

***Summary of Nekton and Vegetation Sampling at
Saugus Iron Works National Historic Site
June-August 2004***

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Introduction

The National Park Service Inventory and Monitoring Program, and more specifically the Northeast Temperate Network and Coastal and Barrier Network, is currently developing long-term natural resource monitoring strategies for park units throughout the northeastern US. For salt marsh ecosystems, Cape Cod National Seashore has implemented long-term monitoring programs for salt marsh nekton (Raposa and Roman 2001, Raposa et al. 2003) and vegetation (Roman et al. 2001). These protocols are currently being tested for long-term implementation at coastal national park units from Maine to Virginia. These protocols have also been implemented on several US Fish and Wildlife Service Refuges along the Atlantic Coast (James-Pirri et al. 2004).

Sampling was conducted using these protocols at Saugus Iron Works National Historic Site (SAIR) in the summer of 2004. SAIR is associated with the NPS Northeast Temperate Network, and thus, it is expected that monitoring will be pursued for the long-term. Nekton were sampled in June and August 2004. Salt marsh vegetation was sampled in July 2004. This report presents the results of this sampling effort. In addition to serving as the initial data sets to the long-term monitoring effort, these data can be included in the marsh characterization being conducted in association with the park's proposed restoring of the Saugus River turning basin (CH2MHill 2004).

Methods

Nekton

Nekton (fish and decapod crustaceans) were sampled with throw traps at SAIR on June 9, and August 5, 2004 during low tide. Sampling stations were randomly located along the upper tidal portion of the Saugus River (Fig 1). A total of 16 stations were sampled at SAIR, between the Bridge Street bridge at and the Hamilton Street bridge.

Nekton were sampled using a 1m² throw trap (Kushlan 1981, Sogard & Able 1991, Raposa & Roman 2001). The throw trap is an enclosure sampler that has excellent efficiency and provides quantitative, repeatable results (Rozas & Minello 1997). The trap had an open top and bottom, was 0.5m in height and 1m square, and the sides were covered with 3mm (1/8 in) wire mesh. Each sampling location was quietly approached from the marsh bank or at 3m to 5m from the creek area that was sampled, the person throwing the trap crouched and waited a few minutes to allow any disturbed nekton to resume normal activity. The person then tossed the trap into the tidal creek, imbedding it in the bottom sediments and captured any nekton within the 1m² area of the trap. All nekton were collected from the trap with a 1mm mesh dip net that fit snugly within the trap. The trap was considered empty when three successive attempts with the dip net produced no organisms.

All fish and decapods were identified and enumerated. A representative number (up to 15 individuals) of each species collected was measured for length (fish – total length; crabs – carapace width; shrimp – total length). Once identified and measured all

organisms were returned to the tidal creek.

Additionally, seine hauls (6m seine with bag, 3mm mesh) were taken during low or ebbing tides on August 5, August 11, and September 2 in the upper portion of the Saugus River and adjacent to the Hamilton Street bridge (Fig. 1). One haul was taken on August 5, and 2 replicate hauls were taken at each location on August 11 and September 2. Seine hauls were taken in an attempt to catch faster swimming fishes that may not be adequately sampled by the throw trap in order to achieve a more complete species list.

Physical variables [water temperature (°C), salinity (ppt), and dissolved oxygen (mg/L)] were recorded at each throw trap station with an YSI unit at the time of sampling.

Vegetation

Vegetation at SAIR was sampled within 1m² plots on July 13, 2004. Location of vegetation plots are shown in Fig 1. A total of 30 vegetation plots were randomly located along 7 transects. Four transects (16 plots) were randomly placed in the upper marsh area adjacent to the boat dock. The remaining 3 transects (14 plots) were randomly placed within the southern *Phragmites australis* dominated marsh. Aquatic vegetation cover within the river adjacent to the nekton sampling stations was estimated for 12 1m² plots using the visual estimate method (Fig 1).

Estimates of percent cover were evaluated using the Braun-Blanquet visual cover estimate method. For this method the observer stands over the plot and visually estimates the cover of each species present within the plot. Cover was estimated within standard cover classes as follows: 0; 1: <1; 2: 1%- 5%; 3: 6-10%; 4: 11-25%; 5: 26-50%; 6: 51-75%; 7: 76-100%.

Results and Discussion

Nekton

A total of 13 species (11 fish and 2 decapods) were collected using seine and throw traps collection methods during nekton sampling in 2004 (Table 1).

Sixteen stations each were sampled on 2 dates (June 9 and August 5, 2004) for nekton using the throw trap. Five fish species (American eel, brook stickleback, four-spine stickleback, three-spine stickleback, and white sucker) and one crab species (green crab and mud crab) were sampled with the throw trap (Table 2). Densities and individual counts for each species are presented in Table 2. Environmental variables (water temperature, salinity, and dissolved oxygen) taken at nekton throw trap stations are given in Table 3. Lengths of nekton are presented in Fig. 2.

In June, the throw trap catch was dominated by young-of-the-year white suckers (*Catostomus commersoni*) and four-spine sticklebacks (*Apeltes quadracus*) comprising

77% and 13% of the catch, respectively (Table 2 and Fig. 2). American eels (*Anguilla rostrata*) and three-spine sticklebacks (*Gasterosteus aculeatus*) were also present and composed 8% and 2% of the catch, respectively. In August, juvenile white suckers and four-spine sticklebacks again dominated the catch with each species comprising 40% of the catch. American eels comprised 15% of the catch and brook sticklebacks (*Culaea inconstans*) and green crabs (*Carcinus maenas*) each comprised 3% of the catch (Table 1). More individuals were sampled in June, primarily due to the abundance of young-of-the-year white suckers (Table 2).

A total 7 seine hauls were made on 3 separate days (August 5, August 11, and September 2) at two locations. Two hauls (on August 11) were made in the upper portion of the Saugus River and the other 5 (on August 5, 11, and September 2) were made adjacent to the Hamilton Street Bridge (Fig. 1). A total of 11 species (10 fish and 1 decapod) were sampled using the seine (Table 1). Species composition and abundance of nekton collected from seine hauls are shown in Table 4. As expected seine hauls captured the faster swimming nekton such as alewife (*Alosa pseudoharengus*), large mouth bass (*Micropterus salmoides*), and redbfin pickerel (*Esox americanus*).

Vegetation

Species composition and percent cover class (Braun-Blanquet scale) of vegetation sampled at SAIR are shown in Table 5. Vegetation of the upper marsh (Transects 1-4, 16 plots), located adjacent to the dock was very complex, with a total of 23 species identified. Narrowleaf cattail (*Typha angustifolia*) and multiflora rose (*Rosa multiflora*) were the dominant species, representing 19 and 13% of the total vegetation cover, respectively. Almost 11% of the marsh area was bare ground, while the remaining species ranged in dominance from 6 to <1% cover.

The southern marsh (Transects 5-7, 14 plots) was dominated by common reed (*Phragmites australis*). Other species comprising up to 75% of the total vegetation cover were (in order of dominance): narrowleaf cattail (*Typha angustifolia*), and hedge bindweed (*Calystegia sepium*). A total of 13 species were identified in this area.

The dominant aquatic vegetation (12 plots) was *Ruppia maritima* (Widgeon grass) which had an average percent cover of 16%. Curly pond weed (*Potamogeton crispus*) and American waterwort (*Elatine Americana*) were also present, but a low percent covers (Table 5). Green alga was also present in 2 of the plots. Forty-two percent (5 plots) of the aquatic vegetation plots were absent of aquatic vegetation.

Invasive, Nonindigenous, and Species of Concern

Table 6 lists invasive, nonindigenous, and species of concern that were encountered at SAIR.

One green crab (*Carcinus maenas*) was sampled using the throw trap. The green crab is a well established exotic species (first recorded observation on the East Coast in 1817) that is abundant in coastal waters from Maine to Maryland (Benson 2004). Introductions have had a negative impact on soft-shell clams, young oysters, and native crabs in the Northeast beginning in the 1950s (Benson 2004).

Two nonindigenous (non-native) fish species, brook stickleback (*Culaea inconstans*) and large mouth bass (*Micropterus salmoides*), were also sampled. Both of these species are native to North America but are introduced to Massachusetts (Fuller 2004a, 2004b; USGS 2004).

Four invasive plant species, purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), black locust (*Robinia pseudoacacia*), and multiflora rose (*Rosa multiflora*) were encountered at SAIR. Purple loosestrife and multiflora rose are also introduced species (USDA, NRCS 2004; Massachusetts Invasive Plant Working Group 2003). These plants have spread into native and minimally managed plant systems in Massachusetts. They have the potential to cause economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to systems where they are established (Massachusetts Invasive Plant Working Group 2003)

One plant species, American waterwort (*Elatine Americana*) is listed by Massachusetts as an endangered species (USDA, NRCS 2004; Natural Heritage and Endangered Species Program 2001).

Table 1. Nekton species list and type of gear species was collected from at SAIR. Two different gear types, a 6m seine and 1m² throw trap, were used to sample nekton in the Saugus River adjacent to SAIR.

Species	Common Name	Seine	Throw trap
<i>Alosa pseudoharengus</i>	Alewife	X	
<i>Anguilla rostrata</i>	American eel	X	X
<i>Apeltes quadracus</i>	Four-spine stickleback	X	X
<i>Carcinus maenas</i>	Green crab		X
<i>Catostomus commersoni</i>	White sucker	X	X
<i>Culaea inconstans</i>	Brook stickleback	X	X
<i>Esox americanus</i>	Redfin pickerel	X	
<i>Fundulus heteroclitus</i>	Mummichog	X	
<i>Gasterosteus aculeatus</i>	Three-spine stickleback		X
<i>Rhithropanopeus harrisii</i>	Harris mud crab	X	
<i>Micropterus salmoides</i>	Large mouth bass	X	
<i>Morone americana</i>	White perch	X	
<i>Pungitius pungitius</i>	Nine-spine stickleback	X	

Table 2. Average density (number $\text{m}^{-2} \pm \text{SD}$) and total number of individuals captured (in parentheses) from 1m^2 throw trap sampling at SAIR. Sample size is given after date.

Species	Common Name	Number $\text{m}^{-2} \pm \text{SD}$ (total no. individuals)		
		June 9, 2004 n = 16	Aug 5, 2004 n = 16	Average summer density n=32
<i>Anguilla rostrata</i>	American eel	1.6 ± 2.6 (25)	0.3 ± 1.0 (5)	0.9 ± 2.0 (30)
<i>Apeltes quadracus</i>	Four-spine stickleback	2.3 ± 4.9 (37)	0.8 ± 1.4 (13)	1.6 ± 3.6 (50)
<i>Carcinus maenas</i>	Green crab	0	0.1 ± 0.3 (1)	0.03 ± 0.2 (1)
<i>Catostomus commersoni</i>	White sucker	13.9 ± 20.9 (223)	0.8 ± 2.5 (13)	7.4 ± 16.1 (236)
<i>Culaea inconstans</i>	Brook stickleback	0	0.1 ± 0.3 (1)	0.03 ± 0.2 (1)
<i>Gasterosteus aculeatus</i>	Three-spine stickleback	0.4 ± 1.5 (6)	0	0.2 ± 1.1 (6)
Total Nekton Density		18.2 ± 26.9 (291)	2.1 ± 3.2 (33)	10.1 ± 20.6 (324)

Table 3. Environmental characteristics (average $\pm$ SD) of nekton throw trap sampling stations at SAIR. Sample size is given after location.

Variable	June 9, 2004 (n=16)	Aug 5, 2004 (n=16)
Water Temperature ($^{\circ}\text{C}$)	21.5 ± 1.4	19.9 ± 0.8
Salinity (ppt)	0.3 ± 0.04	0.1 ± 0.1
Dissolved Oxygen (mg/L)	7.4 ± 0.5	7.5 ± 0.5

Table 4. Species composition, average abundance per seine haul, and total catch of nekton (in parentheses) collected with a seine at SAIR.

Species	Common Name	Average abundance per haul (total catch)	
		Upper portion of river n = 2	Adjacent to Hamilton St. Bridge n=5
<i>Alosa pseudoharengus</i>	Alewife	2.5 (5)	0.2 (1)
<i>Anguilla rostrata</i>	American eel	1 (0.5)	0 (0)
<i>Apeltes quadracus</i>	Four-spine stickleback	4 (8)	23.4 (117)
<i>Catostomus commersoni</i>	White sucker	1 (2)	168.2 (841)
<i>Culaea inconstans</i>	Brook stickleback	1.5 (3)	15.2 (76)
<i>Esox americanus</i>	Redfin pickerel	0 (0)	0.2 (1)
<i>Fundulus heteroclitus</i>	Mummichog	0 (0)	1.2 (6)
<i>Rhithropanopeus harrisii</i>	Harris mud crab	0 (0)	0.2 (1)
<i>Micropterus salmoides</i>	Large mouth bass	0 (0)	0.8 (4)
<i>Morone americana</i>	White perch	0 (0)	0.6 (3)
<i>Pungitius pungitius</i>	Nine-spine stickleback	0 (0)	0.4 (2)

Table 5. Species list, average Braun-Blanquet score and average percent cover (converted from Braun-Blanquet scale) for vegetation sampled at SAIR. Upper marsh (Transects 1-4) corresponds to the area adjacent to the existing dock, lower marsh (Transects 5-7) corresponds to the lower Phragmites dominated marsh. Aquatic vegetation was sampled in the river adjacent to nekton stations. Braun Blanquet cover class scale: (0; 1: <1; 2: 1%- 5%; 3: 6-10%; 4: 11-25%; 5: 26-50%; 6: 51-75%; 7: 76-100%).

Scientific Name	Common Name	Average Braun-Blanquet score and corresponding percentage		
		Upper marsh (Transects 1-4, n=16)	Lower marsh (Transects 5-7, n=14)	Aquatic Vegetation (n=12)
<i>Bidens tripartita</i>	Three-lobed beggarticks	0.1 (0.1%)	0	0
<i>Calamagrostis canadensis</i>	Bluejoint reedgrass	0.1 (0.2%)	0	0
<i>Calystegia sepium</i>	Hedge bindweed	1.4 (5.3%)	0.5 (6.3%)	0
<i>Elatine americana</i>	American waterwort	0.1 (0.1%)	0	0.3 (0.3%)
<i>Eupatorium perfoliatum</i>	Common boneset	0.6 (3.5%)	0	0
<i>Eupatorium purpureum</i>	Sweetscented Joeypyeweed	0.3 (2.4%)	0	0
<i>Impatiens capensis</i>	Jewelweed	1.4 (5.4%)	0.1 (0.1%)	0
<i>Juncus effusus</i>	Comon rush	0.2 (0.5%)	0	0
litter	Litter	1.1 (4.8%)	0.3 (0.4%)	0
<i>Lythrum salicaria</i>	Purple loosestrife	0.7 (2.5%)	0.9 (5.4%)	0
<i>Mikania scandens</i>	Climbing hempvine	0.5 (0.8%)	0.1 (0.2%)	0
mud or bare ground	Mud or bare ground	1.6 (10.8%)	0.2 (0.6%)	0
<i>Peltandra virginica</i>	Arrow arum	1.3 (5.8%)	0.7 (4.9%)	0
<i>Phalaris arundinacea</i>	Reed canary grass	0.5 (2.6%)	0.4 (2.7%)	0
<i>Phragmites australis</i>	Common reed	0.2 (0.5%)	4.9 (59.3%)	0
<i>Polygonum punctatum</i>	Dotted smartweed	0.1 (0.2%)	0.1 (0.2%)	0
<i>Polygonum species</i>	Smartweed species	0.3 (0.4%)	0.1 (0.2%)	0
<i>Pontederia cordata</i>	Pickerelweed	0.3 (0.4%)	0.1 (0.2%)	0
<i>Potamogeton crispus</i>	Curly pond weed	0	0	0.6 (0.8%)
<i>Robinia pseudoacacia</i>	Black locust	0.4 (3.9%)	0	0
<i>Rosa multiflora</i>	Multiflora rosa	1.2 (13.4%)	0	0
<i>Rumex crispus</i>	Curly dock	0.1 (0.2%)	0	0
<i>Ruppia maritima</i>	Widgeon grass	0	0	1.7 (15.7%)
<i>Solanum americanum</i>	American black nightshade	0.1 (0.1%)	0	0
<i>Sparganium americanum</i>	American burreed	0.3 (0.7%)	0.1 (0.2%)	0
<i>Toxicodendron radicans</i>	Poison ivy	0.1 (0.2%)	0.4 (2.7%)	0
<i>Typha angustifolia</i>	Narrowleaf cattail	2.9 (18.9%)	1.9 (12.2%)	0

Table 6. List of exotic, nonindigenous (native species to the U.S. that have been introduced into Massachusetts), and species of concern encountered at SAIR in 2004. Status information is from the USGS Nonindigenous Aquatic Species Database, USDA Plants Database, and the Massachusetts Invasive Plant Working Group.

Scientific Name	Common Name	Status
Nekton		
<i>Carcinus maenas</i>	green crab	exotic
<i>Culaea inconstans</i>	brook stickleback	nonindigenous
<i>Micropterus salmoides</i>	large mouth bass	nonindigenous
Vegetation		
<i>Elatine americana</i>	American waterwort	endangered in MA
<i>Lythrum salicaria</i>	purple loosestrife	introduced, invasive
<i>Phragmites australis</i>	common reed	invasive
<i>Robinia pseudoacacia</i>	black locust	invasive
<i>Rosa multiflora</i>	multiflora rose	introduced, invasive

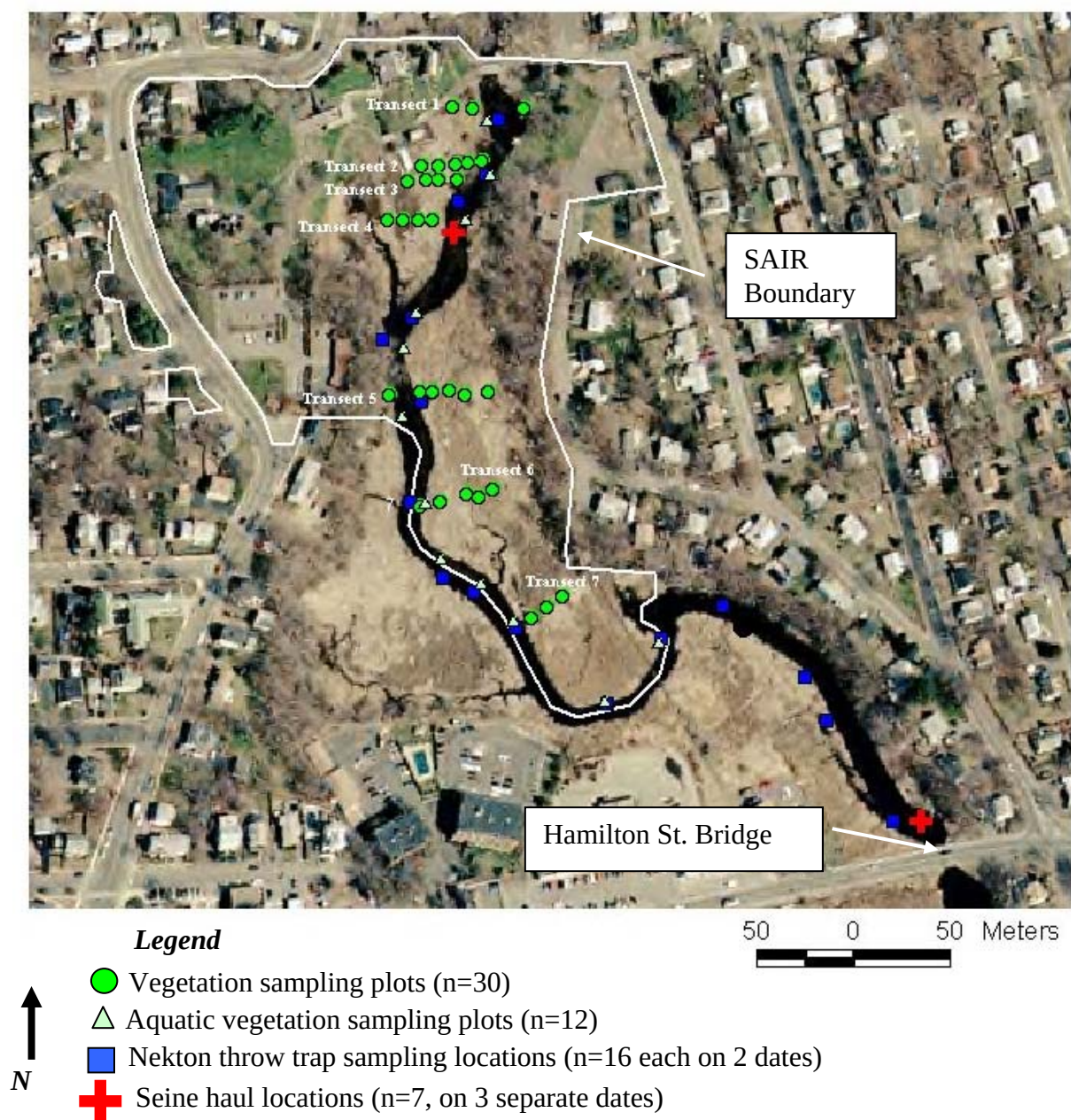


Figure 1. Location of nekton and vegetation sampling stations at SAIR in 2004.

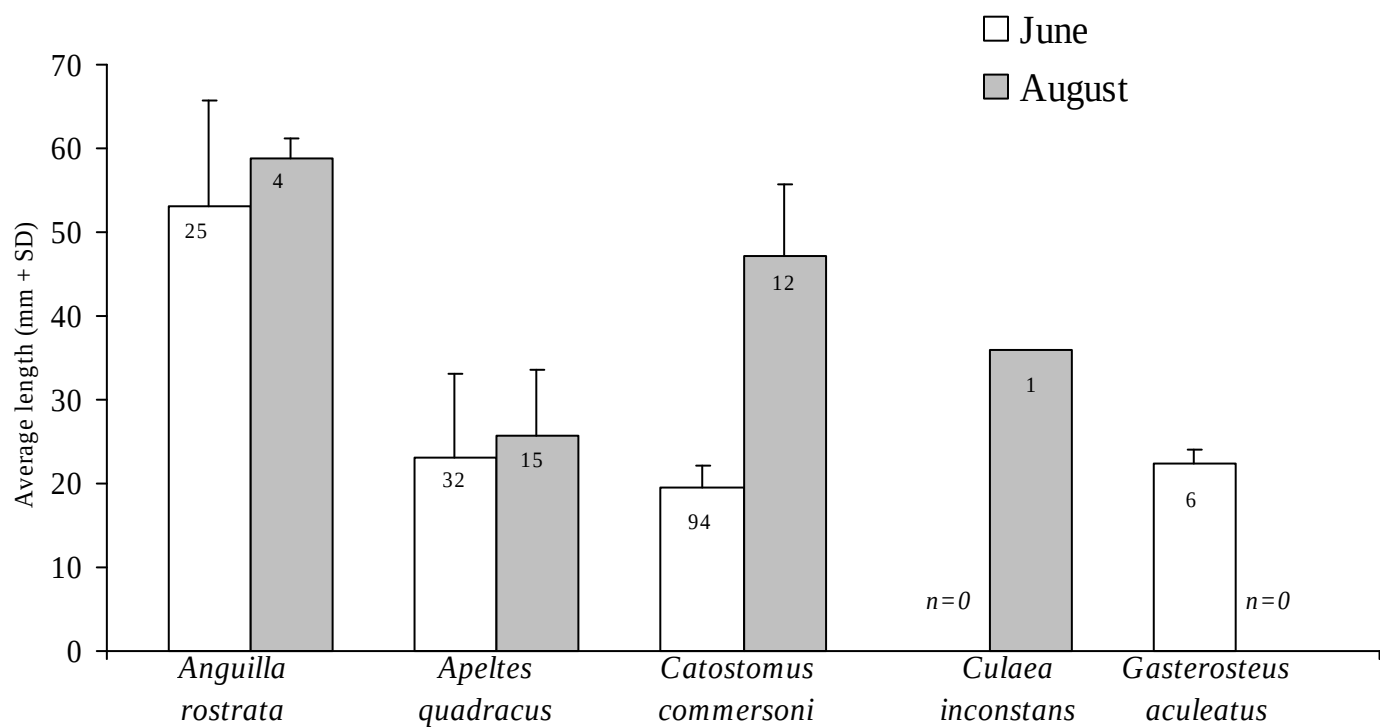


Figure 2. Average length (mm $\pm$ SD) of nekton sampled at SAIR with throw traps in 2004. Number of individuals measured indicated inside bars.

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