 2000-2014 (Fig.3)
- The Simpson's Index of Diversity (1-D) is relatively high (close to 1) across all sites

Discussion

The data collection protocol was standardized so as to control for sources of variation that affect detectability. By having the same 2 experienced professionals for every sample occasion, the detection probability is maximized and bias errors are minimized and there is constant bias (Fryxell et al. 2014).

The species richness (S) reported in the results indicates that bird species are relatively diverse at BNL. Although there was higher species richness in 2015 across all sites, we cannot conclude that bird species richness necessarily increased. The values of S for 2015 are within the normal range (16-31) of species that contributed to the averages for 2000-2014.

The sample size was large enough in the 2000-2014 data set that the estimates are precise and can confidently represent the bird biodiversity during that time. In 2015, however, the sample size is not large enough to make sound conclusions.

Ultimately: It appears as though there are no substantial, immediate impacts on bird biodiversity along the Peconic River.

Recommendations for the Future: continue to monitor the population to evaluate potential long term impacts, adopt an adaptive management strategy, estimate biodiversity indices along with abundance.

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