

The following supplement accompanies the article

Partial migration of striped bass: revisiting the contingent hypothesis

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SUPPLEMENT

TABLE S1. CLUSTER ANALYSIS RESULTS

Total study daily detection data for cluster analysis and resulting cluster assignments. Total lengths (TL, mm) are provided for reference.

Fish ID	Contingent	-----Days Detected-----					TL (mm)	Cluster
		Upper Hudson	Lower Hudson	NYH	Long Island	Coastal		
20	LEC	0	0	0	0	113	510	1
24	LEC	0	0	5	7	78	550	1
46	OC	6	1	1	3	6	920	1
33	LEC	0	0	0	0	13	670	1
13	LEC	0	0	4	0	6	460	1
35	LEC	0	0	5	2	8	790	1
19	LEC	0	0	19	4	4	500	1
25	LEC	0	1	15	4	3	550	1
47	OC	2	4	11	1	10	925	2
48	OC	14	8	10	1	5	925	2
32	LEC	24	5	45	1	5	660	2
6	UEC	53	4	34	24	6	483	2
40	LEC	24	10	14	9	5	960	2
45	OC	13	12	4	14	11	910	2
49	OC	2	5	1	4	7	940	2
51	OC	2	6	2	1	5	975	2
44	OC	2	11	5	2	9	850	2
43	OC	2	17	3	5	4	830	2
41	OC	1	24	6	1	18	820	2
38	LEC	0	17	44	3	5	850	2

Fish ID	Contingent	-----Days Detected-----					TL (mm)	Cluster
		Upper Hudson	Lower Hudson	NYH	Long Island	Coastal		
14	LEC	0	10	20	10	3	475	2
30	LEC	3	11	42	16	2	620	2
8	UEC	102	80	7	8	0	530	3
1	UEC	43	43	5	26	0	410	3
15	LEC	26	6	6	75	0	480	3
21	LEC	45	9	17	52	0	525	3
9	UEC	40	11	7	19	0	533	3
5	UEC	146	12	5	22	0	483	3
26	LEC	32	6	68	21	0	560	3
22	LEC	24	5	44	20	0	540	3
23	LEC	2	3	61	11	0	540	3
17	LEC	0	5	3	14	0	490	4
12	LEC	0	1	6	13	0	460	4
31	LEC	0	0	19	26	0	620	4
18	LEC	0	0	6	27	1	490	4
36	LEC	0	0	0	18	3	790	4
37	LEC	0	0	0	10	7	840	4
28	LEC	0	8	14	1	1	600	5
29	LEC	0	2	9	0	0	610	5
39	LEC	0	2	11	0	2	850	5
11	LEC	2	6	55	0	0	435	5
34	LEC	0	2	366	6	2	710	5
16	LEC	30	4	159	3	0	490	6
27	LEC	23	6	189	0	0	590	6
42	OC	29	68	34	0	0	820	6
10	UEC	62	14	30	0	0	540	6
4	UEC	197	26	6	0	0	470	6
3	UEC	3	22	0	0	0	483	7
2	UEC	211	16	0	0	0	457	8
7	UEC	146	12	0	0	0	508	8
50	OC	42	0	0	0	0	940	8

DETECTIONS AT MIGRATION CORRIDORS

Methods

The number of days each fish was detected by a receiver stationed at one of the corridor sites (Verrazano Narrows (VZN); Kill Van Kull (KVK); East River (ER); George Washington Bridge (GWB); Fig. 2) was tabulated by contingent. For the purpose of this analysis, data from the summers of 2010 and 2011 were combined as were the data for the two fall seasons.

Association between contingent membership and corridor selection was assessed via Pearson's

Chi-squared test (Zar 1999). It is important to note that detection at these sites can indicate either transit or habitat occupancy for foraging or some other purpose.

Results

For the total study, corridor use (VZN, GWB, KVK, and ER) was significantly influenced (Pearson $\chi^2 = 302.33$; $df = 6$; $n = 892$; $p < 0.001$) by contingent membership. The bulk of corridor detections (65%) were contributed by LEC individuals; UEC and OC individuals accounted for 20% and 15% of corridor detections. Striped bass from the LEC were detected at all corridors but predominately utilized VZN (60% of detections) with the remainder of days split between the GWB (17%), ER (11%) and KVK (12%) corridors. Members of the UEC were never detected at KVK or ER, the majority of detections occurred at GWB (69%) and the remainder at VZN (31%). Members of the OC also did not use KVK. Individuals from this contingent utilized VZN (14%) and the ER (5%) but the majority of days detected occurred at GWB (81%) where fish staged before and after detected spawning runs up the Hudson River. In spring of 2011, six of the 10 OC fish remaining in the study were detected in the Hudson River. Four of these entered the harbor through VZN and three of them also exited through the same corridor, with the final fish using the ER. These four fish showed complete fidelity to exit routes between 2010 and 2011.

Telemetered striped bass showed markedly different corridor use according to contingent membership during spring (KWT; $\chi^2 = 44.28$; $df = 6$; $n = 125$; $p < 0.001$), summer (KWT; $\chi^2 = 299.56$; $df = 6$; $n = 449$; $p < 0.001$), and fall (KWT; $\chi^2 = 147.05$; $df = 6$; $n = 254$; $p < 0.001$), but not during winter (KWT; $\chi^2 = 7.27$; $df = 4$; $n = 60$; $p = 0.122$). In spring (Fig. S1d), detections were predominately from the VZN and GWB, reflecting fish that had overwintered in the harbor or coastal environments and were then ascending the Hudson River to spawn. Summer corridor use (Fig. S1a) was dominated by LEC activity at VZN, although LEC fish were detected at all four corridors and individuals from the OC were detected at every gate except KVK as they exited the Hudson after spawning. UEC members during summer and other seasons were largely limited to GWB and VZN corridor sites. Fall detections (Fig. S1b) were suggestive of continued LEC presence at VZN, along with a down-estuary migration by UEC fish into NYH, and in some cases out of the Harbor to adjacent coastal environments. Winter detections (Fig. S1c) were low relative to other seasons but indicated principal use of the GWB – VZN corridor.

The dual role of NYH as foraging and transit habitat complicates the analysis of migration corridors. Sustained periods of residency by some LEC individuals occurred at receivers sited at VZN indicating the strait is not merely a corridor. Similarly, serial detections for weeks and months occurred at receivers near the GWB. Under the assumption that seasonal migrations into and out of the Hudson River and NYH occur during fall and spring months, much higher incidence at VZN than at ER (Fig. S1) suggests that the former is the dominant point of ingress and egress for Hudson River striped bass. For both these transit points, individuals exhibited behaviors consistent with rapid migrations through these regions during spring and fall.

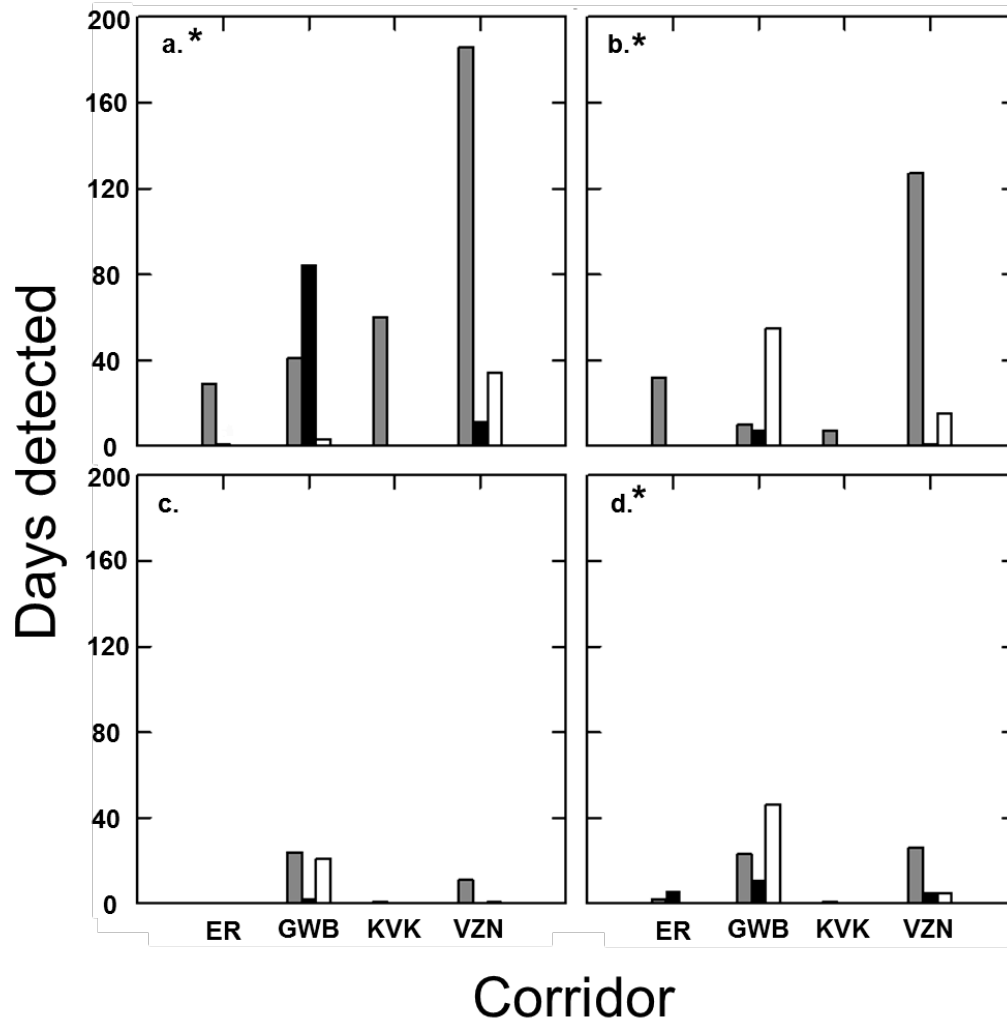


Fig. S1. Bar charts showing seasonal detections (a = Summer; b = Fall; c = Winter; d = Spring) of contingent members at New York Harbor corridors. Asterisks denote seasons in which contingency table analysis indicated that corridor use was not independent of contingent membership. Corridors (ER = East River; GWB = George Washington Bridge; KVK = Kill Van Kull; VZN = Verrazano Narrows) are displayed on the x-axis and the days individuals in each contingent were detected at that corridor (gray = Lower Estuary Contingent; black = Ocean Contingent; white = Upper Estuary Contingent) is displayed on the y-axis.