

**Harbor Watch, a Program of Earthplace
Report on Norwalk Harbor
Juvenile Benthic Marine Fish
May through October 2014**



RV Annie crew member holds up sea star recovered from the harbor bottom

Submitted by:

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Introduction:

The Harbor Watch program of Earthplace, in conjunction with the Wilton High School Marine Biology Club, has been trawling in the Norwalk River Estuary for 23 years. The program began in 1991 under the guidance of the State of Connecticut's Department of Environmental Protection (now known as the CT Department of Energy and Environmental Protection, or CT DEEP) Fisheries Bureau. A trawling program was devised using a one meter beam trawl and a grid system which divides the harbor into 300m² sampling quadrants (Figure 1). The survey targeted the sample collection of juvenile benthic marine fish that live on the harbor floor or spend many months on the harbor floor before heading out to sea. The presence of juvenile benthic fish is evidence of harbor health and support for a robust food chain.

Over the years there has been slight variance in data collection due to weather patterns, fish kills, boat repairs, and a request from the CT DEEP to trawl outside of Norwalk Harbor which disrupted trawling activity. In order to maintain some comparison from year to year all catches are reported as catch per unit of effort (CPU) or the total number of fish caught in a period of time divided by the total number of trawls conducted during that same time period.

The harbor has seen a rise and fall in CPU over the length of the study. The early 1990s saw CPUs between 5 and 17 where the 2000s to present consistently have CPUs below 5 with the exception of 2005 and 2013 which were at 9.00CPU and 6.06CPU respectively. Causes for these increases in elevated catches are unknown. Hypotheses include reduction in predators in the harbor, i.e. the water was too cold for blue crabs, or the water temperature was conducive to a favorable set for *Pseudopleuronectes americanus* (winter flounder) and other benthic species.

Full trawling history:

1990-1994: The early '90s show a harbor floor rich in species diversity with an extensive population of winter flounder. Large numbers of juvenile flounder were caught from the I-95 Bridge down to the Maritime Center where it was not unusual to find up to 50 flounder in a single tow.

1995-1997: The HW vessel RV Annie was laid up for extensive repairs.

1998-2001: Trawling was conducted on the apron outside the harbor from Norwalk west to Scott's Cove based on a CT DEEP request. Results were minimal numbers of benthic fish caught.

2002: HW returned to trawling inside Norwalk Harbor, although only a few trips resulted due to engine problems. The catch per unit of effort (CPU) was very small.

2003-2005: Benthic fish begin a strong recovery both in number of species and population. Recruitment of juveniles was doing well in 2005 especially in the "other" category with good numbers of Tom Cod, *Microgadus tomcod*, and Grubby, *Myoxocephalus aeneus*, recovered.

In mid-August of 2005 a large (one million+) fish kill occurred in the upper harbor when blue fish, *Pomatomus saltatrix*, chased a very large school of menhaden, *Brevoortia tyrannus*, upstream into a zone depleted of dissolved oxygen (<3 ppm, HW records) between the I-95 Bridge and Wall Street. The mass of dead fish sank and did not refloat. Previous fish kills were observed to refloat due to gas generated inside the decomposing fish and were subsequently moved out of the harbor on ebb tide (author's observations).

Extensive dredging began in the upper harbor which was protracted into early spring 2006. This in conjunction with masses of dead fish on the harbor floor curtailed juvenile benthic recruitment in 2006.

Recovery was further hampered by another, although smaller, menhaden kill in July of 2006 of approximately 10,000 fish.

2007: The benthic fish population began to recover again with a CPU of 3.65.

2008-2009: The recovery stalled for reasons unknown. Possible rising water temperatures on the bottom were retarding the winter flounder spawning.

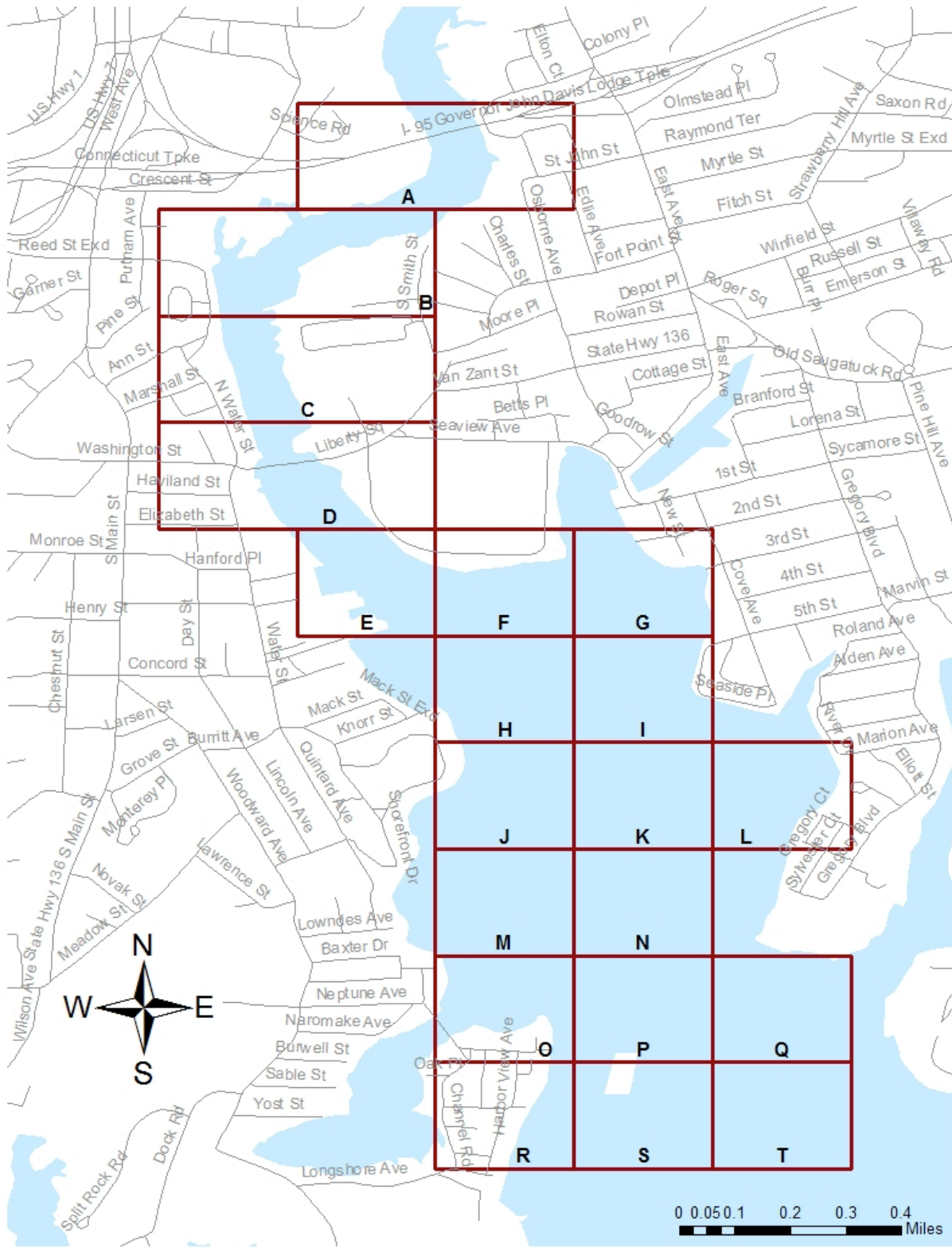
2010: Dredging occurred in the outer harbor. A blue crab, *Callinectes sapidus*, invasion by the thousands was found on the harbor floor which possibly helped consume available benthic fish. Only 27 winter flounder were recovered during the monitoring season.

2011: A modest recovery began in winter flounder with 95 juveniles caught during the year. This is attributed to cold water supplied by the winter of 2010/2011. A few more species begin to appear, i.e. Inshore Lizardfish (2), *Synodus foetens*, Tom Cod (1), *Microgadus tomcod*, and Black Fish (4), *Tautoga onitis*. The CPU for 2011 was 1.84 fish. The cold water also reduced the blue crab population to normal levels which may have eliminated a possible level of high predation by these crustaceans.

2012: Although no great improvement to the harbor was seen, there appeared to be no loss in CPU from 2011 to 2012, 1.8 for both years. Black Fish, a species under pressure, had returned for a second year which is a promising sign for the estuary. Many experts expected a blue crab invasion due to the warm winter of 2011-2012, but the crabs did not appear in any large numbers to damage to the fisheries.

2013: The monitoring season started off strong by way of fish recovered, especially winter flounder. 462 winter flounder were recovered during the monitoring season, with a fish total of 521, the largest CPU since 2007 (Table 3). A decline in catch was recorded again from August through October due to unknown reasons.

Figure 1 Norwalk Harbor trawling box chart



Results: Fourteen different species of fish were caught in Norwalk Harbor. In total, 156 fish were recovered over 79 trawls. Winter Flounder were the most abundant fish caught, totaling 60 individuals caught (Figure 2, Figure 3, Table 3). Fifteen different species of crustaceans were caught in Norwalk Harbor. Shore shrimp were the most abundant crustaceans, totaling 750 individuals caught (Figure 4).

Figure 2 Total number of fish caught by species in Norwalk Harbor, May through September 2014

Figure 3 Breakdown of number of each species caught in each box in Norwalk Harbor, May through September 2014

Table 1 Legend for Figure 3. Common names for each coded color

Code	Common Name	Code	Common Name
BKF	Blackfish	Oyster Toad	Oyster Toad Fish
Chain Goby	Chain Goby	PIP	Northern Pipefish
CUN	Cunner	PUF	Northern Puffer
HOG	Hogchoker	Scup	Scup
NKF	Northern Kingfish	SMF	Smallmouth Flounder
NKG	Naked Goby	WFO	Winter Flounder
NSR	Northern Searobin	WPF	Windowpane Flounder
		ZZZ	No fish caught

Figure 4 Total number of crustaceans caught by species in Norwalk Harbor, May through September 2014

Table 2 Total number of trawls in Norwalk Harbor broken down by box, May through September 2014

Box	Trawls	Box	Trawls
A	5	K	3
B	6	L	3
C	6	M	3
D	1	N	4
E	5	O	3
F	3	P	4
G	3	Q	5
H	3	R	3
I	6	S	5
J	3	T	5
		Total	79

Table 3 Twenty-four year look at Norwalk Harbor

Year	1990	1991	1992	1993	1994	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total Fish Caught	216	450	948	510	504	9	153	319	432	78	84	90	129	52	180	138	521	156
Total Trawls	43	66	60	84	29	6	46	64	48	69	23	50	68	69	98	76	86	79
Catch per unit	5.02	6.82	15.80	6.07	17.38	1.50	3.33	4.98	9.00	1.13	3.65	1.80	1.90	0.75	1.84	1.82	6.06	1.97
Total empty nets	7	14	8	15	6	1	13	8	5	42	7	18	15	36	29	23	25	30
Percent Empty Net	16%	21%	13%	18%	21%	17%	28%	13%	10%	61%	30%	36%	22%	52%	30%	30%	29%	38%
Significant Species	6	6	8	6	5	1	3	5	5	4	5	6	3	3	6	5	6	5
Number of species	9	12	14	11	10	5	16	15	15	9	10	15	9	6	13	14	12	14

Figure 5 Comparison of Catch per Unit of Effort (CPU) from 1990 to 2014 in Norwalk Harbor of the most common fish caught

Figure 6 Flounder distribution in the harbor broken down by monitoring month over a 24 year span

Discussion: Trawling on Norwalk Harbor was completed on 26 days with a total of 79 trawls between May and September 2014. Unfortunately, trawling from September 30th through mid-October was cancelled due to high winds, rain, and engine troubles. Sixty juvenile winter flounder were caught compared to last year's catch of 462 winter flounder (Figure 5). The Catch per unit of effort (CPU) decreased to 1.97 in 2014 from 6.06 in 2013 (Table 3). This CPU more closely matches the results observed from 2008-2012 (Figure 5, Table 3). Reasons for this dramatic decline in fish recruitment are unknown. Speculations include poor oxygenation in the upper harbor, predation from cormorants and osprey, and low water temperatures due to a cold winter. Five significant species were caught (catching five or more of one species) and they include Winter Flounder, *Pseudopleuronectes americanus*, Northern Searobin, *Prionotus carolinus*, Northern Pipefish, *Syngnathus fuscus*, Atlantic Puffer, *Sphoeroides maculatus*, and Blackfish, *Tautoga onitis*. Winter Flounder, the dominant fish species, was observed in 14 of 19 boxes showing even distribution throughout the harbor (Figure 3).

Box Q was observed to be the most prolific box with the recruitment of 22 winter flounder, which equates to 1/3 of total winter flounder caught (Figure 3). This is a unique discovery because past records show low recruitment in this box most likely attributed to the extensive boat traffic in and out of the marina (Harbor Watch records). Past years have seen greater recovery in the upriver boxes above the I-95 bridge, but Harbor Watch observed low oxygen values during the weekly oxygen profile surveys conducted over the summer which may have caused the winter flounder and other benthic fish to spawn in other areas of the harbor like Box Q which is in close proximity to the dissolved oxygen profiling site which had the highest observed dissolved oxygen value averages (Harbor Watch records). Boxes I, K, N, and S were observed to obtain the most species diversity at 6 species recovered over the course of the monitoring period (Figure 3).

Figure 6 shows that there have been two distinct trends observed in the catch per tow of winter flounder each month during the trawling season compared over the 24 year monitoring span. The eight years shown on the graph were chosen for their similar trawling intervals from June through mid-October (with the exception of 2014 where October trawling did not occur). The first trend appears in 1990, 2006, 2010-2012, and 2013 and shows the highest catch per tow during June when the flounder set reached 20mm in length (large enough to be caught in the trawl net). Recruitment then steadily declines from July through September. October landings then show a slight increase in catch per tow (Figure 6). This was originally thought to be a second winter flounder set hatching in late summer, but analysis of flounder lengths during October shows them to be 78mm or larger which disproves this hypothesis (Harbor Watch records). A similar trend was seen in 1992 and 2014 with one exception; July appeared to have the largest recorded catch per tow, increasing only slightly from June, and then rapidly decreasing in August and September, finally increasing again in October. The "second set" hypothesis is slightly more believable in 1992 with flounder lengths in October ranging from 38mm-117mm, but this cannot be the sole reason for a resurgence due to the high percentage of juveniles above 50mm which indicate that they are not newly hatched. A hypothesis for the increase in catch from June to July may be due to an exceptionally cold winter which caused protracted spawning into late spring because the water temperature stayed colder longer.

For many of the crustaceans caught the numbers of individuals recovered were low, but the overall number of different crustacean species caught during the 2014 monitoring period was larger than observed in recent years. Twelve species of crabs were recovered with Black finger mud crabs having the highest recruitment numbers (Figure 4). On two separate trawling days an unidentified crab was caught.

The crab was approximately the same size as a black finger mud crab but had more anterolateral teeth and an orange color to the carapace (see photo). If the crab had been recovered a third time, the specimen would have been collected for identification, but this opportunity did not occur. Although observed in low numbers, it is important to note the slow return of green crab, rock crab, and calico crab to Norwalk Harbor (Figure 4).