Final Monitoring Report

for

Northerly Island

Section 506 Great Lakes Fishery & Ecosystem Restoration (GLFER)

2022

U.S. ARMY

Prepared by: USACE, Chicago District

US Army Corps of Engineers®

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Introduction

Northerly Island was once the bottom of Lake Michigan within the littoral zone. After creation of the peninsula as part of Daniel Burnham's plan in 1925, the area became the site of the 1933-1934 "Century of Progress" World's Fair, eventually becoming a small airport from 1947-2002 known as Meigs Field. In 2002 the parcel was obtained by the Chicago Park District and the southern portion was turned into public open space with compatible recreation trails.

The Section 506 Great Lakes Fishery and Ecosystem Restoration (GLFER) project initiated a feasibility study in January 2012 to create habitats native to the Chicago region and awarded a construction contract 9 months later in September 2012. The 5-year construction contract was completed in 2017 and occurs on the south side of the island encompassing approximately 40 acres of land.

Section 2039 of the Water Resources Development Act (WRDA) 2007 directs the Secretary of the Army to ensure, under the USACE ecosystem restoration mission, the project include a monitoring plan to measure the success of the ecosystem restoration and to dictate the direction adaptive management should proceed, if needed. An effective monitoring program is necessary to assess the status and trends of ecological health and biota richness and abundance on a per project basis, as well as to report on regional program success within the United States. The USACE, Chicago District performed 5 years of post-construction fish and vegetation monitoring from 2018-2022. This final monitoring report presents results from the USACE 5-year post-construction monitoring phase intended to evaluate whether measurable results have been achieved and the intent of Section 506 GLFER have been met.

Fish Monitoring

Fish monitoring in the Northerly Island Pond was performed in the May through September timeframe from 2018 through 2022. The original collection method was to be boat electroshocking as to fully reach multiple depths and habitat areas throughout the pond. However, boat ramp access was limited which prevented use. Therefore, multiple collection methods were used throughout the monitoring period to fully assess the multitude of depths and habitats within the pond. Collection methods included backpack electroshocking, fyke nets, minnow traps, gill nets, and larval light sampling. Electroshocking was the primary method occurring in years 2018, 2019, 2020, and 2022. Fyke net and minnow traps were used in 2019, 2021, and 2022. Gill nets were used in 2021 and larval light sampling was conducted in 2021 and 2022 to assess the nursery potential of the pond. A summary of the collection methods and catch are provided in Attachment 1.

One objective of the Northerly Island restoration project was to restore lacustrine and coastal wetland in support of Great Lakes fishes with the goal to improve native fish species richness, evenness, and diversity. The target taxa richness was ≥15, diversity target was ≥1.9, evenness target was ≥ 0.7. Table 1 below provides the list of species caught by year along with total catch, taxa richness, diversity, and evenness. Fish catch from all applicable collection methods were combined to provide a total catch for that given year. Taxa richness, species diversity, and evenness were then calculated. Overall, success criteria were met for species diversity and evenness for multiple years post-construction. The green boxes in Table 1 indicate that success criteria were met. Taxa richness was not met in any given year which is likely due to collection method constraints such that in any given year not every collection method was used and therefore not every habitat type was sampled. However, when looking at the Northerly Island Pond as a whole, over the 5-year post construction period, there was a total taxa richness of 24 species with 19 of those being native species. It is reasonable to assume that these species of fish are utilizing the pond and collection presence was limited by collection time of year and collection method. Therefore, the success criteria for taxa richness was met. Further, fish monitoring during the construction phase of the project in 2013, immediately after creation of the site's dunal pond, caught several other native fish species including lake chub (*Couesius plumbeus*), silver redhorse (*Moxostoma anisurum*), shorthead redhorse (*Moxostoma macrolepidotum*), and particularly noteworthy juvenile black buffalo (*Ictiobus niger*). A summary of the construction phase catch is provided in Attachment 1.

It should be noted that there are likely additional species utilizing the pond that were not collected during the monitoring period. For example, Adult Northern pike (*Esox lucius*) were observed several times during the larval sampling in 2022 and were the target species for the larval sampling, however larval nor adults were caught by USACE monitoring efforts. Multiple recreational fishermen have stated that they have caught Northern pike in the pond and the citizen scientist iNaturalist platform has a record of a capture in 2022 along with a photo. Northern pike are indicators of high-quality aquatic habitat which is understandable why they would be present in the pond due to the wetland habitat and spawning potential.

Figure 1: Observed Northern Pike (*Esox lucius*) under the connecting channel bridge at Northerly Island during the 2022 Larval sampling effort. Note the slender body and rounded mouth indicating species identification. Source: Sam Belcik (USACE Chicago District).

Table 1: *Species of fish caught in the Northerly Island Pond as part of the USACE monitoring effort from 2018 – 2022. Green indicates success criteria were met.*

Common Name	Scientific Name	2018	2019	2020	2021	2022
Alewife*	*Alosa pseudoharengus*				2	
Rockbass	*Ambloplites rupestris*	11	11	2	9	
Black Bullhead	*Ameiurus melas*	1	10	1	2	
Goldfish*	*Carassius auratus*				1	
White sucker	*Catostomus commersonii*					4
Shads	*Clupeidae sp*				2	
Minnows	*Cyprinidae sp*				1	
Gizzard Shad	*Dorosoma cepedianum*				6	
Threadfin Shad	*Dorosoma petenense*	1				
Banded Killifish	*Fundulus diaphanus*	1	3		1	1
Threespine Stickleback	*Gasterosteus aculeatus*	1				
Green Sunfish	*Lepomis cyanellus*	4				1
Pumpkinseed	*Lepomis gibbosus*	7	1			4
Bluegill	*Lepomis macrochirus*	3	26		9	
Smallmouth Bass	*Micropterus dolomieu*		14			4
Largemouth Bass	*Micropterus salmoides*		4	3	1	4
Round Goby**	*Neogobius melanostomus*	15	9	2	14	
Spottail Shiner	*Notropis hudsonius*	1				
Sand shiner	*Notropis stramineus*				1	3
Rainbow Trout*	*Oncorhynchus mykiss*	3				
Yellow perch	*Perca flavescens*					4
Bluntnose Minnow	*Pimephales notatus*	49	8	4	10	1
Fathead Minnow	*Pimephales promelas*	1				
Brown Trout*	*Salmo trutta*		1			
Total Catch		97	86	12	59	26
Taxa Richness		12	9	5	13	9
Shannon-Wiener Diversity		1.69	1.98	1.52	2.13	2.06
Evenness		0.66	0.86	0.94	0.83	0.94

* Non-native species ** Invasive species

Additional Monitoring Efforts and Observations

There were additional monitoring efforts and observations that occurred at Northerly Island during the 5-year post construction period. Larval fish sampling in 2021 and 2022 occurred as part of the fish monitoring which is discussed above. However, this work was a collaboration between USACE Chicago District and Shedd Aquarium due to their ability to identify larval fish species through genetic work. The work resulted in a report and larval photos that are included in Attachment 1.

Surveys for the State endangered Mudpuppy salamander (*Necturus maculosus*) occurred during the winter months of 2021 and 2022. Mudpuppy salamanders are known to be present in

Lake Michigan in which they live in deeper waters during the summer months and migrate to the shallower shoreline during the winter months. Therefore, surveys were conducted in the winter due to the likelihood of higher Mudpuppy activity. All of the surveys resulted in no captures and there are photos and trap placement maps in Attachment 1.

Citizen scientists are a resource for observations outside of USACE sampling efforts that can be used to aid in some knowledge gaps. The eBird platform indicates that there have been 261 species of birds observed at Northerly Island, with some highlights such as the State endangered black-crowned night heron (*Nycticorax nycticorax*), snowy owl (*Bubo scandiacus*), and osprey (*Pandion haliaetus*). The iNaturalist platforms indicates there have been observations of the following mammals: coyote (*Canis latrans*), eastern coontail (*Sylvilagus floridanus*), American beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), meadow vole (*Microtus pennsylvanicus*), gray squirrel (*Sciurus carolinensis*), eastern chipmunk (*Tamias striatus*), and raccoon (*Procyon lotor).*

Ancillary observations during USACE sampling efforts can corroborate the presence of coyote and beavers at Northerly Island. Additionally, several turtle species have been observed during fish sampling such as painted turtle (*Chrysemys picta*) and softshell turtle (*Apalone sp.*). Based on the additional observations and the USACE monitoring efforts, Northerly Island provides healthy and thriving habitats for a variety of wildlife species.

Figure 2: Beaver swimming near the connecting channel bridge in the Northerly Island Pond. Source: Joe LaMonica

Plant Monitoring

After a decade since conception, Northerly Island has attained a very high level of floristic quality with a Native Mean C of 4.63 and Native FQAI of 72.79. Mean C values above 4.5 are considered high-quality plant communities (Table 2 and Table 3). Ecosystem restoration projects rarely attain and sustain that level of floristic quality (Wilhelm & Rericha, 2017). Northerly Island also harbors eight state endangered & threatened plant species (Table 5).

A quantitative stratified random sampling method was used for recording herbaceous vegetation and their relative abundances to enable the calculation of appropriate numerical indicators of floristic quality to document restoration success. Plots ¼ m^2 in size were placed at random distances along five transects permanently marked during the construction phase of the project and maintained during the post-construction monitoring phase (Attachment 2). Percent cover for all plant species was estimated in each plot. Data was analyzed using the Chicago Region FQA Calculator (Herman, B., Sliwinski, R. and S. Whitaker. 2017) and individual transect summary data are shown in Table 4. Calculated metrics for all transects and full site inventory are reported in Attachment 3.

Table 2: Full Site Inventory Summary Data 2022

Species Richness (Total Species)	Species Richness (Native Species)	Native FQAI	Native Mean C
311	247	72.79	4.63

Table 3: Combined Transects Summary Data 2022

Species Richness (Total Species)	Species Richness (Native Species)	Native FQAI	Native Mean C
85	77	40.23	4.58

Table 4: Individual Transect Summary Data 2022

Transect	Species Richness (Total Species)	Species Richness (Native Species)	Native FQAI	Native Mean C	Dominant Species
Transect 1	19	15	20.66	5.33	*Schizachyrium scoparium, Monarda fistulosa, Bouteloua curtipendula, Echinacea pallida, Asclepias tuberosa*
Transect 2	24	23	19.81	4.13	*Bouteloua curtipendula, Schizachyrium scoparium, Monarda fistulosa, Asclepias tuberosa, Dalea candida*
Transect 3	16	13	20.8	5.77	*Bouteloua curtipendula, Monarda fistulosa, Brickellia eupatorioides var. corymbulosa, Schizachyrium scoparium, Poa pratensis*
Transect 4	35	34	32.76	5.62	*Schizachyrium scoparium, Packera plattensis, Bouteloua curtipendula, Pycnanthemum tenuifolium, Dalea purpurea*
Transect 5	35	34	25.04	4.29	*Calamagrostis canadensis, Carex stricta, Helenium autumnale, Juncus effusus ssp. Solutus, Chamaecrista fasciculata*

Table 5: Northerly Island Illinois Endangered and Threatened Plants

Species	State of Illinois Designation
Inland New Jersey Tea (*Ceanothus herbaceous*)	Endangered
Sweet-Fern (*Comptonia peregrina*)	Endangered
Kalm's St. John's-Wort (*Hypericum kalmianum*)	Endangered
Common Juniper (*Juniperus communis*)	Threatened
Creeping Juniper (*Juniperus horizontalis*)	Endangered
Jack Pine (*Pinus banksiana*)	Endangered
Royal Catchfly (*Silene regia*)	Endangered
Seaside Arrow-Grass (*Triglochin maritima*)	Threatened

Figure 3: Summer spectacle of full blooming Butterfly-Weed (*Asclepias tuberosa*), Pale Purple Coneflower (*Echinacea pallida*), Leadplant (*Amorpha canescens*), Purple Prairie-Clover (*Dalea purpurea*), White Prairie-Clover (*Dalea candida*), and Hoary Vervain (*Verbena stricta*) spreading throughout Northerly Island. Source: Robbie Sliwinski (USACE, Chicago District).

Figure 4: Adjoining areas to Northerly Island's hills and dunal pond fill with blooming Narrow-Leaf Mountain-Mint (*Pycnanthemum tenuifolium*), Wild Bergamot (*Monarda fistulosa*), Yellow Coneflower *Ratibida pinnata*), and Culver's Root (*Veronicastrum virginicum*). Source: Robbie Sliwinski (USACE, Chicago District).

Figure 5: Short-stature blooming forbs at Northerly Island thriving atop a hill amongst graminoids Little Bluestem (*Schizachyrium scoparium*), Side-Oats Gramma (*Bouteloua curtipendula*), Oak Sedge (*Carex pensylvanica*), and scattered Black, Burr, and Hill's Oaks (*Quercus* spp.) with the largest North American convention center's roof (McCormick Place) looming in the background. Source: Robbie Sliwinski (USACE, Chicago District).

Figure 6: Delicate Michigan Lily (*Lilium michiganense*) flowers rise above the wet prairie when right Lake Michigan water level conditions allow. Source: Robbie Sliwinski (USACE, Chicago District).

Conclusion

Northerly Island has developed into species-rich and functionally diverse plant communities. Overall, the Native Mean C and Native FQAI values of plant communities are extremely high. The site is providing high quality habitat for local and migratory wildlife, spawning habitat for native fishes, flower-rich habitat for pollinators, water quality treatment for the watershed, improved soil conditions for native invertebrates and microorganisms, and a quick escape for people from the city's crowd, traffic, and noise.

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BEFORE (2011)

AFTER (2022)

References

Herman, B., Sliwinski, R. and S. Whitaker. 2017. Chicago Region FQA (Floristic Quality Assessment) Calculator. U.S. Army Corps of Engineers, Chicago, IL.

Wilhelm, Gerould & Laura Rericha. 2017. Flora of the Chicago Region: a Floristic and Ecological Synthesis. Indiana Academy of Science, Indianapolis, IN. 1371 pp.

Attachment 1 – Fish Monitoring Data, Reports, and Survey Info

Fish Sampling Efforts by collection Method

Backpack Electrofishing					
Common Name	**Scientific Name**	**2018**	**2019**	**2020**	**2022**
Rockbass	*Ambloplites rupestris*	11	1	2	
Black Bullhead	*Ameiurus melas*	1		1	
Banded Killifish	*Ameiurus melas*	1	3		1
Threadfin Shad	*Dorosoma petenense*	1			
Threespine Stickleback	*Gasterosteus aculeatus*	1			
Green Sunfish	*Lepomis cyanellus*	4			1
Pumpkinseed	*Lepomis gibbosus*	7			4
Bluegill	*Lepomis macrochirus*	3			
Smallmouth Bass	*Micropterus dolomieu*		14		
Largemouth Bass	*Micropterus salmoides*		2	3	4
Round Goby	*Neogobius melanostomus*	15	8	2	
Spottail Shiner	*Notropis hudsonius*	1			
sand shiner	*Notropis stramineus*				3
Rainbow Trout	*Oncorhynchus mykiss*	3			
Bluntnose Minnow	*Pimephales notatus*	49		4	1
Fathead Minnow	*Pimephales promelas*	1			
Brown Trout	*Salmo trutta*		1		

Fyke Net/Minnow Traps				
Common Name	**Scientific Name**	**2019**	**2021**	**2022**
Rockbass	*Ambloplites rupestris*	10	8*	
Black Bullhead	*Ameiurus melas*	10		
Pumpkinseed	*Lepomis gibbosus*	1		
Bluegill	*Lepomis macrochirus*	26		
Smallmouth Bass	*Micropterus dolomieu*			4*
Largemouth Bass	*Micropterus salmoides*	2		
Round Goby	*Neogobius melanostomus*	1		
Bluntnose Minnow	*Pimephales notatus*	8		

* Young of the year fish

Gill Net		
Common Name	**Scientific Name**	**2021**
Rockbass	*Ambloplites rupestris*	1
Black Bullhead	*Ameiurus melas*	2
Gizzard Shad	*Dorosoma cepedianum*	6
Bluegill	*Lepomis macrochirus*	4

Fish Sampling Efforts by collection Method

Larval Sampling			
Common Name	**Scientific Name**	**2021**	**2022**
Alewife	*Alosa pseudoharengus*	2	
Goldfish	*Carassius auratus*	1	
White sucker	*Catostomus commersonii*		4
Shads	Clupeidae sp	2	
Minnows	Cyprinidae sp	1	
Banded Killifsh	*Fundulus diaphanus*	1	
Bluegill	*Lepomis macrochirus*	5	
Largemouth Bass	*Micropterus salmoides*	1	
Round Goby	*Neogobius melanostomus*	14	
Sand Shiner	*Notropis stramineus*	1	
Yellow perch	*Perca flavescens*		4
Bluntnose Minnow	*Pimephales notatus*	10	

Fish Sampling Efforts During Constuction Post-Creation of Dunal Pond Habitat

Location	Date	Crew	Run	lat.	Long.	Time	Shock Tim	species	count	notes
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	1	41°51.755	87°36.357	8:50 AM	900	Spottail Shiner	13	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	1	41°51.755	87°36.357	8:50 AM	900	Smallmouth Bass	3	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	1	41°51.755	87°36.357	8:50 AM	900	Rock Bass	2	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	1	41°51.755	87°36.357	8:50 AM	900	Round Goby	69	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	1	41°51.755	87°36.357	8:50 AM	900	Rainbow Trout	1	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	1	41°51.755	87°36.357	8:50 AM	900	Lake Chub	1	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	2	41°51.729	87°36.356	9:15 AM	900	Smallmouth Bass	4	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	2	41°51.729	87°36.356	9:15 AM	900	Rock Bass	2	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	2	41°51.729	87°36.356	9:15 AM	900	Lake Chub	3	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	2	41°51.729	87°36.356	9:15 AM	900	Rainbow Trout	4	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	2	41°51.729	87°36.356	9:15 AM	900	Round Goby	2	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	3	41°51.195	87°36.440	9:45 AM	900	Silver Redhorse	1	TL=640 mm
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	3	41°51.195	87°36.440	9:45 AM	900	Shorthead Redhorse	1	TL= 520 mm
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	3	41°51.195	87°36.440	9:45 AM	900	Smallmouth Bass	7	Mean TL= 400 ± 60.6 mm
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	3	41°51.195	87°36.440	9:45 AM	900	Rock Bass	13	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	3	41°51.195	87°36.440	9:45 AM	900	Alewife	31	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	3	41°51.195	87°36.440	9:45 AM	900	Yellow Perch	1	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	3	41°51.195	87°36.440	9:45 AM	900	Rainbow Trout	5	
Northerly Island	27-Jun-13	Matt Shanks, Frank Veraldi, Bob Foster, Phil Willink	3	41°51.195	87°36.440	9:45 AM	900	Round Goby	3	

SHEDD AQUARIUM

Larval Fish Survey of Northerly Island Pond

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INTRODUCTION

Northerly Island is a 91-acre manmade peninsula on the shores of Southern Lake Michigan in Chicago, IL and is owned and operated by the Chicago Park District to protect Burnham Harbor from wave action. From 1947 to 2002 the island was home to a small airport known as Meigs Field. Today, the northern end of the island is occupied by a music venue, Charter One Pavilion. Northerly Island's unique location and vicinity within Lake Michigan provides an ecological refuge to a variety of wildlife. In 2017, construction was completed on a project to create 40 acres of coastal habitat out of the southern portion of the island. This included the excavation of a 4.1 acre pond to provide the materials necessary to create 19 acres of oak savanna, 10 acres of mesic prairie, 3.3 acres of wet prairie, 2.2 acres of emergent marsh, and 1.7 acres of lacustrine littoral habitat (Fig. 1).

The restoration is expected to greatly benefit habitat for a variety of migratory and resident bird species, fish, amphibians, reptiles, insects, and mammals. The 4.1 acres of pond was created as an aquatic resource for Great Lakes fishes to use as a habitat refuge area from the lake and as a nursery for larval and young-of-the-year fish. Specifically, the state threatened Banded Killifish (*Fundulus diaphanus*) and Mudpuppy (*Necturus maculosus*) may benefit from this restoration project. To date, monitoring to assess if, and which, fishes are utilizing the constructed aquatic ecosystem for spawning or as nursery areas has not been assessed.

Objective

The objective of this project was to perform a larval fish survey of the Northerly Island pond. The data collected would be used to assess the success of the restored coastal ecosystem as part of the post-construction monitoring program.

METHODS

Three nights were chosen to encompass much of the peak spawning period for this latitude in the Great Lakes, July 8, July 22, and August 5, 2021. Larval fish were captured using passive quatrefoil light traps constructed with a 4mm opening, 500-micron sieves, and a green LED dive-light (Glo-TOOB) as a light source. Nine traps (exception: eight traps on August 5) were set 1 hr after sunset, and allowed to soak for a minimum of 1h, and up to 1h34m. Locations where traps were placed varied each of the three nights sampled but were spaced apart to circumnavigate most of the pond and include variable habitats (piers, emergent vegetation, submergent vegetation, and rocky shorelines). Dissolved oxygen (mg L^{-1}) and water temperature (°C) were recorded at each site upon trap retrieval using a handheld probe (YSI ProDSS with an optical dissolved oxygen sensor). Items captured by traps, including larval fish, zooplankton, and macroinvertebrates were preserved on-site in 95% ethanol. Larval fish were later examined under a dissecting scope for identification following (Auer, 1982), those which were unable to be identified to species were confirmed through sequencing of the 16S rRNA gene in Shedd Aquarium's microbial laboratory.

Analyses primarily focused on total species richness found within the site. Effort was compared to total catch using linear models to assess if traps which were set for longer have more fish captured.

RESULTS

Temperature in the pond was slightly (~1 °C) cooler on the southern end than on the northern end (Fig. 2) and ranged from 19.9 to 25.5 °C. Dissolved oxygen was relatively high throughout the system, ranging from 7.34 to 11.44 mg L^{-1} (Fig. 3).

Total fishing effort amounted to 1,893 minutes (Table 1), or 31hr33m over the course of three dates. On average each trap soaked for 72min48s, but longer soak times occurred on the third date (81m ± 9; mean ± SD; *n* = 8) compared to the others (68 ± 3 & 69 ± 6 m; *n* = 9 each). We did not find a relationship between soak times for traps and number of fish caught (t-value = -0.541, p-value = 0.594).

In total, 38 fish were captured representing eight species (Tables 1 & 2). Fourteen Round Goby were identified visually, twenty-one individuals were identified to species through 16S sequencing and a remaining three individuals could only be identified to family; two of which are members of the family Clupeidae and one is a member of the family Cyprinidae. Species included: Alewife (*Alosa pseudoharengus*; *n* = 2), Banded Killifish (*n* = 1), Goldfish (*Carassius auratus*; *n* = 1), Bluegill (*Lopomis macrochirus*; *n* = 5), Bluntnose Minnow (*Pimephales notatus*; *n* = 10), Round Goby (*Neogobius melanostomus*; *n* = 14), and Sand Shiner (*Notropis stramineus*; *n* = 1). A young-of-the-year Largemouth Bass (*Micropterus salmoides*) was caught (1.92 cm in total length) and retained in our fish counts even though a fish this size is not considered to be in the larval stage.

Of the 38 fish, 15 were captured at one site on the east side of a pier on the southern part of the pond (Table 1, Fig. 4). Of these, seven were Bluntnose Minnows and five were Round Goby. We did not note any relation between emergent or submergent vegetation and increased catch rates (Table 1). The only locations where fish were caught on all three nights were in the northeast corner of the pond (Fig. 4). The only species caught consistently on all three nights was the Round Goby (Table 2).

While not enumerated, we did note large populations of zooplankton within the pond, especially *Hydracarina* spp., *Leptodora kindtii*, and *Cercopagis pengoi*.

CONCLUSIONS

The constructed pond at Northerly Island provides spawning habitat for at least seven documented species. It is unclear if the Largemouth Bass captured was spawned within the pond. Its size suggests that it is capable of swimming through the southern connection with Lake Michigan into the pond.

More fish were captured by the pier located on the southern portion of the pond. In close vicinity (within ~20m) to the pier are several habitat types including emergent vegetation, rocky shoals, some deep-water pockets, as well as the pier itself which may combine to be an attractive spawning location for multiple species. This location is also close to the connecting channel with Lake Michigan proper, it is possible the larval fish are flushed into the pond and accumulate here due to hydrologic movements (i.e., eddies around the pier's eastern side). However, Round Goby are generally not found within the column and were most likely spawned near the trap, offering some evidence to the contrary.

We did catch larvae of the Banded Killifish within the Northerly Island pond. While the pond appears to be providing spawning habitat for this state threatened species, recent genetic analyses suggest the population here is of the Eastern (*Fundulus diaphanus diaphanus*) subspecies and not the native Western (*Fundulus diaphanus* menona) (Tiemann et al., 2021). Recently the Illinois Endangered Species Board approved the separate distinction between the two sub-species, leaving the Western (*F. d. menona*) as state threatened species (IESPB, 2019, 2020) and the other off the list. Although generally being considered a non-native, it

remains unclear what impacts the Eastern subspecies may have on ecosystems where they have largely replaced the Western subspecies (Willink et al., 2018).

Sampling occurred in July and early August, and as such reflects species that spawn in relatively warmer waters. It remains possible that cold water spawning species such as Northern Pike (*Esox lucius*; ~4 °C), Yellow Perch (*Perca flavescens*; ~10 °C), and White Sucker (*Catosomus commersonii*; ~12 °C) utilize the pond earlier in the season and were missed in our survey.

RECOMMENDATIONS

Drift nets placed within the inlet would elucidate if large proportions of larvae are being flushed into the pond from this connection or are in fact being produced within its waters.

Sampling earlier in the season would identify if species that spawn at cooler water temperatures are utilizing the pond as spawning and nursery habitats.

Larvae in the families Ictaluridae, Sciaenidae, and Salmonidae are not known to exhibit phototaxis during larval stages and are thus not susceptible to the sampling gear used in this survey. If these species are of interest, sampling using benthic sleds or ichthyoplankton nets would help identify if these species are using the site as nursery habitat.

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Table 1 Summary of larval fish caught at Northerly Island by location of capture, presence of emergent or submergent vegetation at the site, and if the site was off of a man-made pier structure.

Site	1	2	3	4	5	6	7	8	9	10	11	12
Total Effort (min)	226	237	228	70	227	152	71	143	209	207	63	60
Cardinal Location	W	W	S	S	SE	SE	E	E	E	NE	NE	N
Emergent		x		x	x			x				x
Submergent					x	x	x	x			x	x
Man Made Structure	x		x									
Alewife									1	1		
Banded Killifish										1		
Bluegill	3	1					1					
Bluntnose Minnow			7						1	2		
Goldfish			1									
Largemouth Bass		1										
Round Goby	1	1	5	2		2			1	2		
Sand shiner											1	
Cyprinidae spp.	1											
Clupeidae spp.			2									

Table 2 Summary of larval fish caught at Northerly Island by date of capture.

	7/8/2021	7/22/2021	8/5/2021
Alewife	2	-	-
Banded Killifish	-	-	1
Bluegill	4	1	-
Bluntnose Minnow	-	9	1
Goldfish	1	-	-
Largemouth Bass	-	-	1
Round Goby	9	3	2
Sand Shiner	-	1	-
Cyprinidae spp.	-	-	1
Clupeidae spp.	-	2	-

Fig. 1 Map and description of the restoration of the southern portion of Northerly Island, including the constructed pond. (image provided by US Army Corps of Engineers)

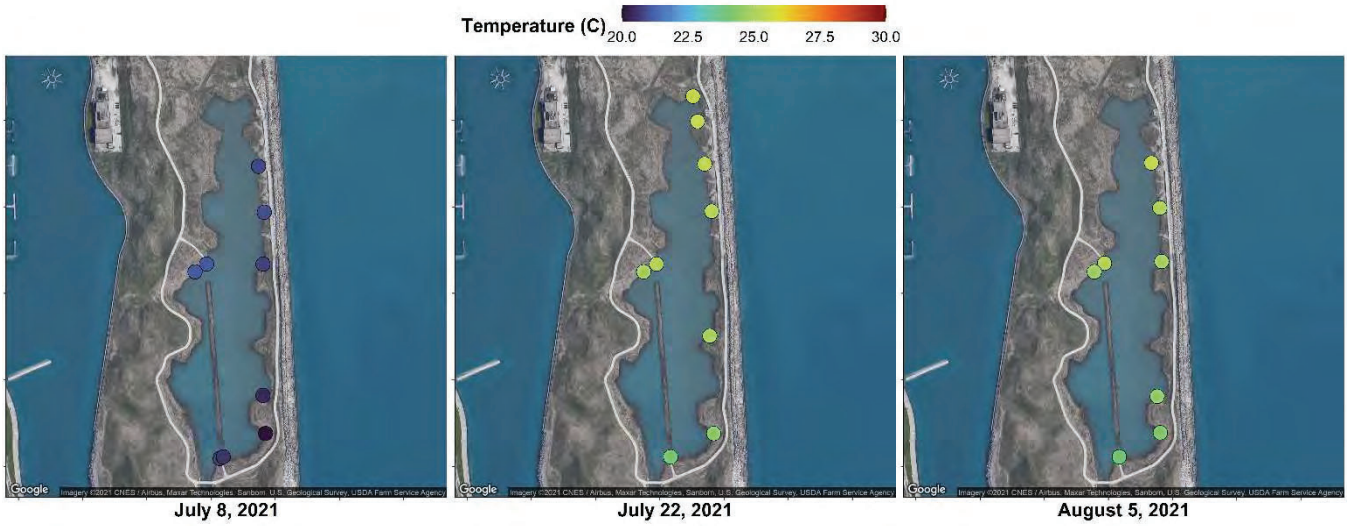


Fig. 2 Water temperature (°C) in Northerly Island pond at time of larval fish survey.

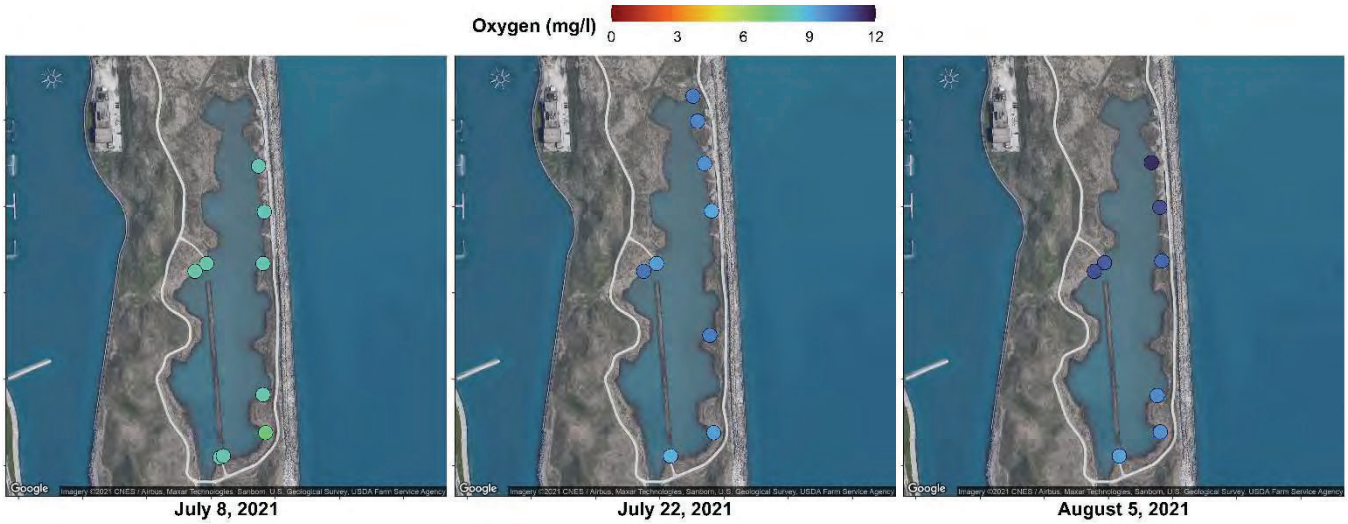


Fig. 3 Dissolved oxygen (mg L^{-1}) in Northerly Island pond at time of larval fish survey.

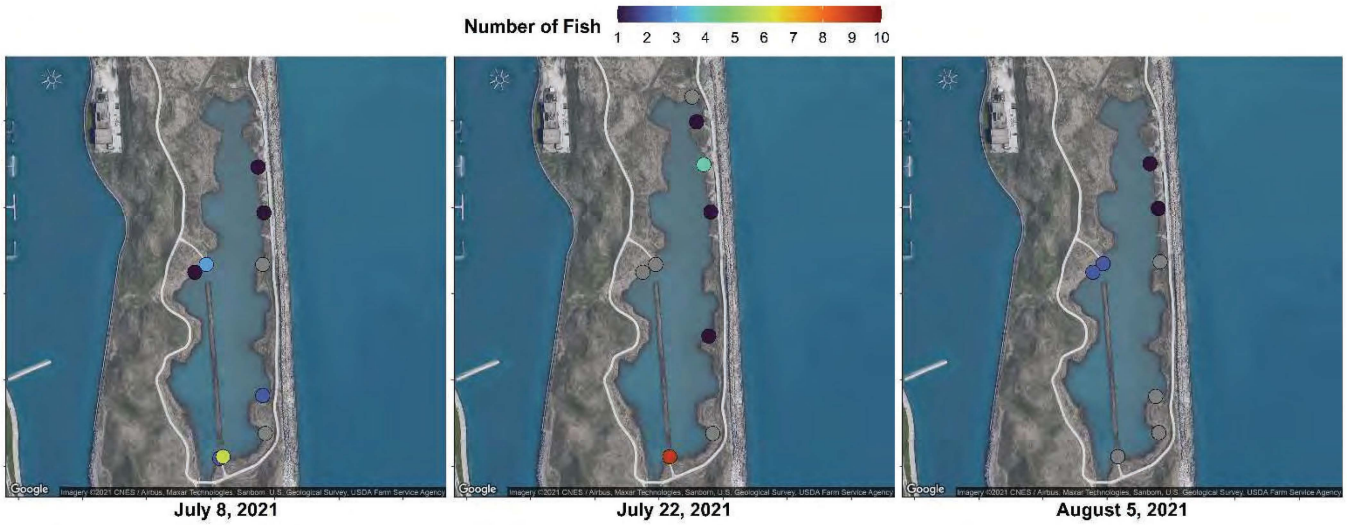
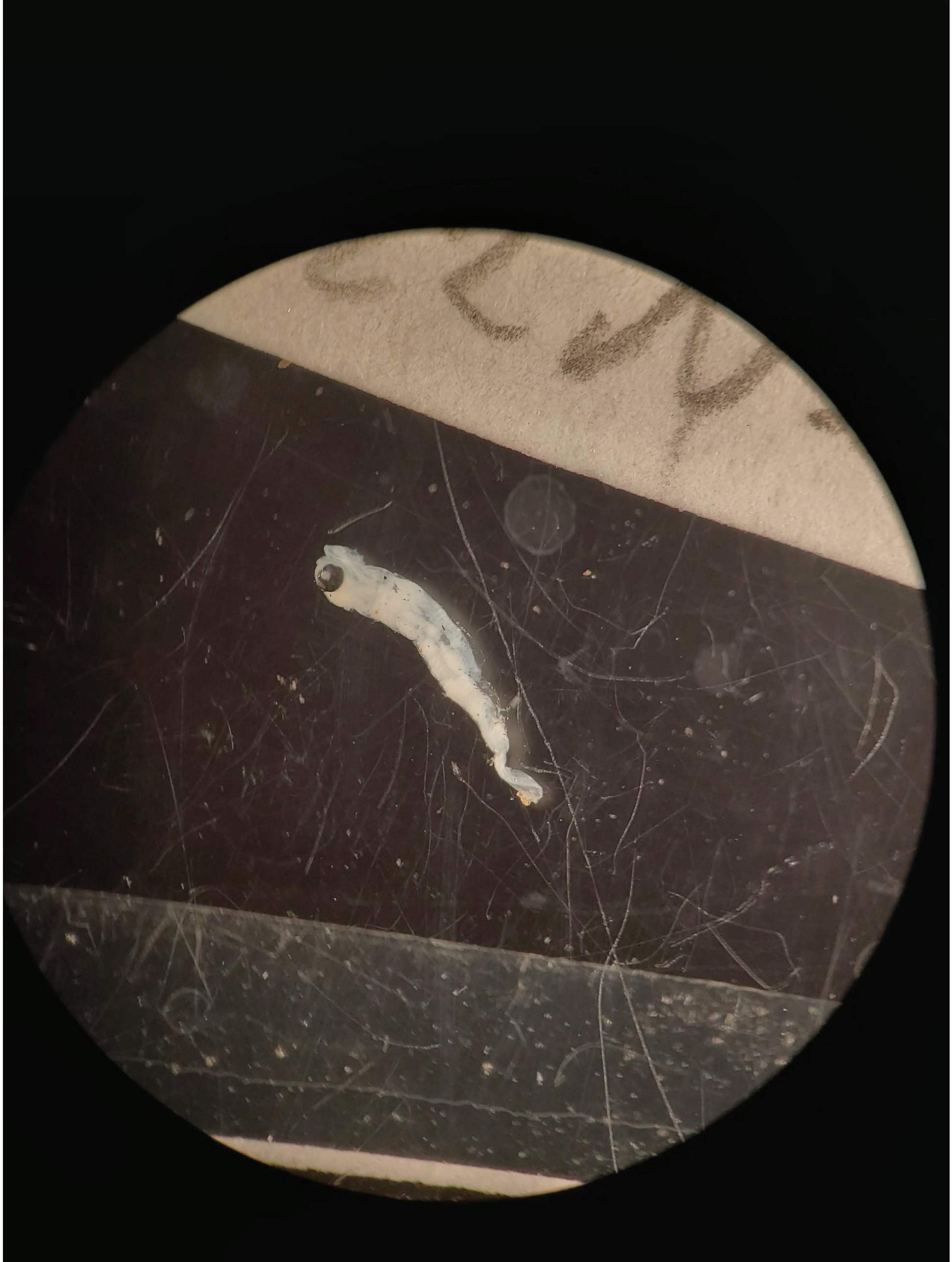
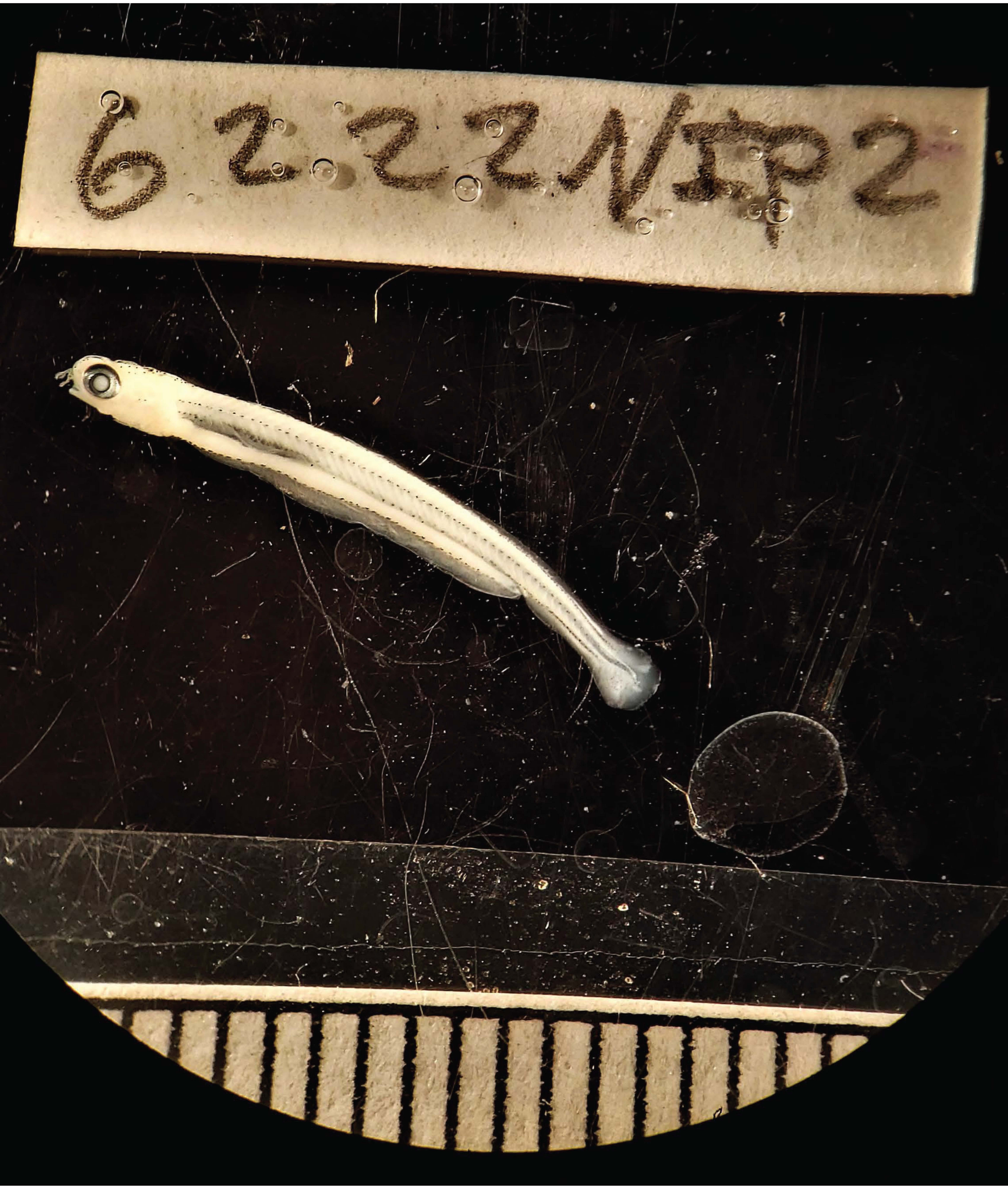
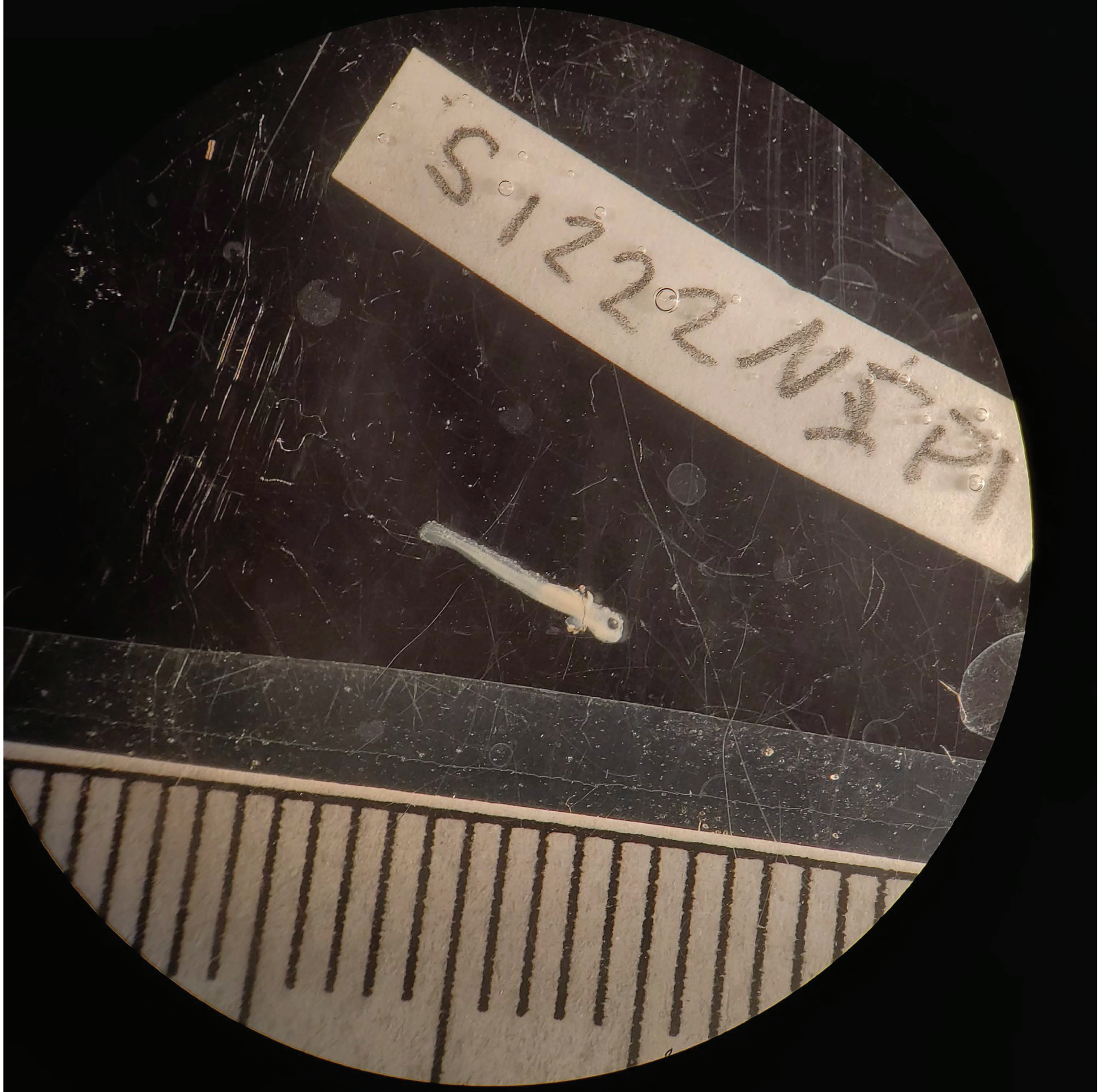


Fig. 4 Number of fish caught in each light trap in Northerly Island Pond.




6.2.2.2.1/1-2


S122 V4P