MICRO-MOVEMENTS OF BLACK SEA BASS ON THE ATLANTIC CITY REEF SITE

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INTRODUCTION

It is generally recognized that black sea bass (*Centropristis striata*) along the New Jersey coast undergo a migration from deeper, offshore waters to shallow, nearshore habitats during the spring and a reverse, offshore migration to deepwater wintering grounds as ocean waters cool in the fall (Kendall 1977). The inshore migration brings sea bass to shipwrecks and artificial reefs located near the coast.

In 1977, the Division began a tagging study to investigate the migrational patterns of sea bass to better understand seasonal and geographical shifts in distribution. As a subset of this statewide tagging effort, we decided to also examine the micro-movements of sea bass while summering on a section of the Atlantic City Reef Site. A micro-movement is defined as a movement less than one nautical mile in distance. By tagging a large number of fish in a discrete area, we hoped to understand more about sea bass behavior toward a home base and answer the following questions: Do sea bass continually move between reefs in close proximity? Or, do they remain faithful to a particular home structure for extended periods of time?

In addition, since numerous tagging events were conducted on the same sites, we also attempted to estimate the sea bass population size of individual reefs using tagging-recapture data.

STUDY SITE

The study site is a square NM portion of the Atlantic City Reef Site. It is located 10 to 11 NM offshore of Atlantic City and ranges in depth from 20 to 30 in. In addition to concrete-ballasted tire units and 5 army tanks, there are 20 reefs constructed from coils of undersea telecommunications cable (Figure 1). Telecommunications cable is designed to carry phone messages across the sea floor. It is very rigid, heavy, armored cable, 5 to 8 cm in diameter, that consists of twisted, stainless steel cables surrounding a central telecommunication wire. Each reef is constructed by spooling out 4 to 20 km of cable into a pile on the sea floor from a stationary vessel. Each cable pile is approximately 50 m in diameter and may rise off the sea floor from 0.3 to 3 in. The loose weave-effect of overlapping layers of cable coils provides an intricate habitat that harbors a high density of sea bass.

METHODS

Sea bass were caught by hook and line and tagged during late April to October, 2002 on the Atlantic City Reef Site. Floy anchor tags (FD-94) were inserted with a tagging gun between the bony rays under the dorsal fin. Each tag had a unique identification number and a phone number to call to report the date and location of the recapture. Fish were measured to the nearest cm (TL=total length), tagged and returned to the water as quickly as possible. Since most of the reefs were in relatively shallow water 20 to 25 iii in depth, few fish suffered prolonged effects related to decompression. No fish were vented to relieve distended air bladders.

RESULTS

A total of 18 different reef locations were fished during the survey. During a typical tagging day, 2 to 4 different locations were sampled. No attempt was made to sample all the locations equally. Rather, the majority of sampling was centered around 4 locations.

During the 6-month study period, 1 7 tagging trips were conducted. A total of 3,299 sea bass were tagged amid released; a grand total of 3,525 sea bass were caught, including recaptured tagged fish and ones that were not tagged. Study personnel recaptured a total of 9l tagged sea bass, including 4 fish tagged the year before. In addition, anglers recaptured and reported 82 tagged fish during the study period.

Tagged fish ranged in size from 15 to 50 cm TL. Length frequencies of tagged fish are broken down by time period in Table 1. The length frequencies of tagged fish do not exactly reflect the length frequency distribution of the total hook and line catch, since some larger fish were kept and not tagged. However, the tagged sample included adequate numbers of fish in all size classes.

Sea bass arrived on the Atlantic City Reef Site from deeper, offshore wintering grounds in late April. Fishing success was very good during May and June. The success rate declined in July, when sea bass exhibited their breeding coloration, and then, improved again in late August. September and October provided excellent catch rates; this was largely due to recruitment of young sea bass from bays and nearshore ocean waters. The length frequency distributions (Table 1) suggest that the reef populations consisted of large-size-class fish during April to August, but shifted to more small-size sea bass during September amid October. This shift is due to the movement of juvenile sea bass from nearshore ocean and estuarine habitats to the offshore reef while en route to deep water wintering grounds.

MOVEMENTS

Of the 3,299 fish tagged in 2002, 87 were recaptured on the Atlantic City Reef Site by Division personnel. A total of 2,975 were available for recapture prior to the last tagging or recapture event. The recapture rate over the survey period was 2.9 percent. Of the survey recaptures, 78 percent were recaptured at the exact location where they were tagged (Table 2). This rate was similar over the 5-month study period, with one dip at the 101-125 day time period, when only 53 percent of the tagged fish remained at their original location. These data suggest that once sea bass establish a home base the majority do not shift their home base even when numerous other identical habitats are located nearby, in this case, within 0.1 to 1.0 NM. Four sea bass tagged in 2001 were also recaptured during 2002. All four were tagged in the study area, but their exact tagging location was unknown. In 2003, an attempt will be made to catch fish tagged in 2002 to see if they return to their home reef in subsequent years.

Eighty-two of the tagged fish were also caught and reported by other anglers during the April-October study period. This represents a recovery rate of 2.5 percent over the course of the study. For angler-reported recoveries, only the general recapture location was identified. Also, the reporting rate of recaptured sea bass by anglers was unknown, but assumed to be low. Forty percent of the sea bass recaptured amid reported by anglers were within 1 NM of the tag location amid 43 percent were between amid 5 NM (Table 5). Due to the uncertainty of reported recapture locations, it is reasonable to conclude that about 80 percent of the fish were caught on or very near the study area where they were tagged. The Atlantic City Reef Site may have been only a temporary, stop-over site, rather than a final inshore destination for those fish that were recaptured outside the study area.

The results of both survey and angler recaptures suggest that once sea bass move to their inshore summer grounds, the majority establish a home residence or limited home range. Most fish remain faithful to this home base until their offshore migration in the fall. The fidelity of sea bass to a home reef is consistent with observations by party and charter fishing captains.

POPULATION ESTIMATES

When tagged fish were recaptured, the sea bass population size of the that reef location was estimated using the Lincoln-Peters on Index, as follows:

$$\text{Population estimate} = \frac{\text{Number of Previously Tagged Fish}}{\text{Number of tagged fish recaptured}} \times \text{Total Catch}$$

We recognize that the sea bass population on the reef was undoubtedly modified by factors that violated the tenets of this estimation technique. These factors included tagging mortality, fishing mortality, tag loss and migration (Figure 2). Not considering these biases leads to overestimating population size. Also, with factors responsible for removing tagged fish from the population, over-estimation should be further exaggerated over time, since mortality and emigration would have more time to remove tagged individuals from the population. Only one bias, a mathematical one, would lead to underestimating population size. Population estimates could only be generated when at least 1 tagged fish was recaptured, since the estimation formula is undefined when a 0 appears in the denominator. Many of the tagging events produced no tag recaptures.

When looking at just the tagging event (day) from which tagged fish were recaptured, estimated sea bass populations on individual reefs ranged from 620 to 16,984, with a mean of 4,996 sea bass per reef (Figure 3). Population estimates generated by combining data from multiple tagging dates, ranged from 2,265 to 32,826, with a mean of 12,284 sea bass per reef (Figure 4). Despite what we expected, there was no correlation between estimated population size amid the time between tagging and recapture. Using either method (Figure 3: r=0.28; Figure 4: r=0.2 1).The vast difference of the mean estimated size of sea bass population on individual reefs (4,996 vs. 12,284) produced by the two methods suggest that the populations are not stable and confined, but rather, are affected by recruitment, mortality amid migration. However, the estimates also suggest that sea bass populations on these small reefs (50-m diameter) are extensive amid probably number thousands of fish. This conclusion is borne out by excellent catch rates and the difficulty of recapturing large numbers of tagged fish, even a few days after tagging. The total population of sea bass on the 1 NM square study site probably exceeded 100,000 fish during May to October.

REFERENCES CITED

Kendall, A. W. 1977. Biological amid fisheries data on black sea bass, *Centropristis Striata*. NMFS Tech. Series Rep. No. 7. 29 pp.

Table 1. The length frequencies of 3,299 sea bass tagged on the Atlantic City Reef study site during two time periods.

TL (cm)	Percentage		TL (cm)	Percentage	
	April-August	September-October		April-August	September-October
15	0.1	0.1	35	3.2	1.2
16	0.1	0.1	36	1.8	1.2
17	0.1	0.5	37	1.5	0.5
18	0.1	0.2	38	1.2	0.4
19	0.1	0.2	39	0.6	0.1
20	0.4	3.5	40	0.8	0.3
21	0.4	3.1	41	0.3	0.1
22	0.6	4.9	42	0.4	0.2
23	2.3	4.0	43	0.2	0.1
24	5.2	3.7	44	0.1	0.2
25	7.8	4.5	45	0.1	0.1
26	7.6	7.4	46	0.1	0.1
27	8.7	9.6	47	0.1	0.1
28	13.6	11.1	48	0.1	0.1
29	8.5	8.1	49	0.1	0.1
30	13.6	13.1	50	0.1	0.1
31	7.7	6.0	Total	101%	101.1%
32	5.1	6.7			
33	5.1	4.3			
34	3.2	4.1			

Table 2. Micro-movements of sea bass tagged and recaptured by survey personnel broken down by days since tagging and distance traveled.

Distance traveled (NM)	Number of tagged fish recaptured Days since tagging							
	1-25	26-50	51-75	76-100	101-125	126+	Total	Percentage
0	25	13	9	12	8	I	68	78
0.1	1	3	--	1	4	--	9	10
0.2	--	1	--	--	--	--	1	1
0.3	--	--	--	--	I	--	1	1
0.4	--	--	--	--	--	--	0	0
0.5	2	2	1	--	1	--	6	7
0.6	--	1	--	--	--	--	1	1
0.7	--	--	--	--	--	--	--	0
0.8	--	--	--	--	1	--	1	1
TOTAL	28	20	10	13	15	1	87	99
Percentage Recaptured at tag location	89	65	90	92	53	100	78	--

Table 3. Distribution of sea bass recaptured by survey personnel broken down by tagging and recapture month.

Recapture period	Percentage of Recaptures from Month of Tagging				
	May	June	July	August	September
June	1.56	---	---	---	---
July	0	0.31	---	---	---
August	0	1.02	0.78	---	---
September	1.20	0.70	3.34	1.27	---
October	0.35	1.45	2.38	1.92	2.46

Table 4. Percentage of sea bass recaptured by survey personnel in months subsequent to tagging.

Time span between tagging and re-capture	Number of tagged fish available	Number of recaptures	Percentage
1 months	1776	21	1.18
2 months	1409	15	1.06
3 months	1236	5	0.40
4 months	1137	14	1 .23
5 months	570	2	0.35

Table 5. Movements of tagged sea bass recaptured and reported by anglers broken down by days since tagging and distance traveled.

Distance traveled in NM	Days since tagging						Row	Row
	1-25	26-50	5 1-75	76-100	10 1-125	126+	Total	Percentage
<1	15	10	3	1	4	0	33	40
1-5	10	13	7	0	3	2	35	43
6-10	3	2	1	3	0	0	9	10
11-20	0	2	0	0	0	0	2	2
21-50	0	3	0	0	0	0	3	4
Column Total	28	30	11	4	7	2	82	99
Column Percentage	34	37	13	5	9	2	100	--