

DEPARTMENT OF FISH AND GAME

Marine Resources Division
Northern California Operations
Fort Bragg, California 95437



CRUISE REPORT 95-M-10

Northern California Sport Fish Project Lingcod Hooking Mortality Study

Prepared by

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31 January 1996

Vessel: R/V MAKO

Dates: 24-29 September 1995

Locality: Nearshore waters between Monterey and Lopez Point, Monterey County.

Purpose: To determine medium-term (within 5 days) hooking mortality to lingcod, *Ophiodon elongatus*, using conventional sport rod and reel gear. To determine medium-term hooking mortality and tag retention (percutaneous tags, coded wire tags, and elastopolymer marks) of nearshore rockfishes, *Sebastes spp.*

Procedures: Using sonar, we located schools of fish over rocky habitats of depth less than 50 m. We then drifted the R/V MAKO over the schools and fished with conventional sport rod and reel gear, mainly with large baits or lures intended to target lingcod. Baits were predominately live market squid, *Loligo opalescens*, live jack mackerel, *Trachurus symmetricus*, or live Pacific sardine, *Sardinops sagax*. All hooks had a typical single barb on the point. Nearly all hooks had a gap distance from the point to the shank of 18-20 mm, and were single hooks; however some anglers occasionally used somewhat larger or smaller hooks, or treble hooks. While rod and reel was the main gear used, we also tested the effectiveness of set hook and line gears. The MAKO II skiff was occasionally also used as a fishing platform. Hooks were removed from the fish immediately upon landing with needle-nose pliers. Hooks were backed out to minimize additional tissue damage.

Captured lingcod were tagged with numbered yellow spaghetti tags (Model FD-94, Floy Tag and Manufacturing Inc., Seattle WA) anchored in the dorsal musculature between proximal pterygiophores. Fork length, sex (based on external genitalia), depth of capture, and tackle (bait vs. lure) were recorded. Tackles with bait attached to a lure were recorded as bait.

Captured lingcod were placed in the R/V MAKO's port live well. A habitat structure consisting of nine 102 mm diameter plastic pipes about 0.7 m long bundled together was placed in the port live well to provide the lingcod opportunity to stabilize themselves within crevice-like locations and isolate themselves from one another. Lingcod in the live well were observed daily for condition and mortality, and were provided small live rockfish and other live baits

to discourage cannibalism.

Rockfishes and other fishes captured incidental to lingcod fishing were placed in 110-litre plastic tubs with flow-through sea water. Rockfishes with excessive gas in the swim bladder were deflated by one or more punctures with an 18-gauge needle through the left side of the body. Fish that appeared healthy were tagged with various combinations of: 1) Floy FD-94 yellow spaghetti tags; 2) fabric basting tacks (Model 1500, Quiltak Inc., Flagstaff AZ); and 3) coded wire tags (CWTs) with fluorescent pink elastopolymer marks (Northwest Marine Technology, Shaw Island WA) (Figure 1). Species, length, depth of capture, gear, marks and tags applied, and fish condition were recorded.

Spaghetti tags were anchored in the dorsal musculature between proximal pterygiophores. The basting tacks were applied through the left opercular bone; their purpose was to evaluate an external tag location potentially less subject to tag loss and infection than the dorsal spaghetti tag location. The CWTs each carried a unique sequential code. They were placed in the left cheek muscle parallel to the muscle fibers, and also in the dorsal musculature of some fish. A portable hand-held wand CWT detector (Northwest Marine Technology, Shaw Island WA) was used during tagging and subsequent census to determine if CWTs were present. The elastopolymer marks were applied subcutaneously as an external visual indicator that the fish had a coded wire tag. The marks were injected with a 23-gauge needle under areas of clear skin over the left dentary bone, in the isthmus, or over the left cleithrum (Figure 1).

Set line gears (vertical long line and tube gear) were occasionally used to test gear effectiveness and increase rockfish catch. Set lines and tube gear were baited with squid pieces. Vertical set lines had 20 hooks per line and were deployed from the R/V MAKO. The tube gear consisted of 200 cm x 2 cm PVC tubes weighted on one end and floated on the other, each with 6 hooks on 20 cm ganions (Figure 2). Tubes were set over rocky habitat adjacent to kelp beds at 11 to 23 m off the MAKO II skiff, without using sonar to find fish. Tubes were set in strings of 3 to 5 with each tube 10 meters apart. Fish captured with set line gear were handled and tagged like fish captured with rod and reel.

Tagged rockfishes were placed in the starboard live well (isolated from lingcod) and observed daily for mortality. On 29 September, the last day of the cruise, a thorough census was conducted with each fish examined for tag retention and general condition. Fish with clouded eyes or in a condition judged as terminal were sacrificed. Following the census a subset of 89 fish was released in northern Carmel Bay. During release, health was qualitatively rated as either good, fair, or poor.

At the conclusion of the cruise, 21 rockfish and 10 lingcod were transferred to Monterey Bay Aquarium where they were held in a 1.2 x 1.2 x 2.4 m continuous

flow tank 18 days for further observation. Lingcod were segregated from rockfish by a screen to avoid predation.

The remaining 60 fish in the live wells were released from the R/V MAKO at Point Lobos Reserve 30 September by personnel conducting cruise 95-M-11.

On 19 October all rockfish and lingcod held at Monterey Bay Aquarium were examined for tag retention and infection. Dr. Karen Novak, a Fort Bragg veterinarian with experience in fish pathology, drew blood samples from a subset of the lingcod and rockfish to test for evidence of infection. The rockfish were sacrificed for autopsy by Dr. Novak while the lingcod were released off the Monterey Bay Aquarium pier. During autopsy tag insertion and anchor points and swim bladders were visually inspected for signs of infection. Fins and the bodies of fish were also examined for evidence of holding stress and healing from hook-induced injuries.

Results: Due to an administrative issue, the start of the cruise was postponed 6 hours, until 12 noon 24 September. Initially strong winds and high seas limited fishing effort, but sea conditions during the cruise gradually improved. Mornings were generally calm followed by rougher afternoons and evenings. During the cruise we fished 32 stations in eight locations between Monterey and Lopez Point (Figure 3, Table 1).

We captured 323 fish of 18 different species (Table 2). Rockfish dominated, comprising 91.3% of the catch by number. Blue rockfish, *Sebastes mystinus*, gopher rockfish, *S. carnatus*, and olive rockfish *S. serranoides*, were the main species, each with over 20% of the catch by number.

Catch per unit effort (CPUE) with rod and reel gear for all species combined reflected improving weather conditions throughout the cruise. Fish per angler-hour increased from 0.4 (SE=0.3) on 24 September to a maximum 5.6 (SE=1.3) on the last day of the cruise (Table 3). Fish per angler-day increased even more dramatically from 1.3 to 23.6, reflecting the combined effect of increased time on station and catch success as winds decreased daily. CPUE varied between locations with no apparent trend from north to south. Fish per angler-hour ranged from 0.3 at Pfeiffer Point to 3.0 (SE=1.5) Point Sur (Table 4).

Lopez Point was the only location where rod and reel, tube, and vertical set gears were all used (Table 5). Rod and reel caught the most fish per hour.

Lingcod: Hooking Mortality

Despite use of terminal baits and lures intended to target lingcod, only 15 were taken (4.6% by number) (Tables 2 and 6). All were captured with rod and reel

gear. Ten were identified as males and three as females; the sex of two small fish could not be determined. Fork length ranged from 337 mm to 670 mm; mean length was 534 mm. Eight fish were landed with bait, and seven with lures. Depth of capture ranged from 9 to 47 m, with a mean of 26 m. Eleven fish were hooked in the mouth, one in the isthmus, and one in the body about halfway along its length. One lingcod had no hook wound. It was a "hitchhiker" that bit onto a blue rockfish that had taken a lure.

Only one lingcod died during the experiment. That fish was hooked with a treble hook externally through the isthmus, puncturing the ventral aorta. It died a few minutes after it was landed, and was the smallest lingcod (337 mm) captured on the cruise (Table 6). The other lingcod survived their observation periods of 2 to 22.8 days, and appeared healthy when released. Damage to fins (erosion of fin margins or incision of fin membranes) was noted in 11 of the 14 fish held. Four of the 10 fish that were held at Monterey Bay Aquarium had what appeared to be bite wounds inflicted by the other lingcod while in the aquarium tank.

During the holding periods, the hooking-related wounds of six fish were observed to be actively healing, while those of five fish were observed to be relatively static. The wounds observed to be healing included a torn gill arch and a hook wound to the abdomen. The wounds observed to be not healing were generally tears in thin membranous tissues around the mouth.

The lingcod used the habitat structures in the R/V MAKO's live well by positioning themselves against it or by residing in the tubes. They consumed the fish fed to them and not one another.

Although fewer lingcod were captured than we had hoped, the low mortality rate and apparent recovery from wounds during the observation period upheld the reputation of lingcod as a relatively hardy species. Based on their survival during the holding period and condition on release, hooking mortality appears to be low. Additional studies with larger sample sizes are required for a more quantitative estimate of hooking mortality. Such studies are being undertaken in the Fort Bragg area by the Fort Bragg Salmon Troller's Marketing Association with guidance of the Northern California Sport Fish Project.

All Fish: Mortality and Tag Retention

Between the R/V MAKO and the Monterey Bay Aquarium, fish were held up to 24 days; the average holding period was 2.5 days. Of the 280 fish monitored for mortalities, 92 (33%) died following capture (Table 2). The mortalities consisted of 91 rockfish and one lingcod. Most of the fish that died (57; 22%) did so during the day of capture.

A cause of death was apparent in only 32 of the 92 mortalities; 15 (47%) were

attributed to barotrauma, 13 (41%) to hook-related injuries, and four (13%) to tagging procedures. At Monterey Bay Aquarium, four of the 21 rockfish died within 6 days of capture. The remaining 17 fish survived the 18 days to the end of the experiment.

Tag loss ranged from 1% for spaghetti tags to 6% for basting tacks (Table 7). Most tag loss, with the exception of one elastopolymer mark, occurred within 5 days of tagging. Fish held at Monterey Bay Aquarium lost only one elastopolymer mark, suggesting tag loss may have resulted during the tagging procedure at sea. Indeed, subsequent reading of CWTs that were alternately tagged on the data sheets for each fish tagged revealed that half of the CWT loss (5) resulted from misfiring of the tag gun. Elastopolymer marks showed evidence of some degradation over time. Marks during census were occasionally described as spotty or poor on fish whose marks were initially described as good. Loss of basting tacks may also have resulted by initial missapplication; basting tacks were stretched or broken when the needle was inserted too deeply during tagging.

A total of 159 tagged fishes was released in the Monterey Bay area (Table 8). Most of those, 85 rockfish and four cabezon, were released in northern Carmel Bay the last day of the cruise. An additional 53 rockfish, two cabezon, and four lingcod were released at Point Lobos Reserve on 30 September (the California sheephead released there was not tagged). An additional 10 lingcod were released at Monterey Bay Aquarium pier 19 October. One sublegal lingcod, tag number 36, was recaptured and released in Monterey Bay by sport angler Paul Scott, 22 November.

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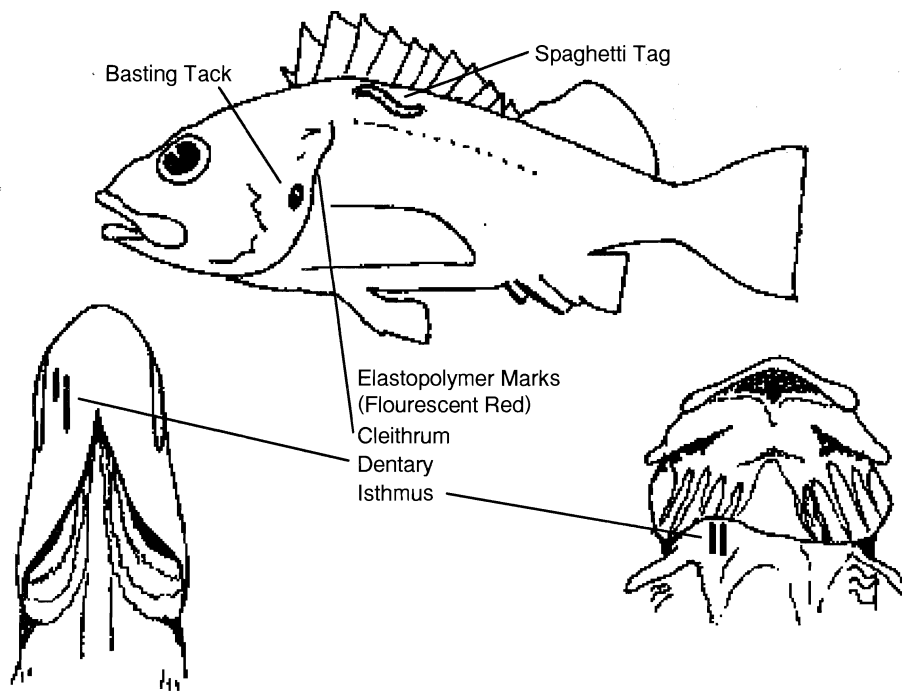


Figure 1. Tag types used for marking fishes on cruise 95-M-10

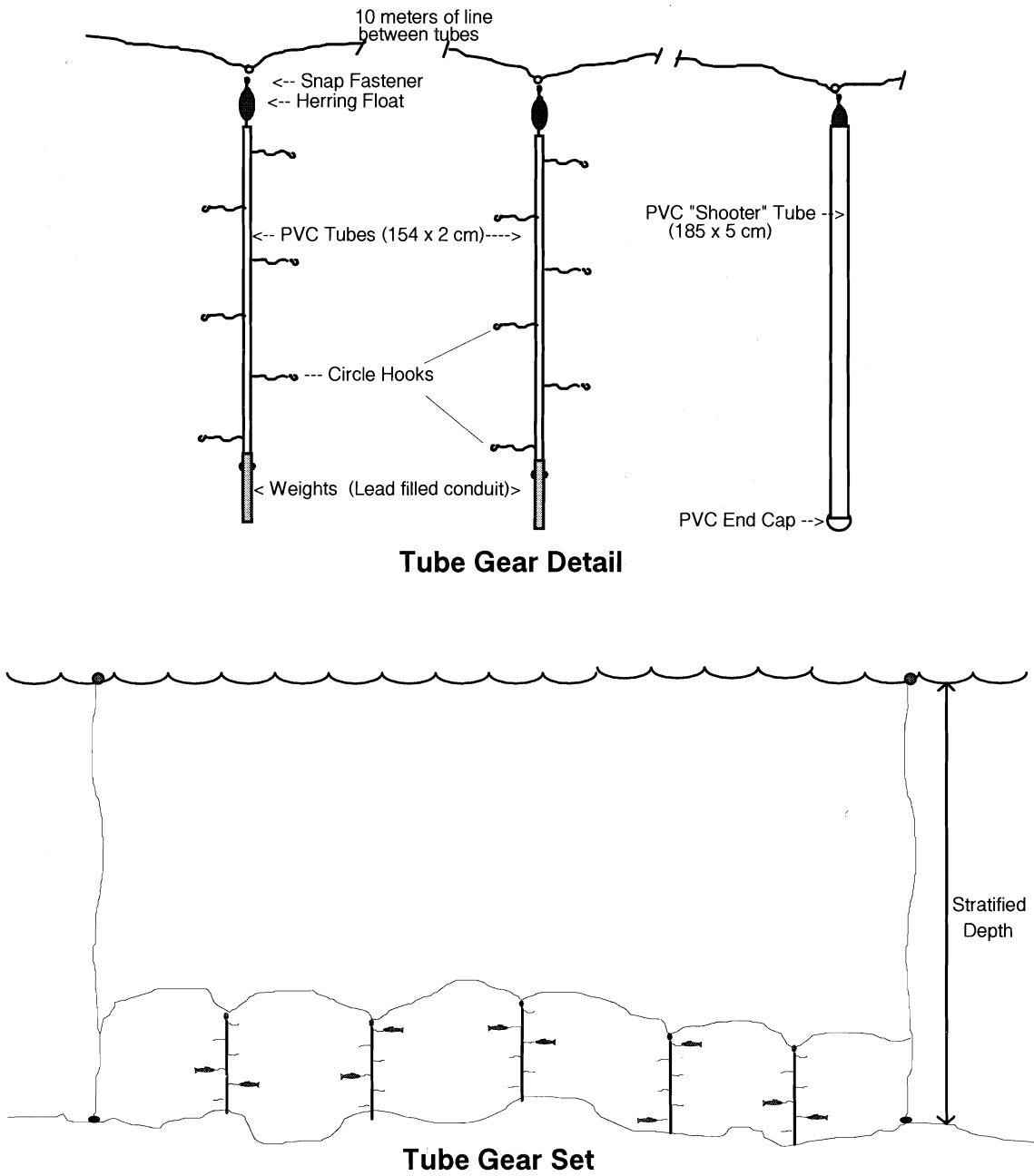


Figure 2. Set line fishing gear using PVC tubes.

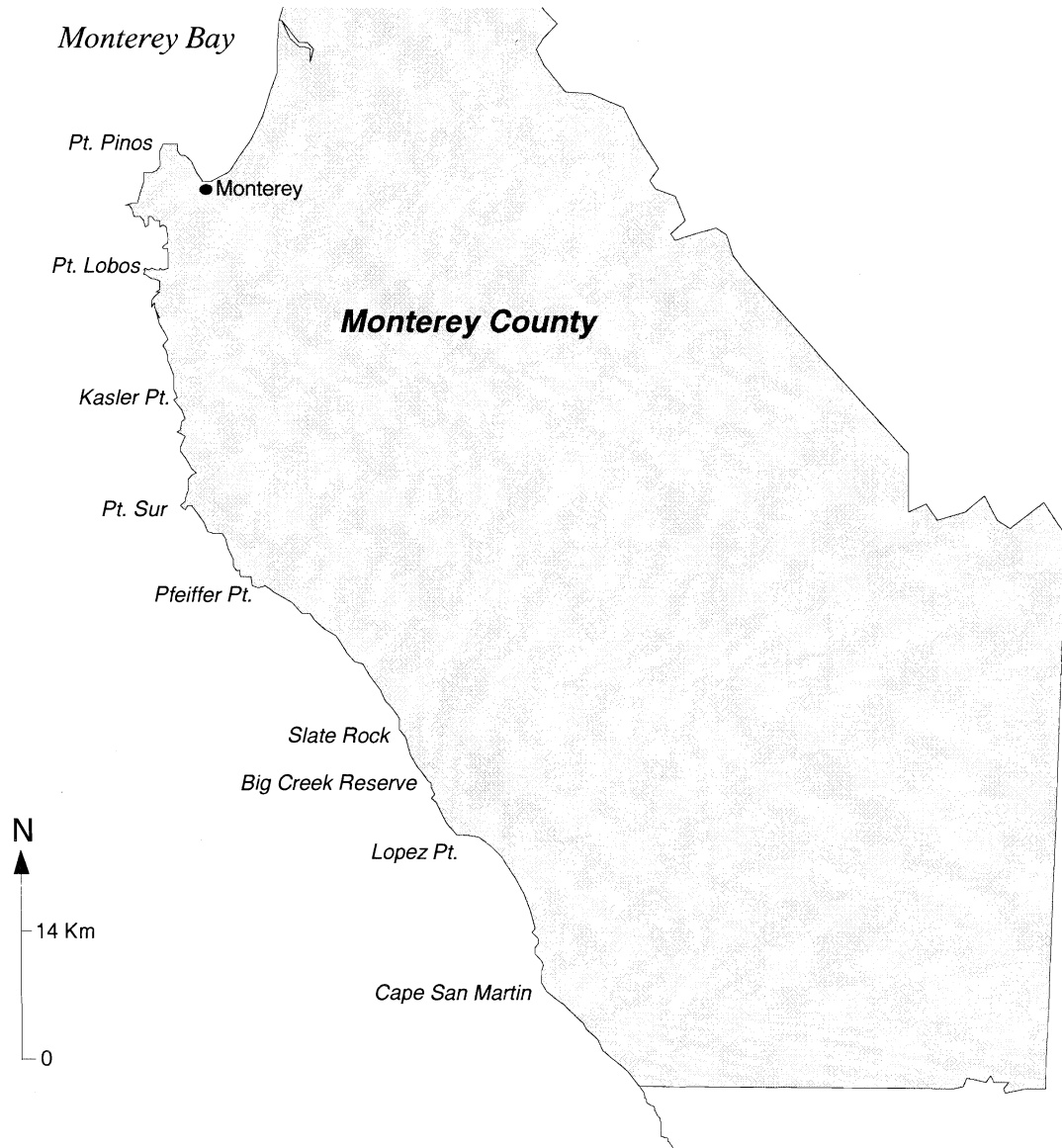


Figure 3. Monterey County coast.

Table 1. Fishing location and effort data for R/V MAKO cruise 95-M-10.

Date	Set	Location	Latitude	Longitude	Gear Type	Gear No.	Gear Unit	Depth (m)	Time In	Time Out	Fish Taken
9/24/95	1	Pt. Pinos	36 38.86	121 55.79	Rod&Reel	6	Poles	46	1415	1430	0
9/24/95	2	Pt. Pinos	36 38.96	121 56.28	Rod&Reel	7	Poles	49	1440	1510	3
9/24/95	3	Pt. Pinos	36 38.54	121 56.68	Rod&Reel	8	Poles	37	1520	1730	6
9/25/95	1	Kasler Pt.	36 25.96	121 56.06	Rod&Reel	6	Poles	40	905	1010	13
9/25/95	2	Pt. Sur	36 20.72	121 54.51	Rod&Reel	7	Poles	30	1100	1130	4
9/25/95	3	Pt. Sur	36 16.37	121 52.95	Rod&Reel	4	Poles	27	1225	1240	2
9/25/95	4	Pfeiffer Pt.	36 13.26	121 47.09	Rod&Reel	5	Poles	27	1400	1445	1
9/25/95	5	Pfeiffer Pt.	36 13.00	121 47.00	Tube	8	Tubes	11	1454	1600	1
9/26/95	1	Slate Rock	36 8.43	121 39.66	Rod&Reel	8	Poles	27	735	915	29
9/26/95	2	Slate Rock	36 7.50	121 39.25	Rod&Reel	7	Poles	30	930	940	0
9/26/95	3	Slate Rock	36 7.38	121 38.96	Rod&Reel	7	Poles	27	945	1050	19
9/26/95	4	Slate Rock	36 5.89	121 37.79	Rod&Reel	8	Poles	27	1112	1120	0
9/26/95	5	Slate Rock	36 5.67	121 37.73	Rod&Reel	8	Poles	29	1125	1200	5
9/26/95	6	Lopez Pt.	36 0.80	121 33.50	Rod&Reel	4	Poles	15	1330	1700	14
9/26/95	7	Lopez Pt.	36 0.80	121 33.50	Tube	10	Tubes	12	1330	1720	20
9/27/95	1	Lopez Pt.	36 1.38	121 35.35	Vert Set	20	Hooks	32	820	930	0
9/27/95	2	Lopez Pt.	36 1.38	121 35.35	Rod&Reel	5	Poles	34	830	930	7
9/27/95	3	Lopez Pt.	36 1.23	121 34.95	Rod&Reel	7	Poles	27	1000	1150	2
9/27/95	6	Lopez Pt.	36 1.40	121 35.03	Rod&Reel	5	Poles	0	1240	1340	6
9/27/95	7	Lopez Pt.	36 2.22	121 35.20	Vert Set	20	Hooks	26	1150	1340	0
9/27/95	4	Lopez Pt.	36 2.36	121 35.08	Tube	4	Tubes	12	826	1103	4
9/27/95	5	Lopez Pt.	36 1.98	121 35.00	Tube	5	Tubes	13	950	1219	3
9/27/95	8	Lopez Pt.	36 1.25	121 34.81	Vert Set	20	Hooks	20	1420	1520	0
9/27/95	10	Lopez Pt.	36 1.25	121 34.81	Tube	7	Tubes	22	1456	1705	0
9/27/95	9	Lopez Pt.	36 1.20	121 34.88	Rod&Reel	5	Poles	18	1410	1730	66
9/28/95	1	Slate Rock	36 5.75	121 37.61	Rod&Reel	5	Poles	15	725	900	52
9/28/95	2	Slate Rock	36 5.69	121 37.73	Rod&Reel	5	Poles	23	900	1017	17
9/28/95	3	Slate Rock	36 5.59	121 37.60	Rod&Reel	5	Poles	18	1017	1025	0
9/28/95	4	Slate Rock	36 6.04	121 37.75	Rod&Reel	5	Poles	24	1044	1145	29
9/28/95	5	Pt. Sur	36 16.50	121 54.02	Rod&Reel	1	Poles	46	1420	1430	1
9/28/95	6	Pt. Sur	36 17.08	121 53.95	Rod&Reel	4	Poles	31	-	-	18
9/28/95	7	Pt. Sur	36 17.28	121 54.08	Rod&Reel	4	Poles	24	-	-	1
Total											323

Table 2. Species composition, lengths, and mortalities of fishes taken on cruise 95-M-10.

Species	No. % by		Fork Length (mm)				Mortalities			
	Taken	No.	No. Meas.	Min.	Max.	Mean	Number Monitored	Day 0	Days 1-5	%
Black rockfish <i>Sebastes melanops</i>	4	1.2	4	251	320	292	4	2	1	75.0
Blue rockfish <i>S. mystinus</i>	93	29.1	93	165	358	270	73	14	7	28.8
Black-and-yellow rockfish <i>S. chrysomelas</i>	8	2.5	7	196	307	260	7	0	0	0.0
China rockfish <i>S. nebulosus</i>	3	0.9	2	264	282	273	3	0	0	0.0
Copper rockfish <i>S. caurinus</i>	4	1.2	4	278	382	343	4	1	0	25.0
Grass rockfish <i>S. rastrelliger</i>	1	0.3	1	404	404	404	1	0	0	0.0
Gopher rockfish <i>S. carnatus</i>	69	21.4	67	194	316	264	60	19	5	40.0
Kelp rockfish <i>S. atrovirens</i>	8	2.5	8	265	348	301	6	0	0	0.0
Olive rockfish <i>S. serranoides</i>	84	26.0	81	193	502	351	78	11	20	39.7
Rosy rockfish <i>S. rosaceus</i>	1	0.3	1	215	215	215	1	1	0	100.0
Starry rockfish <i>S. constellatus</i>	1	0.3	1	327	327	327	1	1	0	100.0
Vermilion rockfish <i>S. miniatus</i>	17	5.3	17	344	490	438	17	8	1	52.9
Yellowtail rockfish <i>S. flavidus</i>	1	0.3	1	306	306	306	1	0	0	0.0
Subtotal	294	91.3	287	165	502		256	57	34	35.5
Cabezon <i>Scorpaenichtys marmoratus</i>	7	2.2	6	284	412	362	7	0	0	0.0
Kelp greenling <i>Hexagrammos decagrammus</i>	1	0.3	1	346	346	346	1	0	0	0.0
Lingcod <i>Ophiodon elongatus</i>	15	4.6	15	337	670		15	1	0	6.7
Pacific mackerel <i>Scomber japonicus</i>	5	1.5	5	230	331	262	0	-	-	-
California sheephead <i>Pimelometopon pulchrum</i>	1	0.3	0	-	-	-	1	0	0	0.0
Total	323	100	299	165	502		280	58	34	32.9

Table 3. Rod and reel Effort, catch, and catch-per-unit effort by date fished on cruise 95-M-10.

Date	Average No. Poles	Hours Fished	No. of Stations	No. of Fish	Station Average Fish/angler-hr	S.E.	Fish/Angler Day
9/24/95	7.0	2.9	3	9	0.4	0.3	1.3
9/25/95	5.5	2.6	4	20	1.4	0.4	3.6
9/26/95	7.0	7.1	6	67	1.3	0.4	9.6
9/27/95	5.5	7.2	4	81	2.1	0.8	14.7
9/28/95	4.2	4.2	5	99	5.6	1.3	23.6
Total	5.8	24	22	276	1.9	0.4	10.4

Table 4. Rod and Reel effort, catch, and catch-per-hour by location fished on cruise 95-M-10.

Location	Mean No. Poles	Hours Fished	No. of Stations	No. of Fish	Station Mean Fish/angler-hr	S.E.
Pt. Pinos	7.0	2.9	3	9	0.4	0.2
Kasler Pt.	6.0	1.1	1	13	2.0	-
Pt. Sur	4.0	0.9	3	7	3.0	1.5
Pfeiffer Pt.	5.0	0.8	1	1	0.3	-
Slate Rock	6.4	7.7	9	151	2.3	0.8
Lopez Pt.	5.2	10.7	5	95	1.5	0.6
Total	5.8	24.0	22	276	1.9	0.4

Table 5. Gear comparison of catch-per-hour at Lopez Point on cruise 95-M-10.

Gear Type*	Mean No. Units**	Hours Fished	No. of Stations	No. of Fish	Station Mean Fish/unit-hour	S.E.
Rod & Reel	5.2	10.7	5	95	1.5	0.6
Tube Gear	6.5	11.1	4	27	0.4	0.1
Vertical Set	1	4	3	0	0	0

* Gear comparison was standardized by using only data from Lopez Point collected on the 26 and 27 September.** Units varied by gear type - rod and reels had 1 to 6 hooks, tube gear with 6 hooks each tube, and vertical set with 20 hooks per string.

Table 6. Capture and holding time data for lingcod, *Ophiodon elongatus*, captured on cruise 95-M-10

Capture Date	Set	Depth (m)	Gear	Hook Location	Fork Length (mm)	Floy Tag No.	Sex	Days Held	Disposition*
9/24/95	3	18	Bait	Mouth	508	34	M	6.1	Released Pt Lobos-good condition
9/24/95	3	27	Lure	Mouth	503	36	M	22.8	Released at MBA-good condition**
9/24/95	3	23	Bait	Mouth	602	37	M	5.7	Released Pt Lobos-good condition
9/25/95	1	37	Bait	Mouth	598	38	F	22.1	Released at MBA-good condition
9/25/95	1	37	Lure	Mouth	416	40	M	22.1	Released at MBA-good condition
9/26/95	1	20	Lure	Mouth	521	66	M	21.1	Released at MBA-good condition
9/26/95	3	27	Lure	Isthmus	337	-	-	0.0	Died on landing
9/26/95	3	27	Bait	Mouth	453	88	-	21.1	Released at MBA-good condition
9/26/95	7	9	Lure	Mouth	670	123	F	20.8	Released at MBA-good condition
9/27/95	3	27	Bait	Mouth	435	133	M	20.1	Released at MBA-good condition
9/27/95	9	23	Bait	Mouth	630	149	M	2.8	Released Pt Lobos-good condition
9/27/95	8	21	Lure	Body	600	158	M	19.9	Released MBA-good condition
9/28/95	2	23	Bait	Hitchhike	568	233	M	2.0	Released Pt Lobos-good condition
9/28/95	2	23	Bait	Mouth	572	246	M	19.1	Released at MBA-good condition
9/28/95	5	47	Lure	Mouth	603	266	F	18.9	Released at MBA-good condition

* Fish released at Point Lobos on 9/30/95 and off Monterey Bay Aquarium Pier

** Recaptured 11/22/95 by Paul Scott, sport angler, at Monterey Point and again released in good condition.

Table 7. Fish tag retention from cruise 95-M-10.

Treatment	Short term holding experiment on R/V Mako			Extended holding experiment at Monterey Bay Aquarium.		
	Number with tag	Number Lost	%	Number with tag	Number Lost	%
CWT - Cheek	197	7	4	10	0	0
CWT - Dorsal	77	3	4	11	0	0
Basting tack	71	4	6	11	0	0
Elastopolymer	179	4*	2	16	1*	2
Spaghetti	198	2	1	18	0	0

* Degraded elastopolymer marks were considered lost only if undetectable.

Table 8. Fish release locations and health from cruise 95-M-10.

Species	Release Locations			Release Health			Number Released
	Monterey Bay Aq.	North Carmel Bay	Pt. Lobos Reserve	Good	Fair	Poor	
Black rockfish	0	0	1	1	0	0	1
Blue rockfish	0	32	15	22	21	4	47
Black and yellow rockfish	0	1	4	4	1	0	5
China rockfish	0	0	0	0	0	0	0
Copper rockfish	0	0	0	0	0	0	0
Grass rockfish	0	0	1	1	0	0	1
Gopher rockfish	0	21	9	19	8	3	30
Kelp rockfish	0	0	3	2	1	0	3
Olive rockfish	0	29	15	22	14	9	44
Rosy rockfish	0	0	0	0	0	0	0
Starry rockfish	0	0	0	0	0	0	0
Vermilion rockfish	0	2	5	2	2	3	7
Yellowtail rockfish	0	0	0	0	0	0	0
Sub Total	0	85	53	73	47	19	138
Cabezon	0	4	2	4	0	2	6
Kelp greenling	0	0	0	0	0	0	0
Lingcod	10	0	4	14	0	0	14
California sheephead	0	0	1	0	0	0	1
Totals	10	89	60	91	47	21	159
Percent	6	56	38	57	30	13	