AN ABSTRACT OF THE THESIS OF

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Title: Movement of Tagged Lingcod and Rockfishes off Depoe Bay, Oregon

Abstract approved: Howard F. Horton
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A tagging study was conducted from June 1978 through January 1982 to provide information on the movements of adult neritic reef fishes off the central Oregon coast. To evaluate the cause of low tag returns of previous tagging studies of reef fish in this area, tag retention, post-tagging mortality, and tag reporting rates were analyzed.

The retention of Floy FD-68C tags was analyzed in a double tagging study in the research area. Short term tag retention (0-450 days) was good (0.66) at the dorsal position. However, tag retention over the long term (0-900 days) was low (0.28) at the dorsal position and contributed to reducing the number of tag returns. The tag at the operculum position had a significantly lower rate of retention than the tag at the dorsal position.

The activity at release and extent of air bladder inflation were assessed to determine if these factors affected rates of survival of tagged rockfishes. The results were inconclusive. However, the results suggest that mortality of rockfishes exhibiting inflated air bladders can be reduced by puncturing their air bladders with a syringe either through the mouth or through the side of the abdomen.

The rate of tag reporting by fish cleaners and personnel of charter offices was estimated by seeding the catch of charter vessels as they were unloaded at the docks. The rate of tag reporting was 71.4%. An intensive educational program and frequent spot-checking of the catches were largely responsible for this favorable rate of tag reporting by charter fishing personnel. The rate of tag reporting by private sportfishermen was not assessed.

A total of 8,471 reef fish was tagged during a 27-month period. The tagged fish were predominately black rockfish (Sebastes melanops) (69.7%) with relatively small percentages of other species of reef fishes. Over a 44-month period the average return rate of tags from all species was 1.71%. The zero return rate (of 859 tagged) of blue rockfish (Sebastes mystinus) was significantly (X^2, $p < 0.005$) lower than the average return rate for the other species except cabezon (Scorpaenichthys marmoratus) and China rockfish (Sebastes nebulosus). The low return rate may indicate low utilization of this species.

Analysis of tag returns indicates that the population of yelloweye rockfish (Sebastes rubberimus) is characterized by local sedentary stocks. Recaptures of tagged black rockfish, lingcod (Ophiodon elongatus), yellowtail rockfish (Sebastes flavidus), and canary rockfish (Sebastes pinniger) suggest that some individuals of each species are resident while others move extensive distances. However, the actual amount of movement and stock mixing of each of these species could not be quantified.

The results of this study suggest that this fishery can best be managed by catch limits of combined species of rockfishes on a statewide basis. Other species of reef fishes including lingcod could effectively be managed separately. Because of significant increases in fishing pressure and advances in fishing techniques considerations should be given to reducing the total catch.

MOVEMENT OF TAGGED LINGCOD AND ROCKFISHES
OFF DEPOE BAY, OREGON

by

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

MOVEMENT OF TAGGED LINGCOD AND ROCKFISHES OFF DEPOE BAY, OREGON

INTRODUCTION

This thesis reports on a tagging study of neritic reef fishes off Depoe Bay, Oregon. The research was conducted from June 1978 through January 1982 to provide biological information for use in managing the neritic reef fish resource. To effectively conserve this resource, information on movements of the fish is necessary to determine if the fishery exploits a single, freely mixing population or a series of discrete stocks with limited mixing. In the latter case, local regulations would likely be necessary to effectively manage the fishery.

The neritic reef fishes of the Pacific Northwest are being subjected to increasing recreational and commercial fishing efforts. Conflicts between these user groups are becoming an important concern (Coombs, 1979). Although scientific data were sparse during the mid 1970's, over-exploitation of neritic reef fishes was suggested by reports of declining catches from charter boat captains over heavily exploited reef areas off Westport, Washington; off Depoe Bay, Oregon; and off Newport, Oregon (Personal communication with Don Christianson, charter boat operator, at the Oregon Charter Boat Association Annual Meeting, Lincoln City, Oregon, March, 1982). In addition, studies in central California concluded that blue rockfish (*Sebastes mystinus*) were vulnerable to over-exploitation in continually fished areas (Miller and Geibel, 1973). In Puget Sound, reduced limits and area closures have recently been implimented to protect depleted stocks of lingcod (*Ophiodon elongatus*) (Bargmann, 1982).

Fishery biologists of the Oregon Department of Fish and Wildlife (ODFW) have shown concern for the conservation of neritic reef fishes off the Oregon Coast. In 1977, ODFW biologists recommended a reduction in the sportfishing bag limit from a total of 25 to 10. The efforts of these biologists were partially negated by public pressure to maintain a liberal bag limit. The 1978 regulations were revised to a daily bag limit of 15 rockfish (*Sebastes* sp.) and 3 lingcod. ODFW biologists believe that insufficient biological information is available to manage the neritic reef fish resource properly and fully support efforts to study these fishes (Personal Communication to Candia Coombs, OSU, from Jerry Butler, ODFW, 1976).

Studies of several species of reef fishes have indicated discrete localized stocks of adult fish. A localized stock of adult yellowtail rockfish (Sebastes flavidus) was suggested from evidence of homing and high recapture rate (22%) at a wreck site near Juneau, Alaska (Carlson and Haight, 1972). Displaced fish returned to the home site from as far as 22.5 km. Some individuals were recaptured five or more times at the home site. The results of another tagging study off southern California indicated that stocks of olive rockfish (Sebastes serranoides) on isolated reefs were disjunct and heavily exploited (Love, 1980). Tag returns suggested that little movement of olive rockfish occurred between small isolated reefs. On some heavily fished reefs the return rates were as high as 25 to 35 percent. In addition, analysis of tag returns of blue rockfish from central California indicated restricted movements and discrete stocks. Although the return rate of 2.2% was low (172 of 7,645), 84 percent of the recovered fish moved less than 1.6 km (1 mi) and only two moved more than 16 km (10 mi) (Miller et al., 1967).

There is also evidence that some species of neritic reef fishes may exhibit seasonal movements. For the black rockfish (Sebastes melanops), tag returns have provided evidence of extensive movements. Based on studies in Puget Sound and off Depoe Bay, Oregon, researchers reported recaptures of individual fish that moved over 100 km (Barker, 1979; Coombs, 1979). In addition, a spent black rockfish was recaptured in a surface gillnet over 445 km south of the Alaska Penninsula in offshore waters (4,938 m deep) (Dunn and Hitz, 1969). They speculated that black rockfish may be pelagic and possibly move offshore to spawn. Studies of sex ratios and sizes of lingcod by season and depth, indicate that seasonal nearshore-offshore migrations occur (Miller and Geibel, 1973). However, seasonal spawning migrations from deep to shallow water have not been confirmed by tagging studies. Data from recaptured lingcod tagged in commercially utilized offshore areas suggest that movements of most mature lingcod in offshore waters are restricted (Chatwin, 1956; Phillips, 1959).

Recently, attempts were made to study the movements and migrations of lingcod off the central Oregon coast. The results of tagging studies suggested little movement of adult stocks of lingcod (Golden et al., 1979). From November through March of 1977-78, ODFW biologists tagged lingcod, of which 83% were males, and rockfishes (Sebastes spp.) on neritic reefs off Newport, Oregon. All of the 19 lingcod recaptures (6.5%) occurred at the site of release. No other tagged fishes of other species were recaptured. In July 1978, ODFW biologists tagged 3,818 lingcod, of which 89% were females, in an offshore area adjacent to Stonewall Bank off Newport, Oregon. Of the 347 (9.1%) recovered, only 18 had moved a detectable distance. Golden et al. (1979) thought the difference in the relationship between male and female lingcod in nearshore and offshore areas was due either to seasonal differences or actual differences between the stocks.

From 1976 through 1978, a tagging study of neritic reef fishes off Depoe Bay, Oregon was conducted by graduate students from Oregon State University. The results of the study indicated limited movements of most species (Coombs, 1979). During a 15-month period, 1,300 reef fishes were tagged. By the fall of 1978, only 27 of these tagged fishes had been recaptured. All but four returns showed no detectable movements (< 5 km). Movements of two lingcod and two black rockfish were significant (24 to 100+ km). The rate of return varied considerably between species: Black rockfish, 10 of 916 (1.1%); yelloweye rockfish (Sebastes rubberimus), 7 or 33 (21.2%); lingcod, 9 of 186 (4.8%); blue rockfish, 0 of 138; cabezon (Scorpaenichtys marmoratus), 1 of 3 (33%); and other species of rockfish 0 of 24. Coombs (1979) thought the low return rate for most species was due to the non-reporting of tags by fishermen and to movement of the charter fishing vessels to new reef areas. This reduced the fishing effort on reefs used as tagging and release sites by the researchers. The retention of tags and viability of tagged fish was thought to be acceptable by researchers, but these subjects were not directly investigated in the research area.

The information derived from the low tag returns reported by Coombs (1979) may not be representative of the population. If more reliable data were to be obtained, the rate of tag return and number of marked fish needed to be increased. With this goal in mind, the tagging study off Depoe Bay, Oregon was initiated in June 1978. This thesis reports on the results of my efforts to obtain further information on the movements of reef fishes, to evaluate reasons for the low rate of tag return, and to implement methods to increase the rate of return. The specific objectives were:

1. To determine if tagged lingcod and selected species of rockfish on neritic reefs off Depoe Bay, Oregon, exhibit predictable seasonal or annual movements.

2. To determine if the rate of tag loss among rockfishes and lingcod was a major cause of the low rate of tag return.

3. To evaluate methods to increase the survival of rockfishes with inflated air bladders.

4. To determine if the rate of nonreporting of recovered tags by fishermen was a major cause of the low rate of tag return.

MATERIALS AND METHODS

Study Area

The study area was located on neritic reefs from Depoe Bay to Cascade Head off the Central Oregon Coast (Fig. 1). This study area was chosen because Depoe Bay is typical of small ports along the Oregon Coast with an intensive and expanding sport fishery for neritic reef fishes. A general description of each reef area is presented in Table 1. The depth of the release sites ranged from 9-55 m. Tagging efforts were concentrated in certain areas based on their utilization by the sport-fishing fleet, the apparent density of fish population, accessibility of the reefs, and prevailing weather conditions. Because of these factors, the greatest tagging effort was exerted on the shallowest, and closest reef to Depoe Bay, Government Point Inshore (#1).

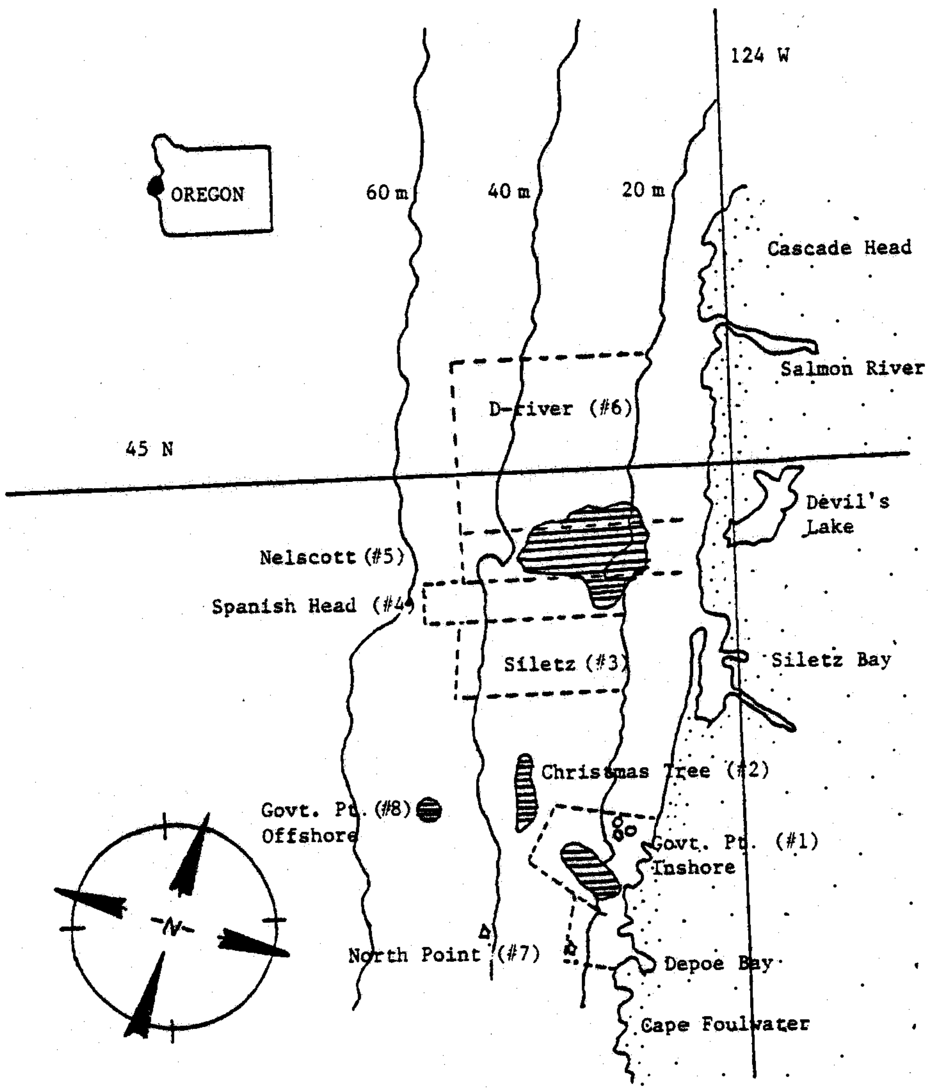

Figure 1. Map of the reef areas off Depoe Bay, Oregon, where reef fishes were tagged and released between 1978-80. Extensively utilized reef areas are sketched.

Table 1. Description of tagging areas off Depoe Bay, Oregon, over which neritic reef fishes were tagged between June 1978 and August 1980.

Reef No.	Name of Reef	Depth Range (m)	Approx. Depth (m) Most Often Fished	Description of Reef Area
#1	Government Point Inshore	9-28	18	A general area off Government Point to approximately 2 km north characterized by a continuous rocky area on the south side and several small rocky areas separated by sandy bottom areas to the north. The heaviest fishing effort occurs on this reef.
#2	Christmas Tree	31-46	39	A specific site directly offshore of reef #1 characterized by a narrow rocky area less than 1 km in length along a 9 m drop-off. The direction of the reef is roughly north to south. The dropoff is the eastern boundary.
#3	Siletz	18-46	37	A general area south of the Siletz River mouth off Salishan Spit characterized by rocky areas separated by large sandy areas.
#4	Spanish Head	18-55	42	A general area north of the Siletz River to just south of Nelscott. The Inn at Spanish Head is a prominent landmark. The inshore rocky areas are large and sharply defined. The offshore rocky areas are small and difficult to detect because only slight changes in depth occur. The rocky sites are separated by large sandy areas.
#5	Nelscott	6-46	13	A large continuous rocky area off Nelscott marked by a large

Table 1. Continued.

Reef No.	Name of Reef	Depth Range (m)	Approx. Depth (m) Most Often Fished	Description of Reef Area
				kelp bed on the inshore side. The rocky areas are often very jagged with deep drop-offs on the edges of the reef. Sandy bottom areas are present on the offshore sides.
#6	D-river	18-46	27	A general area off D-River and north characterized by rocky areas separated by sandy bottom areas.
#7	North Point	9-18	12	A shallow area from the Depoe Bay bell channel marker north to Government Point-Inshore (#1) characterized by jagged rocky reef sites separated by sandy bottom areas.
#8	Government Point Offshore	46	46	A small site offshore of reef #1 and #2. There are no noticeable changes in bottom characteristics. The site is located by a Loran C fix and indications of concentrations of reef fishes on a paper recording fish finder.

Sampling Methods

Capture and tagging of reef fishes was conducted aboard the R/V Tooshqua, a 7.9-m (26-ft) Oregon dory. The tagging team consisted of the researcher and one to three volunteers. Loran readings and visual bearings were used to locate general areas for each days tagging effort. Specific locations and concentrations of reef fishes were pinpointed with a flasher/paper depth recorder and fish finder. When a concentration of reef fishes was located, the vessel was positioned up current and then allowed to drift over the site. The reef fishes were captured with conventional hook and line gear. Preliminary research by Barker (1974) indicated that this was the most feasible method of capturing fishes over reef areas. He used Norwegian and conventional jigs successfully. Coombs (1979) added one or two plastic lures (hootchies) above the jig. In this project, two to six (usually two) rockfish flies (consisting of 3-inch strands of pink or white yarn tied to a hook) were tied above the lead jig at 10-to 16-inch intervals.

To reduce the potential for post tagging mortality, the handling, exposure to air, and violent movements of each fish were kept to a minimum during the entire tagging operation. When each fish was captured, it was unhooked and released directly into a 114-liter holding tank partially filled with seawater. The seawater was replaced as needed. Within 1 to 5 minutes, each fish was individually removed from the holding tank and placed on a tagging board where it was measured, tagged, and immediately released.

Reef fishes were tagged with internal anchor tags and Floy tagging guns for rapid application. The tags were serially numbered and marked for return to the researcher. Each fish was either single or double tagged. In most cases the Floy FD-68C (9.0-cm) orange or green spaghetti tag was attached singly between the ptergiophores of the dorsal fin or in conjunction with a Floy FD 68-C (5.5-cm) yellow spaghetti tag which was attached through the left operculum. In some cases, only the yellow Floy tag was attached through the left operculum.

Most of the tagging was performed by the researcher. I adhered to the tagging methods recommended by Dell (1968) as closely as possible. The fish were held firmly on the tagging board to prevent unnecessary injury. When tagging the fish in the dorsal position, I was careful not to force any scales into the flesh of the fish, which would enlarge the entry wound and increase the chances of infection. The tagging gun was partially compressed to assure that the tag would not jam in the gun. The tagging needle was inserted into the skin on the left side of the fish and pushed through the pterygiophores toward the anterior of the dorsal fin. The gun was compressed fully and twisted so that the tag would remain as the needle was withdrawn. The tag was pulled moderately to "lock" the T-bar firmly behind the pterygiophores and to check if the nylon filament was properly bonded to the vinyl tubing of the tag. The yellow spaghetti tag was pushed through the left operculum and care was taken to not damage the gills.

The rates of tag loss for the dorsal and operculum positions were evaluated by double tagging reef fishes in the research area and by observations of double tagged reef fishes in the Underseas Garden Aquarium, Newport, Oregon. The tag return of double tagged fishes was analyzed with the method described by Russell (1980). This method involved calculating the probability of tag loss by comparing the number of recaptures of double tagged fishes to single tagged fishes.

Most of the reef fishes were released immediately on the surface. When rapidly brought to the surface from deep water, rockfish often show signs of rapid decompression. These signs are inactivity, loss of equilibrium, distended air bladder, and/or the stomach everted through the mouth. Since the air bladder of rockfish has no opening to the mouth, rockfish are unable to release gases when decompressed. These fish have little chance of survival because they float on the surface. To reduce the mortality of these rockfishes, their air bladders were deflated prior to release with a 20-gauge syringe inserted either through the mouth or lower abdomen with methods similar to those described by Gotshall (1964). Rockfishes with gas bubbles in their eyeballs were not released. In a further effort to evaluate methods to reduce mortality of yelloweye rockfish, during the last three months of the study some of the yelloweye rockfish were lowered to the bottom in an inverted, weighted crab ring without puncturing their air bladders.

At the time of release, the rockfishes were rated for activity and extent of air bladder inflation to determine if differential mortality exists between the various conditions of the fishes. The use of the puncture technique was also recorded. The numbers 1, 2, 3 were used to characterize activity in the following way:

1. Fish immediately dive under the surface and disappear.
2. Fish remains on the surface for 5 seconds or less before submerging.
3. Fish remains on the surface for 6 seconds or more, but eventually submerges.

The letters A through C were used to represent air bladder condition before deflation in the following way:

A. Air blader not extended (no deflation).

B. Air bladder extended into throat 2 cm or less.

C. Air bladder extended into throat more than 2 cm.

The air bladders of sample reef fishes were punctured and the fish were released in the Depoe Bay Aquarium to evaluate mortality and observe post-tagging behavior.

In an attempt to reduce the nonreporting and inaccurate reporting of tags, a publicity campaign was conducted. Pertinent information was disseminated that would increase the chances of a person recognizing and returning a tag with accurate information. Personal communication with the charter boat captains and fish cleaners kept most of them well informed. They were asked to remove any tags they observed on the fishes immediately and place them in a safe place until I could collect them. Signs were posted regularly in Depoe Bay so people on private and commercial boats would know how to report tag recoveries accurately. In addition, two newspaper articles were published about this study.

Reporting of tag recoveries by fish cleaners and charter boat offices was assessed by the seeding of the catch of the charter fleet. A maximum of one fish per charter dock per day was marked with a green colored tag at the dorsal position. Green tags were less conspicuous than orange tags and did not attract immediate attention. Usually the tag was placed without the knowledge of anyone on the dock. The person placing the tag immediately left the dock. To minimize suspicion, the seeding of the catch was spread over the duration of the study. The percentage of seeded tags returned was used as the reporting rate. The rate of reporting of tags by independent sportsfishermen was not assessed.

Movements of tagged lingcod and selected species of rockfish were determined by analysis of the recovery data and location. The distance of the movement was the direct route between the sites of release and recapture. A significant movement is defined as any change in location from the original tagging site > 5 km. This distance was chosen because individual fishermen often called the same area different names. Unless the distance of reported site of recapture was at least 5 km from the orginal site of release, one could not determine whether the fish actually moved or the fishermen reported the recapture site by a different name.

RESULTS

Tag Loss

To estimate the rate of tag loss, 3,809 reef fishes were double tagged and released. A total of 83 were recaptured. The number of tags recovered for each tagging position over 90-day intervals is shown in Table 2. Of the tagged fish recaptured, retention of the dorsal tag was 66% over a 450-day period (Table 3). During the same time period tag retention of the operculum tag was 34%. The probability of retention and loss of Floy tags overtime at the dorsal and operculum position is shown in Table 4. The retention of the operculum tag was signficantly less ($P < 0.01$) than the retention of the dorsal tag over the 900-day study period (Table 2).

Reef fishes were also observed in aquariums to study tag loss. Twenty black rockfish and two lingcod were observed for 11 months in the Underseas Garden Aquarium at Newport, Oregon. The results (Table 5) provide further evidence of higher tag loss for the operculum tags. No black rockfish and only one lingcod lost a dorsal tag during the 11-month period. During the same time period at least four black rockfish and one lingcod lost the operculum tag.

Post-tagging Mortality

To evaluate mortality due to capture, handling, and tagging, the condition of 2,178 reef fishes was evaluated as they were released. The cumulative rated condition of these fishes is shown in Table 6, and the rated condition of 51 recaptured fishes is shown in Table 7. The majority of the fishes recaptured (43) were from the group released in good condition (1A). Five yelloweye rockfish were recaptured that had their air bladders punctured to relieve pressure prior to release. Four recaptured canary rockfish had been inactive after release for over 6 seconds. One of these had its air bladder punctured and was inactive for several minutes after being released.

Table 2. Tag returns over time for all species of neritic reef fishes marked with dorsal and operculum Floy FD-68C t-bar internal anchor (spaghetti) tags on reefs off Depoe Bay, Oregon from 1978 to 1982.

Days at Liberty	Both Tags Returned	Dorsal Tag Returned Only	Operculum Tag Returned Only	Total
90 or less	17	3	2	22
91-180	1	3	0	4
181-270	2	1	2	5
271-360	9	4	3	16
361-450	3	12	0	15
451-540	1	4	1	6
541-630	1	4	0	5
631-720	0	2	0	2
721-810	1	3	2	6
811-900	0	1	1	2
Total	35	37*	11*	83

*Significantly different (X^2 test at $P < 0.01$).

Table 3. Cumulative probability (Russell, 1980) of tag retention and loss over time of Floy FD-68C t-bar internal anchor (spaghetti) tags at the dorsal and operculum positions based on recaptures of double tagged neritic reef fishes along the N.W. Pacific coast from 1978 to 1982.

Days at Liberty	Retention of Dorsal Tag	Retention of Operculum Tag
0-180	0.90	0.75
0-450	0.66	0.34
0-900	0.28	0.06

Table 4. Probability of tag retention (Russell, 1980) and loss over time of Floy FD-68C t-bar internal anchor (spaghetti) tags at the dorsal and operculum positions based on recaptures of double tagged neritic reef fishes along the N.W. Pacific coast from 1978 to 1982.

Days at Liberty	Retention Both Tags	Retention of Dorsal Tag	Retention of Operculum Tag	Retention of Dorsal & loss of Operculum Tag	Retention of Operculum & Loss of Dorsal Tag	Loss of Both Tags
0-180	0.68	0.90	0.75	0.23	0.08	0.03
181-450	0.33	0.74	0.45	0.40	0.11	0.14
451-900	0.08	0.43	0.18	0.35	0.10	0.47

Table 5. Observations of tag retention in black rockfish (BR) and lingcod that were double tagged and held captive in the Underseas Garden Aquarium in Newport, Oregon, from June 1978 to June 1979.

Days After Release in Aquarium	Species	Total in Tank	Total Observed	Cumulative Dorsal Tags Lost	Cumulative Operculum Tags Lost	Observations
19	BR	20	15	0	0	Infections on fish at point
	Lingcod	2	2	0	0	of insertion
35	BR	20	13	0	0	Large chunk of operculum
	Lingcod	2	2	0	0	rotted away at point of insertion of several black rockfish. Algae growth on tags of black rockfish.
64	BR	20	12	0	1	
	Lingcod	2	1	0	0	
75	BR	20	12	0	0	
	Lingcod	2	2	0	0	
107	BR	18	12	0	1	Two black rockfish died from
	Lingcod	2	2	0	0	unknown causes
127	BR	18	14	0	0	
	Lingcod	2	1	0	0	
165	BR	18	6	0	0	
	Lingcod	2	0	0	0	
183	BR	18	10	0	1	
	Lingcod	2	0	0	0	
198	BR	18	12	0	3	One black rockfish died from
	Lingcod	2	2	0	0	unknown causes
258	BR	17	13	0	4	
	Lingcod	2	1	0	0	
273	BR	17	8	0	4	
	Lingcod	2	1	1	0	
300	BR	17	10	0	4	
	Lingcod	2	2	1	1	
320	BR	17	3	0	4	
	Lingcod	2	0	1	1	
350	BR	17	5	0	4	
	Lingcod	2	0	1	1	

Table 6. Rated physical condition of neritic reef fishes that were captured, tagged, and released off Depoe Bay, Oregon, from June 1978 through August 1980.

Activity Rating*	Air Bladder Rating**						
	A	B	B-P	C	C-P	C-S	C-SP
1	1395	64	3	67	385	14	3
2	30	16	0	13	33	0	0
3	29	8	0	11	101	0	6

*1 -- Fish immediately dove under surface.

2 -- Fish remained on surface for 5 sec or less before submerging.

3 -- Fish remained on surface for 6 sec or more but eventually submerged.

**A -- Air bladder not extended.

B -- Air bladder extended into throat 2 cm or less.

C -- Air bladder extended into throat more than 2 cm.

P -- Air bladder was punctured to release gas pressure.

S -- The fish was subsurface released in a trap.

Table 7. Rated physical condition of recaptured neritic reef fishes that were released off Depoe Bay, Oregon, from June 1978 through August 1980.

Condition Rating at Release*	Number Recaptured	Percent Returned
1-A	43	3.1
1-C-P	7	1.82
3-A	2	6.9
3-C-P	2	2.0

*1 -- Fish immediately dove under surface.

2 -- Fish remained on surface for 5 sec or less before submerging.

3 -- Fish remained on surface for 6 sec or more but eventually submerged.

A -- Air bladder not extended.

B -- Air bladder extended into throat 2 cm or less.

C -- Air bladder extended into throat more than 2 cm.

P -- Air bladder was punctured to release gas pressure.

S -- The fish was subsurface released in a trap.

Tag Reporting

To estimate reporting of tags by the charter fleet, a total of 28 tags were seeded on the fish as the catch from various charter vessels was unloaded on their respective docks. Twenty were returned and eight were not reported. The reporting rate was 71.4% for the charter fleet for the fishes that reached the dock with tags undetected.

Releases and Recaptures

From June 1978 through September 1980, a total of 8,471 reef fishes were tagged and released on eight reef areas between Depoe Bay and Cascade Head (Table 8). These fishes were predominantly black rockfish (69.7%) with relatively small percentages of all other species. The majority of the releases (69.5%) were made on shallow reefs off Government Point and Nelscott. These releases were 83.8% black rockfish. In reef areas #2, #3, #4, and #8, where the effort was concentrated in deeper water (30-55 m), the relative percentage of each species differed from the shallower reef areas and differed among the deeper reef areas (Table 8). Generally the black rockfish was relatively less common on the offshore reefs, and the yellowtail rockfish, lingcod, yelloweye rockfish, and canary rockfish were relatively more common on these areas.

Tags from 151 fishes were recovered from June 1978 through January 1982. Six recoveries were from fish tagged prior to this study by previous OSU graduate students, and these recoveries were used only in the analysis of fish movements. The return rate for each species is listed in Table 9. The average return rate for all species over the duration of the study (44 months) was 1.71%. Canary rockfish (<u>Sebastes pinniger</u>) had the highest return rate of 2.87% (10 of 348). Only small variations in the return rates of most of the different species were evident. The return rate of 0% of blue rockfish (0% of 859) was significantly different ($p < 0.01$) from the return rate of the other species except cabezon and china rockfish (<u>Sebastes nebulosus</u>). Table 10 shows the return rate of black rockfish recaptured at the original site of release. The return rate of black

Table 8. Summary, by species and reef, of tagged of neritic reef fishes released off Depoe Bay, Oregon, from June 1978 to September 1980.

Reef*	Black Rockfish	Lingcod	Yelloweye Rockfish	Blue Rockfish	Canary Rockfish	Yellowtail Rockfish	Cabezon	China Rockfish	Other Rockfish	Total and Percent Released
1a	3,789	134	5	471	28	43	29	4	3	4,506
b	84.1	3.0	.1	10.5	.6	1.0	.6	.1	.1	
c	64.1	24.3	2.5	54.8	8.0	8.9	64.4	12.5	7.3	
d	44.7	1.6	.1	5.6	.3	.5	.3	0.0	0.0	53.2%
2a	104	106	35	219	90	160	4	8	10	736
b	14.1	14.4	4.8	29.8	12.8	12.8	21.7	0.5	1.14	
c	1.8	19.2	17.2	25.5	25.9	33.3	8.9	25.0	24.4	
d	1.2	1.3	.4	2.6	1.1	1.9	0.0	0.1	0.1	8.7%
3a	66	57	10	32	36	18	0	1	1	221
b	29.9	25.8	4.5	14.5	16.3	8.1	0.0	0.5	0.5	
c	1.1	10.3	4.9	3.7	10.3	3.7	0.0	3.1	2.4	
d	.8	.7	.1	.4	.4	.2	0.0	0.0	0.0	2.6%
4a	377	125	90	47	88	48	5	6	13	799
b	47.2	15.6	11.3	5.9	11.0	6.0	0.6	0.8	1.6	
c	6.4	22.7	44.1	5.5	25.3	10.0	11.1	18.8	31.7	
d	4.5	1.5	1.1	.6	1.0	.6	0.1	0.1	0.2	9.7%
5a	1,145	46	24	60	45	38	4	10	8	1,380
b	83.0	3.3	1.7	4.3	3.3	2.8	0.3	0.7	0.6	
c	19.4	8.3	11.8	6.9	12.9	7.9	8.9	31.2	19.5	
d	13.5	.5	.3	.7	.5	.4	0.0	0.1	0.1	16.1%
6a	256	62	34	29	42	14	2	3	6	448
b	57.1	13.8	7.6	6.5	9.4	3.1	0.4	0.7	1.3	
c	4.3	11.3	16.7	3.4	12.1	2.9	4.4	31.2	14.6	
d	3.0	.7	.4	.3	.5	.2	0.0	0.1	0.1	5.3%
7a	59	19	0	1	0	0	1	0	0	80
b	73.9	23.8	0	1.2	0	0	1.2	0.0	0.0	
c	1.0	3.4	0	.1	0	0	2.2	0.0	0.0	
d	.7	.2	0	0.0	0	0	0.0	0.0	0.0	0.9%
8a	112	3	6	0	19	160	0	0	0	300
b	37.3	1.0	2.0	0	6.3	53.3	0.0	0.0	0.0	
c	1.9	.5	2.9	0	5.5	33.3	0.0	0.0	0.0	
d	1.3	0.0	0.1	0	0.2	1.9	0.0	0.0	0.0	3.5%
Total	5,908	552	205	859	348	481	45	32	41	8,471
Percent of Total	69.7	6.5	2.4	10.1	4.1	5.7	0.5	0.4	0.5	99.9%**

*1—Government Pt-Inshore, 2—Christmas Tree, 3—Siletz, 4—Spanish Head, 5—Nelscott, 6—D-river 7—North Points, 8—Government Pt.-Offshore; a—Total number, b—% of species on reef, c—% of total of each species, d—% of total of all species.

**Differs from 100 due to rounding error.

Table 9. Number and percentage of tagged reef fishes recaptured along the N.W. Pacific coast from June 1978 through January 1982.

Species	Number Tagged	Percentage of Total Tagged	Number Recaptured	Percentage Recaptured of Species Tagged	Percent Recaptured of Total Recaptured
Black Rockfish	5,908	69.7	109	1.84	75.2
Lingcod	552	6.5	14	2.54	9.7
Yelloweye Rockfish	205	2.4	5	2.44	3.4
Blue Rockfish	859	10.1	0	0.00	0.0
Canary Rockfish	348	4.1	10	2.87	6.9
Yellowtail Rockfish	481	5.7	7	1.46	4.8
Cabezon	45	0.5	0	0.00	0.0
China Rockfish	32	0.4	0	0.00	0.0
Other Species	41	0.5	0	0.00	0.0
Totals	8,471	99.9*	145	1.71	100.1*

*Differs from 100 due to rounding error.

Table 10. Number and percentage of tagged black rockfish recaptured at the original site off Depoe Bay, Oregon, from June 1978 through January 1982.

Reef	Number Tagged	Number Recaptured	Percent Recaptured
#1	3,789	72	1.90
#2	104	2	1.92
#3	66	0	0.00
#4	377	7	1.86
#5	1,145	7	0.61
#6	256	3	1.17
#7	59	0	0.00
#8	12	1	0.89
Total	5,908	92	1.56

*Refers to Figure 1 for location of reefs.

rockfish did not substantially differ between reefs except for Nelscott reef (#5).

Information on the number of tags returned is recorded by species in the appendix. A total of 114 black rockfish were recaptured with return information including five from releases of the previous study. The majority of the recaptures occurred at the original release site. Seven of the black rockfish were recovered at the site of release over two years later (Appendix Table 1). The longest interval between release and recovery at the original tagging site was 1,357 days. Significant movements (> 5 km) were demonstrated by 15.8% (18) of the tagged black rockfish recovered (Fig. 2). Because six tags were recovered at fish proceessing plants in Newport, Oregon, after receiving deliveries from trawlers, the return information on these recoveries was incomplete. However, since trawlers do not normally work near the release site, the movements of these fish were thought to be substantial.

The tags from 14 lingcod were returned. The longest interval between release and recapture at the orginal site was 311 days. Significant movements were exhibited by 43% (6) of the recaptures (Fig. 3). The longest migration was 442 km to the north and offshore by a lingcod released on Christmas Tree reef (#2) in February, 1980. This lingcod was recaptured 170 days later by a commercial trawler off Big Bank, Canada, in 73 m of water. Another lingcod, released on North Point reef, was recaptured 240 days later by a commercial trawler, which delivered the catch to a processing plant in Newport, Oregon. Personnel of the processing plant returned the tag. Since there is no trawler activity in the vicinity of North Point reef, this fish exhibited significant movement but the actual direction and distance were not determined.

Significant movements were indicated by 43% (3 of 7) of the recaptured yellowtail rockfish (Fig. 4). The four other recoveries occurred at or near the site of release. The longest period between release and recapture at the original site was 627 days.

Tags were recovered from 10 canary rockfish. One recovery was received from a charter office in Depoe Bay with no recovery information. Two canary rockfish were recaptured at or near the site of

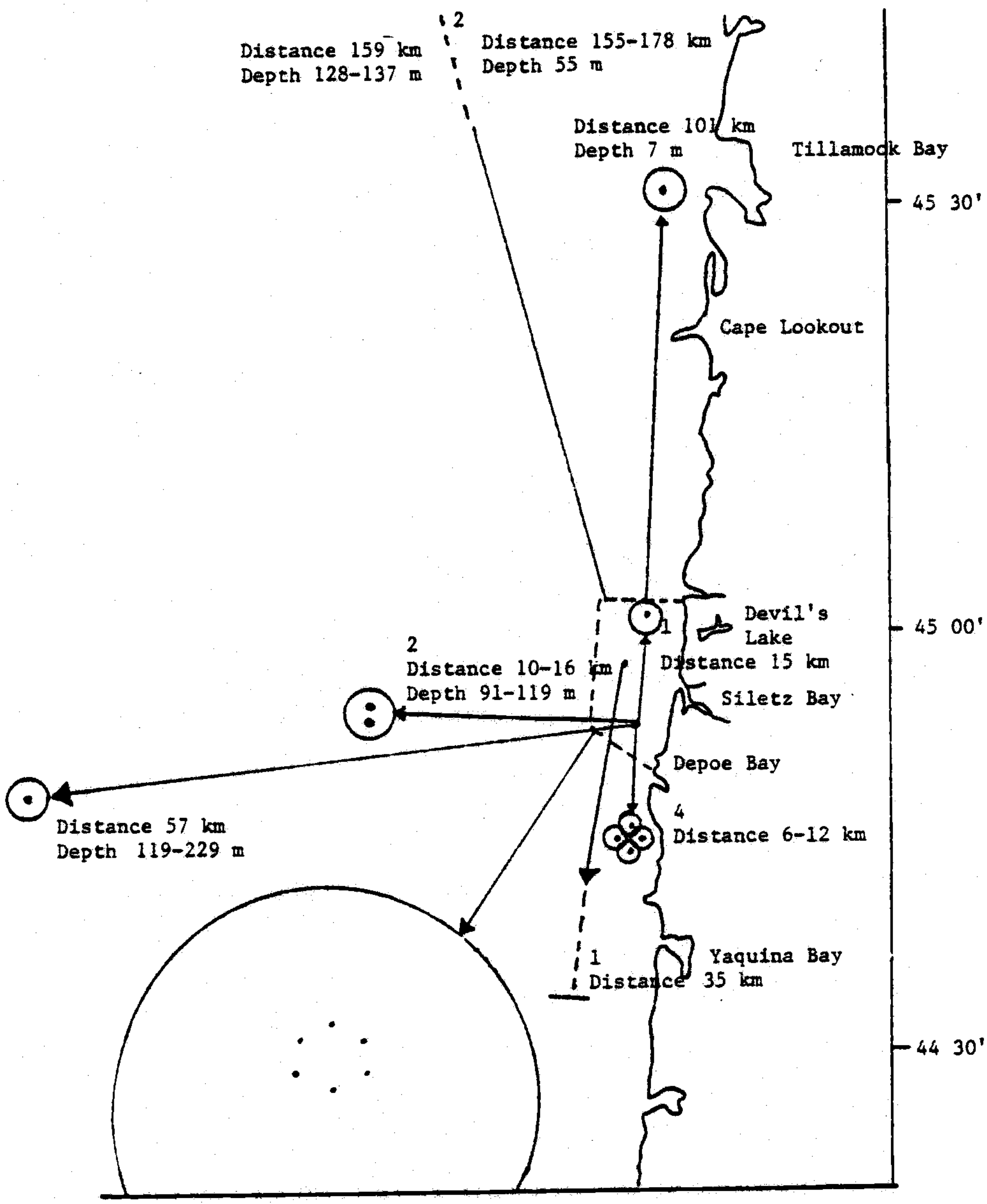

Figure 2. **Diagram representing general direction and extent of movements of black rockfish recaptured off the N.W. Pacific coast from June 1978 through January 1982. The dotted lines indicate that movement continued off the map. The large circle indicates the exact location was not known but the recapture site was likely to have been within the circumscribed area.**

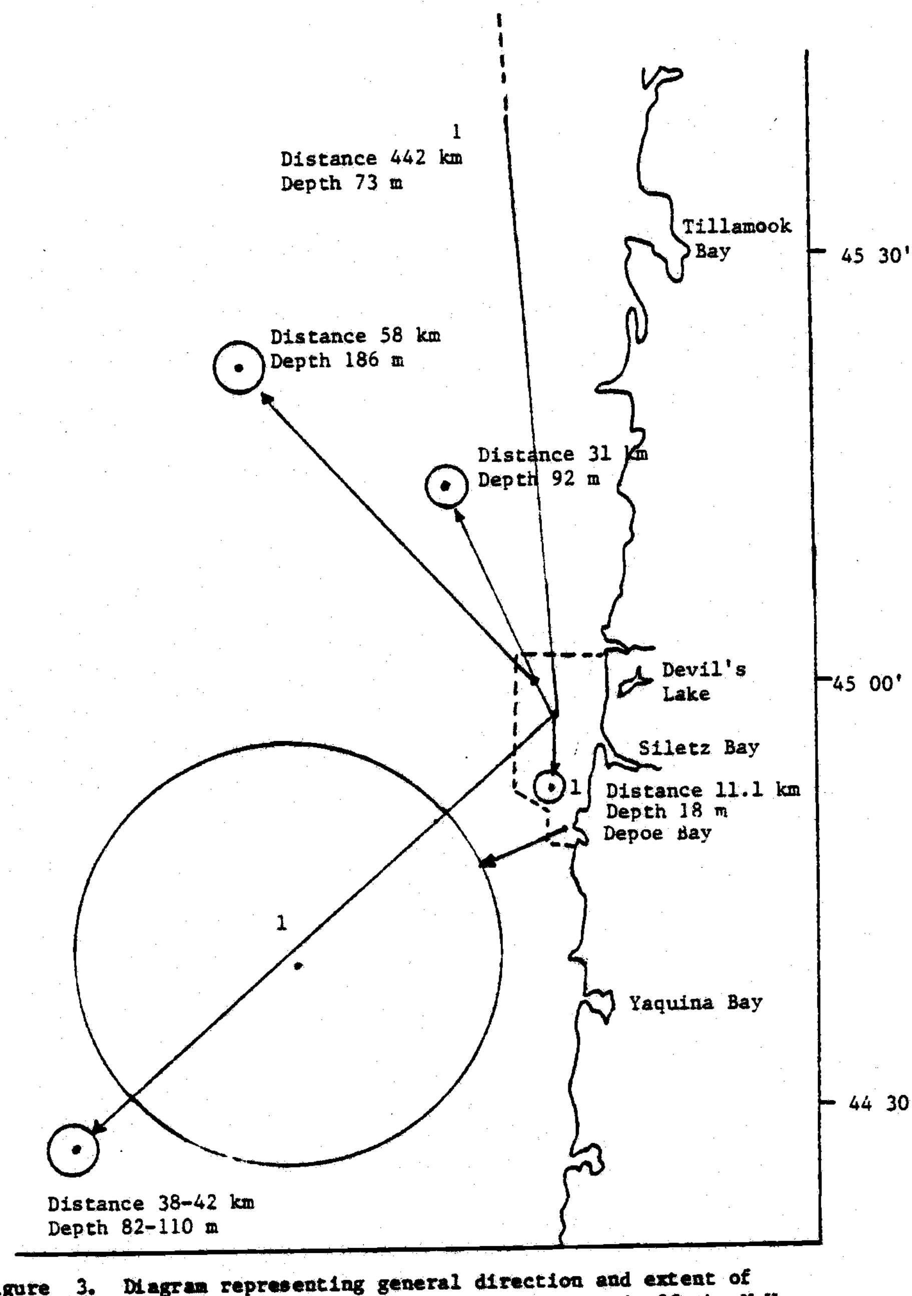

Figure 3. Diagram representing general direction and extent of detectable movements of lingcod recaptured off the N.W. Pacific coast from June 1978 through January 1982. The dotted line indicates that movement continued off the map. The large circle indicates the exact location was not known but the recapture site was likely to have been within the circumscribed area.

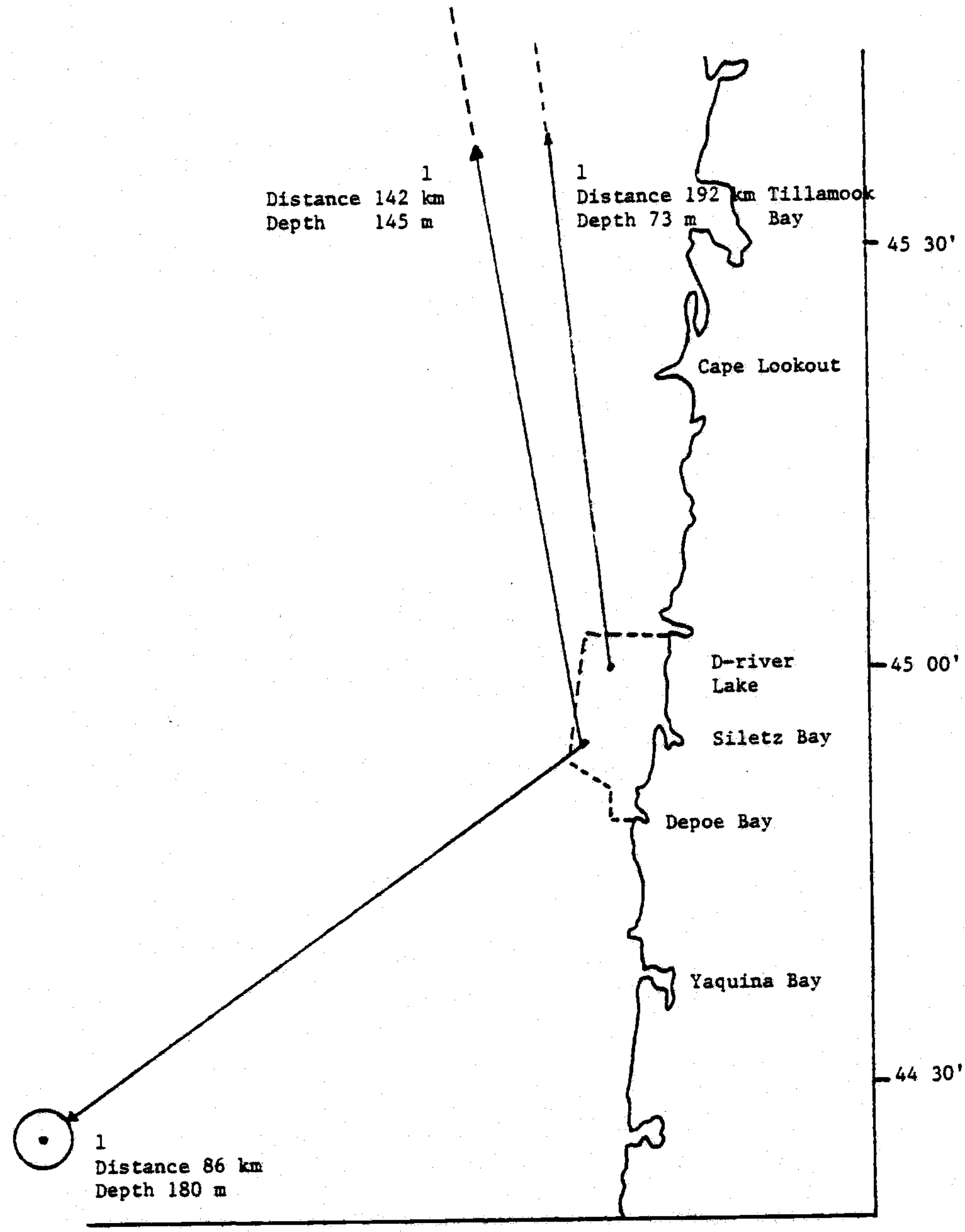

Figure 4. Diagram representing the general direction and extent of movements of yellowtail rockfish recaptured off the N.W. Pacific coast from June 1978 through January 1982. The dotted line indicates that movement continued off the map.

release after 335 and 445 days at liberty. Significant movement was indicated from the recaptures of seven (70%) canary rockfish (Fig. 5). The most extensive movement was 236 km south and offshore (depth 93 m) of the release site (Spanish Head #4). A commercial trawler recaptured this fish 775 days after release. The recovery site was not specifically determined on two returns. One fish was caught by a commercial trawler reportedly between Charleston and Newport, Oregon, 594 days after release. The other, released on Christmas Tree #2 in November, 1979, was landed in Newport in May, 1981, 530 days after release.

A total of five yelloweye rockfish was recaptured. These individuals exhibited no detectable movement. The longest period a yelloweye rockfish was at liberty was 739 days. No recaptures of tagged specimens occurred for other species of rockfish including blue rockfish, China rockfish. and cabezon.

A variety of fishing vessel types recaptured tagged reef fishes. A total of 96 (63.6%) were caught by the private and charter fishing fleet. Most of these returns occurred in the research area. Personnel on the research vessel, Tooshqua, recaptured 30 (19.9%) of the tagged reef fishes. Commercial trawlers and crabbers returned 24 (15.9%) and 1 (0.7%) of the recoveries, respectively. The returns from commercial vessels occurred outside the research area.

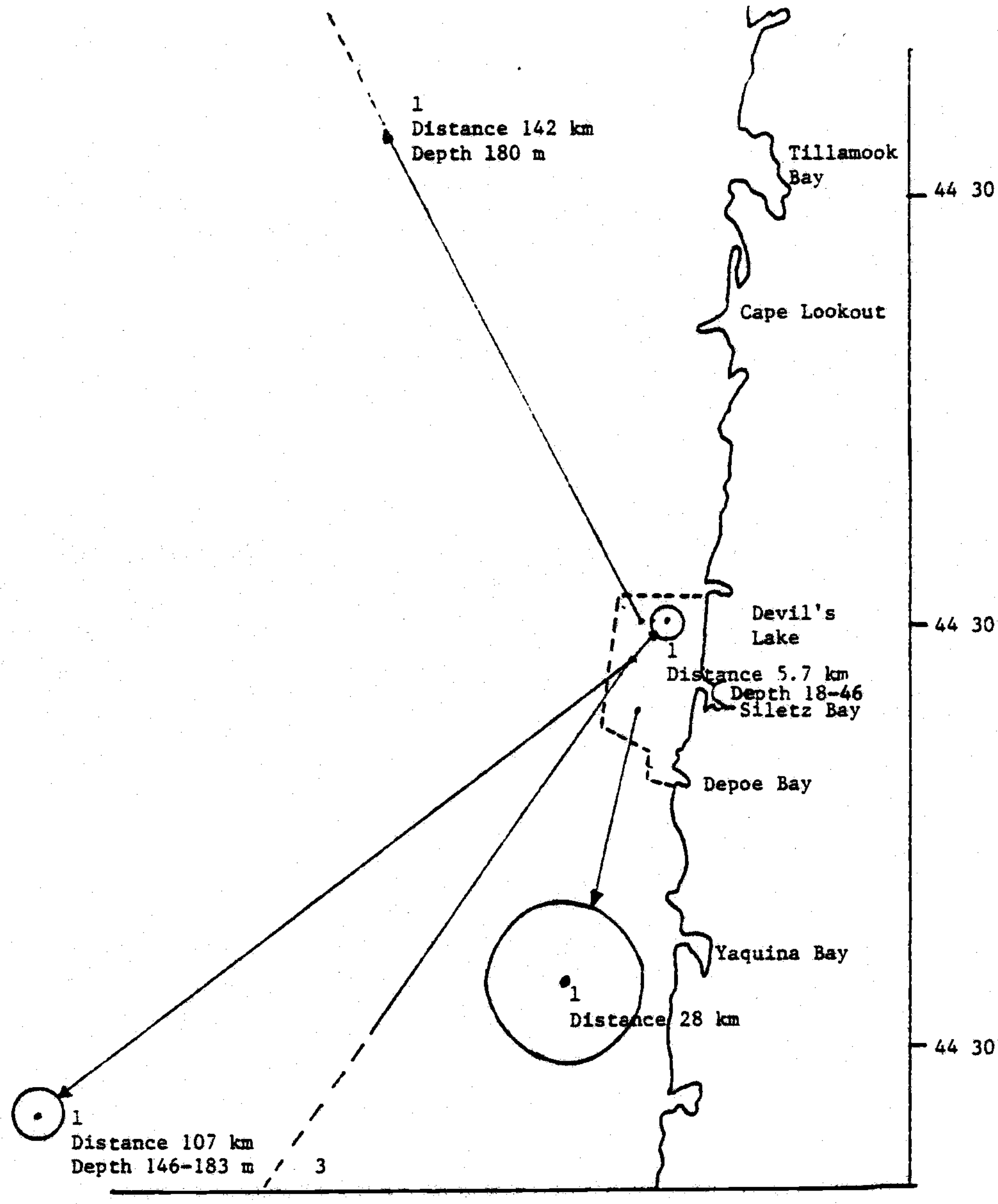

Figure 5. Diagram representing the general direction and extent of movements of canary rockfish recaptured off the N.W. Pacific coast from June 1978 through January 1982. The dotted line indicates that movement continued off the map. The large circle indicates the exact location of recapture was not known but was likely to have been within the cicumscribed area.

DISCUSSION

Tag Loss

The construction and strength of the tags was a concern, because the vinyl tubing occasionally separated from the nylon filament of tags even before the release of tagged fishes. Previous studies by Rawstron (1973) and Wilbur and Duchrow (1973) reported severe losses of the Floy FD-67, a similar tag. The high rate of tag loss was attributed to separation of the vinyl tubing from the nylon filament. However, Wilbur and Duchrow (ibid) found the Floy FD-68 to be much more dependable. During this study, in which the Floy FD-68 was used, I recaptured only one fish with just the nylon filament part of the tag remaining. A few other recoveries with this problem were reported by operators of charter vessels, but I was unable to confirm them. The small number of recoveries demonstrating this problem suggests that tag loss due to mechanical failure was insignificant.

Improper placement of the Floy FD-68 tag was another potential problem. Studies of small brook trout (*Salvelinus fontinalis*) by Keller (1971) and salmon (*Oncorhynchus* spp.) by Rawstron (1973) revealed that improper placement of the Floy tag was the cause of significant tag loss. The small pterygiophores on brook trout and salmon make the tags difficult to properly insert and lock behind the dorsal fin bases. However, improper insertion was probably not an important problem with rockfishes because they have much larger ptergiophores than brook trout or salmon. In addition, tags that were improperly inserted (Approx. 1 in 12) were often discovered when the tag was set. Improperly inserted tags often pulled out to the skin of the fish prior to release, and were replaced. Despite these precautions, tags that worked free of the pterygiophores or that were only embedded in the dorsal musculature probably were quickly shed.

A double tagging study evaluated the rate of tag loss. The low number of double tag recoveries made the following assumptions necessary: The rate of tag loss remained constant for different species and over each time period, and (2) the loss of one tag did not affect the probability that the second tag would be lost. The results in Table 4 indicate the tag at the dorsal position had a reasonably good probability of retention (0.66) over a term of 450 days. During the 450-900 day period, the rate of tag loss (0.57) was nearly double the rate of the first 450 days (0.34). The other tag at the operculum position had a significantly (X^2, $p < 0.005$) poorer probability of retention (0.06) than the tag at the dorsal position (0.28) over the 900-day period. Tag loss made recovery beyond 900 days unlikely for tags located at either tagging position.

In agreement with the double tagging study in the research area, aquarium observations indicated that the tag at the dorsal position was better than the tag at the operculum position (Table 5). The point of insertion of both tagging positions often became infected. Movement of the operculum caused the tag to move, aggravating and enlarging the wound at the point of insertion. When the entry wound had became large enough, the t-bar slipped through the insertion wound and the tag was lost. When the tag at the dorsal position was properly placed, this tag was securely "locked" behind the pterygiophores well within the fish. Infections at the point of insertion did not seem to affect the retention rate of tags placed at this position.

Long-term tag loss was probably increased by the growth of fouling organisms on the tags. Heavy growths of fouling animals, particuarly colonial tunicates, commonly occurred on tags of fishes at liberty for over a year. The tag of one black rockfish recovered 1,357 days after release had a massive growth of fouling animals, including numerous colonical tunicates, bryozoans, polychaete worms, and four barnacles. The additional weight and drag on tags from fouling animals probably increased the chances of the tags working free or breaking. The higher rate of tag loss during the 451 to 900-day period of the double tagging study was at least partially the result of the heavy growths of fouling animals on the tags.

Evidence suggests that tag loss was a major factor in reducing returns over the long term (> 2 years). Tag loss was probably not a major factor contributing to the low rate of return over the short term (< 1.3 years). The Floy FD-68C tag at the dorsal position yielded a good rate of retention for over a year. Since the Floy FD-68C tag at the operculum position had high rates of loss, this position is not recommended for tagging studies of neritic reef fishes.

Post Tagging Mortality

The activity at release and extent of air bladder inflation were assessed to determine if these factors affected rate of survival The results were inconclusive (Table 7) because most of the reef fishes were released in good condition. Only a small percentage of fishes that were released were punctured to deflate extended air-bladders. There were no indications that would suggest rates of mortality due to capture, handling, and tagging that would effect the overall rate of tag return.

Some mortalitites resulted from excessive bleeding that occurred when the gills of the fish were occasionally damaged by the tagging gun needle as the Floy tag was pushed through the operculum (< 2%). Damage from hooking also caused mortalities (< 2%). Some mortalities also resulted from rapid decompression when capture occurred in deep water (> 40 m) particularly for canary rockfish, black rockfish, blue rockfish, and yelloweye rockfish. When captured in deep water, these species often showed everted stomachs and/or bulging eyes and occasionally died before release. The swim bladders of canary rock-fish were punctured through the mouth. When the syringe was removed, the wound appeared to seal immediately. The recovery of four canary rockfish, some of which were very inactive shortly after release, indicated some of the releases of this species survived. Blue rock-fish and yelloweye rockfish were punctured through the side of the abdomen to release gases from the air bladder, because puncture through the mouth was ineffective. When rockfishes were punctured through the side, the wound did not immediately seal. Because gases continued to escape as the fishes dove, internal damage may have occurred to fishes punctured through the abdomen. While this method may have caused a high rate of mortality, the return of five yelloweye rockfish indicated some of the fishes punctured by this technique did survive.

Predation was a factor in the survival of tagged fish. One tagged black rockfish was recovered from the stomach of a lingcod 351 days after release. Smaller reef fishes (< 35 cm) still recovering from the stress of capture and handling were probably the most vulnerable to predation from large lingcod. Brightly colored tags may have attracted some predators but this hypothesis was not supported by observations in the Underseas Garden Aquarium. Also, because large lingcod are not common in the research area, the effect of predation on the return rate was probably insignificant.

Tag Reporting

This study relied on voluntary tag reporting. Paulik (1963) found that voluntary tag reporting may have particularly high levels of non-reporting and recommended a reward incentive. However, Evans (1957 in Butler, 1962) found that if the educational programs are well done and if fishermen are checked often, rewards may not be necessary. Because of the small harbor at Depoe Bay, I felt that the educational program would be effective in stimulating tag reporting in the research area.

Publicity outside the research area was very light. The publicity consisted of one informational article published in The Oregonian newspaper. However, this lack of publicity was compensated by cooperation from government agencies such as ODFW and the Washington Department of Fisheries. Publicity for their tagging programs attracted recoveries of tags from this study.

The use of conspicuous and easily recognized tags has been recommended to increase the rate of tag returns (Margetts, 1963; Templeman, 1963; Wise, 1963). For example, the tag reporting rate of the catch of saltwater boat anglers in Texas was only 28%, largely because an inconspicuous abdominal tag was used, which fisherman failed to find (Matlock, 1981). The tags for this study were colored bright orange, green, and yellow, and were located externally for easy detection and identification. As mentioned earlier, I found that the common occurrence of fouling animals on the tags greatly reduced the conspicuousness and recognizability of the tags. Several tags were discarded by fish cleaners who did not recognize the tags under the mass of fouling animals. This problem was partially corrected by direct communication with the local charter fishing personnel. However, most of the private sportfishermen in the local area and other persons outside the local area were not informed of this problem. The growth of fouling organisms on the tags also made the legends very difficult to read. Before the tags could be read, the fouling animals had to be carefully removed without damaging the legends. Two tags were recovered with the legends partially destroyed by secretions from these animals. For these reasons, the occurrence of fouling organisms on the tag contributed to tag loss by increasing the rate of non-reporting.

The rate of tag reporting by the charter fishing fleet was roughly measured by seeding the catch. The reporting rate of the tags that reached the dock undetected was estimated to be 71.4%. Clean tags were used to seed the catch. Therefore, the estimate does not reflect losses that may have resulted from the occurrence of fouling animals on the tags. The effect of the color of the tag was not investigated but was probably minimal for the tags returned through the charter fishing fleet. This rate most accurately represents the actual reporting rate during 1978 and 1979. During these years most of the tags were returned by fish cleaners on the docks.

The seeding of the catch was useful in evaluating patterns of tag reporting. Steps were then taken to improve tag reporting. During 1978-79, I observed that some fish cleaners were not reporting seeded tags. I contacted these individuals and instructed them on identification of tags and proper procedure in returning the tags. Some fish cleaners were not dependable. Carelessness and confusion on the docks also resulted in tag loss. Beginning in 1980, to avoid these problems, the charter skippers and deck hands removed most tags from fishes as soon as the tags were detected. Since fish cleaners returned tags not observed on the vessels, the tag reporting rate was probably even higher during the last 2 years than during the first two year of the study.

Sampling and spot-checking the catch of the charter fishing vessels indicated a high rate of tag reporting but only a rare occurrence of a tag recovery. The high rate of reporting was probably due to the following: considerable individual contact and instruction with charter personnel, generally good cooperation from charter personnel, and simple efficient methods to return recovered tags.

The rate of reporting from the private sportfishing catch was not assessed because I was unable to seed the catch without the knowledge of the sportfishermen. Spot-checking the sportfishing catch indicated that tags were being discarded. The rate of reporting by the sportfishing fleet was probably lower than the charter fleet for the following reasons. Because only a small percentage of the private sportfishermen were contacted and instructed on identifying and reporting tag recoveries, a significant number of sportfishermen were unaware of the study. The return of many of the tags by private sportfishermen involved writing a letter to OSU within a few days of reccapture. This method of returning a tag was often time consuming and burdensome, which probably contributed to non-reporting. The content of the letters from fishermen who returned tags indicated that these individual were interested in the study and the conservation of the reef fish resource. The impact of the lower rate of tag reporting by the sportfishing fleet was probably not significant. The private sportfishing effort was not as intense as the charter fishing effort, and spot-checking the catch reduced some of the losses.

The accuracy of the report of a tag recovery is critically important. Tags were recovered by personnel of several kinds of vessels including trawlers, crabbers, private sportboats, and charter vessels. The recapture site was usually accurately reported by persons from all vessel types except trawlers. The accuracy of return information from persons involved with handling and processing catches from trawling vessels was a problem. The fishermen on trawlers were usually not able to identify tags at the time of capture, because of the large number of fishes involved in each catch. In a few instances the tags were discovered immediately upon capture by the fishermen, and returned with an accurate report of the site of recovery.

However, usually personnel in the processing plant usually recovered the tags while filleting the fish.

Margetts (1963) recommended treating tag returns with caution when the locality of capture is reported by persons other than the fishermen. The tags could be reported from the wrong ship or the wrong day, which could yield misleading results. Many locations of recapture were determined by ODFW personnel who received the tags from personnel at the processing plant. The recapture site was determined from location of the catch in the ship's log book on the day or day before the reported delivery at the processing plant. This procedure was the best one available. However, some of the reports are probably inaccurate. For example, returns of two black rockfish reported directly offshore in this thesis were originally reported off the northern Washington coast. By rechecking the log books of the vessel, I learned that the day before the catch was processed, the vessel was used to trawl for groundfish directly off Government Point Inshore (#1). After unloading, the vessel was moved to northern Washington where the crew began to trawl for shrimp. Because it was difficult to accurately determine the location of a recapture reported from a trawler when the tag was recovered in a processing plant, the distance and direction reported for recaptures from trawling vessels may be misleading. However, most of these recaptures probably do indicate substantial movement because very little trawling activity was observed in the vicinity of the release sites.

Low tag return rates have plagued tagging studies of neritic reef fishes of the Pacific Northwest. The results of my studies of tag loss did not indicate any major inefficiencies in the tagging study. The rates of tag reporting and tag retention were comparable to other successful tagging studies of similar species. The study of post-tagging mortality was inconclusive. While improvement in each of these areas would be useful, the results of this study provide no easy answers for increasing tag return rates in studies of neritic reef fishes.

Biological Implications

Black Rockfish

The recoveries of 86% of the tagged black rockfish showed no appreciable movement. Year around residency of the species was indicated by recoveries of tagged black rockfish throughout the year. Seven of the recoveries occurred at the original site of release over two years later. These results indicate that most recaptured black rockfish remained in the local area and demonstrated very little movement or migration.

Because the percentage of recovered tags is a measure of movement only when the directed fishing effort is constant between recovery areas (Golden et al., 1979), the difference between the resident and detectable movement recovery percentages may not be an accurate indication of the actual amount of stock movement. The reporting rates and fishing efforts probably vary considerably between the research and non-research areas. A very light fishing effort occurred north of the research area for a substantial distance. The port of Garibaldi, about 50 km to the north, is the first area having significant fishing effort. Significant fishing effort occurred just south of the research area from the port of Newport, Oregon. Because the chance of long distance movement increases with time, increasing tag loss over time should result in a bias against long distance recoveries. Moreover, the actual effect on the return rate of tagged fish that are moving and mixing with other stocks of fish is not known. Mixing and dispersing tagged fish with other stocks, particularly into areas of reduced fishing effort, may have reduced the number of returns by reducing the probability of recapture. In addition, the return rate was only 1.84%. For these reasons, the movement and migration of black rockfish may have been significantly underestimated by this tagging study.

The extent of the movement of individual black rockfish may indicate stock movement. Movements of black rockfish occurred north, south, and offshore of the release sites. Two black rockfish moved distances of over 155 km north and offshore of the release site. Another moved over 100 km north of the release site. Six moved significant distances south and offshore. In addition, three black rockfish were recaptured offshore of the release site in much deeper water. The offshore movements suggest the possibility of seasonal offshore movements to spawn (Dunn and Hitz, 1969) or to avoid poorer conditions in shallow water during the winter months (Love, 1980).

The small differences in the return rate from reef area to reef area (Table 10) suggest mixing of the stocks of black rockfish. If black rockfish were sedentary, distinct differences in the return rates would be expected due to variation in fishing effort among specific reef sites. For example, I tagged large numbers of black rockfish on Government Point Inshore (#1) at a specific site on the north side of the reef, and also at Government Point Offshore (#8) (only 112 were tagged) but the site is very small. These areas were fished heavily, but an elevated return rate was not observed. Because of the complex evidence of residency and movements, and the lack of information on fishing effort, the actual amount of stock movement could not be determined.

The high number tagged (5,908) and the low tag return rate (1.84%) indicate that black rockfish were abundant in the research area. Large schools of black rockfish were commonly observed feeding near the surface. During these feeding periods, large catches occurred over relatively short periods of time.

Lingcod

Eight lingcod (57%) were recovered at the release site. The longest period of liberty at the release site was 311 days. This evidence supports the contention that some lingcod are localized (Chatwin, 1956; Phillips, 1959; Bargmann, 1982). Six other lingcod (43%) demonstrated significant movements. Five of these recoveries indicated movement between neritic and offshore reefs. Because very few lingcod were tagged during the winter because of poor weather conditions, this study can not be used to evaluate the contention that individuals of the offshore stock may move to the neritic reefs to spawn and then return offshore. Although, tagging studies have not been able to confirm seasonal nearshore-offshore migrations of lingcod, this contention has been supported by evidence of changes in sex ratios and sizes of lingcod by seasons and depth (Miller and Geibel, 1973).

A tagging study of lingcod off Newport, Oregon, found very limited movement of neritic reefs and very little nearshore-offshore interchange (Golden et al., 1979). The results of this study suggest that some nearshore-offshore interchange occurs. Due to the small sample size of both neritic reef tagging studies, differences between the two studies may be more apparent than real. The study in offshore waters from Newport, Oregon, was not likely to succeed in detecting offshore-nearshore interchange. The nearshore fishing effort is very light during the winter months because of rough seas and light sport-fishing interest. Thus, the probability of catching a sufficient number of tagged lingcod to indicate inshore movement is very unlikely. Future tagging studies of lingcod that attempt to verify seasonal migrations will have to provide large numbers of tagged lingcod during the spawning season on neritic areas. If an offshore migration occurs, significant numbers of recaptures from nearshore releases may be obtained in offshore waters because of the intensity of the fishing pressure from commercial trawlers.

Yelloweye Rockfish

Local residency of yelloweye rockfish was suggested by the recovery of five individuals at their respective sites of release and the complete absence of recoveries elsewhere. The results of an earlier study by Coombs (1979) in this study area also provided evidence for local residency of yelloweye rockfish. She reported a high rate of return (22%) and that all (7) the recaptures occurred at the original site.

The return rate of yelloweye rockfish for this study was only 2.4%. The substantial differences in the return rates of the two studies may have been due to the following reasons. The rate of mortality may have been different for the two studies. Coombs (1979) captured the yelloweye rockfish on a moderately deep reef (33 m) and released them by lowering them towards the bottom in a trap. I captured yelloweye rockfish on many generally deep reef areas (30-55 m) and released the fish on the surface after deflating the air-bladder by the puncture technique. If the puncture technique was not effective, a high rate of morality may have occurred. A major difference in the fishing effort of the two studies may be a more likely explanation for the substantial difference in the return rate. During the study by Coombs (1979), a large buoy marking a fish trap was located on the reef where the high return rate of yelloweye rockfish occurred. Charter boat captains advised me that the buoy was often used as a marker for the reef. The buoy probably artificially increased the fishing effort on this reef. During my study, yelloweye rockfish were released over many different reef areas. These reefs were small and difficult to relocate until 1980, when Loran C was introduced. With a Loran C, a vessel can relocate specific sites consistently. All of the recoveries of yelloweye rockfish for this study occurred after the introduction of this instrument.

The Loran C will have an important impact on the yelloweye rockfish stocks by effectively increasing the fishing intensity on specific reef sites. The results of the previous study (Coombs 1979) demonstrated that stocks of yelloweye rockfish can be heavily exploited when the specific site can easily be relocated. During 1981, radical decreases in the catch of yelloweye rockfish occurred at specific reef sites on my charterfishing vessel after repeated return trips (3-7). Typically, the catch ranges from 5-15 yelloweye rockfish per trip on newly discovered reef sites, and later decreases to a constant catch of zero after repeated visits to the site. In addition, while searching the "depleted" reef site for fish, recordings on a graphic fish finder on my vessel indicate that few or no large fish remain at the site. These experiences along with the results of the previous study by Coombs (1979) suggest that this species rapidly becomes depleted at specific sites from intensive fishing pressure.

The yelloweye rockfish is a highly prized reef fish because of its bright orange color, large size (commonly 10-20 lb), and reputation as a high quality food fish. In the future, this species will likely become a rare component of the catch because of intensive and increasingly effective sportfishing efforts. Conservation measures that might protect this species are likely to be ineffective for the following reasons. Releasing this species results in excessive mortalitites unless special precautions are taken to deal with the problem of extended air bladders. And, because this species is already a relatively small percentage of the catch, only unrealistic reductions in the total catch limit would offer further protection. In addition, the recovery of a locally depressed stock of yelloweye rockfish may take many years. Recent age studies off Depoe Bay, Oregon, indicate that many adult yelloweye rockfish captured by sportfishermen are old, commonly between 12 and 20 years of age (McClure, 1982).

Yellowtail Rockfish

Residency of some yellowtail rockfish was evident by the recapture of four individuals at the original release site. However, three other recaptures occurred significant distances from their release sites. Two were released on the same day at Government Point (#8). One moved 192 km north and offshore. The other moved 86 km south and offshore. In addition, one yellowtail rockfish, released on Spanish Head in June, was recaptured by a commercial trawler 558 days later 143 km north and offshore (145 m) of the release site. These movements may have been initiated by displacement during the tagging operation. Otherwise, these recaptures demonstrated movement of individuals of this species.

The results of a study by Carlson and Haight (1972) indicated that yellowtail rockfish were resident at specific sites. The return rate was high (22%) and no returns occurred elsewhere (fishing effort was suggested to be random). Displaced individuals were recaptured at the original site indicating a homing instinct. The results of my study indicate that yellowtail rockfish off the central Oregon coast may not display this type of behavior. Differences in the habitat of the two areas may have caused the apparent differences in behavior.

Canary Rockfish

A total of 10 tagged canary rockfish were recovered. Three of the recoveries occurred in the vicinity of the release site after being at liberty 335, 425, and 615 days. The seven other recoveries (70%) demonstrated movement. One significant movement was 142 km north and offshore of the release site. The greatest movement was 236 km south and offshore. The results suggest mixing of the nearshore-offshore stocks. Comparison of the age and length of canary rockfish in the research area support this contention. A substantial amount of variation in observed age-length relationships was found in samples of canary rockfish taken in a concurrent study (McClure, 1982). Variation in the observed length of canary rockfish of the same age captured in the same area suggested that individuals had originally come from other habitats with different food resources. Other species of rockfish did not show this variation.

Other Species

No tag returns occurred from any other species of tagged reef fishes including blue rockfish, China rockfish, and cabezon. The small number of releases for all of these species, except blue rockfish, probably accounts for the absence of recoveries. The blue rockfish accounted for 10% of all the releases. Their return rate (0 of 859) was significantly different ($P < 0.005$) from the return rate of the other species except cabezon and China rockfish. A high mortality rate due to the effects of rapid decompression, and gear selectivity for other species may have been factors partially responsible for the absence of returns. Schools of blue rockfish were usually located in midwater. Fishermen on sportfishing vessels used lead jigs or bait fished along the bottom. This fishing technique would be ineffective in catching blue rockfish because the gear was selective for other larger species on the bottom and usually passed well under the schools of blue rockfish. Blue rockfish represented only 3% of the total sport catch from 1976-78 (Coombs, 1979). However, neither of these explanations seems adequate because 55% of the releases occurred on a shallow reef, Government Point #1, where these explanations would not have as great an effect. Another unknown factor may be responsible.

The low return rate of blue rockfish suggests that this species is presently underutilized or that their survival rate was poor. In the future this species may become more important to the overall rockfish catch. In 1981, charter vessels modified their fishing gear and techniques to utilize schooling species of reef fishes more efficiently.

CONCLUSION

Low tag return rates, and difficulties in capturing, tagging, and successfully releasing reef fishes have hindered the collection of useful information. Our understanding of these fishes is limited by the efforts and costs required to individually capture and tag large numbers of specimens. However, despite the problem of drawing conclusions from modest numbers of tag returns, the results of my study, along with the results of the previous study of Coombs (1979), provide important information on movements of neritic reef fishes that should be helpful in managing this resource.

As one of the most highly prized reef fishes, the movements and population structure of the yelloweye rockfish are of special interest. Analysis of tag returns from this study and the previous study by Coombs (1979) indicates that the population structure of yelloweye rockfish off central Oregon is characterized by local, sedentary stocks.

In contrast to the results from yelloweye rockfish, the analysis of tag returns of black rockfish, lingcod, yellowtail rockfish, and canary rockfish suggest that more movement of these species occurs than was previously suspected. Some individuals of each of these species are resident while others undergo significant movements. Substantial neritic-offshore mixing of canary rockfish was indicated by tag returns and supported by the results of a concurrent age-length study (McClure, 1982). The amount of movement and mixing of stocks of the population of each of these species could not be quantified for several reasons. Only limited numbers of tag returns of each species occurred. In addition, the percentage of recaptures that exhibited movement may not accurately indicate stock movement, because the effect of bias caused by tag loss and variances in fishing effort among different fishing areas could not be measured.

Since the results of this study indicate more movement and mixing of the stocks of species of reef fishes than was originally suspected, this fishery can best be managed by catch limits of combined species of rockfish on a statewide basis. Because of the biological problem of extended gas bladders on rockfish caught and released on deeper reefs, and the education problem of teaching sportfishermen to identify rockfish by species; catch limits by species would be impractical and ineffective for rockfishes. Other species of reef fishes including lingcod and cabezon could effectively be regulated separately because these species are easily identified by sportfishermen and have no biological problems that prevents their safe release after capture.

This fishery resource is now managed as a food resource. Liberal limits are in effect (15 rockfish and 3 lingcod). The low rate of tag returns of this study suggests a light rate of exploitation and a healthy reef fish resource off Depoe Bay, Oregon. However, the effect of sport fishing on the neritic reef fishery is not well understood because only limited biological information has been obtained on reproduction, age structure, recruitment, growth rates, interaction between species, and movements of juveniles and adults. Increasing fishing effort was documented from 1976-78 off Depoe Bay, Oregon, by Coombs (1979). Shortened seasons and bag limits on salmon will further intensify the fishing effort on these stocks of rockfish. Another major concern is increasingly effective fishing efforts. Since 1980, advances in fishing gear and techniques have substantially increased the efficiency of many charter vessels (average catches have increased as much as 2-3 times above previous years). The current rate of exploitation by charter vessels seems to be maintained by constant searching and locating of new unexploited reef sites, and by recent changes in fishing gear to target on schooling species of reef fishes, rather than by recruitment and growth of exploited populations. Management goals are usually aimed at sustaining yields through a balance between recruitment and fishing mortality of exploited stocks. For these reasons, I do not believe the current yield can be sustained. Because of the effects of an intensive fishery on a multiple species resource, I expect the species composition of the catch to become less diverse with some previously heavily exploited species becoming a rare component of the catch. If liberal limits are to remain in effect, I recommend close monitoring of the catch, particularly mean size per species by reef area. The collection of biological evidence that will warn of a coming depression in the fishery will require much effort and money, both of which may become difficult to obtain in the near future. Because of the slow growing, long-lived and low reproductive capability of reef fishes (McClure, 1982), the recovery of a depressed reef fishery would take many years.

For the reasons mentioned above, I recommend that the resource be managed to maintain a quality experience for sportfishermen. The capture of several kinds and sizes of reef fishes is needed to have a quality fishing experience. A reduction in catch limit to a more conservative level (10 reef fishes including 2 lingcod) will maintain the quality of the experience by reducing the chance of overexploitation of the resource and by helping to maintain a healthy, diverse reef fish community. The fishing effort on the reef fish resource could also be effectively reduced without affecting the quality of the experience by restricting the number of terminal hooks on the sportfishing gear (from 3 to 2 or even 1). The enactment of conservative regulations now may prevent the necessity for extreme regulations in the future to protect a depressed resource.

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Appendix 1. Date and location where reef fishes were tagged and recaptured along the N.W. Pacific coast from June 1978 through January 1982.

Species	Date & site released	Date & site recaptured	Distance moved (km)	Days at liberty	Tag no. dorsal	Tag no. operculum	Size (TL) (cm)
Black	06/13/80 Govt.Pt.	06/13/80 Govt.Pt.	0	3 hrs	12492	13531	40
Black	06/06/80 N.Govt.Pt.	06/15/80 N.Govt.Pt.	0	9	11863	-- *	40
Black	08/27/79 D-river	09/07/79 D-river	0	12	08611	--	48
Black	08/01/79 Govt.Pt.#8	08/14/79 Otter Crest	7.4-8.3 South	13	14837	13842	53
Black	06/22/78 Govt.Pt.	07/16/78 Govt. Pt.	0	24	02210	05167	44
Black	04/26/79 Govt.Pt.	05/21/79 Govt.Pt.	0	25	03868	07021	46
Black	05/03/79 Govt.Pt.	05/31/79 Govt.Pt.	0	28	04118	07174	40
Black	06/06/79 Govt.Pt.	07/09/79 Govt.Pt.	0	33	04921	07609	45
Black	06/06/80 N.Govt.Pt.	07/10/80 N.Govt.Pt.	0	34	11800	13202	37
Black	09/05/78 Govt.Pt.	10/15/78 Govt.Pt.	0	40	--	06043	35
Black	05/10/79 Govt.Pt.	06/23/79 Govt.Pt.	0	44	04255	07310	44
Black	05/03/79 Govt.Pt.	06/18/79 Govt.Pt.	0	46	04142 lost	07193	46
Black	05/15/79 Govt.Pt.	7/12/79 Govt.Pt.	0	58	04314	--	41
Black	06/23/79 Nelscott	08/22/79 Nelscott	0	61	--	07897	--
Black	06/21/78 Govt.Pt.	08/20/78 Govt.Pt.	0	61	02189	05751 lost	--
Black	10/31/79 Govt.Pt.	03/02/80 Govt.Pt.	0	62	09587	--	43
Black	06/21/78 Govt.Pt.	08/21/78 Govt.Pt.	0	62	02179	05760	42
Black	06/24/78 Govt.Pt.	09/05/80 Govt.Pt.	0	74	02285	05271	45
Black	07/23/80 Govt.Pt.#8	10/07/80 off Newport	Significant S. & Offshore	76	14740	-	47
Black	05/17/79 Govt.Pt.	08/07/79 Govt.Pt.	0	82	04386	07406 lost	36

Appendix 1. Continued

Species	Date & site released	Date & site recaptured	Distance moved (km)	Days at liberty	Tag no. dorsal	Tag no. operculum	Size (TL) (cm)
Black	09/13/78 Govt.Pt.	12/04-79 off Newport	Significant S. & Offshore	83	--	06164	45
Black	07/08/78 Govt.Pt.	09/30/78 Govt.Pt.	0	84	02520	05534	43
Black	05/22/79 Govt.Pt.	08/20/79 Govt.Pt.	0	90	04400	07383	37
Black	05/13/79 Govt.Pt.	08/21/79 Govt.Pt.	0	100	04279	07328 lost	35
Black	06/02/79 Govt.Pt.	09/27/79 Govt.Pt.	0	117	--	07571	36
Black	05/07/80 Nelscott	09/04/80 Nelscott	0	120	11287	--	36
Black	05/17/79 Nelscott	09/22/79 Nelscott	0	128	04350	--	36
Black	09/27/79 Govt.Pt.	02/26/80 Govt.Pt.	0	152	09074	--	50
Black	09/27/79 Govt.Pt.	03/08/80 Govt.Pt.	0	163	09182	10651	42
Black	05/03/79 Govt.Pt.	10/16/79 off Govt.Pt. Depth 91-119 m	10-16.6 West	166	04185	--	35
Black	11/10/79 Govt.Pt.	05/01/80 Off Astoria Depth 55 m	155-178 North & Offshore	173	09804	10912 lost	43
Black	03/25/79 Span.Head	09/15/79 Span.Head	0	174	03528	--	45
Black	04/01/79 Govt.Pt.	10/11/79 Govt.Pt.	0	193	03595	--	48
Black	10/07/78 Span.Head	05/18/79 Span.Head	0	223	--	06361	--
Black	09/27/79 Govt.Pt.	05/28/80 Govt.Pt.	0	224	09096	10586	41
Black	09/20/78 Govt.Pt.	05/22/79 Govt.Pt.	0	232	--	06204	40
Black	10/19/78 Span.Head	06/12/79 Span.Head	0	238	03072	06629	41
Black	09/20/78 Govt.Pt.	05/03/79 Govt.Pt.	0	245	--	06183	44
Black	09/11/79 N.Govt.Pt.	06/06/80 N.Govt.Pt.	0	269	08841 lost	10383	48
Black	07/04/78 Govt.Pt.	04/01/79 Govt.Pt.	0	271	02439 lost	05443	41

Appendix 1. Continued

Species	Date & site released	Date & site recaptured	Distance moved (km)	Days at liberty	Tag no. dorsal	Tag no. operculum	Size (TL) (cm)
Black	08/22/78 Govt.Pt.	05/03/79 Govt.Pt.	0	274	02880 lost	05872	43
Black	08/10/78 Govt.Pt.	05/27/79 Govt.Pt.	0	281	02787	--	43
Black	08/02/80 Govt.Pt.#8	05/19/81 Govt.Pt.#8	0	290	14869	--	48
Black	03/15/77 Govt.Pt.	07/01/30 N.of Columbia Depth 128-137 m	159 North & Offshore	291	01868	--	38
Black	07/04/78 Govt.Pt.	04/29/79 D-River	15 North	300	02410	05417	--
Black	07/13/78 Govt.Pt.	05/10/79 Govt.Pt.	0	301	02631 lost	05580	47
Black	07/04/78 Govt.Pt.	05/01/79 Govt.Pt.	0	302	02422	05425	--
Black	10/19/78 Nelscott	08/19/79 Nelscott	0	304	03111	06643	47
Black	07/04/78 Govt.Pt.	05/16/79 Govt.Pt.	0	317	02411	05418	--
Black	06/15/80 Govt.Pt.	05/01/80 Landed in Newport	Significant South + offshore?	320	12627	--	37
Black	06/17/78 Govt.Pt.	05/03/79 Govt.Pt.	0	321	02144	05153	47
Black	07/13/80 Span.Head	05/30/81 Span.Head	0	321	14353	--	37
Black	07/04/78 Govt.Pt.	05/26/79 Govt.Pt.	0	327	02425	05428 lost	--
Black	09/19/78 D-River	08/15/79 D-River	0	329	--	06116	39
Black	Winter/77 Yaquina Bay	11/30/79 Off Newport	Unknown	330?	01681	--	36
Black	10/19/78 Span.Head	09/15/79 Span.Head	0	331	03075	06632	52
Black	07/04/78 Govt.Pt.	05/31/79 Govt.Pt.	0	332	02382	05389 lost	--
Black	09/06/78 D-River	08/08/79 D-River	0	333	--	06059	47
Black	07/08/80 N.Govt.Pt.	06/13/81 N.Govt.Pt.	0	340	14095	--	38
Black	07/06/78 Govt.Pt.	06/21/79 Govt.Pt.	0	349	02495	05503	--

Appendix 1. Continued

Species	Date & site released	Date & site recaptured	Distance moved (km)	Days at liberty	Tag no. dorsal	Tag no. operculum	Size (TL) (cm)
Black	10/10/79 Govt.Pt.	09/25/80 Govt.Pt.	0	351	09404	--	33
Black	07/13/79 Govt.Pt.	06/10/79 Govt.Pt.	0	351	02659	05661	41
Black	09/07/78 Govt.Pt.	09/01/79 Govt.Pt.	0	359	--	06136	38
Black	06/24/78 Govt.Pt.	06/18/79 Govt.Pt.	0	359	02299	05285 lost	41
Black	06/07/80 Govt.Pt.	06/04/81 Govt.Pt.	0	362	11579	13325 lost	37
Black	08/23/79 Nelscott	08/30/81 Nelscott	0	373	08344	10206 lost	43
Black	05/31/79 Govt.Pt.	06/14/80 Govt.Pt.	0	381	04884	07553 lost	40
Black	06/06/80 N.Govt.Pt.	06/24/81 N.Govt.Pt.	0	383	11770	13290	40
Black	04/26/79 Christmas T.	05/15/80 Christmas T.	0	385	03849	07014 lost	43
Black	05/25/79 Govt.Pt.	06/16/80 Govt.Pt.	0	388	04699	07447 lost	39
Black	09/12/80 Govt.Pt.	10/11/81 Govt.Pt.	0	393	14937	--	--
Black	04/25/79 Govt.Pt.	05/27/80 Govt.Pt.	0	398	03839	07008	34
Black	05/03/79 Govt.Pt.	06/05/80 Govt.Pt.	0	399	04109	07169	44
Black	06/06/80 N.Govt.Pt.	07/10/81 N.Govt.Pt.	0	399	11906	--	36
Black	05/22/79 Govt.Pt.	06/26/80 Gull Rock	11 South	401	04408	07391 lost	41
Black	05/03/79 Govt.Pt.	06/07/80 Govt.Pt.	0	401	04101	07161 lost	43
Black	05/03/79 Govt.Pt.	06/07/80 Govt.Pt.	0	401	04067	07152 lost	43
Black	05/03/79 Govt.Pt.	06/13/80 Govt.Pt.	0	407	04062	07123	41
Black	05/17/79 Nelscott	06/29/80 Nelscott	0	409	04359	-	47
Black	05/03/79 Govt.Pt.	06/16/80 Govt.Pt.	0	410	04045	07148 lost	46
Black	05/03/79 Govt.Pt.	06/16/80 Govt.Pt.	0	410	04063	07124 lost	43

Appendix 1. Continued

Species	Date & site released	Date & site recaptured	Distance moved (km)	Days at liberty	Tag no. dorsal	Tag no. operculum	Size (TL) (cm)
Black	05/01/79 Govt.Pt.	07/06/80 Govt.Pt.	0	432	03973	--	49
Black	06/07/79 Govt.Pt.	08/15/80 Govt.Pt.	0	435	04933	07701 lost	35
Black	07/22/78 Govt.Pt.	10/16/79 Off Govt.Pt. Depth 92-119 m	10-16 West	451	02748	--	31
Black	06/24/78 Govt.Pt.	09/25/79 Govt.Pt.	Significant South + Offshore	458	02310	05297 lost	42
Black	06/24/78 Govt.Pt.	10/06/79 Govt.Pt.	0	464	02313 lost	05300	36
Black	03/09/80 Govt.Pt.	06/18/81 Govt.Pt.	0	466	11119	--	36
Black	10/23/78 Govt.Pt.	02/05/80 Beverly Beach	12 South	471	03200	06671 lost	46
Black	04/25/79 Govt.Pt.	08/12/80 Rocky Creek	6 South	475	03828	07000 lost	50
Black	05/05/80 Govt.Pt.	08/29/81 Govt.Pt.	0	481	11224	13016 lost	40
Black	11/10/79 Govt.Pt.	05/31/81 Govt.Pt.	0	567	09822	--	31
Black	08/10/79 Govt.Pt.	03/01/80 Govt.Pt.	0	569	02792	--	43
Black	09/12/79 Nelscott	05/18/81 Nelscott	0	614	08907	10409 lost	44
Black	09/11/79 N.Govt.Pt.	05/18/81 N.Govt.Pt.	0	615	08837	10382 lost	46
Black	07/13/78 Govt.Pt.	03/24/80 Govt.Pt.	0	620	02617	05642	44
Black	09/20/78 Govt.Pt.	06/07/80 Govt.Pt.	0	626	--	06188	42
Black	11/07/79 Christmas Tree	08/01/81 N.Govt.Pt.	0-1	632	09633	--	32
Black	08/10/78 Govt.Pt.	05/17/80 Govt.Pt.	0	645	02786	--	42
Black	10/02/78 Govt.Pt.	07/19/80 Govt.Pt.	0	656	00260	--	36
Black	07/08/78 Govt.Pt.	05/28/80 Govt.Pt.	0	660	02540	05548 lost	38
Black	10/10/79 Govt.Pt.	08/04/81 Off Tillamook rock Depth 7 m	101 North	664	09423	--	36

Appendix 1. Continued

Species	Date & site released	Date & site recaptured	Distance moved (km)	Days at liberty	Tag no. dorsal	Tag no. operculum	Size (TL) (cm)
Black	08/17/77 Govt.Pt.	05/03/79 Govt.Pt.	0	686	00663	--	44
Black	09/24/79 Span.Head	09/10/81 Landed in Newport	Significant South + offshore?	706	08952	10502 lost	41
Black	07/12/79 Span.Head	08/25/81 Span.Head	0	713	08823	--	32
Black	08/18/79 Span.Head	08/1-6/81 Off Newport	35 South	715	--	10026	36
Black	07/08/78 Govt.Pt.	07/06/80 Govt.Pt.	0	729	02535	05543 lost	44
Black	08/24/79 Span.Head	08/31/81 Siletz	0-1	738	08396	10251 lost	41
Black	05/10/79 Govt.Pt.	05/31/81 Govt.Pt.	0	752	04252	07308 lost	46
Black	04/01/79 Govt.Pt.	05/24/81 Govt.Pt.	0	784	03617	--	35
Black	07/19/77 Govt.Pt.	09/15/79 Govt.Pt.	0	788	00957	--	45
Black	10/18/78 Govt.Pt.	04/01/81 Govt.Pt.	0	895	03035 lost	06498	40
Black	07/22/78 Govt.Pt.	01/05/81 Nelson Island 9940-W-12860-12885	57.4 W-SW	898	02749	05795 lost	40
Black	09/04/77 Govt.Pt.	05/28/80 Govt.Pt.	0	997	00728	--	49
Black	10/05/78 Nelscott	06/28/81 Landed in Newport	Significant South + offshore	998	00279	--	--
Black	09/19/76 Govt.Pt.	06/07/80 Govt.Pt.	0	1357	01315	--	34
Black	Unknown	06/16/80 Govt.Pt.	Unknown	Unknown	--	Unreadable	46
Lingcod	05/17/79 Neslcott	05/31/79 Nelscott	0	14	04360	07402	62
Lingcod	06/15/80 N.Govt.Pt.	07/10/80 N.Govt.Pt.	0	25	12600	13503	67
Lingcod	06/21/79 Span.Head	6-9/79 Haystack rock Depth 92 m	31 N+offshore	15-62	04498 lost	07878	66
Lingcod	07/19/80 North Reef	09/01/80 Govt.Pt.	0-.93	44	14608	13778	60
Lingcod	06/22/79 Span.Head	08/23/79 Span.Head	0	62	03447	07880	60

Appendix 1. Continued

Species	Date & site released	Date & site recaptured	Distance moved (km)	Days at liberty	Tag no. dorsal	Tag no. operculum	Size (TL) (cm)
Lingcod	06/22/80 N.Govt.Pt.	09/14/80 N.Govt.Pt.	0	84	12935-6	13752 lost	62
Lingcod	06/22/80 N.Govt.Pt.	09/14/80 N.Govt.Pt.	0	84	12932	13749 lost	58
Lingcod	02/13/80 Christmas Tree	08/01/80 Big Bank Canada	442 N+offshore	170	09826	10324 lost	69
Lingcod	07/18/80 North Point	03/?/81 Landed in Newport, Or.	S+offshore	240	14630	13775 lost	66
Lingcod	10/03/78 Govt.Pt.	06/04/79 Govt.Pt.	0	244	02954 lost	06238	73
Lingcod	08/18/79 Span.Head	06/1-15/80 N.Stonewall Bank Depth 82-110 m	38-42 S+offshore?	295	04650	10012 lost	62
Lingcod	09/09/79 Christmas Tree	07/16/80 Christmas Tree	0	311	08645	10473 Not readable	60
Lingcod	07/15/80 D-river	09/7-8/81 12494-12459/ 27954 Depth 186 m	58.3 N+offshore	419	14469	--	76
Lingcod	07/14/79 Span.Head	08/20/81 Govt.Pt.	11.1 South	768	04630 lost	06827	50
Yellow-eye	08/06/80 Span.Head	09/14/80 Span.Head	0	39	14923	--	46
Yellow-eye	10/10/79 Christmas Tree	09/10/80 Christmas Tree	0	336	09835-6	--	55
Yellow-eye	08/20/79 Span.Head	08/30/80 Span.Head	0	376	08100	--	--
Yellow-eye	06/15/79 Span.Head	02/01/81 Span.Head	0	597	04883	07811 lost	64
Yellow-eye	08/20/79 Span.Head	08/28/81 Span.Head	0	739	08088	10110	64
Yellow-tail	03/11/79 Christmas Tree	10/11/79 Christmas Tree	0	214	06798	--	--
Yellow-tail	07/23/80 Govt.Pt.#8	05/20/81 Govt.Pt.#8	0	301	14745	--	44
Yellow-tail	08/19/80 Nelscott	06/21/80 Nelscott	0	307	08034	--	32
Yellow-tail	07/23/80 Govt.Pt.#8	07/01/81 Loran C 59/14950x28060 Depth 73 m	192 N + offshore	343	14667	--	38