

# **Investigating the Genetic and Environmental Factors Contributing to Dwarfed Atlantic White Cedar Populations in Sears Bellows County Park**

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#### **Abstract**

The Atlantic White Cedar is found along the eastern coast of the United States. Recently, a dwarf variation having a decreased maximum height and diameter has been found in several locations. **Possible reasons for several clusters of dwarfed Atlantic White Cedar in the Pine Barrens of Southeastern New York State were** investigated. The study was a cooperative effort between Cold **Spring Harbor Laboratory DNA Learning Center, the Central Pine Barrens Commission, the Seatuck Environmental Association, and** Massapequa High School. The dwarfed feature on these trees was thought to be a result of either genetic differentiation in the species or environmental conditions or both. Measurements of the environmental conditions as well as samples of leaves collected from both dwarfed and normal stature Atlantic White Cedars were analyzed using the rbcL and ITS genes to detect abnormalities amongst the dwarfed populations as compared to non-dwarfed trees. No DNA difference between the populations, using DNA Subway and both genes, was found. Therefore, it was concluded that the populations were dwarfing due to environmental conditions. **Introduction** 

The Atlantic white cedar, Chamaecyparis thyoides, is an evergreen tree in the cypress family. The genus name derives from the Greek word chamai, for dwarf or low to the ground, and kyparissos, for cypress. The Atlantic white cedar prefers to grow within swamps, marshes, and other more acidic and wet environments with sandy, peaty soil. They tend to grow on a small mound, with water pooling in the depression surrounding it. The Atlantic white cedars thrive in full sun to part shade. Populations of Atlantic white cedars can form dense stands which allows for minimal light penetration to the understory due to the sprays of flattened, blueish-green needle-like leaves that the trees possess. An area which provides excellent conditions for the growth of Atlantic white cedar is the Long Island Pine Barrens. The Long Island Pine **Barrens contain the greatest diversity of plant and animal species** anywhere in the state of New York. They contain a diverse range of wetland communities, including marshes, heath bogs, and red maple swamps; They also contain Atlantic white cedar swamps.

However, in recent years, populations of Atlantic White cedar have been growing in the Long Island Pine Barrens which differ greatly from the existing population. With no clear reason, the cedar have begun growing in what appears to be a pattern of stunted growth, dwarfism. The trees are noticeably shorter than the average Atlantic White cedar, posing question as to what has caused the error in growth. The present research investigating a possible genetic cause of this abnormality.

#### Method:

10 samples of dwarfed and non-dwarfed tree branches collected throughout Sears Bellows Park, Long Island, NY.



Samples were documented along with metadata on Barcode Sample Database as a group project





DNA was extracted using a silica-based protocol and purified for rbcL and ITS genes with PCR.



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Amplified DNA Barcode regions were uploaded to DNA Subway to be processed and trimmed using Blue Line.

### <u>Results</u>

10 samples were collected; however, only 7 were successfully sequenced and were usable for rbcL gene analysis. For both genes sequences, the cladogram for the rbcL and resulting ITS both came to support the conclusion that the dwarfed samples were still within the same species as the non-dwarfed Cedars. Bodies of water surrounding certain samples were tested for pH and the soil for duff area. Core samples of alike trees were also taken in order to view the differences in circular rings. Dwarfed samples had rings of smaller distance between each.

	Water characteristics	Site characteristics	AWC population	Additional comments		Water characteristics	Site characteristics	AWC population	Additional comment
Site 1	N/A	Downslope, minimal deer browse, pitted mands and wooded debris	no seedlings, 10-12 in ave. DBH, no saplings, 3 in duff area, 98% crown density, 120 Basal Area	Normal Height	Site 2	pH 4.5, 0.5 ft water depth	flat slope, no deer browse present	no seedlings nor saplings, 20-25 cm average DBH, greater than 12 Basal Area, 3.5 in Duff Area, no Crown Density	Dwarfed samples
Sample ID	Diameter at 💌 breast height	Height	Tree Age*	GPS coordinates	Sample ID	Diameter at breast height	Height	Tree Age*	GPS coordinates
CTX-001	9.6 in	34.8 ft	92	Lat: 40.884053 N Long: -72.558816 W	СТХ-004	9.8 in	8.5 ft	32	Lat: 40.885452 N Lon -72.565620 W
CTX-002	16.2 in	56.0 ft	103	Lat: 40.884011 N Long: -72. 558837 W	CTX-005	1.4 in	7.0 ft	49	Lat: 40.885873 N Lon -72.566117 W
CTX-003	14.0 in	48.0 ft	113	Lat: 40.884083 N Long: -72.558837 W	CTX-006	2.4 in	111.5 ft	72	Lat:40.885750 N Lon -72.565928 W
			* counted rings of nearby r	recently fallen trees				* counted rings of nearby	recently fallen trees

Name	Sequence	Action
CTX-003	GCGGGTGTTAAAGATTACAGATTAACTTATTATACTCCGGAATATCAGACCAAAGATA	View Results
CTX-004	TTAAAGATTACATATTAACTTATGANNCTCCGGAATATCANNNCNAAGATACTGATAT	BLAST
CTX-005	TGTCGGATTCAAGGCGGGTGTTAAAGATTACAGATTAACTTATTATACTCCGGAATAT	View Results
CTX-006	TGTCGGATTCAAGGCGGGTGTTAAAGATTACAGATTAACTTATTATACTCCGGAATAT	View Results
CTX-007	TGTCGGATTCAAGGCGGGTGTTAAAGATTACAGATTAACTTATTATACTCCGGAATAT	View Results
CTX-008	TGTCGGATTCAAGGCGGGTGTTAAAGATTACAGATTAACTTATTATACTCCGGAATAT	View Results
CTX-009	TGTCGGATTCAAGGCGGGTGTTAAAGATTACAGATTAACTTATTATACTCCGGAATAT	View Results
CTX-010	GCGGGTGTTAAAGATTACAGATTAACTTATTATACTCCGGAATATCAGACCAAAGATA	View Results

Figure 2: An image of the BLAST sequences to be used to construct the Cladog

#### **Discussion:**

- The data indicated that the dwarfed Atlantic White Cedar populations were the same species as the Atlantic White Cedars that were growing normally. Therefore, environmental factors are thought to be the cause of the dwarfed trees.
- A limitation is that only one region was sampled. Gathering data from multiple, distinct locations would strengthen the above conclusion.
- Further research of the Pine Barrens and of the environments of the dwarfed Atlantic White Cedar must be studied in order to determine the specific environmental condition(s) which caused the dwarfing.
- Results from expanded studies could be used to predict where and how different species may adapt to environmental conditions.

#### **References**

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	Water characteristics	Site characteristics	AWC population	Additional comments	
Site 3	pH 5.5 water surface, pH 9.0 in water depth	downhill slope, deer browse present	no seedlings, no saplings, 2-3 in ave. DBH, 20/4 Basal Area, 1 in duff area, 80% crown density, ave height of tree: 10-15ft	Dwarfed samples	
Sample ID	Diameter at breast height	Height	Tree Age*	GPS coordinates	
CTX-007	2.3 in	7.0 ft	N/A	Lat: 40.887996 N Long: -72.560899 W	
CTX-008	4.0 in	9.0 ft	N/A	Lat: 40.887930 N Long: -72. 560916 W	
CTX-009	1.0 in	6.0 ft	N/A	Lat: 40.887777 N Long: -72.561028 W	
CTX-010	15.3 in	38.0 ft	N/A	Lat: 40.888015 N Long: -72.560788 W	



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