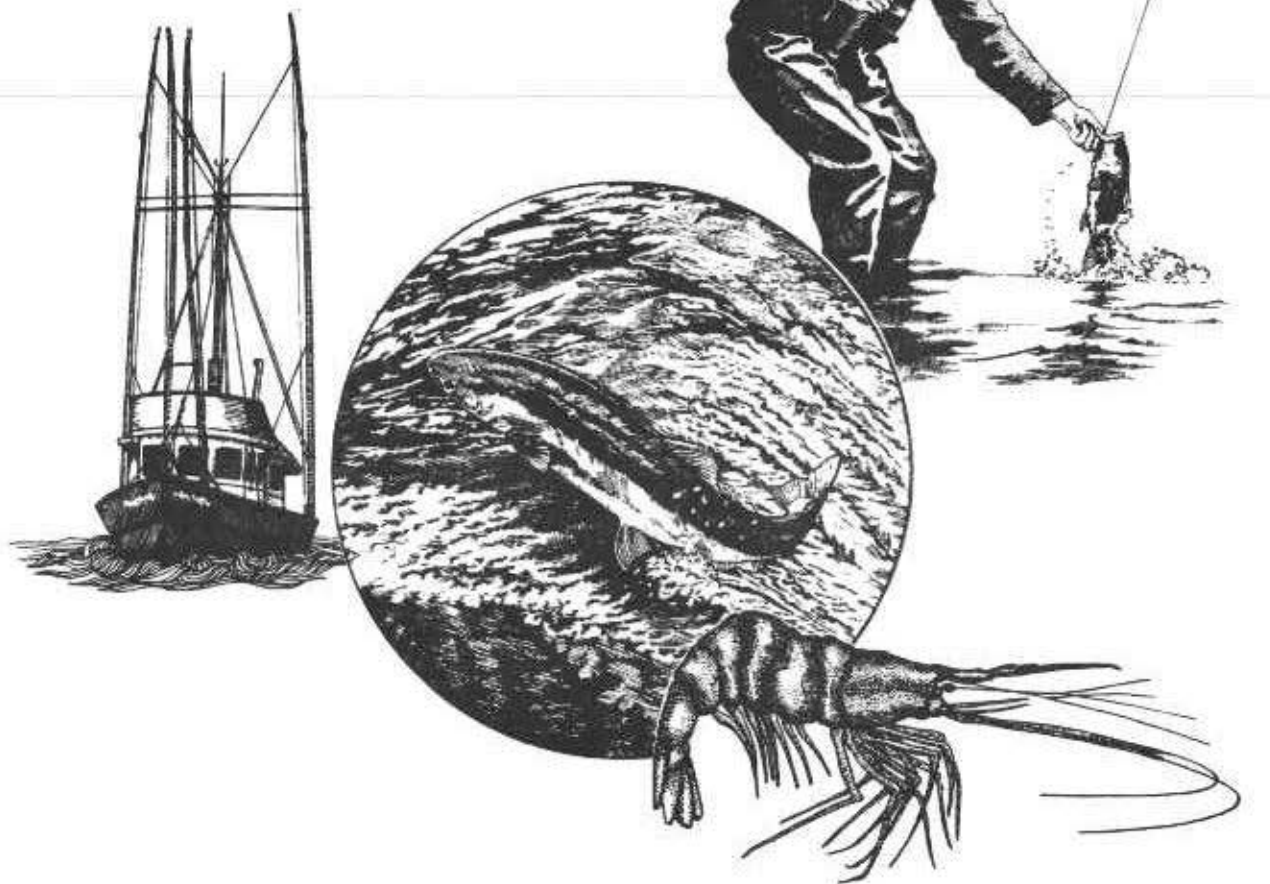


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## FISH DIVISION

**Oregon Department of Fish and Wildlife**

Movement of Lingcod Tagged off the  
Central Oregon Coast

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## ABSTRACT

The Oregon Department of Fish and Wildlife conducted tagging experiments in 1977 and 1978 to determine the inshore - offshore exchange of lingcod *Ophiodon elongatus* off the central coast of Oregon. We tagged 293 lingcod near Johnson Rock in inshore waters off Newport in December 1977 through March 1978 and 3,818 near Stonewall Bank in offshore waters off Newport in July 1978. Female lingcod composed 16% of the fish tagged near shore and 89% of the fish tagged off shore. We recovered 20 (6.8%) and 637 (16.7%) tagged fish from inshore and offshore tagging, respectively. Most tagged fish were recovered from the area where they were tagged. Only 11% of recovered fish had moved 5 nautical miles or more from the area of tagging. Less than 5% had moved more than 25 nautical miles. Interchange between Johnson Rock and Stonewall Bank was not observed. Changes in depth, as measured by depth increments originating at each tagging site, were uncommon; 87% of the males and 77% of the females were recovered within 10 fathoms of the depth at their tagging site. The offshore commercial fishery did not appear to strongly affect nearshore stocks of lingcod, but some lingcod, whose range probably included nearshore reefs, were caught by commercial fishermen trawling for sole in nearshore waters.

**Movement of Lingcod Tagged off  
the Central Oregon Coast**

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## INTRODUCTION

Lingcod *Ophiodon elongatus* is an important species to Oregon recreational and commercial fishermen. In recent years fishing effort for lingcod has increased, particularly by recreational users, in response to restrictions on ocean angling for Pacific salmon *Oncorhynchus* spp. As lingcod have been subjected to increased fishing effort, conflict between recreational and commercial user groups has become increasingly intense. Even before reduced availability of salmon, the Oregon Fish and Wildlife Commission established a daily bag limit of five lingcod per angler in 1976. This was reduced to three lingcod per angler in 1978 based on concerns for lingcod stocks in areas of high use. The three-fish bag limit also established uniformity in bag limits between the states of Oregon and Washington.

Commercial lingcod fishermen, by contrast, have had comparatively few restrictions placed upon their fishery. The commercial fishery operates mostly on and adjacent to offshore reefs, whereas the recreational fishery operates mostly on nearshore reefs. Although total landings of lingcod caught by commercial fishing gear, particularly trawls, are relatively small (3% of all commercial groundfish landings in 1988) anglers perceive that the commercial fishery is responsible for reduced abundance of lingcod.

In late 1977 and in 1978 the Oregon Department of Fish and Wildlife (ODFW) undertook a project to (1) determine if lingcod move between inshore and offshore reefs and (2) determine lingcod temporal and north-south movement. We tagged lingcod at a nearshore reef and at an offshore reef, and obtained tag recoveries from recreational and commercial fisheries. We chose known and popular lingcod fishing areas, so that a large number of tags would likely be recovered.

Other tagging studies have indicated that lingcod do not show well-defined migration patterns (Hart 1943; Chatwin 1956; Phillips 1958; Reeves 1966; Miller and Geibel 1973). Most adult lingcod appeared to be sedentary on rock reefs, although fish residing in deep water (probably >40 fathoms (fm)) may have moved annually into shallow areas to spawn. Hart (1943) noted that most tagged lingcod moved less than 1 nautical mile (nm). Reeves (1966) found little horizontal or coastal movement of lingcod tagged on Forty-mile Bank off Puget Sound. Miller and Geibel (1973) concluded that juveniles move into reef areas at a size of about 35 cm total length (TL) and that lingcod from 35 cm to 60 cm TL tend to move about more randomly than larger fish. Miller and Geibel (1973) also noted a gradual decrease in number of males with increasing depth and a sharp decrease below 100 fm. Females resided in shallow and in deep areas. According to Miller and Geibel (1973), adults (males and females) from deeper water (>40 fm) appeared to migrate annually into shallow water to spawn.

DeMott (1983) reported on returns from 552 lingcod tagged on shallow reefs (<30 fm) 16 nm north of Johnson Rock. Of 14 fish recaptured, over one-half were recovered at the tagging site. Four fish showed movement of 31, 38, 53, and 440 nm from the tagging site. All recoveries were of fish from 50 to 76 cm TL.

The scope of this report is limited to a discussion of the inshore - offshore exchange of tagged lingcod, movement with respect to time of year, and north-south movement of tagged lingcod. We also offer an explanation of why males dominate the recreational catch of lingcod.

## METHODS AND MATERIALS

We chose Johnson Rock, a nearshore reef, and Stonewall Bank, an offshore reef, as our tagging sites. The sites are separated by about 12 nm of mostly sandy substrate. Because the sites are near our office at Newport, Oregon, and the Port of Newport, we had good access for tagging and recovery of tags.

The Newport Tradewinds' vessels *Sea Venture I* and *Sea Pirate* were chartered to fish for lingcod during the winter of 1977-78 near Johnson Rock on popular reefs about 5 nm south of Newport, Oregon, and 1.5 nm offshore at a depth of about 10 fm (Figure 1). Fish were caught with hook and line by ODFW personnel and cooperating recreational anglers as the vessel repeatedly drifted over the reef. Trips lasted 4-6 hours. Herring, lead jigs, and plastic worms were used for bait. Hooked lingcod were immediately brought aboard, unhooked, measured, and tagged. Sex was determined visually before they were released. We used individually numbered, orange, Floy anchor tags. Tags were inserted on the left side just below the middle of the first dorsal fin.

We tagged 293 lingcod (242 males, 47 females, 4 undetermined sex) in the Johnson Rock area from 4 December 1977 to 15 March 1978. Length ranged from 40 to 100 cm TL; mean length was 66.3 cm TL for males and 80.8 cm TL for females (Table 1). We obtained too few length measurements of recaptured tagged fish for analysis, but we include the length of tagged fish here because the size composition database for lingcod, especially for fish measured at sea before any culling has occurred, is lacking.

The 45-foot commercial trawler *F/V Mitoi* was chartered in July 1978 to fish for lingcod adjacent to Stonewall Bank about 14 nm west of Newport, Oregon, at depths between 40 and 83 fm (Figure 1). July was chosen because lingcod become available to trawl gear at this time with regular predictability. An Atlantic-Western IV trawl (Fisher 1974) was used to capture fish. Tows usually lasted 1 to 1.5 hours, and tagging began as soon as the codend was emptied on deck. Fish were tagged with individually numbered, orange, Floy anchor tags. Sex of each fish was recorded, but fork length to the nearest centimeter was taken only when catch was small and time permitted. When more than 50 fish were caught in a tow, the catch was held for tagging in a portion of the vessel's deck that was flooded with sea water.

In the Stonewall Bank area we tagged 3,818 lingcod (418 males, 3,400 females) from 14 to 26 July 1978. Most fish were released within 2 nm of lat. 44° 44' N and long. 124° 27' W. We recovered and rereleased 170 tagged fish during the tagging period. Length, which was recorded for 256 males and 868 females, ranged from 40 to 119 cm TL; mean length was 65.0 cm TL for males and 74.9 cm TL for females (Table 1).

We relied entirely on anglers and commercial fishermen to recover tagged fish. A reward of \$1.00 was offered for each tag returned to us. We did not encourage anglers or commercial fishermen to return tagged fish, but we did encourage them to report gear type used, fish length, and area and date of capture. Length was usually reported for fish returned by anglers, but rarely was length reported by commercial fishermen. Tag returns from commercial fishermen fishing in the vicinity of and within the tagging area usually reported location as the "north end of the rock pile," and date of landing. More precise measures of location were usually obtained from trawlers who captured tagged fish some distance from the tagging site.



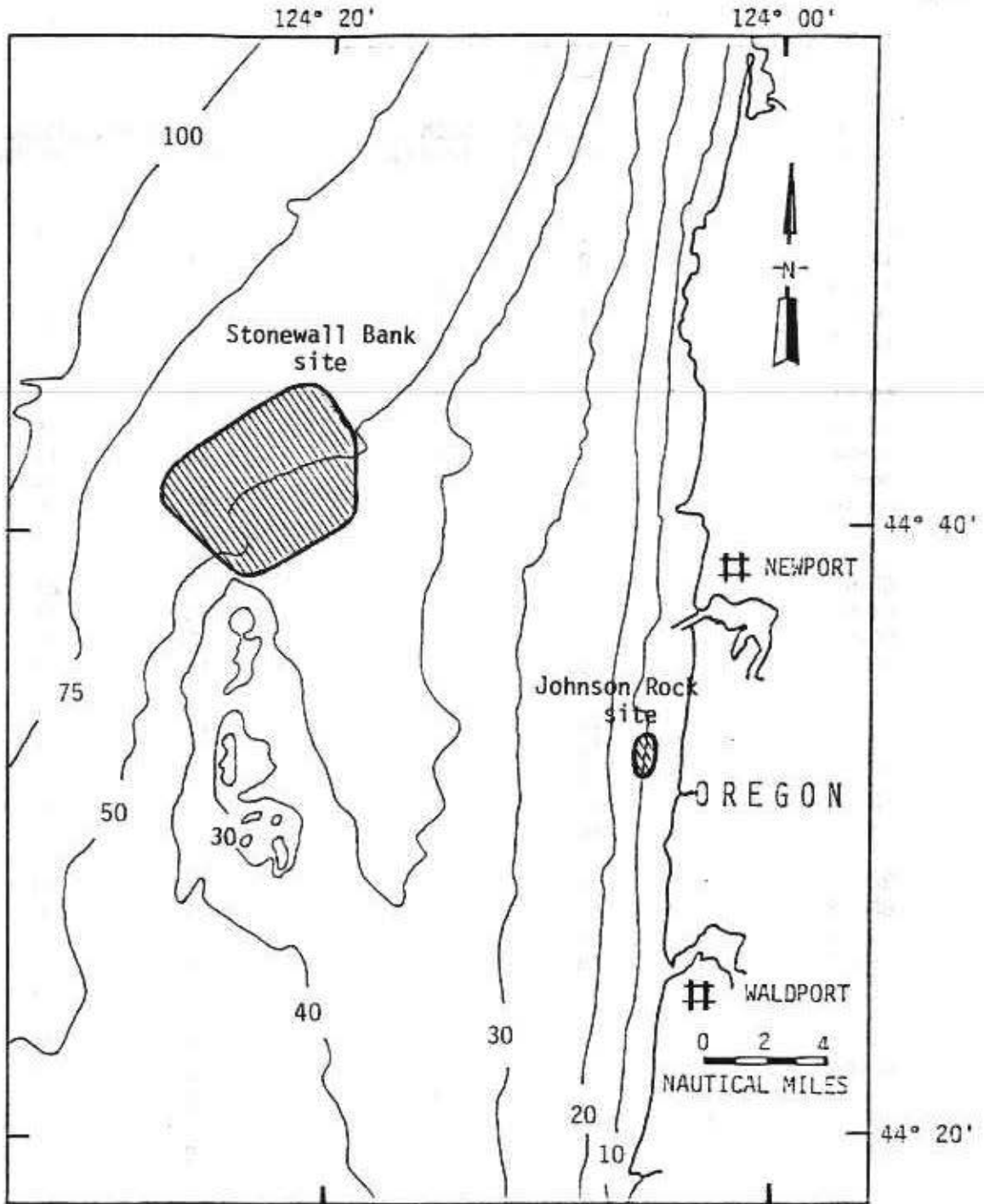


Figure 1. Location of tagging sites where lingcod were tagged from December 1977 to March 1978 and during July 1978. Size of tagging sites are to scale. Depth contours in fathoms.

Table 1. Length frequency distributions for lingcod tagged during the 1977-78 tagging projects.<sup>a</sup>

Fork length (cm)	Johnson Rock		Stonewall Bank	
	Males	Females	Males	Females
40-41	1	0	0	2
42-43	2	0	1	0
44-45	3	0	0	1
46-47	4	0	0	2
48-49	5	0	2	3
50-51	6	0	5	4
52-53	12	2	8	8
54-55	15	0	17	17
56-57	15	2	25	32
58-59	4	3	26	50
60-61	10	2	15	25
62-63	13	1	13	27
64-65	11	1	18	37
66-67	18	3	23	36
68-69	16	1	16	42
70-71	23	1	21	43
72-73	16	1	21	62
74-75	16	1	16	74
76-77	12	1	13	73
78-79	10	1	10	55
80-81	8	3	4	39
82-83	9	4	1	26
84-85	4	1	0	30
86-87	5	3	0	44
88-89	0	1	0	38
90-91	0	2	1	26
92-93	0	3	0	12
94-95	0	4	0	5
96-97	0	3	0	8
98-99	0	1	0	8
≥100	0	1	0	39

<sup>a</sup> Table excludes 2,699 fish: four males, one female, and four with sex unknown tagged at Johnson Rock; and 162 males and 2,532 females tagged at Stonewall Bank.



## RESULTS

### Exchange Between Tagging Areas

We recovered 20 fish (6.8%) from the Johnson Rock area of which only two were females, and 637 fish (16.7%) from the Stonewall Bank tagging area of which 573 were females.

None of the fish tagged on Johnson Rock were recovered on Stonewall Bank and none of the fish tagged on Stonewall Bank were recovered on Johnson Rock.

Seventeen of the 20 fish recovered from the Johnson Rock tagging area showed seaward displacement toward deeper water, but 11 of these were recovered at depths less than 5 fm deeper than the depth where they were tagged (Table 2).

Table 2. Change in depth by lingcod recovered from the 1977-78 tagging. Fish were tagged at Johnson Rock at a depth of 10 fm and at Stonewall Bank at a depth of 40-83 fm.<sup>a</sup>

Direction	Change in depth (fm)	Johnson Rock		Stonewall Bank	
		Males	Females	Males	Females
Shallower	>24.9	--	--	1	11
	20 - 24.9	--	--	0	4
	15 - 19.9	--	--	0	6
	10 - 14.9	--	--	5	21
	5 - 9.9	1	0	18	174
	<5	0	0	16	151
Deeper	<5	9	2	12	77
	5 - 9.9	1	0	3	20
	10 - 14.9	3	0	2	13
	15 - 19.9	1	0	0	16
	20 - 24.9	0	0	0	8
	>24.9	1	0	0	47

<sup>a</sup>Table excludes 34 recovered tags: two males with no recovery data from fish tagged at Johnson Rock; and one fish of unknown sex and 25 females and 6 males with no recovery data from fish tagged at Stonewall Bank.

Of the fish recovered from the Stonewall Bank area, 433 showed shoreward displacement toward shallower water, but the majority were recovered within 20 fm of where they were tagged. Twenty-one fish were recovered more than 20 fm shallower than where they were tagged (Table 2).

### Tag Recovery by Month and Year

All but one of the recoveries from the Johnson Rock area were recaptured within a year of tagging (Table 3). The single exception was a fish recaptured in April 1983, approximately 5 years after being tagged. All of the recoveries from Johnson Rock occurred during the March - October period, also the period of most recreational angling effort.

Table 3. Month of recovery in 1978 for lingcod tagged at Johnson Rock between 4 December 1977 and 15 March 1978.

Sex	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Females	0	0	1	0	1	0	0	0	0	0	0	0
Males	0	0	7	2	0	0	1	2	3	2	0	0

Tagged fish were recovered throughout the year from the Stonewall Bank tagging area, but 89% were recovered during the months of June through September (1978-83 combined). Most were female (Table 4). All but one of the recoveries of males tagged on Stonewall Bank occurred during the June through September period. No males were recovered after 1981.

Table 4. Year and month of recovery for lingcod tagged at Stonewall Bank, July 1978.<sup>a</sup>

Sex, year of recovery	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Females:</b>												
1978	--	--	--	--	--	--	55	95	27	4	1	1
1979	2	0	4	7	5	17	98	18	7	4	1	3
1980	1	0	0	3	5	23	63	9	2	1	0	0
1981	2	2	2	0	4	23	17	2	4	3	1	0
1982	0	0	0	0	0	6	18	1	10	4	0	0
1983	0	0	1	3	2	4	4	1	0	2	0	0
<b>Males:</b>												
1978	--	--	--	--	--	--	5	13	4	0	0	0
1979	0	0	0	0	0	2	14	5	2	0	0	0
1980	0	0	0	0	1	3	5	3	0	0	0	0
1981	0	0	0	0	0	2	4	0	0	0	0	0

<sup>a</sup>Table excludes two recoveries: one fish of unknown sex recovered July 1979 and one female with no recovery data.

### North-South Movement

Based on tag recoveries, movement away from Johnson Rock to the north or to the south was limited. All but three of the recoveries were within 5 nm of the tagging area, and all but one were recovered from the north end of the tagging site (Table 5).

Table 5. Movement by lingcod recovered from the 1977-78 tagging projects.<sup>a</sup> nm = nautical miles.

Direction	Distance (nm)	Johnson Rock		Stonewall Bank	
		Males	Females	Males	Females
North	>24.9	1	0	1	15
	20 - 24.9	0	0	0	4
	15 - 19.9	0	0	0	6
	10 - 14.9	0	0	2	4
	5 - 9.9	1	0	0	11
	<5	14	2	28	365
South	<5	0	0	25	122
	5 - 9.9	1	0	0	3
	10 - 14.9	0	0	0	0
	15 - 19.9	0	0	1	2
	20 - 24.9	0	0	0	4
	>24.9	0	0	0	12

<sup>a</sup>Table excludes 33 recovered tags: one male with no recovery data tagged at Johnson Rock; and one fish of unknown sex and 25 females and 6 males with no recovery data from fish tagged at Stonewall Bank.

Movement away from the Stonewall Bank tagging area to the north and to the south was also limited. Eighty nine percent of all recoveries were made within 5 nm of the tagging area. For males only, 93% of the recoveries were within 5 nm and about equally divided between north and south. Only one male was recovered more than 15 nm from the tagging site.

Although most females tagged off Stonewall Bank were recovered within 5 nm, about 75% were recovered to the north, probably within the confines of the entire tagging area, which was about 6 nm long. The number of females recaptured more than 20 nm from their tagging site was about equally divided between north and south.

We also examined recovery data for females from Stonewall Bank in terms of distance moved and month of recovery (years combined), and we found no relationship between month of recovery and distance travelled. Fish recovered the greatest distance away were recovered during the months of June through September (Table 6).

Table 6. Distance moved, by month of recovery, for female lingcod tagged at Stonewall Bank, July 1978.<sup>a</sup> Recoveries for 1978-83 combined. nm = nautical miles.

Direction	Distance (nm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
North	>24.9	0	0	0	0	2	1	6	4	2	0	0	0
	20 - 24.9	0	0	0	0	0	0	0	1	1	2	0	0
	15 - 19.9	0	0	4	1	0	1	0	0	0	0	0	0
	10 - 14.9	0	0	0	0	2	1	1	0	0	0	0	0
	5 - 9.9	2	0	0	2	3	1	2	0	1	0	0	0
	<5	0	2	0	2	2	52	183	86	31	5	1	1
South	<5	1	0	0	3	2	12	58	28	11	7	0	0
	5 - 9.9	0	0	0	0	2	0	0	0	0	1	0	0
	10 - 14.9	0	0	0	0	0	0	0	0	0	0	0	0
	15 - 19.9	0	0	0	0	0	0	0	0	1	0	0	1
	20 - 24.9	0	0	0	0	0	0	2	0	0	2	0	0
	>24.9	1	0	0	3	2	0	1	2	0	1	2	0

<sup>a</sup>Table excludes one female with no recovery data.

Data from the Stonewall Bank tagging suggest that movements greater than 100 nm were usually made by fish less than about 80 cm TL when tagged. These fish had also been at liberty from 2 to 4 years.

## DISCUSSION

We did not observe any interchange of lingcod between Johnson Rock and Stonewall Bank. However, the apparent shoreward shift of some fish tagged offshore and the apparent seaward shift of some fish tagged nearshore suggests that interchange could occur. Short term interchange is possible even though we did not detect it. Fish tagged offshore were mostly mature females. Because lingcod are known to spawn in shallow water but only males guard nests (Wilby 1937; Jewell 1968; Miller and Geibel 1973), ripe females may move into the nearshore area, spawn, and leave immediately. Wilby (1937) supported this idea with his description of a pair of spawning lingcod he observed; he reported that the female left the nest immediately after spawning. This type of behavior would result in low availability of females to the shallow water recreational fishery or to a rather intense adjacent nearshore trawl fishery.

If interchange of lingcod does exist between nearshore and offshore areas, then detection of the interchange may require more extensive tagging, especially on nearshore reefs during the spawning period. Charter boats usually fish nearshore during winter months and seldom venture offshore. Commercial trawling during winter months is usually directed at offshore spawning concentrations of petrale sole *Eopsetta jordani* and Dover sole *Microstomus pacificus*. Fishing of any kind is usually absent or diminished on Stonewall Bank during the spawning period; therefore, recreational or commercial fishing may fail to intercept female lingcod on or enroute to and from spawning areas.

Recreational anglers took most of the recoveries of lingcod tagged on nearshore reefs. Eleven recovered fish tagged on Johnson Rock were caught by recreational anglers fishing on Johnson Rock and only seven were caught by commercial trawlers fishing just offshore of the reef at depths of 8 to 25 fm. Ninety-four percent of fish recovered from the Stonewall Bank tagging were caught by commercial bottom trawlers. Five percent were caught by other commercial fishing activities including shrimp trawl, midwater trawl, troll, pot, and jig. Recreational anglers caught only 1% of these fish.

The movement north by males tagged nearshore may be due to the particular terrain features of the central Oregon coast. Although the nearshore tagging took place south of Yaquina Bay, extensive nearshore reefs lie between the mouth of Yaquina Bay and Yaquina Head 5 to 6 nm to the north. Few nearshore reefs are located to the immediate south of Johnson Rock.

Our observations support the findings of Hart (1943), Chatwin (1956), and Reeves (1966) that few lingcod migrate long distances, but that a small percentage of the population moves considerable distances. Our observations give weak support to the findings of Hart (1943) and Miller and Geibel (1973) that the longer migrations were usually made by the smaller lingcod. Of the 10 fish recaptured more than 100 nm from the tagging sites, six were 81 cm TL or shorter at tagging. Length at tagging of the other four is unknown. In contrast to the findings of Miller and Geibel (1973), we observed that most male lingcod caught in deep water were mature.

On Stonewall Bank males composed only 11% of the fish tagged, whereas on Johnson Rock males composed 84% of the fish tagged. We compared these percentages against percentages obtained from creel surveys (Oregon Department of Fish and Wildlife, unpublished data) from both areas. In the Johnson Rock area, the percentage of males observed in recreational catches for the 12-month period November 1976 through October 1977 ranged from 57% in September to 100% in August. The average percentage of males observed from the creel survey, which would correspond to the period of tagging (December - March), was 78%. For the 12-month period the average percentage of males observed was 81%. All of these fish were caught by hook and line.

The recreational fishery that operates on Stonewall Bank actually lies immediately to the south of the tagging area at a depth less than 30 fm. The fishery here is intermittent with most effort occurring during the April through July period. The percentage of males observed during this period averaged 73%. Again, these fish were caught with hook and line.

The percentages of fish caught by hook and line over the respective reef areas contrast strongly with the percentage of males observed for the Stonewall Bank tagging site. We could hypothesize that the differences were due to the difference in timing of the creel surveys and the actual tagging. We could also hypothesize that the difference was due to the fishing gear used. Indeed, the trawl was restricted to an area adjacent to Stonewall Bank, rather than on the bank proper. Females were much more available to the trawl than were males, especially during the tagging period, but the lack of females in the recreational fishery suggests that they were not particularly available to that fishery either.

Because males seem to remain in the reef areas at all times, we believe that what we have observed is a territorial response. Defending a territory at all times would serve to insure a nesting site.



## ACKNOWLEDGMENTS

We thank Bert Waddell of Newport Tradewinds, owner-skipper of the charter vessels *Sea Venture I* and *Sea Pirate*, and Bob Carpenter, then owner-skipper of the trawler *F/V Mitoi*. Their cooperation and fishing skill made our project possible and successful. We also thank the crews of the above vessels for their cheerful help at sea. Our appreciation is also expressed to the fishing industry, recreational anglers, and cooperating members of the California Department of Fish and Game, Washington Department of Fisheries, and Canada Department of Fisheries and Oceans who provided catch information on recovered lingcod tags. Credit is due Jerry Butler who organized and supervised tagging near Johnson Rock and ODFW staff and friends who participated in the project.

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## APPENDIX A

### Evaluation of Tagging Methods

We evaluated cost and efficiency of the two methods of catching lingcod to be tagged. Each method had its own special requirements.

Tagging on the Johnson Rock area required at least four anglers on a boat to catch fish by hook-and-line gear and to tag fish. A larger angling party resulted in greater efficiency because total catch per hour was greater. ODFW placed up to nine anglers aboard vessels designed to carry up to 19 recreational anglers. Fishing time averaged about 4 hours per trip. The short fishing time was because the tagging area was close to port and because there were usually paying customers aboard who had been scheduled to take 4-hour fishing trips. Tagging from the charter vessel took 40 vessel days at sea by an average of five ODFW personnel per day to tag 293 lingcod. Cost was \$1,930 or \$6.59 per tagged lingcod, excluding ODFW salary and equipment (APPENDIX B). If we had been able to tag fish caught by paying customers, the number of fish tagged would have been 562 at a cost of \$3.43 per tagged fish.

The Stonewall Bank tagging was conducted offshore aboard a small trawler, and this work required intensive effort and high cost over a relatively short time. Because of the distance to the tagging area and subsequent demands of time and fuel, trips were 3 to 5 days in duration. We used 11 days at sea to tag 3,818 lingcod at a total cost (excluding ODFW salary and equipment) of \$15,390 or \$4.03 per tagged fish (Appendix B). Our total cost could have been about \$22,000, but by allowing the vessel owner to sell the 25,000 pounds of fish caught incidentally to lingcod, we realized a savings of \$6,600 over a straight charter fee.

## APPENDIX B

### Project Expenditures of Effort and Funds During the Lingcod Tagging Study, 1977-78

Item	Area	
	Johnson Rock	Stonewall Bank
Gear used	hook and line	trawl
Days at sea	40	11
Hours at sea	220	236
Staff time (days)	196	33
Cost of personal service contract	\$1,930	\$15,390
Number of lingcod tagged	293	3,818
Cost per tagged lingcod	\$6.59	\$4.03
Number of lingcod recovered	20	637
Cost per recovered lingcod	\$96.50	\$24.16