Sampling Sessile Invertebrates found in Oyster Restoration Stations in Lower East River

Authors: Choedon Pema, Li Yonglong, and Lakouetene Elizette
Sponsoring Teacher: Alfred Lwin
Manhattan Comprehensive Night and Day High School

Funded by the Thompson Family Foundation

Abstract

Oysters are important organisms in terms of their economic values and ecological roles. Oysters also play important roles in filtering water. Therefore, oyster restoration sites are important to bring back oyster population. Oyster gardens are often rich in biodiversity and we believed that oyster cages in oyster restoration may harbor diversity of invertebrates. Our objective was to sample sessile invertebrates found in one of the BOP's Oyster Restoration Stations in Lower East River, NY by DNA barcoding and determine the species richness, an indicator for the suitable habitats to restore the oysters in NY. And our research question was: Are all the invertebrates found in oyster cages beneficial or harmful to oyster population? Our barcode result showed that at least 8 different species of sessile invertebrates: (Ampithoe valida, Ectopleura crocea, Jassa slattery, Jassa marmorata, Botryllus schlosseri, Synidotea laticauda, and Synidotea laevidorsalis) were found to inhabit in the oyster cages.

Introduction

Oysters are bivalves that belong to family Ostreacea and most of the members of this family can be classified into major genera: Ostrea, Saccostrea, and Crassostrea and under those genera many species of oysters are included. The common oysters that we consume belong to Crassostrea virginica and they are also known as American oyster, Eastern oyster, Atlantic oyster or Virginia oyster. C. virginica is mostly found in estuaries on the eastern coast of the America, and they are the major sources of oyster reefs. Oysters are considered beneficial because of their ability to purify water by filtering and ecological roles as they serve as a keystone species. Moreover they are considered as economically important as the commercial oysters are high demands. (University of Maryland Center Oyster importance). However, oyster population and oyster reefs in East River have drastically declined since 1800 and until 1920s due to industrialization and pollutions. Later the decline was due to overharvesting and diseases This has impacted on Estuary ecosystems. Billion Oyster Project aims to restore one billion live oysters in New York Harbor. Oyster "Restoration Stations are used to monitor Oyster Growth, Biodiversity and succession of sessile organisms". DNA Learning Center of Cold Spring Harbor Laboratory is collaborating with Billion Oyster Project to sample Oyster Restoration Stations located in the Gowanus Canal and Lower East River and Soundview Park in the Bronx. When our team explored to choose a topic for a DNA Barcode project, we were quite interested in sessile invertebrates found in Oyster Restoration Stations and we decided to work on sampling diversity of sessile invertebrates found at Oyster Restoration Stations. We hypothesized that such sessile invertebrates, tube worms, barnacles and bryozoans, sea anemone and hydroids may be found in oyster restoration station because they are sessile invertebrates commonly found in oyster reef. Our DNA Barcode team's aim was to determine species richness in oyster restoration station. Because of the limited time and limited resources, we mainly focused on identifying sessile invertebrates collected from Lower East River Oyster Restoration Stations, using DNA Barcoding. Understanding types of sessile invertebrates, and diversity can help us to see if the water quality is good enough for healthy ecosystem and also oyster growth. Moreover, we also wanted to find out beneficial or harmful effects of sessile invertebrates on the larvae or adult oyster in the oyster station.

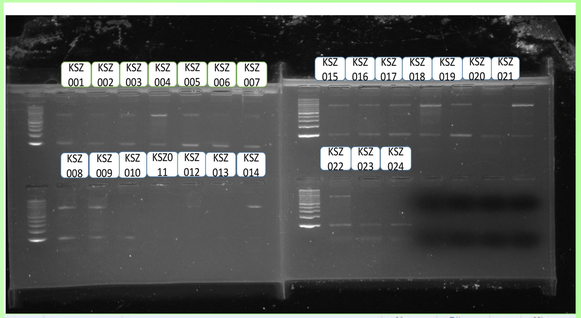
Materials and Methods

We collected our sessile invertebrate samples from an oyster restoration station Lower East River located at the Lower East Side Ecology Center, NYC on December 2nd, 2017. Initially we planned to collect some sessile invertebrates samples from two to three oyster cages which were submerged in the water. However, when we were trying to pull up the cage, the wind was blowing hard. So, it was difficult to pull up the oyster cages. But after a while, the tides in the river calmed down and we were able to pull up only one cage. We examined the samples on the cage and picked up the samples with our hands. We collected more than 30 sessile invertebrate samples in small tubes filled with 70% alcohol, properly labelled and photographed the samples. After that we stored the samples in the refrigerator at our school and at a later date we took the samples to the Harlem DNA Learning Center DNA. We used the Barcoding 101 protocol for DNA extraction and PCR. To run the PCR for our invertebrate samples, the invertebrate primer was used. After Gel analysis and sequencing and we used DNA Subway to BLAST the sequence results.

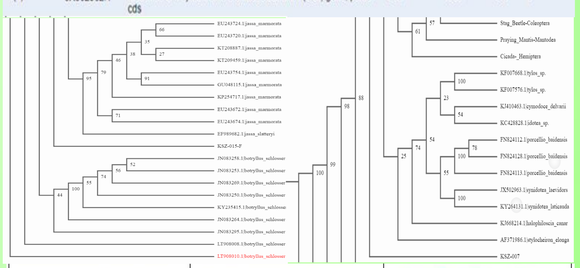
Sample number	Location	Date of collection	DNA Sequencing Result	Species name
KSZ-001	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-002	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-003	Lower East River Ecology Center	02/10/2017	Successful	Ectopleura crocea
KSZ-004	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-005	Lower East River Ecology Center	02/10/2017	Successful	Jassa marmorata
KSZ-006	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-007	Lower East River Ecology Center	02/10/2017	Successful	Ampithoe valida
KSZ-008	Lower East River Ecology Center	02/10/2017	Successful	Ectopleura crocea
KSZ-009	Lower East River Ecology Center	02/10/2017	Successful	Jassa marmorata
KSZ-010	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-011	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-012	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-013	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-014	Lower East River Ecology Center	02/10/2017	Successful	Botryllus schlosseri
KSZ-015	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-016	Lower East River Ecology Center	02/10/2017	Successful	Synidotea laticauda
KSZ-017	Lower East River Ecology Center	02/10/2017	Successful	Ectopleura crocea
KSZ-018	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-019	Lower East River Ecology Center	02/10/2017	Successful	Botryllus schlosseri
KSZ-020	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-021	Lower East River Ecology Center	02/10/2017	Successful	Ectopleura crocea
KSZ-022	Lower East River Ecology Center	02/10/2017	Failed	N/A
KSZ-023	Lower East River Ecology Center	02/10/2017	Failed	N/A

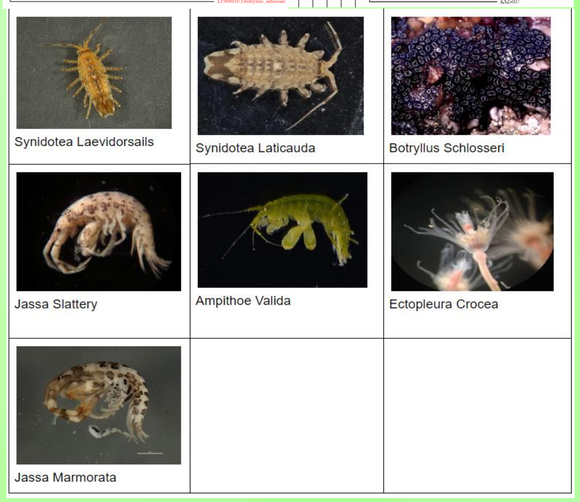
Data table for sessile invertebrates collected from oyster restoration station, Lower East River, New York.

Common sessile invertebrates found in oyster cages



#	Accession #	Details	Aln. Length	Bit Score	e	Mis-matches
1(1).	JN083270.1	**Botryllus schlosseri** - Botryllus schlosseri isolate QST211 cytochrome oxidase subunit I (COI) gene, partial cds	675	1209	0.0	0
2(2).	JN083266.1	**Botryllus schlosseri** - Botryllus schlosseri isolate FLM211 cytochrome oxidase subunit I (COI) gene, partial cds	675	1209	0.0	0
1(1).	JX121589.1	**Ectopleura crocea** - Ectopleura crocea voucher MHNG:INVE 34010 cytochrome oxidase subunit I (COI)gene, partial cds	545	958	0.0	6
2(2).	JX898192.1	**Ectopleura crocea** - Ectopleura crocea isolate Acro03JU cytochrome c oxidase subunit I (COI) gene,partial cds	489	868	0.0	3
3(3).	JX898194.1	**Ectopleura crocea** - Ectopleura crocea isolate Acro01PR cytochrome c oxidase subunit I (COI) gene,partial cds	489	865	0.0	4
1(1).	EF989682.1	**Jassa slatteryi** - Jassa slatteryi isolate 17 cytochrome oxidase subunit I-like (COI)gene, partial sequence	684	1229	0.0	1
2(2).	KT209366.1	**Jassa marmorata** - Jassa marmorata voucher MT02766 cytochrome oxidase subunit 1 (COI) gene, partial cds	658	1187	0.0	0
1(1).	KY264131.1	**Synidotea laticauda** - Synidotea laticauda cytochrome c oxidase subunit I (COI) gene, partial cds	624	1121	0.0	1
2(2).	KX824113.1	**Synidotea laticauda** - Synidotea laticauda cytochrome c oxidase subunit I (COI) gene, partial cds	616	1112	0.0	0
3(3).	JX502963.1	**Synidotea laevidorsalis** - Synidotea laevidorsalis isolate ls330109-2-2 cytochrome c oxidase subunit I (COI) gene, partial cds	600	1083	0.0	0
4(4).	JX502962.1	**Synidotea laevidorsalis** - Synidotea laevidorsalis isolate ls330109-2-1 cytochrome c oxidase subunit I (COI) gene, partial cds	600	1083	0.0	0





Result

The result showed that out of 23 samples, only 17 samples have good DNA sequences.
Our barcode result showed that at least 8 different species of sessile invertebrates: (Ampithoe valida, Ectopleura crocea, Jassa slattery, Jassa marmorata, Botryllus schlosseri, Synidotea laticauda, and Synidotea laevidorsalis) were found to inhabit in the oyster cage.

Discussion

According to NEMESIS Database species summary, Ampithoe valida is a type of tube-dwelling amphipod, native to the East Coast and found among algae and seagrass and only feed on Macro-algae and Eelgrass. Ectopleura crocea, is known as pink-mouthed hydroid that feeds on zooplankton and small epibenthos. Jassa slattery and Jassa marmorata are also tube-dwelling and tube-building amphipods. Synidotea laticauda, and Synidotea laevidorsalis are isopods which are believed to feed on hydroids. Botryllus schlosseri is commonly known as golden star tunicate that feeds on phytoplankton. All of those species found in the oyster cages have no known ecological impact and they serve food for other organisms in the ecosystem. So, we concluded that those species are indirectly beneficial to oyster population and Estuary Ecosystem. We wished we had had more time and resources to barcode larger samples sizes and from different oyster restoration stations. However, we had limited time and we were allowed to do DNA extraction of certain numbers of samples.

In conclusion, even though our research result gave a small amount of data on sessile invertebrates from oyster cages, we believe that it might be useful in monitoring oyster population and biodiversity of East River Estuary Ecosystem..

References

Oyster Restoration Station and Billion Oyster Project fact sheets. [Internet]. 2013. [Cited 2018 April 30]. Available from: https://billionoysterproject.org/wp-content/uploads/2013/06/ORS-fact-sheet.pdf

National Academy Press [Internet]. 2018. [Cited 2018 May 1]. Available from: (https://www.nap.edu/read/10796/chapter/5)

Smithsonian Marine Station at Fort Pier. [Internet]. 2018. [Cited 2018 May 1]. Available from: https://www.sms.si.edu/irlspec/Crassostrea_virginica.htm

University of Maryland Center for Environmental Science Horn Point Oyster Hatchery Oyster Importance. [Internet]. 2018. [Cited 2018 May 2]. Available from: http://hatchery.hpl.umces.edu/oysters/importance-of-oysters/

Susan Hua [Internet]. 2006. Oyster and Oyster Reef Restoration in the East River. Columbia University (NYC): Columbia.edu; [updated 2006 Dec 20; cited 2018 April 29]. Available from: http://www.columbia.edu/itc/cerc/danoff-burg/RestoringNYC/RestoringNYC_EastRiver.html

(BOP) Billion Oyster Project. [Internet]. 2013. [Cited 2018 April 29]. Available from: https://billionoysterproject.org/about/our-story/

California Non-native Estuarine and Marine Organisms(Cal-NEMO). [Internet]. 2018. [Cited 2018 May 3]. Available from: https://invasions.si.edu/nemesis/calnemo/SpeciesSummary.jsp?TSN=159373

Acknowledgements:

- Our Sessile Invertebrate DNA Barcode Team is truly grateful to Cold Spring Harbor Laboratory, for making this project possible.
- Dr. Christine Merizzi, Dr. Alison Cucco, Dr. Melissa Lee, Dr. Janet and the rest of the UBP team whose valuable feedback and advices and helps for our project is greatly appreciated.
- Our principal Michael Toise, Asst. principal (science) Mark Testa and MCNDHS staff for their constant supports.
- Ms. Margaret Aylward, and CDI staffs for their avid support.
- Science teacher and mentor Alfred A. Lwin for his tireless support and encouragement during DNA project.