



Restoration of the Turning Basin and Tidal Wetlands at Saugus Iron Works National Historic Site

2015 Data Report

Natural Resource Data Series NPS/SAIR/NRDS—2016/1006





ON THIS PAGE

Sampling nekton and vegetation at Saugus Iron Works, 2015.
Photo courtesy of M. J. James

ON THE COVER

Saugus Iron Works National Historic Site (SAIR), 2015.
Photo courtesy of M. J. James

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January 2016

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

James, M. 2016. Restoration of the turning basin and tidal wetlands at Saugus Iron Works National Historic Site: 2015 data report. Natural Resource Data Series NPS/SAIR/NRDS—2016/1006. National Park Service, Fort Collins, Colorado.

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Abstract

In 2015, vegetation and nekton were sampled at Saugus Iron Works National Historic Site. This monitoring is part of an on-going post restoration monitoring associated with the restoration of the historic turning basin and freshwater tidal wetland adjacent to the Saugus River. Vegetation in both the natural and restoring marsh were sampled using 1-m² vegetation plots. Species composition and percent cover were estimated along with other cover types such as bare ground, and wrack. Nekton were sampled twice, once in early July and again in early September in both the turning basin and the Saugus River. Two types of gear were used; a quantitative 1-m² throw trap and a seine.

The natural marsh was characterized by high species diversity (26 species) although narrow leaf cattail (*Typha angustifolia*) was the most abundant cover type observed. In the restored marsh, bare ground and algal mat comprised the majority of the relative percent cover. Dwarf spike rush (*Eleocharis parvula*) was the most common vegetative cover. Two invasive species were observed in the natural marsh: purple loosestrife (*Lythrum salicaria*) and reed canary grass (*Phalaris arundinacea*). Aquatic vegetation was primarily horned pondweed (*Zannichella palustris*) in both the turning basin and river. The invasive curly pondweed (*Potamogeton crispus*) was observed in the turning basin.

Common nekton in both the turning basin and river were the mummichog (*Fundulus heteroclitus*). Other common species that were collected were four spine sticklebacks (*Apeltes quadracus*), Sevenspine bay shrimp (*Crangon septemspinosa*), American eel (*Anguilla rostrata*), and white suckers (*Catostomus commersoni*).

Physical parameters (water temperature, salinity, and dissolved oxygen) were all generally within the water quality standard for Massachusetts warm water fisheries, except during the September nekton sampling when one temperature reading was above the threshold for warm water fisheries.

Acknowledgments

Many thanks to National Park Service (NPS) staff who assisted with logistics and field sampling in 2015: Marc Albert, Charley Roman, Robin Baranowski, Dana Filippini, Alex Etkind, Patrick Maloney, Rachel Shepard, and Lowell Watkins.

Introduction

In 2007, the National Park Service initiated a restoration program at Saugus Iron Works National Historic Site (SAIR) to restore the historic turning basin and wetland area adjacent to the Saugus River. To fulfill regulatory requirements and enhance understanding of tidal freshwater wetland restoration practices, an intensive pre- and post-restoration monitoring program from 2012 to 2016 was implemented. The purpose of this Data Report is to summarize vegetation and nekton data monitoring collected in 2015.

Methods

Vegetation sampling

Quantitative vegetation monitoring of the restoration area (turning basin and southern salt marsh area) was conducted following protocols of the NPS Northeast Coastal and Barrier Network (Roman et al. 2001, James-Pirri et al. In Review). Vegetation, including intertidal freshwater marsh and submerged aquatic vegetation, was sampled once per year at the end of the growing season in late summer/early fall. Vegetation was sampled in a minimum of 30, 1-m² plots that were randomly located along transects that traversed throughout the restoration area and in the small natural marsh just south of the restored turning basin (James-Pirri et al. 2007). Transects were located perpendicular to the river and traversed the elevation gradient from low marsh (or tidal flat) to the upland edge and varied in length from approximately 15 m to 60 m depending on location and width of the marsh. Species composition and species cover/abundance were recorded for each 1-m² plot. In addition to live vegetation, non-vegetative covers were also recorded (e.g., bare ground, open water, rock, wrack and litter). Estimates of percent cover were determined using a modified Braun-Blanquet (1965) visual cover scale method. For this method the observer stands over the plot and visually estimates the cover of each species present in the plot. Cover was estimated using standard cover classes as follows: 0: absent; 1: <1%; 2: 1-5%; 3: 6-25%; 4: 26-50%; 5: 51-75%; 6: 76-100%. In statistical analyses, the Braun-Blanquet data were analyzed as ordinal data (statistical analyses are not presented in this data report, but will be presented in the final report). The relative percent cover of each species (for graphical purposes) was calculated by converting Braun-Blanquet values to the midpoint of the percent range (<1%= 0.5%, 1-5%=2.5%, 6-25%=15.5%, 26-50%=38%, 57-75%=63%, 76-100%=88%), then averaging the mid-point values for all replicate plots by marsh (natural n=19, restored n=49), and standardizing to 100% to achieve relative percent cover for all cover types per marsh.

Submerged aquatic vegetation cover in the river was estimated during nekton throw trap sampling. Percent cover of aquatic vegetation was estimated using a modified Braun-Blanquet (1965) visual cover scale method in 1-m² plots randomly located throughout the river and in the restored turning basin.

Nekton sampling

The nekton community of the turning basin and the Saugus River was monitored following protocols of the NPS Northeast Coastal and Barrier Network (Raposa and Roman 2001, James-Pirri et al. 2012). Nekton were sampled twice per year, once in mid-summer and once in late summer/early fall, on low or ebbing tides. Quantitative data on nekton composition and abundance (density) were collected using a 1-m² throw trap at a minimum of 15 stations randomly located throughout the turning basin and 15 river stations (Raposa et al. 2003). The sampling area was limited to locations with standing water present at ebbing tide conditions, but not higher than the top of the side walls of the trap (0.5-m high) (i.e., the deeper portions of the river channel and the deeper areas in the turning basin were excluded). The throw trap was an enclosure sampler that has excellent efficiency and provides quantitative, repeatable results (Kushlan 1981, Sogard and Able 1991, Rozas and Minello 1997). The trap had an open top and bottom (0.5-m in height and 1-m square) with the sides covered

by 3-mm wire mesh. The trap was thrown into water and captured any nekton in the 1-m² area of the trap. All nekton were collected from the trap with a 1-mm mesh dip net that fitted snugly within the trap. The trap was considered empty when three successive attempts with the dip net produced no organisms (refer to James-Pirri et al. 2102 for complete details on gear and sampling protocol). Average density of nekton from throw trap samples was estimated as the number of individuals per m². Relative abundance was calculated as the percent catch of each species standardized to 100% for throw trap samples.

Qualitative samples of nekton were also collected using a seine (6-m seine with bag, 3-mm mesh) at a minimum of five random locations throughout the turning basin and 5 in the river system as ancillary information on the nekton community. Seine hauls were taken in order to achieve a more complete species list by attempting to catch faster swimming fishes that may have avoided the throw trap. Seine data are presented as average number of individuals per seine haul.

At each station (both throw trap and seine stations), all nekton were identified, enumerated, and up to 15 individuals of each species were measured for length (total length for fish and shrimp, carapace width for crabs). Once identified and measured all organisms were returned to the water. Physical variables (water temperature [°C], salinity [ppt], and dissolved oxygen [mg/L]) were recorded at each nekton sampling station with a YSI unit (model 85) at the time of sampling (during ebb tide).

Results

Vegetation

In 2015, 49-1m² vegetation plots were sampled in the restored wetland and 19 plots were sampled in the natural wetland (Table 1, Figure 1). In the restored wetland eight plant species and four non-vegetative covers (e.g., bare ground, wrack) were observed (Table 2). The most abundant cover types on the restored marsh were bare ground and algal mat. Dwarf spike rush (*Eleocharis parvula*) was the most common vegetative cover (Figure 2, Figure 3). An interesting anecdotal observation was that dwarf spike rush appeared to be more vigorous in growth early in the summer (e.g., early July) than later in the year during vegetation sampling. This in addition to the presence of dead dwarf spike rush on the restored marsh in September may indicate that although this native species is able to colonize the restored marsh, growth conditions throughout the growing season may not be ideal for this species to thrive (MJ James, personal observation) (Figure 4). 2015 was a dry year in terms of precipitation, and that may also have played a role in the presence of dead dwarf spike rush; however, dead dwarf spike rush has been observed in previous years (e.g., 2014, James 2015).

In the natural marsh 26 plant species as well as some non-vegetative covers (Table 2) were observed. The most abundant cover type in the natural marsh was narrow leaf cattail (*Typha angustifolia*) (Figure 2).

Two invasive species: purple loosestrife (*Lythrum salicaria*) and reed canary grass (*Phalaris arundinacea*) were observed in the natural marsh, no invasive species were observed in the restored marsh (Table 2).

Aquatic Vegetation

Three species of aquatic vegetation were observed in the throw traps. The most abundant species, found in both the turning basin and the river was horned pondweed (*Zannichella palustris*) (Table 3). The invasive curly pondweed (*Potamogeton crispus*) was observed in the turning basin.

Nekton

In 2015, 51 throw traps and 12 seine hauls were conducted to determine the composition of the nekton community throughout the turning basin and the river (Table 1, Figure 1). Seven fish species, three crustaceans (shrimp and crab), two insect (*Odonata* and *Trichoptera*) and a tadpole larvae were observed (Table 4). The mummichog (*Fundulus heteroclitus*) was the most abundant nekton in both the turning basin and in the river (Figure 5). Other common species that were collected were four spine sticklebacks (*Apeltes quadracus*), Sevenspine bay shrimp (*Crangon septemspinosa*), American eel (*Anguilla rostrata*), and white suckers (*Catostomus commersoni*). The majority of the fish collected were juveniles (Figure 6).

Physical parameters (water temperature, salinity, and dissolved oxygen) were all generally within the water quality standard for Massachusetts warm water fisheries, except during the September nekton sampling when one temperature reading was above the threshold for warm water fisheries (Massachusetts Water Quality Standards 314 CMR 4.0) (Table 5).

Table 1. Sampling dates and number of stations sampled in 2015.

Sample Type	Date Sampled	# of Plots Sampled
Vegetation, natural marsh	15-16 September 2015	19 plots
Vegetation, restored wetland	15-17 September 2015	49 plots
Aquatic vegetation, river	7 July & 3 September 2015	33 (16-17 during each period)
Aquatic vegetation, turning basin	7 July & 3 September 2015	18 (8-10 during each period)
Nekton, river throw traps	7 July & 3 September 2015	33 (16-17 during each period)
Nekton, river seine hauls	7 July & 3 September 2015	8 (3-5 during each period)
Nekton, turning basin throw traps	7 July & 3 September 2015	18 (8-10 during each period)
Nekton, turning basin seine hauls	7 July & 3 September 2015	4 (1-3 during each period)

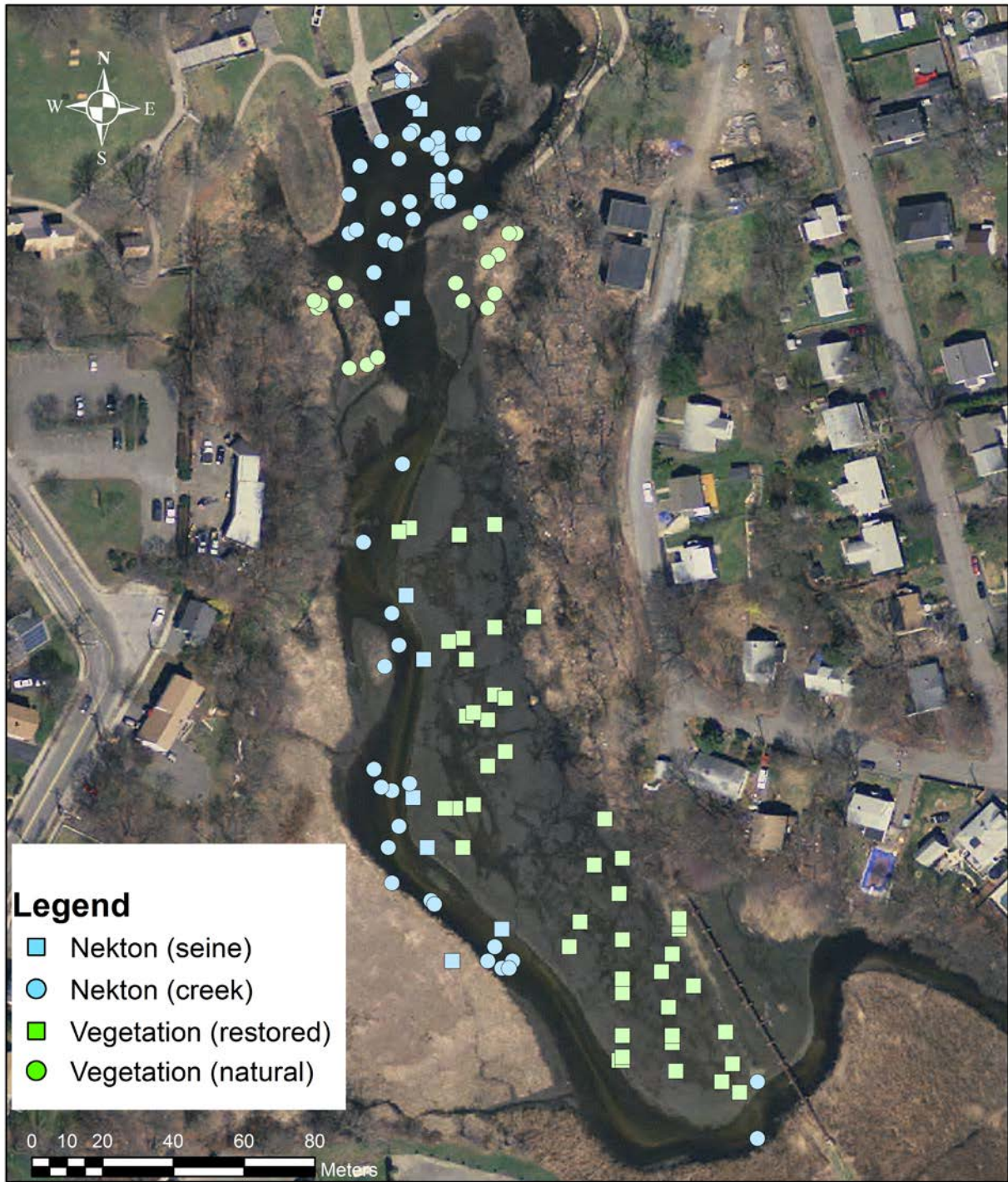


Figure 1. Sampling stations for nekton and vegetation in 2015.

Table 2. Vegetation and non-vegetative cover types observed on the restored and natural during 2015 sampling. Average Braun Blanquet value¹ and relative percent of total cover in parentheses, are given. Bold type indicates invasive species.

Scientific Name	Common Name	Restored ²	Natural ²
<i>Acalypha virginica</i>	Three-seeded mercury	-	0.2 (0.7)
<i>Acorus americanus</i>	Sweet flag	-	0.1 (0.1)
<i>Apios americana</i>	Groundnut	-	0.4 (2.2)
<i>Bidens frondosa</i>	Devil's beggartick	-	0.2 (1.6)
<i>Calystegia sepium</i>	Hedge bindweed	-	0.8 (2.8)
<i>Conyza canadensis</i>	Canadian horseweed	-	0.1 (0.1)
<i>Cyperus</i> species	Flatsedge species	-	0.1 (0.1)
<i>Digitaria</i> species	Crabgrass species	0.02 (0.01)	-
<i>Dysphania ambrosioides</i>	Mexican tea	-	0.1 (0.1)
<i>Eleocharis parvula</i>	Dwarf spikerush	2.7 (13.2)	1.1 (5.4)
<i>Eutrochium dubium</i>	Coastal plain joeypyeweed	-	0.2 (0.7)
<i>Lythrum salicaria</i>	Purple loosestrife	-	0.4 (3.8)
<i>Oenothera biennis</i>	Common evening primrose	-	0.1 (0.1)
<i>Oxalis stricta</i>	Common yellow oxalis	-	0.1 (0.1)
<i>Peltandra virginica</i>	Green arrow arum	-	0.6 (4.9)
<i>Persicaria amphibia</i>	Water smartweed	-	0.5 (1.9)
<i>Persicaria hydropiper</i>	Marshpepper knotweed	-	0.1 (0.1)
<i>Persicaria hydropiperoides</i>	Swamp smartweed	-	0.2 (0.3)
<i>Persicaria maculosa</i>	Spotted ladythumb	-	0.2 (0.7)
<i>Phalaris arundinacea</i>	Reed canary grass	-	0.6 (5.3)
<i>Pluchea odorata</i>	marsh fleabane	0.2 (0.8)	0.3 (1.6)
<i>Samolus valerandi</i>	Water-pimpernel	0.6 (0.8)	0.2 (4.5)
<i>Schoenoplectus tabernaemontani</i>	Hardstem bulrush	0.04 (0.05)	-
<i>Sonchus oleraceus</i>	Common sowthistle	-	0.1 (0.1)
<i>Symphyotrichum puniceum</i>	Purplestem aster	-	0.3 (0.7)
<i>Symphyotrichum subulatum</i>	Eastern annual saltmarsh aster	0.2 (0.2)	0.4 (0.8)
<i>Typha angustifolia</i>	Narrowleaf cattail	0.3 (1.8)	3.3 (28.4)
<i>Zannichella palustris</i>	Horned pondweed	0.5 (0.9)	0.4 (2.2)
Non-vegetative and Dead Covers		-	-
Algal mat only	Algal mat only	3.6 (28.0)	0.7 (5.9)
Bare ground/algal mat ³	Bare ground/algal mat	5.6 (73.3)	0.8 (9.8)
Bare ground only	Bare ground only	4.8 (47.4)	2.2 (12.0)
Dead, <i>Eleocharis parvula</i>	Dwarf spikerush (Dead)	1.6 (3.7)	-
Dead, <i>Typha angustifolia</i>	Narrowleaf cattail (Dead)	-	0.2 (0.6)
Rock	Rock	0.6 (0.3)	-
Wrack & Litter	Wrack & Litter	2.7 (2.8)	1.6 (1.7)

¹ Braun Blanquet cover class scale (0; 1: <1; 2: 1%- 5%; 3: 6-25%; 4: 26-50%; 5: 51-75%; 6: 76-100%). “-” indicates species was not present.

² Percent cover estimated without the cover of “bare and algal mat” combined.

³ Percent cover and “bare and algal mat combined” estimated within the separate covers of “bare” and “algal mat”.

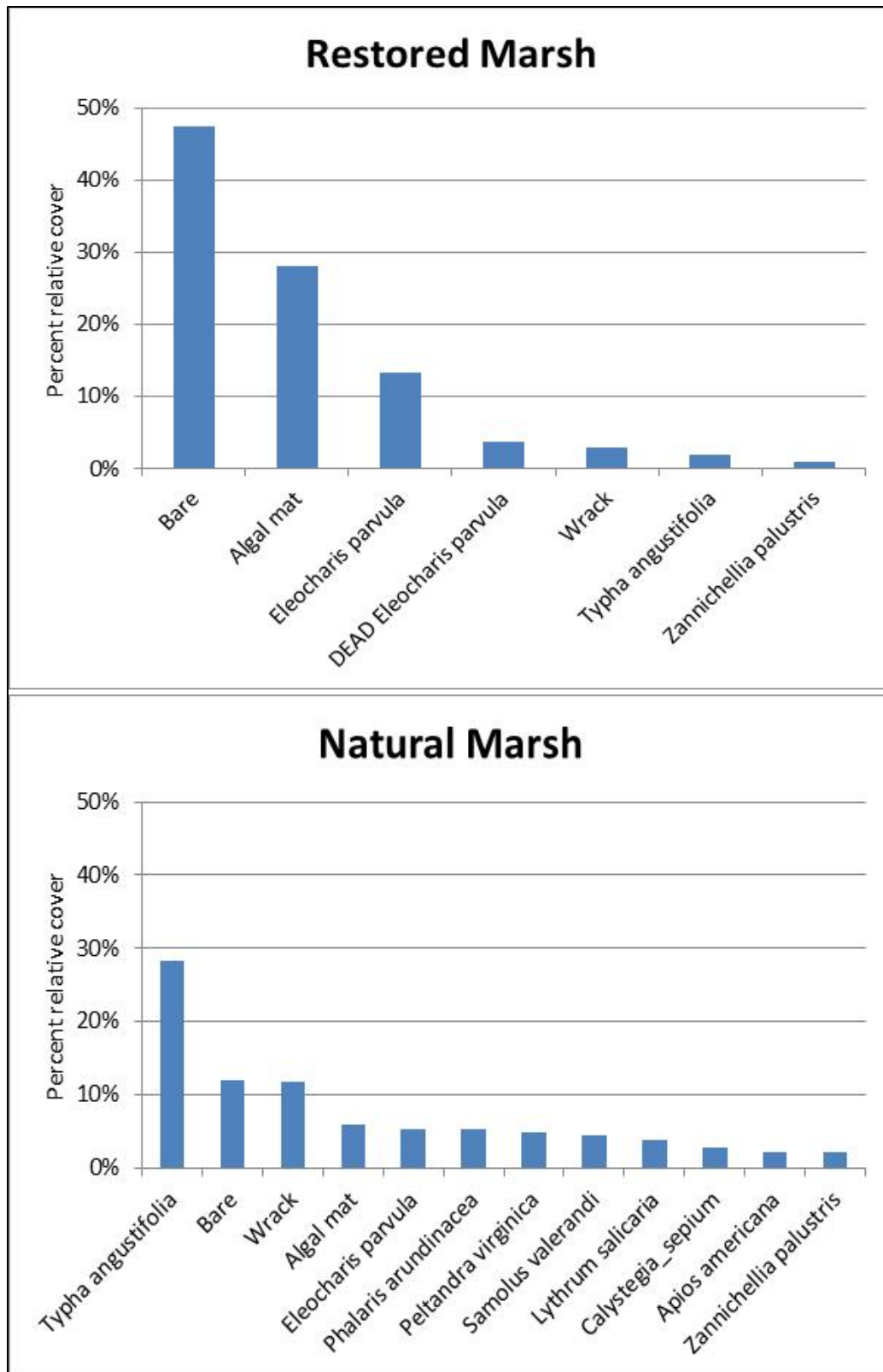


Figure 2. Relative percent cover non-vegetative and vegetation species comprising approximately 90% of the total cover on the restored marsh (top graph) and natural marsh (bottom graph) in 2015.



Figure 3. View of the restored marsh in September 2015.



Figure 4. *Eleocharis parvula* as it appeared in early July 2015 (left photo) and in a typical vegetation plot in September 2015 (right photo) on the restored marsh.

Table 3. Aquatic vegetation species list, average Braun-Blanquet score, and percent of sampling stations where observed in 2015. Invasive species are indicated in bold type.

Scientific Name	Common Name	Basin	River
Potamogeton crispus	Curly pondweed	0.4 (11%)	-
Unknown filamentous green algae	Unknown filamentous green algae	0.4 (11%)	0.7 (30%)
Zannichella palustris	Horned pondweed	4.1 (100%)	3.4 (81%)

Braun Blanquet cover class scale (0; 1: <1; 2: 1%- 5%; 3: 6-25%; 4: 26-50%; 5: 51-75%; 6: 76-100%).
 “-” indicates species was not present.

Table 4. Nekton species collected in the turning basin and river during 2015 sampling.

Scientific Name	Common Name	Basin	River
<i>Anguilla rostrata</i>	American eel	X	X
<i>Apeltes quadracus</i>	Four-spine stickleback	X	X
Caddis fly larvae	Caddis fly larvae		X
<i>Catostomus commersoni</i>	White sucker	X	X
<i>Crangon septemspinosa</i>	Sevenspine bay shrimp		X
<i>Fundulus heteroclitus</i>	Mummichog	X	X
<i>Gasterosteus aculeatus</i>	Three-spine stickleback	X	X
<i>Micropterus salmoides</i>	Largemouth bass	X	
Odonata spp.	Dragonfly/Damselfly larvae	X	
<i>Palaemonetes vulgaris</i>	Grass shrimp	X	X
<i>Pungitius pungitius</i>	Nine-spine stickleback	X	X
<i>Rhithropanopeus harrisii</i>	Harris mud crab		X
Tadpole (species unknown)	Tadpole species	X	
Unknown larval fish	Unknown larval fish	X	

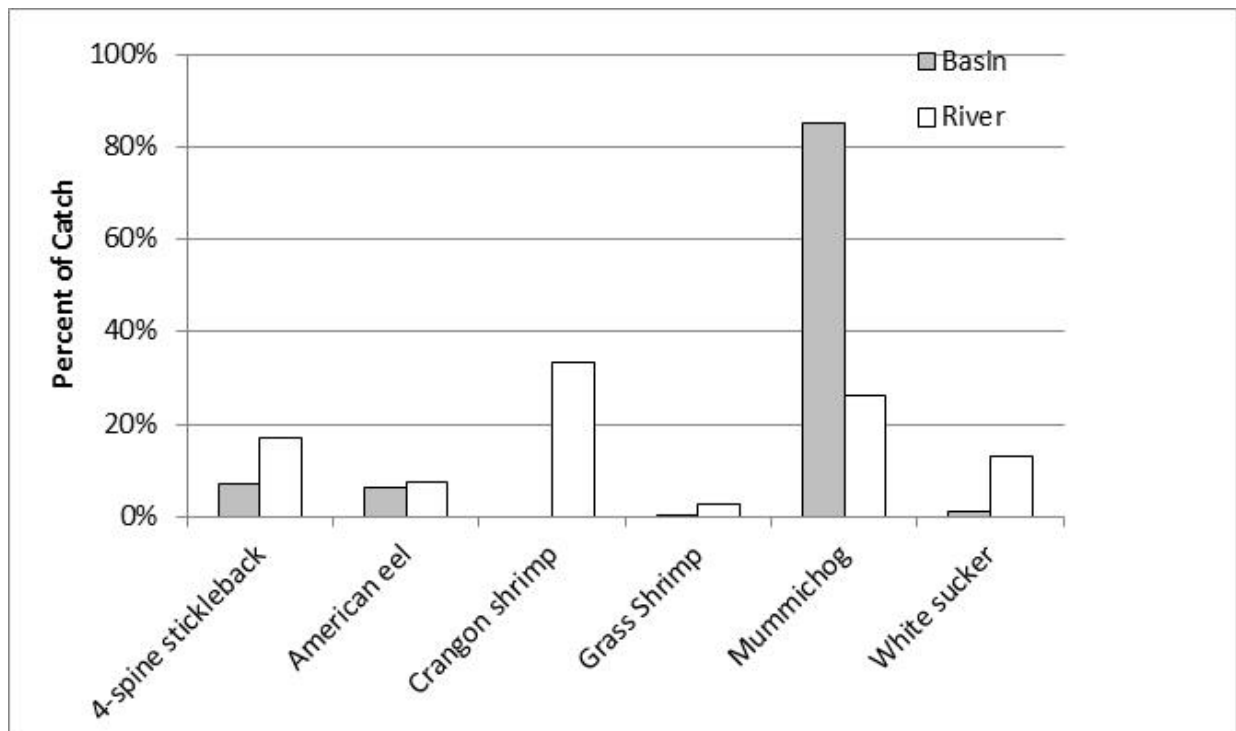


Figure 5. Percent catch of nekton from throw trap sampling in the turning basin and river during 2015 sampling (species representing less than 1% of total catch are not shown).

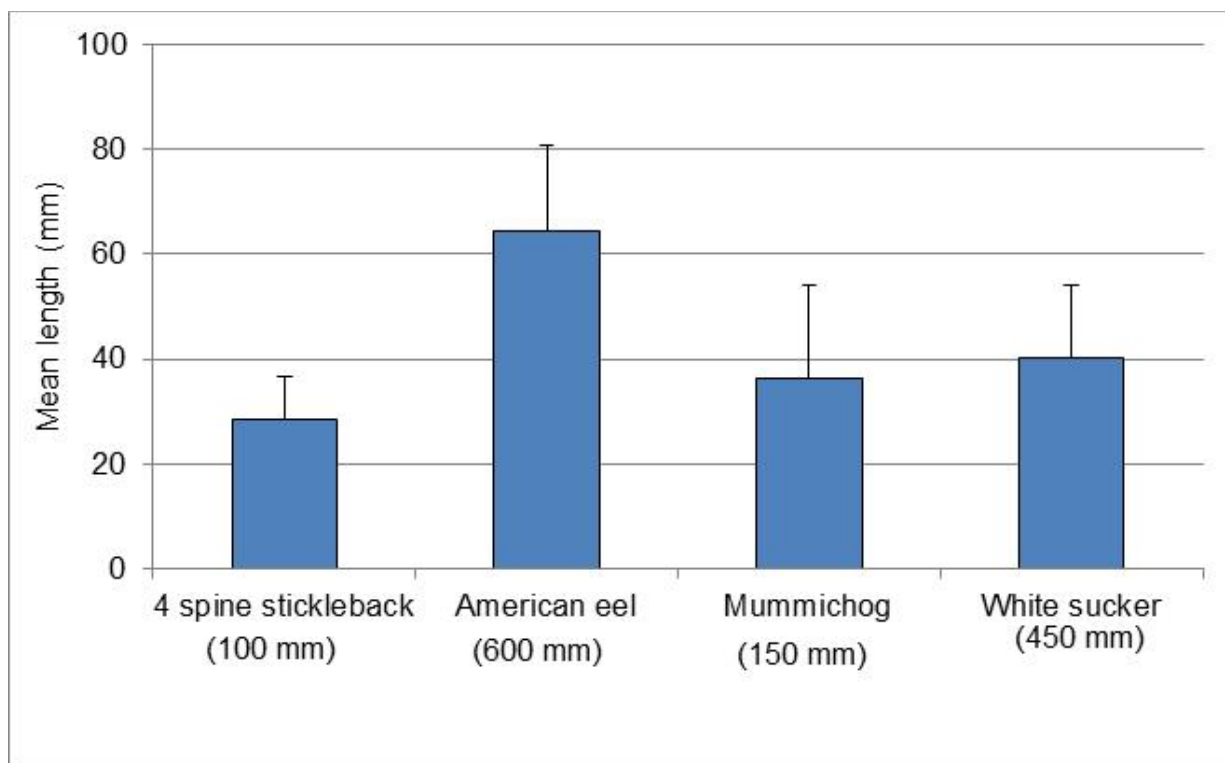


Figure 6. Mean lengths (mm $\pm$ SD) of common fish sampled at Saugus Iron Works NHS using throw traps and seines in 2015. Mean adult length (mm) is given under each species name for reference.

Table 5. Environmental data (average $\pm$ SD) associated with the 2015 nekton sampling (sampling occurred during ebb tides). Sample size is given after location. Bold, underlined values indicate samples outside of Class SB water quality criteria (Massachusetts Water Quality Criteria CMR 314 4.0).

Sampling date	Water Temperature ¹ °C (maximum)	Salinity ppt	Dissolved Oxygen mg l ⁻¹ (minimum)
7 July 2015 (n=11) (basin)	23.3 $\pm$ 2.3 (28.0)	0.7 $\pm$ 0.1	8.1 $\pm$ 3.8 (5.0)
7 July 2015 (n=22) (river)	22.2 $\pm$ 0.8 (24.0)	0.4 $\pm$ 0.2	8.5 $\pm$ 1.1 (5.3)
3 Sept 2015 (n=11, basin)	23.0 $\pm$ 3.1 (<u>30.0</u>)	2.9 $\pm$ 5.9	10.5 ²
3 Sept 2015 (n=19, river)	24.9 $\pm$ 1.7 (28.0)	1.5 $\pm$ 1.4	9.9 $\pm$ 0.9 (7.5)

¹ Acceptable value for temperature (Class SB waters) is <29.4°C (MA CMR 314 4.0).

² Only one reading taken for dissolved oxygen.

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NPS 444/131326, January 2016

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