Wood boring beetles prevalence and diversity in different enviroments on Long Island Carl Guan, Jack Lu, Zach Nasruddin, (Mentor) Danielle Davey The Stony Brook School

Abstract

Within nature, beetles can be found in rotting wood or plants, carrion, fungi, and feces. There are many species of wood-boring beetles that live in the Northeastern region of America and kill trees. Our goal was to observe how the prevalence of wood-boring beetles varies between our Stony Brook and Southampton collection sites and how the different environments of the collection sites affect the biodiversity of beetles. We collected the beetles by setting up Lindgren funnel traps, and then assessed the biodiversity of beetles by counting the number of unique beetle species at each site. In the end, our results point to the fact that there are more wood-boring beetles in the deciduous forest site, but due to an insufficient amount of data, we are unable to determine whether the biodiversity of beetles was affected by the different collection environments.

Methods and Materials

Sampling/Collection devices and locations.

Lindgren Funnel Trap:

The Lindgren Funnel Trap is a vertical series of black funnels designed to mimic a tree trunk. It is set up between two trees, near the bushes, baited with diluted 90% ethanol to simulate trees natural odors which will attract beetles.

We collected from 2 main sites:

• Site A: Chapman Pkwy, Stony Brook, NY 11790 (On School Grounds) *Latitude:* 40°92'26" N







Introduction

Our project focused on wood boring beetles and our research question was whether wood boring beetles were more prevalent and had a lower rate of biodiversity in our Stony Brook School collection sight which was a highly wooded environment considered to be a the deciduous forest, or a house of one of our members from South Hampton, which is in a lowly wooded area. We hypothesized that the Stony Brook School collection site would have a greater ammount of woodboring beetles as they primary live in wooded areas, but the South Hampton site would have a greater ammount of biodiversity of other types of beetles as the less wooded areas do not face the harmful effects of the wood-boring beetle. Through the process of sample collection, DNA extraction using the Chelex bead method and barcoding of DNA using DNA subway, we find out the answers to our questions above.

DNA Barcoding is helpful for the disciplines of Ecology, Evolution, and Zoology as it allows the scientific community to classify both known and novel organisms with one or few gene regions. Our project allows the scientific community to receive more barcodes of previously barcoded mosquitoes and allows scientists to track the beetle population and species in different regions of Long Island. Determining whether the beetles we collected were wood-boring or not has major implications for the health of the environments on Long Island, as these beetles infest and feed on trees, boring tunnels through the wood that disrupts the flow of nutrients within the tree. These beetles contribute to tree mortality on a large scale, alter the composition of forests, and reduce habitats available for wildlife. Woodboring beetles can even cause large scale issues like increasin 001: Lined Flat Bark Beetle (Laemophloeus biguttatus) the chance for a forest fire, as once trees die from the beetle, they become large dry objects, which is the perfect fuel for a fire. Understanding the location and ecological impact of these beetles on Long Island is crucial to the preservation of Long Islands natural landscape.

Longitude: 73°12'97" W

Site B: 37 Millfarm Lane, backyard (John Duggal's property), inland, Southampton Latitude: 40°54'14" N Longitude: 72°22'42" W

From Site A, there were 9 samples collected, and from Site B there were 0 samples collected.

Experimentation:

For experimentation, we used **DNA Isolation using the Chelex Bead protocol** (Courtesy of Cold Spring Harbor DNALC/BNL). After sample collection, gel electrophoresis chambers with agarose gel were used to determine which beetle DNA samples were viable to send **Our Collection Sites:** for sequencing. We had 7 samples viable for sequencing.

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1013 0.0 1

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971 0.0 2

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We also used PCR (Polymerase Chain Reaction) to amplify the DNA extracted from each beetle sample.

South Hampton (above) Stony Brook School (below)





Data processing:

We used the **Blue Line** on the DNA Subway website to analyze and compare the beetle DNA sequences.

Results

CKF-007 « back

≜ # Accession # ≜ Details





		cytochrome c oxidase subunit I (COX1) gene, partial cds								1 (COI) gene, partial cds	
3(:	3). MG054609.1	Laemophloeus biguttatus voucher BIOUG00873-D06 cytochrome oxidase subunit 1 (COI) gene, partial cds - Laemophloeus biguttatus voucher BIOUG00873-D06 cytochrome oxidase subunit 1 (COI) gene, partial cds	605	812	0.0	62		3(3).	C KT706563.1	Monarthrum mali voucher BIOUG24015-H08 cytochrome oxidase subunit 1 (COI) gene, partial cds - Monarthrum mali voucher BIOUG24015-H08 cytochrome oxidase subunit 1 (COI) gene, partial cds	590
4(4	4) KR489853 1	Laemophloeidae sp. BOLD:ABW8699 voucher BIOUG05881-H11 cytochrome oxidase subunit 1 (COI) gene, partial cds - Laemophloeidae sp. BOLD:ABW8699 voucher BIOUG05881-H11 cytochrome oxidase subunit 1	605	803	0.0	64		<mark>4(4)</mark> .	C KT706713.1	Monarthrum mali voucher BIOUG24015-G04 cytochrome oxidase subunit 1 (COI) gene, partial cds - Monarthrum mali voucher BIOUG24015-G04 cytochrome oxidase subunit 1 (COI) gene, partial cds	564
		(COI) gene, partial cds						E(E)		Monarthrum mali voucher BIOUG21983-H03 cytochrome oxidase subunit 1 (COI) gene, partial cds - Monarthrum	540
5(5	6). MG054119.1	cytochrome oxidase subunit 1 (COI) gene, partial cds - Laemophloeus biouttatus voucher BARS 2016 24 191	605	801	0.0	65		ວ(ວ).	□ MG060080.1	mali voucher BIOUG21983-H03 cytochrome oxidase subunit 1 (COI) gene, partial cds	543
		cytochrome oxidase subunit 1 (COI) gene, partial cds								Monarthrum mali voucher BARS_2015_26_614	
8/	8)	Laemophloeus biguttatus voucher BIOUG14392-A05 cytochrome oxidase subunit 1 (COI) gene, partial cds -	600	704	0.0	64	*	6(6).	G056848.1	Monarthrum mali voucher BARS_2015_26_614 cytochrome	543
Citt.	RD171108 1	· · · · · · · · · · · · · · · · · · ·	GAO	1 194	0.0	04	1				

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002: Apple wood stainer(Monarthrum Mali)

003: Fruit-tree pinhole borer (Xyleborinus saxesenii)

partial cds

partial cds

partial cds

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)#	Accession #	\$ Details	¢ Aln. Length	# Bit # Score	0 e	¢ Mis- matches
1(1).	MG060080.1	Monarthrum mali voucher BIOUG21983-H03 cytochrome oxidase subunit 1 (COI) gene, partial cds - Monarthrum mali voucher BIOUG21983-H03 cytochrome oxidase subunit 1 (COI) gene, partial cds	537	969	0.0	0
2(2)	D MG056846 1	Monarthrum mali voucher BARS_2015_26_614 cytochrome oxidase subunit 1 (COI) gene, partial cds - Monarthrum mali voucher BARS_2015_26_614 cytochrome oxidase subunit 1 (COI) gene, partial cds	537	965	0.0	1
3(3)	C KR486234.1	Monarthrum mali voucher BIOUG05699-H07 cytochrome oxidase subunit 1 (COI) gene, partial cds - Monarthrum mali voucher BIOUG05699-H07 cytochrome oxidase subunit 1 (COI) gene, partial cds	537	960	0.0	2
4(4)	D MG060440.1	Monarthrum mali voucher BARS_2016_2_140 cytochrome oxidase subunit 1 (COI) gene, partial cds - Monarthrum mali voucher BARS_2016_2_140 cytochrome oxidase subunit 1 (COI) gene, partial cds	537	956	0.0	3
5(5).	D MG054180.1	Monarthrum mall voucher BIOUG24091-E08 cytochrome oxidase subunit 1 (COI) gene, partial cds - Monarthrum mali voucher BIOUG24091-E08 cytochrome oxidase subunit 1 (COI) gene, partial cds	537	951	0.0	4
6(6).	C KT623883.1	Monarthrum mali voucher BIOUG22354-B06 cytochrome oxidase subunit 1 (COI) gene, partial cds - Monarthrum mali voucher BIOUG22354-B05 cytochrome oxidase subunit	530	948	0.0	2

BLASTN

Xyleborinus saxesenii voucher BIOUG<CAN>:10BBCOL 0362 cytochrome oxidase subunit 1 (COI) gene, partial cds - mitochondrial KU912452.1 Xyleborinus saxesenii voucher ZFMK-TIS-2501022 cytochrome oxidase subunit 1 (COI) gene,

Xyleborinus saxesenii isolate SAX284 cytochrome oxidase subunit I (COI) gene, partial cds - Xyleborinus saxesenii isolate SAX284 cytochrome oxidase subunit I (COI) gene,

Xyleborinus saxesenii isolate SAX226 cvtochrome oxidas subunit I (COI) gene, partial cds - Xyleborinus saxesenii

subunit I (COI) gene, partial cds - Xyleborinus saxesenii

isolate SAX357 cvtochrome oxidase subunit I (COI) gene.

Xyleborinus saxesenii mitochondrial J602-COI-GZ COI gene for cytochrome oxidase subunit 1, partial

isolate SAX94 cytochrome oxidase subunit I (COI) gene, partial (vleborinus saxesenii isolate SAX357 cvtochrome oxida subunit I (COI) gene, partial cds - Xyleborinus saxesenii

MN620032.1 isolate SAX226 cytochrome oxidase subunit I (COI) gene,

cytochrome oxidase subunit 1 (COI) gene, partial HQ983971.1 cds - Xyleborinus saxesenii voucher BIOUG<CAN>:10BBCOL-0268 cytochrome oxidase subunit 1

007: Fruit-Tree Pinhole Borer (Xvleborinus saxesenii)

	(ool) gene, paradi edo				
HQ984018.1	Xyleborinus saxesenii voucher BIOUG <can>:10BBCOL- 0325 cytochrome oxidase subunit 1 (COI) gene, partial cds - Xyleborinus saxesenii voucher BIOUG<can>:10BBCOL-0325 cytochrome oxidase subunit 1 (COI) gene, partial cds</can></can>	641	1152	0.0	1
KJ092354.1	Xyleborinus saxeseni voucher BIOUG02988-H10 cytochrome oxidase subunit 1 (COI) gene, partial cds - Xyleborinus saxeseni voucher BIOUG02988-H10 cytochrome oxidase subunit 1 (COI) gene, partial cds	634	1144	0.0	0
OP617789.1	Xyleborinus saxesenii isolate SAX470 cytochrome c oxidase subunit I (COX1) gene, partial cds - Xyleborinus saxesenii isolate SAX470 cytochrome c oxidase subunit I (COX1) gene, partial cds	627	1127	0.0	1

Xvleborinus saxesenii voucher BIOUG<CAN>:10BBCO

vtochrome oxidase subunit 1 (COI) gene, partial cds -641 1121 0.0 8 5(5). 🗌 KU907300.1 Xyleborinus saxesenii voucher ZFMK-TIS-252704 cytochrome oxidase subunit 1 (COI) gene, partial cds Xyleborinus saxeseni youcher BC-PNEE-PSEOR0374

008: Fruit-Tree Pinhole Borer(Xvleborinus Saxesenii)

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1(1).	C KJ092354.1	Xyleborinus saxeseni voucher BIOUG02988-H10 cytochrome oxidase subunit 1 (COI) gene, partial cds - Xyleborinus saxeseni voucher BIOUG02988-H10 cytochrome oxidase subunit 1 (COI) gene, partial cds	552	996	0.0	0
2(2).	🗆 но984018.1	Xyleborinus saxesenii voucher BIOUG <can>:10BBCOL- 0325 cytochrome oxidase subunit 1 (COI) gene, partial cds - Xyleborinus saxesenii voucher BIOUG<can>:10BBCOL-0325 cytochrome oxidase subunit 1 (COI) gene, partial cds</can></can>	552	996	0.0	0
3(3).	🗆 но983971.1	Xyleborinus saxesenii voucher BIOUG <can>:10BBCOL- 0268 cytochrome oxidase subunit 1 (COI) gene, partial cds - Xyleborinus saxesenii voucher BIOUG<can>:10BBCOL-0268 cytochrome oxidase subunit 1 (COI) gene, partial cds</can></can>	552	996	0.0	0
4(4).	OP617789.1	Xyleborinus saxesenii isolate SAX470 cytochrome c oxidase subunit I (COX1) gene, partial cds - Xyleborinus saxesenii isolate SAX470 cytochrome c oxidase subunit I (COX1) gene, partial cds	552	992	0.0	1
5(5).	C KU907300.1	Xyleborinus saxesenii voucher ZFMK-TIS-2527041 cytochrome oxidase subunit 1 (COI) gene, partial cds - Xyleborinus saxesenii voucher ZFMK-TIS-2527041 cytochrome oxidase subunit 1 (COI) gene, partial cds	552	960	0.0	8
		Yvleborinus saveseni voucher BC-PNEE-PSEOR0374				

Gel Electrophoresis

Start

Completed



009: Platynus cincticollis (Ground Beetle)

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MN620033.1

MN620030.1

MN620034 1

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CKF-0 « back	009					
#	Accession #	Details	♦ Aln. Length	Bit Score	\$ e	Mis- matches
1(1).	HQ978622.1	Carabidae sp. BOLD:AAI2719 voucher BIOUG <can>: TDWG-0177 cytochrome oxidase subunit 1 (COI) gene, partial cds - Carabidae sp. BOLD:AAI2719 voucher BIOUG<can>: TDWG-0177 cytochrome oxidase subunit 1 (COI) gene, partial cds</can></can>	648	1 <mark>15</mark> 1	0.0	4
2(2).	C KM850224.1	Platynus cincticollis voucher 08SOCOL-0020 cytochrome oxidase subunit 1 (COI) gene, partial cds - Platynus cincticollis voucher 08SOCOL-0020 cytochrome oxidase subunit 1 (COI) gene, partial cds	648	1142	0.0	6
3(3).	□ JF888959.1	Platynus cincticollis voucher BIOUG <can>:08TTML-2626 cytochrome oxidase subunit 1 (COI) gene, partial cds - Platynus cincticollis voucher BIOUG<can>:08TTML-2626 cytochrome oxidase subunit 1 (COI) gene, partial cds</can></can>	648	1133	0.0	8
4(4).	D MZ610250.1	Platynus mannerheimii voucher ZMUO.011201 cytochrome oxidase subunit 1 (COI) gene, partial cds - Platynus mannerheimii voucher ZMUO.011201 cytochrome oxidase subunit 1 (COI) gene, partial cds	648	1025	0.0	32
5(5).	G KJ203177.1	Platynus mannerheimii voucher 06-PROBE-0233 cytochrome oxidase subunit 1 (COI) gene, partial cds - Platynus mannerheimii voucher 06-PROBE-0233 cytochrome oxidase subunit 1 (COI) gene, partial cds	648	1025	0.0	32
		Platynus mannerheimii voucher ZMUO <fin>:006207 cytochrome oxidase subunit 1 (COI) gene, partial cds -</fin>				



PHYLIP M Select Outgroup: CKF-001 V

Molecular Phylogenetic tree with outgroup CKF-001



CKF-004					
CKF-003					
CKF-007					
CKF-008					



References/ Acknowledgements

Discussion/Future Directions

References:



Thank you to Mrs. Davey for mentoring our project through the review phase of the proposal. Thank you to the staff at the BNL who helped us learn DNA Isolation. Thank you parents who allowed us to capture beetles on your property. Thank you to The Stony Brook School for funding us. Thank you to all the group members who worked on the project.

Discussion: Despite having the same setup in the Southampton and Stony Brook School collection site, there was a far greater amount of wood-boring beetles, and other species of beetles from the Stony Brook School collection site. This was most likely, as stated in the hypothesis, due to the increased presence of trees and plants that wood-boring beetles feed on(pine, eucalyptus, etc.). This being said, even though more wood-boring beetles were found at the Stony Brook School collection site, the biodiversity of the wood-boring beetles in the two sites cannot be determined because our Southampton collection site did not collect any specimens.

Future Direction: In the future, a more ideal time to collect samples would be in the summer or early fall(late May to September) rather than from early to late March. This would increase the sample size in both of our collection sites as those are the primary months for beetle activity. Having a larger sample size would allow for a more accurate comparison of whether or not there is a greater prevalence of wood-boring beetles in the Stony Brook School collection site, and if the biodiversity of the beetles in the Stony Brook School site is different from that of the South Hampton site.

