Movement of Tagged Sea Scallops on Georges Bank

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ABSTRACT — The reported locations of recapture of tagged sea scallops show little evidence of any widespread movement. Eighty-five percent of the reported recoveries were less than 10 miles from the points of release. The direction of movement was generally along the axis of the strongest tidal current.

Introduction

The Atlantic sea scallop, *Placopecten magellanicus* (Gmelin), is the subject of an important fishery for both U.S. and Canadian vessels throughout its range from the Strait of Belle Isle to just north of Cape Hatteras (Posgay, 1957a). Georges Bank, particularly the eastern half, has historically been the most productive fishing ground. During 1957 and 1958, the NMFS Northeast Fisheries Center conducted a tagging program on Georges Bank primarily to investigate growth and mortality rates. In all we tagged and released about 13,000 sea scallops and recovered about 3,500 shells during the next 5 years. The growth data have been reported by Merrill et al. (1966) and the mortality data by Posgay (1963).

Sea scallops are vigorous swimmers and there have been persistent reports of beds of scallops "migrating," or at least moving away, to the distress of the fishermen. In an earlier paper (Posgay, 1963), I reported that of about 2,200 tagged scallops recovered during the first 2.5 years after release that 80 percent were reported less than 2 miles from the release point, 17 percent between 2 and 10 miles, and only 3 percent more than 10 miles. Many fishermen, however, still assert that sea scallops "migrate" and it was decided that a review of the release and recovery data was needed.

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Methods

Tagging a sea scallop is a simple and rapid procedure. We fished them up in the same type of dredge used by the commercial fishermen (Posgay, 1957b) and immediately put them in a large tank of running seawater. All those with broken shells or other signs of damage were discarded.

The lower (right) valve has a deep byssal notch that is not present in the upper valve. We used a small drill press and a fine drill bit to bore a hole in the upper valve just over the byssal notch. A stainless steel pin with a circular numbered Petersen disc tag and a length of yellow plastic tape to increase visibility was then inserted in the hold and the pin bent over to secure it (Fig. 1) The animal is not injured in any way and soon puts down a layer of shell covering the pin and the hole. The entire procedure takes only a few seconds and the scallops are then returned to running seawater after the margin is nicked with a triangular file to permanently mark the size at the time of tagging. The disturbance caused by handling and tagging puts a "tagging check" on the shell. After several hundred had accumulated in the live well, they were carefully dip-netted out and returned to the sea. Records were kept of the number of scallops, the tag numbers, and the loran bearings of the release point (Table 1, Fig. 2)

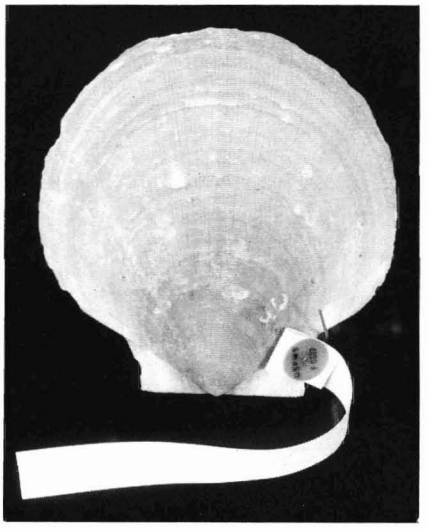

Figure 1.—Recovered sea scallop shell showing tag and streamer. The nick put in the margin at the time of tagging can be seen on the left.

Fishery statistical agents in all the major ports of landing in the United States and Canada were informed of the tagging program and provided with posters offering rewards for the return of tagged scallops (Fig. 3) to be put up in favorable locations. Port agents were provided with funds so that they could pay the rewards immediately when a tagged shell was turned in. Press releases were distributed to give the program the widest possible publicity. Preprinted cards with spaces for the required recovery data were given to the port agents with instructions for their completion. The tagged shells and the cards with the recovery data were then sent to the laboratory, checked, and time at large and size at release and recapture were recorded.

Table 1.—List of drop numbers, dates, locations, and number of tagged sea scallops released.

Drop no.	Date	No. released	Location
16	9/22/57	498	41°52'N 66°20'W
20	9/23/57	575	41°51'N 66°21'W
21	9/23/57	790	41°51'N 66°22'W
25	6/23/58	676	41°56'N 66°46'W
26	6/22/58	538	42°07'N 66°56'W
27	6/23/58	285	42°09'N 66°52'W
28	6/23/58	581	42°07'N 66°52'W
29	6/23/58	452	42°08'N 66°52'W
30	6/21/58	999	41°43'N 66°14'W
31	6/23/58	500	41°26'N 66°22'W
32	6/23/58	500	41°28'N 66°26'W
33	6/24/58	800	41°30'N 66°16'W
34	6/23/58	500	41°33'N 66°18'W
35	6/23/58	600	41°26'N 66°23'W
36	6/23/58	608	41°30'N 66°27'W

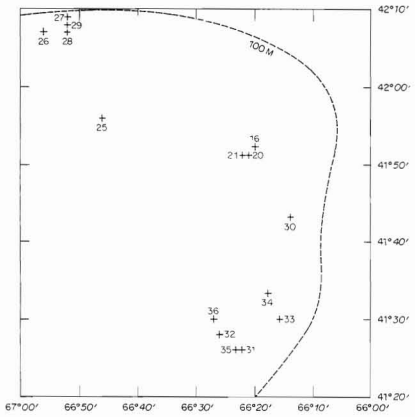

Figure 2.—Locations and drop numbers of the releases of tagged sea scallops on eastern Georges Bank.

Figure 3.—Reward poster publicizing the sea scallop tagging experiment.

The locations at which the groups of tagged scallops were released were all determined using the loran-A equipment on the research vessel and most of the recoveries also gave loran bearings for the locations of recapture. These kinds of data are not extremely precise. At best, with good equipment well maintained and operated, a loran fix is accurate to about ±0.25 mile (Haislip, 1962). This is probably a fair estimate of the release locations but the recovery locations are almost certainly much less accurate.

A single tow by a scalloper may cover 3-5 miles depending upon the skipper's estimates of the abundance. This may mean crossing the loran lines of position by as much as 50-60 microseconds depending on the area being fished. The fishing skippers are usually not particularly concerned about their exact location during a trip and very few keep records of the location of each tow. Therefore, the reported locations of capture are apt to be good only in a general sense. Inspection of the records shows some digit bias; locations are given as the intersection of two of the printed lines on the chart with few indications of any attempt at interpolation. In addition to these inherent sources of error, there are certainly instances of memory lapse and some cases of deliberate misinformation. Most fishermen don't like to tell anyone, let alone a government representative, just where they were fishing even if they have

been surrounded by a dozen other boats.

An aquarium experiment was conducted to determine if the tag and streamer affected the movement of the tagged scallops. The tank used was about 3 m wide by about 7 m long with the water about 1 m deep. Sea scallops used were all healthy and vigorous with a mean size of about 110 mm. Fifty were tagged, in the manner described above, and 50 left untagged. Both groups were placed in a windrow equidistant from the ends of the tank and left undisturbed for a week. When next examined, all of the scallops, tagged and untagged, were congregated at one end of the tank. During normal daytime activities around the experimental tank it was illuminated by overhead fluorescent lights which were nondirectional, but at night a single light some distance away was left on for the watchman. This seemed to be the only gradient so we put the scallops back in the center of the tank and covered it with a black plastic tarpaulin. A space was left open at one end and a small desk lamp left on over the opening. Once again, all the scallops moved toward the light. The position of the light was reversed and again the scallops moved towards it. A small ultraviolet lamp of the type used for examining geological specimens was substituted for the incadescent lamp with the same results. The scallops were put back in the center of the tank and the tank covered completely. Observations over the next few weeks (Fig. 4) showed that the scallops sorted themselves out more or less at random with no difference between those tagged and those untagged.

Figure 4.—Tagged and untagged sea scallops in experimental tank.

Results

The card files were purged of all records of scallops that showed that they had been dead for some time before recapture, those that had been recaptured less than 5 months after release, and those that had incomplete recapture information. The remaining 1,070 records were then placed on a computer tape and run through a program that converted the loran bearings to latitude and longitude and calculated the distance and direction of each reported recovery point from each release point. In the interest of brevity, only summaries of these data are given here; the complete data set can be found in the NEFC Laboratory Reference 80-28[1]. Table 2 gives the total number of tag returns separated into yearly intervals. Many of the tag returns came back in batches, more than one scallop turned in by the same vessel on the same trip. For the purposes of this paper, we have treated each of these multiple recaptures as a single data point. Tables 3-8 give the drop number, time at large in weeks, the distance and bearing of the reported recapture location from the point of release, and the number of scallops recovered from each location. These data were then plotted to show the distance and bearing of each recovery point from each release point without regard to actual geographic location (Fig. 5-8).

Table 2.—Number of recaptures by yearly intervals and percent returns by distance between release point and reported recapture point.

Time out (years)	Percent returns by distance				No. of recaptures
	0-2 miles	2-5 miles	5-10 miles	> 10 miles	
< 1	47.6%	33.3%	6.0%	13.1%	84
1-2	37.2	34.3	11.8	16.7	102
2-3	33.3	44.4	11.1	11.1	36
3-4	25.6	30.8	15.4	28.2	39
4-5	20.0	66.7	13.3	0	15
Total	37.3%	36.6%	10.5%	15.6%	276

About 17 of the 276 data points were located outside the frame of the charts used to plot Figures 5-8. These and all of the other points that were more than 10 miles from the release locations are given in Table 9.

Discussion

It is apparent from the tables and figures that most of the reported locations of recapture are fairly close to

[1]J. A. Posgay. 1980. Data report on the recoveries of tagged sea scallops from Georges Bank. NEFC Lab. Ref. 80-28.

Table 3.—List of tagged sea scallop recoveries with the distance and bearing of the reported location of recapture from the location of release (19.7-29.4 weeks at large).

Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.	Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.
16	19.7	1.5	170	11	28	24.0	1.2	143	2
20	19.7	7.1	323	3	28	24.4	1.6	175	2
21	20.0	0.4	234	44	30	24.4	9.1	335	2
16	20.0	2.2	235	8	21	24.7	0.9	223	4
20	20.0	1.1	257	10	30	24.8	7.4	006	1
30	20.1	5.0	195	4	28	25.3	3.7	143	1
29	20.3	1.2	131	7	28	25.3	4.9	163	1
21	20.3	3.3	355	8	28	25.3	0.8	294	17
26	20.7	3.3	186	1	28	25.3	2.1	313	1
20	21.0	1.1	118	13	25	25.6	10.7	024	1
21	22.7	0.9	357	4	25	25.6	1.2	081	1
30	23.0	0.9	004	1	25	25.6	3.3	337	2
21	23.0	2.0	151	33	25	26.0	1.3	257	12
16	23.0	2.8	191	15	25	26.1	1.8	131	6
21	23.0	0.2	343	45	25	27.1	0.9	288	4
28	23.4	1.8	143	2	16	29.0	2.7	303	1
28	23.4	1.9	155	1	21	29.0	2.6	342	4
29	23.4	2.7	156	1	26	29.3	0.3	039	3
25	23.6	0.9	288	21	26	29.3	3.4	145	2
28	23.7	1.6	175	7	26	29.4	1.6	043	3
25	23.7	4.3	277	1	26	29.4	1.4	120	2
25	23.7	0.8	300	9	29	29.4	2.4	226	1
25	23.9	0.6	194	1	26	29.4	1.5	329	34

Table 4.—List of tagged sea scallop recoveries with the distance and bearing of the reported location of recapture from the location of release (29.4-54.3 weeks at large).

Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.	Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.
26	29.4	0.8	335	1	28	48.1	23.1	103	1
30	29.6	10.8	339	11	30	48.1	3.2	327	1
30	29.6	1.9	355	1	36	49.0	17.2	032	1
26	30.1	3.4	145	2	30	49.0	1.5	344	3
16	30.1	1.6	170	1	36	49.4	2.6	013	2
26	30.6	4.7	145	3	20	49.6	0.8	143	21
26	30.7	14.7	137	1	33	50.6	16.4	006	5
25	30.7	2.6	331	2	34	50.6	13.6	013	9
30	31.7	1.4	013	1	30	50.6	12.5	112	1
30	31.7	1.9	355	31	34	50.7	0.5	188	3
30	32.6	1.4	013	1	34	50.7	1.0	200	4
30	32.6	1.7	016	21	33	50.7	2.7	285	1
30	32.6	2.9	352	3	33	50.7	3.0	328	5
30	32.7	1.9	355	1	33	50.8	17.6	344	7
26	34.1	19.6	098	3	34	51.6	0.8	167	4
16	37.1	2.4	186	6	30	52.1	9.7	216	1
25	37.4	5.7	291	1	34	52.1	3.5	307	2
21	44.7	3.6	124	5	34	52.4	2.7	199	2
20	44.7	3.0	132	3	30	53.4	35.9	312	2
16	44.7	3.4	153	1	36	53.7	3.0	324	7
35	45.1	11.9	008	2	20	54.0	1.2	138	1
30	45.4	7.2	245	1	20	54.3	1.4	161	6
26	47.4	4.7	178	2	20	54.3	2.2	182	1

Table 5.—List of tagged sea scallop recoveries with the distance and bearing of the reported location of recapture from the location of release (54.4-73.3 weeks at large).

Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.	Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.
25	54.4	1.1	171	7	26	61.0	1.5	161	2
30	55.9	0.9	004	1	16	61.3	1.0	267	2
34	55.9	10.4	014	1	26	62.2	9.0	144	1
30	55.9	0.5	274	6	26	63.1	8.4	144	4
33	56.0	11.8	019	1	20	63.4	1.6	080	1
25	56.0	17.8	095	1	16	63.4	1.1	133	20
30	56.0	1.1	302	21	16	64.4	5.5	107	6
25	56.5	1.1	171	3	21	64.4	1.0	136	20
20	56.6	1.4	161	3	16	64.4	1.9	204	2
28	57.0	12.2	076	1	16	64.7	18.7	282	1
21	57.1	3.5	013	1	20	65.3	1.4	161	10
16	57.1	2.5	344	4	16	65.3	2.4	186	4
26	57.3	4.9	086	1	21	65.3	5.2	326	6
26	58.0	4.7	124	1	16	66.0	26.6	294	2
16	58.1	2.1	323	1	21	66.0	25.7	298	1
26	58.2	4.7	124	6	20	66.3	1.4	161	2
25	58.2	1.1	171	6	21	67.3	3.7	360	3
20	58.4	2.9	181	12	16	67.3	3.0	331	3
20	58.7	1.4	161	3	20	67.7	0.6	070	1
30	59.4	12.4	335	11	21	68.3	8.8	327	4
26	60.1	1.5	161	11	20	71.4	8.6	138	8
26	60.4	28.0	130	2	16	71.4	8.9	146	2
20	60.7	2.9	181	13	21	73.3	1.0	109	3

Table 6.—List of tagged sea scallop recoveries with the distance and bearing of the reported location of recapture from the location of release (73.3-104.0 weeks at large).

Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.	Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.
16	73.3	1.4	200	9	16	93.0	13.5	183	2
30	77.8	30.8	299	1	21	94.4	1.8	107	1
20	78.0	1.1	118	1	21	94.4	6.8	115	1
16	78.0	1.6	170	3	21	94.4	6.8	119	1
25	80.6	1.1	171	2	21	94.4	4.9	139	2
25	80.8	1.8	193	3	16	94.4	1.6	170	1
25	80.8	3.6	301	1	21	95.0	26.3	306	4
25	81.3	1.1	171	1	21	95.9	2.1	118	3
20	83.0	13.1	187	3	21	95.9	2.5	121	2
25	83.0	3.6	315	2	16	95.9	3.6	126	4
25	83.4	3.6	301	1	21	95.9	2.5	132	4
28	85.4	11.8	265	1	16	95.9	2.1	170	8
25	89.0	4.6	350	2	16	95.9	1.6	170	5
20	90.0	6.0	047	2	16	95.9	2.7	172	5
20	90.0	4.2	192	1	16	95.9	4.7	305	3
21	90.0	0.9	223	1	21	95.9	4.4	327	1
26	91.1	3.8	105	1	20	95.9	1.7	334	3
26	91.3	5.2	104	1	26	96.7	10.2	264	1
21	92.3	1.8	107	2	21	97.0	2.5	132	1
20	92.3	1.1	118	1	20	97.0	2.0	146	2
16	92.3	1.6	170	1	21	99.3	1.8	138	3
26	92.5	0.9	091	1	26	100.3	2.8	146	1
21	93.0	12.5	177	8	21	104.0	4.0	174	1

the release points. Overall, 37 percent of the recaptures are within 2 miles of the release points, 74 percent are within 5 miles, and 85 percent are within 10 miles (Table 2). Many of the remaining 15 percent are somewhat suspect for one reason or another although we could find no objective grounds for disregarding them.

The direction of the apparent movement is interesting (Table 10). About 39 percent showed movement

Table 7.—List of tagged sea scallop recoveries with the distance and bearing of the reported location of recapture from the location of release (104.0-159.1 weeks at large).

Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.	Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.
21	104.0	3.7	178	3	25	129.4	3.7	329	1
16	104.0	4.9	196	1	25	130.0	4.1	193	1
26	105.1	2.2	158	1	35	130.2	3.2	207	1
16	106.8	27.9	307	2	21	130.8	1.5	099	6
36	108.4	2.8	294	5	16	130.8	1.0	194	9
25	112.1	3.6	315	1	28	135.2	1.9	148	1
25	112.3	4.6	209	1	25	137.7	3.5	163	1
25	113.0	3.6	315	2	36	138.0	3.0	254	1
36	113.0	33.1	329	1	28	138.2	7.4	077	1
36	113.3	0.5	330	14	36	141.5	3.0	254	4
36	117.4	1.4	230	1	35	141.8	10.2	345	2
30	121.1	0.3	108	2	36	144.4	2.2	324	2
30	125.5	0.5	274	1	29	152.0	8.3	205	1
16	127.4	2.9	054	7	20	153.2	2.4	105	3
21	127.4	4.7	055	6	20	155.5	1.4	161	1
29	127.7	2.5	127	7	26	157.6	3.5	152	1
36	128.0	1.4	247	3	25	157.6	24.4	276	1
28	128.2	6.0	132	2	32	158.4	3.6	147	1
29	128.2	6.7	141	10	16	158.5	11.3	321	1
21	128.7	1.8	085	1	32	158.6	3.1	020	1
29	128.7	1.9	135	4	30	158.7	17.9	206	1
16	128.7	1.0	194	2	30	159.0	0.9	004	1
28	129.0	12.5	118	1	32	159.1	3.1	020	2

Table 8.—List of tagged sea scallop recoveries with the distance and bearing of the reported location of recapture from the location of release (159.1-259.0 weeks at large).

Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.	Drop no.	Weeks out	Distance (n. mi.)	Bear.	No.
21	159.1	9.9	322	1	34	205.1	2.3	177	1
35	159.4	0.6	189	3	34	205.3	19.8	209	1
32	159.7	3.2	130	1	31	205.3	12.2	212	1
35	159.9	0.2	117	1	31	205.3	1.7	322	1
32	159.9	3.2	130	1	33	205.9	0.8	348	1
20	160.4	9.8	145	1	25	206.0	1.1	171	1
20	160.8	16.8	304	1	32	208.0	8.6	189	1
34	165.1	1.6	264	1	31	208.0	0.8	357	1
34	165.7	2.4	099	1	32	208.2	2.6	060	2
35	168.9	2.5	348	1	36	208.7	3.5	357	4
28	169.0	34.7	116	3	36	208.9	10.0	251	1
28	172.9	15.1	165	2	36	208.9	3.0	284	1
33	174.7	2.6	329	1	36	209.6	2.6	013	1
32	175.1	1.4	318	1	36	209.6	4.5	021	1
35	176.6	2.1	297	1	36	209.6	2.8	229	3
28	180.9	0.4	026	1	35	209.6	5.6	292	1
28	182.1	2.1	359	1	32	210.6	2.6	102	1
32	186.6	7.6	192	1	35	210.6	3.6	296	1
25	188.6	16.4	294	1	31	211.4	1.0	236	1
27	193.0	7.7	169	1	36	225.0	2.9	314	1
32	197.4	47.7	321	1	36	252.0	1.2	303	1
35	202.4	9.7	211	1	34	259.0	0.8	167	3
31	202.4	10.1	215	1	33	259.0	2.6	329	1

Table 9.—List of tagged sea scallop recoveries that were reported recaptured more than 10 miles from the point of release.

Drop no.	Tag no.	Weeks out	Dist. ance (n.mi.)	Bearing.	Drop no.	Tag no.	Weeks out	Distance (n. mi.)	Bearing
25	S4825	25.6	10.7	024	20	F4804+	83.0	13.1	187
30	S159+	29.6	10.8	339	28	F9975	85.4	11.7	265
26	F7163	30.7	14.7	137	21	F6264	93.0	12.5	177
26	F8486+	34.1	19.6	098	16	F3081	93.0	13.5	183
35	S4045+	45.1	11.9	008	21	F6083+	95.0	26.2	306
28	F9966	48.1	23.1	103	26	F7157	96.7	10.2	264
36	S4220	49.0	17.2	032	16	F3041+	106.8	27.9	307
33	S2498+	50.6	16.3	006	36	S4486	113.0	33.1	329
34	S3457+	50.6	13.6	013	28	F9314	129.0	12.5	118
30	E4961	50.6	12.5	112	35	S3554+	141.8	10.2	345
33	S2415+	50.8	17.5	344	25	D5757	157.6	24.4	276
30	S 643+	53.4	35.9	312	16	F3002	158.5	11.3	321
34	S3294	55.9	10.3	014	30	S 175	158.7	17.9	206
33	S2806	56.0	11.8	019	20	F4786	160.8	16.8	304
25	D5682	56.0	17.8	095	28	F9101+	169.0	34.7	116
28	F9361	57.0	12.1	076	28	F9274	172.9	15.1	165
30	E4900+	59.4	12.4	335	25	D5766	188.6	16.4	294
26	S 887+	60.4	28.0	130	32	S1684	197.4	47.6	321
16	F3144	64.7	18.7	282	31	S1208	202.4	10.1	215
16	F2714	66.0	26.6	294	34	S2000	205.3	19.8	209
21	F5656	66.0	25.7	298	31	S1090	205.3	12.2	212
30	S4842	77.8	30.8	299					

towards the southeast while about 30 percent went northwest. The tidal currents on eastern Georges Bank are rotary with the strongest vectors toward the southeast and northwest.

The data presented here and the inherent imprecision of the reported locations of recapture strongly suggest that adult sea scallops move very little if at all. We believe that the distance and direction that any individual sea scallop may swim at any given time is

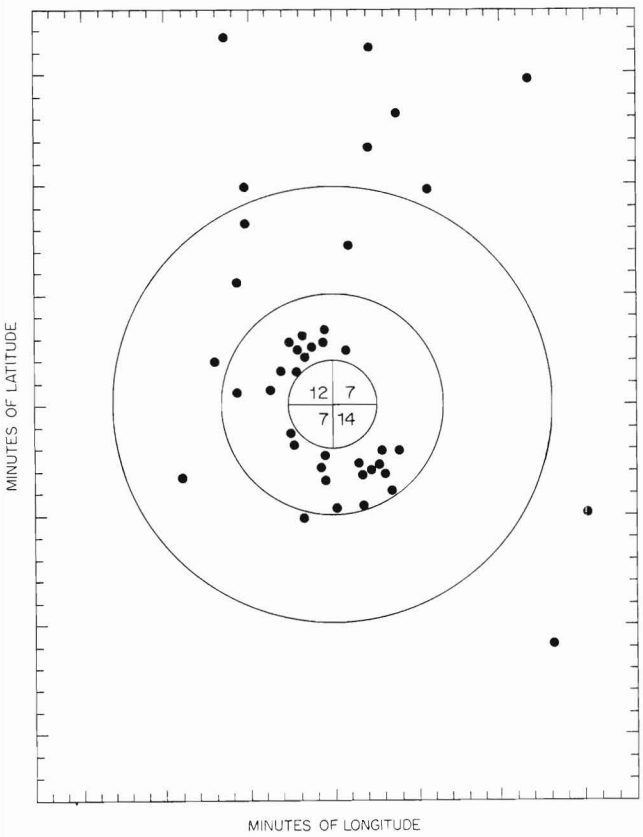

Figure 5.—Locations at which tagged sea scallops were reported recaptured during the first year after release relative to the location at which they were released. The figures inside the 2-mile circle give the number of recoveries in each quadrant.

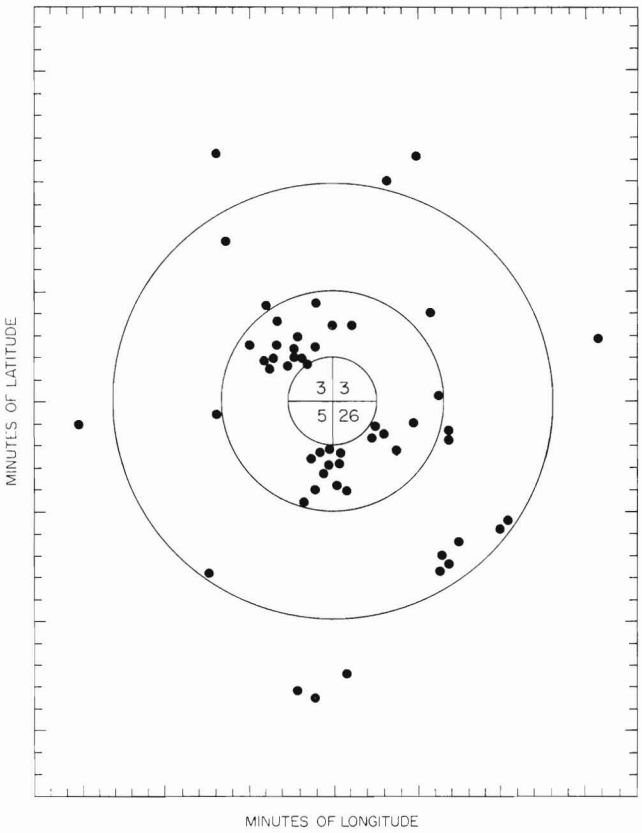

Figure 6.—Locations at which tagged sea scallops were reported recaptured during the second year after release relative to the location at which they were released. The figures inside the 2-mile circle give the number of recoveries in each quadrant.

Table 10.—Direction of movement of tagged sea scallops away from point of release by quadrant and years at large.

	Quadrant				
Years	001-090	091-180	181-270	271-360	001-360
< 1	14	29	13	28	84
1-2	9	52	17	24	102
2-3	4	12	10	10	36
3-4	4	12	9	14	39
4-5	3	2	3	7	15
Totals	34	107	52	83	276

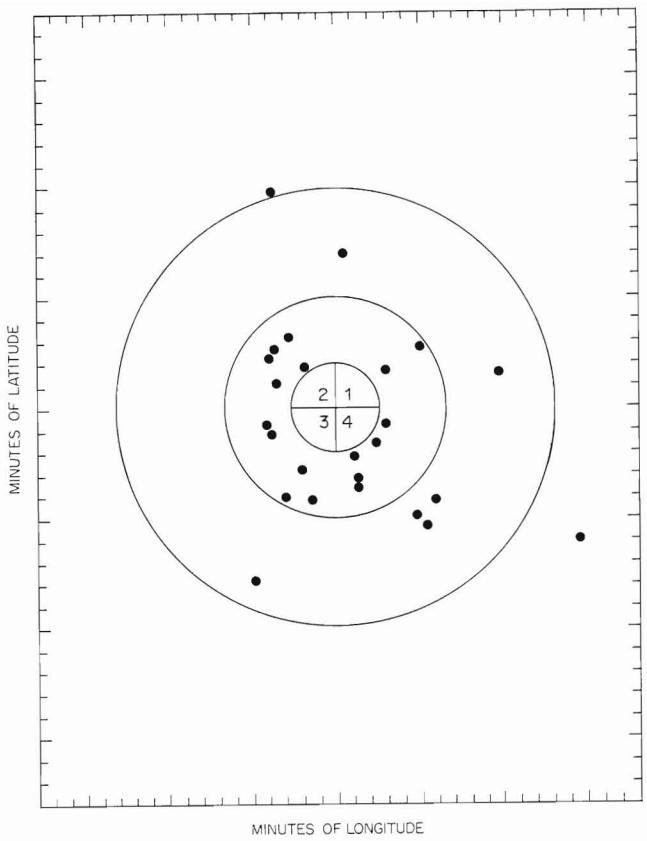

Figure 7.—Locations at which tagged sea scallops were reported recaptured during the third year after release relative to the location at which they were released. The figures inside the 2-mile circle give the number of recoveries in each quadrant.

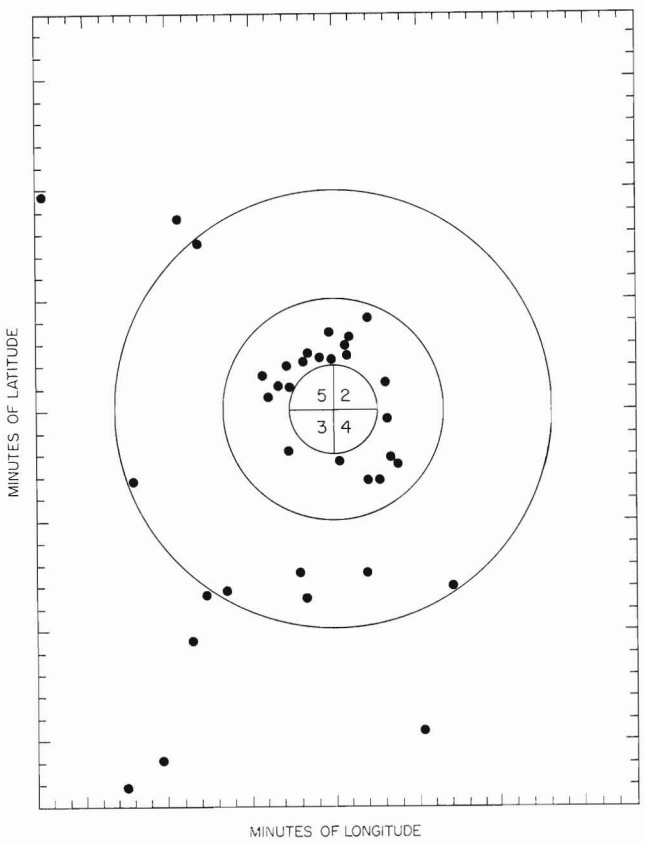

Figure 8.—Locations at which tagged sea scallops were reported recaptured during the fourth and fifth year after release relative to the location at which they were released. The figures inside the 2-mile circle give the number of recoveries in each quadrant.

probably random and that any net movement over time is probably the result of the strength and direction of the tidal currents.

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