

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

THE PACIFIC HERRING, CLUPEA HARENGUS PALLASI,
OPEN POUND ROE-ON-KELP EXPERIMENTAL FISHERY IN
SAN FRANCISCO BAY, 1988 to 1989

by

Kenneth T. Oda

MARINE RESOURCES DIVISION
Administrative Report No. 89-7
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ABSTRACT

The experimental open pound herring roe-on-kelp (ROK) fishery was studied in San Francisco Bay from the second week of December 1988 through the third week of February 1989.

Three spawning runs were fished successfully by four operations consisting of six permittees. A total of 47.1 tons of herring ROK was packed this season.

Giant kelp, Macrocystis sp., was harvested from the Santa Barbara Channel Islands and trucked to San Francisco for hanging on the pounds. Sources of high-quality giant kelp in California were difficult to locate this season because of unfavorable oceanographic conditions during the winter months.

ROK was sampled at each shoreside processing facility. There were no significant differences in ROK blade measurements or roe densities among the permittees². ROK densities ranged from 0.250 to 0.699 g/cm².

Plastic totes containing processed ROK averaged 1756 lbs total gross weight. Totes contained an average of 42.3% ROK by weight.

Siltation of ROK harvested in south San Francisco Bay continued to be a problem. High winds damaged rafts in December 1988. Gear conflicts were reported between ROK and herring roe permittees.

^{1/} Marine Resources Administrative Report No. 89-7.

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ACKNOWLEDGMENTS

I wish to thank John Keeler, Mike Fitzgerald, Karin Marsh, and Paul Reilly for their assistance this season.

I would also like to thank the staff and crew of Bay Roe Co., Meatball Bait Distributor Inc., Ship-to-Shore Seafoods, and Watashi Corp. for their help and cooperation.

The manuscript was reviewed by Tom Jow, Jerry Spratt, Fred Wendell, Tom Moore, Paul Reilly, and Ken Miller.

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INTRODUCTION

Pacific herring, Clupea harengus pallasi, roe and eggs are served as a side dish or appetizer during the holidays, especially New Year's celebrations, among Japanese and Japanese-Americans. Two forms of herring roe or eggs are currently marketed: kazunoko or salted herring roe in skeins, and kazunoko or komochi kombu, or salted herring roe on seaweed. Salt is used primarily as a preservative and is leached out of the eggs in freshwater prior to eating. Both products are commonly served with soy sauce and dried, shaved bonito flakes (katsuo). The ex-vessel value of these products from California in 1987 was over 11 million dollars. The California Department of Fish and Game (CDFG) has management responsibility for all herring fisheries in California.

One fishing method used in the herring roe on seaweed fishery is still experimental. During spawning, female herring release eggs which adhere to a wide variety of substrates for development (Spratt 1981). The experimental fishery provided substrate in the form of giant kelp (Macrocystis pyrifera) suspended from lines attached to floating rafts or pounds. This fishery, the experimental open pound herring roe-on-kelp (ROK) fishery, is the subject of the following report.

This was the second year in which the CDFG Pacific Herring Research Project sampled the experimental open pound Pacific herring ROK fishery in San Francisco Bay,

California (Figure 1). Moore and Reilly (1989) reported on the 1987-1988 season's activities.

Considerable interest in obtaining additional permits for the 1988-1989 season was generated by the success of the ROK fishery the previous two seasons. Last season's landings totaled approximately 20 tons (Moore and Reilly 1989). On May 13, 1988 California's Fish and Game Commission authorized CDFG to issue up to four additional experimental gear permits to take herring ROK with the open pound method for the 1988-1989 season.

Permittees were chosen by lottery from a pool of qualified applicants. To qualify, applicants must have possessed a San Francisco Bay herring fishery permit (round haul or gill net). Applicants agreed to forfeit all herring fishing privileges under their existing herring roe permits for the 1988-1989 season, if successful in the lottery.

Regulations for the ROK fishery were not drafted before the start of the season, due to the lengthy legislative process involved; therefore, the fishery remained experimental. The primary objectives of CDFG's monitoring of the fishery were to determine any variations in ROK harvested among the permittees and to determine future sampling and monitoring needs necessary for an ongoing assessment of the fishery.

Description of the Current Roe-on-Kelp Fishery

Fishing and processing methods were relatively unchanged from the previous season (Moore and Reilly

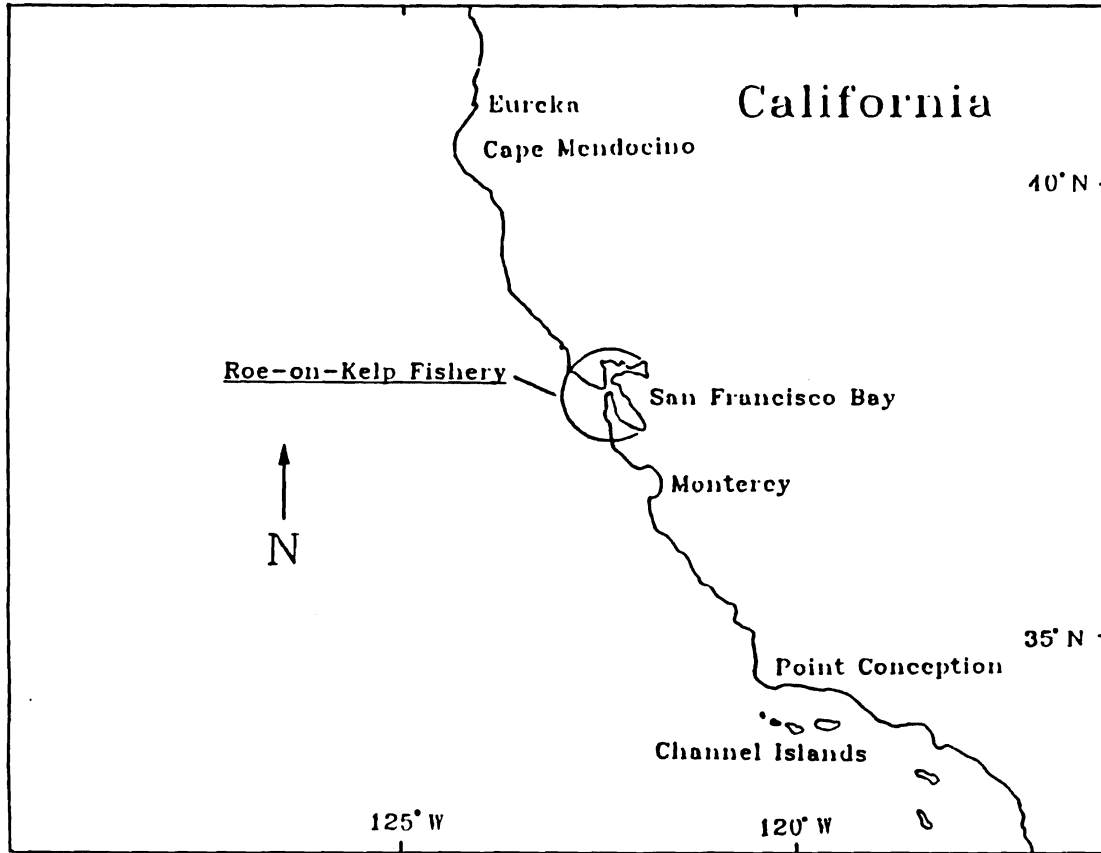


FIGURE 1. Location of roe-on-kelp fishery in California.

1989). Rafts were constructed of aluminum, or wood and plastic and used in suspending lines of attached giant kelp fronds. Giant kelp was harvested from the Channel Islands (Figure 1) and trucked to San Francisco. The rafts were positioned in areas where the permittees anticipated a herring spawn, based on constant monitoring of the herring school. When spawning was over, workers pulled up lines suspending kelp fronds and broke off kelp blades covered with herring eggs from the kelp stipe (Figure 2).

ROK blades were placed in plastic containers (totes) in layers and transported to a processing facility where trimming of the ROK blades was performed. In trimming, the basal end of the kelp blade just above the pneumatocyst was discarded, as well as the apical tip (Shields et al. 1985). All trim at the harvest location and processing facility was returned to the water to allow attached eggs to hatch.

Trimmed ROK was placed in small plastic trays, drained, weighed, and later placed in totes on a bed of medium grained rock salt. Single layers of ROK were alternated with layers of salt until the tote was full. Totes were then filled with a 100% brine solution, covered with a lid and placed in cold storage. At a later date, the totes were shipped out of state for further trimming, if necessary, and sold.

Five permits were issued for the ROK fishery this season. One permit was granted to the permittee from the

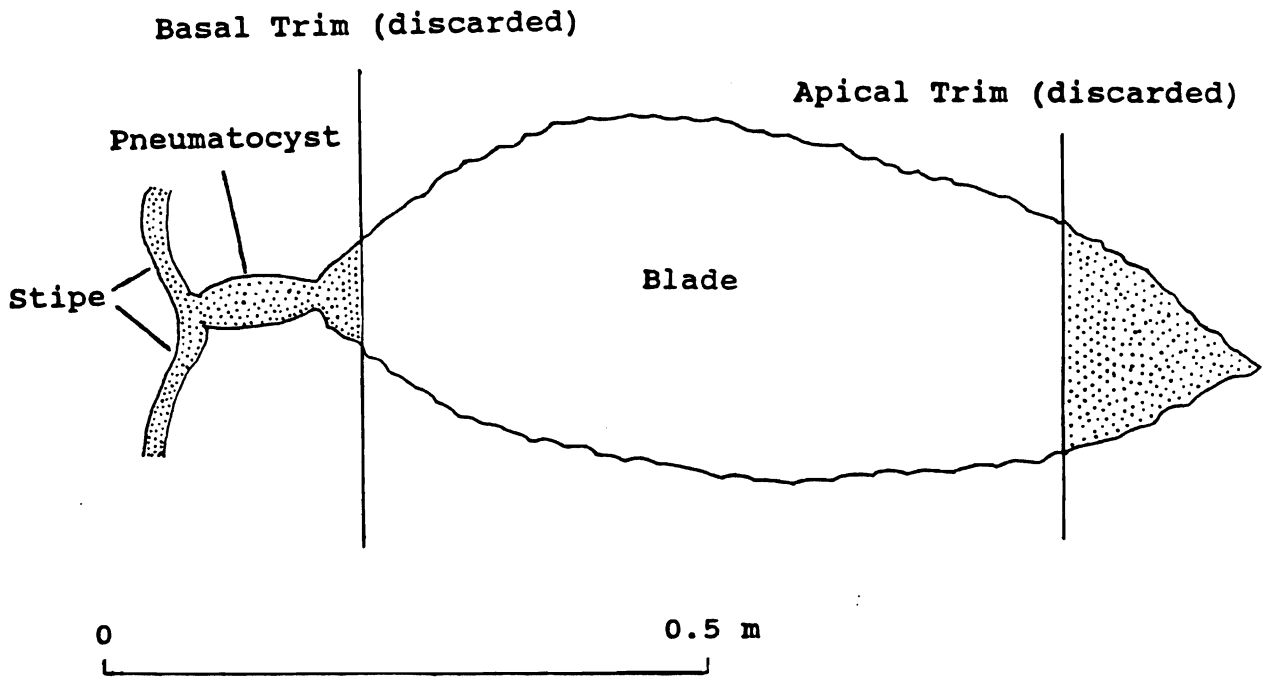


FIGURE 2. The portion of a kelp blade removed by trimming (Shields et al. 1985).

previous season and four by lottery. In addition, two permits were issued by bid for herring roe-on-native-algae allotments which could be used in the experimental fishery. The amount of the bid was a royalty paid to CDFG per ton of processed product (Spratt 1981). One successful bidder worked with a permittee chosen by lottery. The same permittee chosen by lottery also bid successfully on an allotment of roe-on-native-algae. Two lottery winners, gill net permittees, also partnered.

Herring roe quotas were converted to herring ROK quotas. The conversion translated a quota based on whole body weight to an equivalent quota based on roe weight. A conversion factor, 0.206, was calculated based upon fecundity and sex ratio data collected by CDFG (Moore and Reilly 1989; Reilly and Moore 1986). ROK quotas were set this season at 17 tons per round haul permittee and 4 tons per gill net permittee.

The roe-on-native algae quota was split into two allotments at 2.5 tons each. The total ROK quota was 64 tons for the 1988-1989 season.

METHODS

Field Sampling

Permittees were required to notify CDFG 24 h in advance of placing giant kelp in the pounds or of harvesting. Sampling of harvested ROK was conducted at shoreside processing facilities on Pier 45 Shed D (Figure 3) in San Francisco.

Each permittee's harvest was sampled in the processing facility. Samples consisted of at least 30 untrimmed ROK blades randomly selected from totes prior to trimming by workers. Lengths and maximum widths of untrimmed blades were measured to the nearest millimeter. At least 30 trimmed blades from each permittee's harvest were measured to the nearest millimeter and weighed to the nearest 5 g.

Rectangular samples (11.9 x 7.0 cm) were excised by scalpel at either 10, 20, or 30 cm from the basal end of an untrimmed blade covered with roe. Three samples were taken at each interval from nine different blades for each permittee's harvest. Samples were labeled and placed in plastic bags for further processing.

Laboratory Procedures

Rectangular samples were removed from plastic bags, dried with paper towels, and weighed to the nearest 0.01 g on a Mettler P1200N balance.

Net weights of product, gross weights of totes, tare weights of totes with lids, and the weight of salt and brine added were obtained from photocopies of each permittee's official tally sheets post season.

The identities of the permittees were coded in tables. This season, unlike the previous season, there was more than one permittee involved in the fishery.

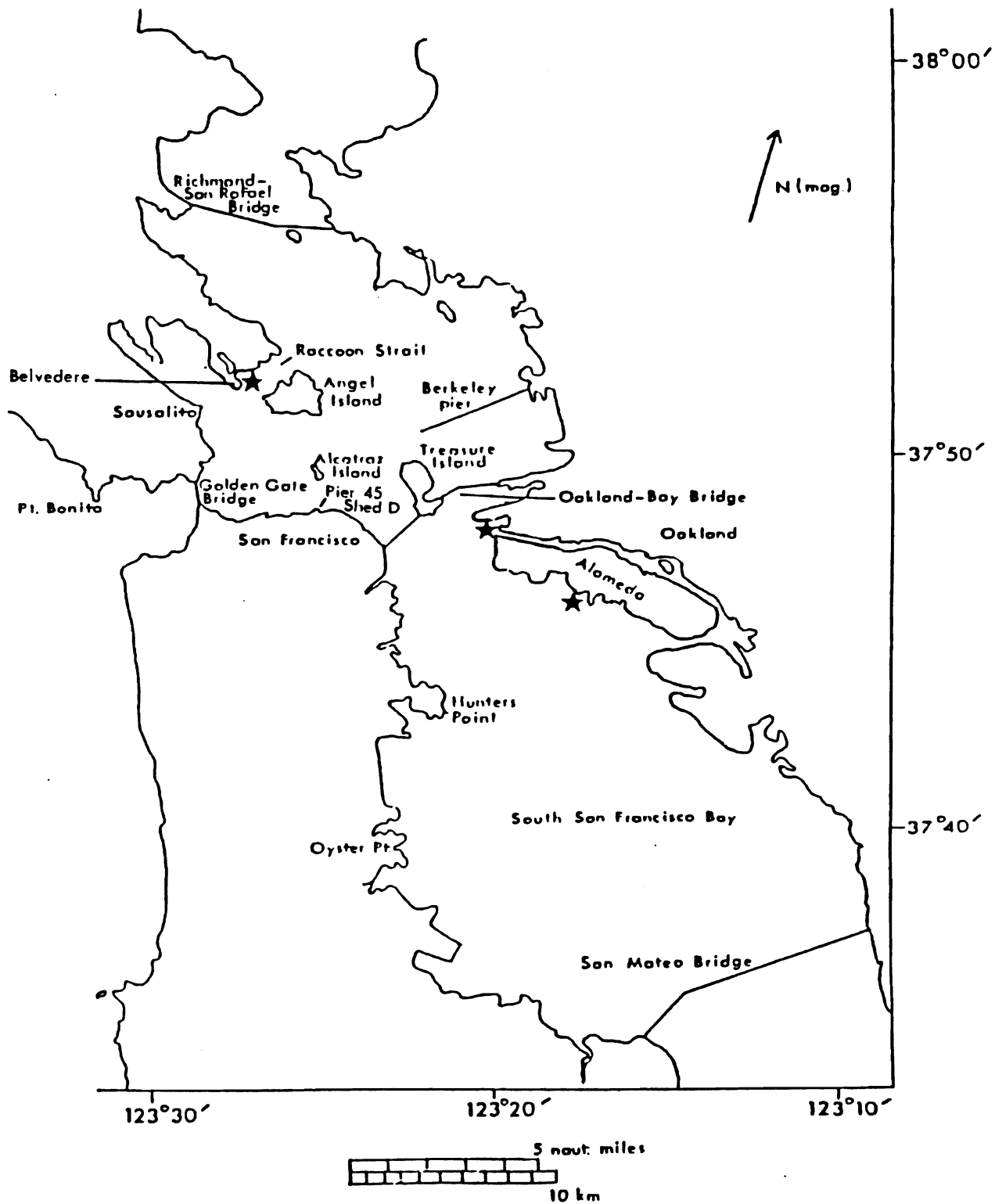


FIGURE 3. Roe-on-kelp harvest locations (★) in San Francisco Bay, California.

RESULTS

ROK Statistics

Nine of 10 ROK harvests from three spawns were sampled this season. The first spawn harvested was located in Oakland, the second in Belvedere, and the third in Alameda (Figure 3). One harvest was not sampled because the permittee failed to notify CDFG.

Average ROK untrimmed measurements (Table 1) were very close to the 1987-1988 season, but average trimmed ROK blade lengths were slightly less than the past season (Table 2). Mean untrimmed ROK blade lengths were significantly different between spawns (Mann-Whitney U, $\alpha = 0.05$).

Roe densities varied with each spawn harvested. Densities ranged from light to heavy, based on criteria in Moore and Reilly (1989). Most of the ROK sampled fulfilled requirements for number 1 grade product (Shields et al. 1985). ROK sample data were not significantly different among permittees for all spawns (Table 3). Roe coverage was highest, for all permittees, on the second spawn harvested January 26-29, 1989 (Table 3).

ROK Production

Permittees reported landing 47.1 tons of ROK from open pounds for the 1988-1989 season. The total ROK quota was 64 tons. Landings were obtained from each permittee's tally sheets. Three spawns were harvested successfully by three of the four operations (Figure 4).

TABLE 1. Summary of Untrimmed Roe-on-Kelp Blade Measurements.

Harvest date	Permittee	n	Mean blade length (mm)	S.D.	Mean blade width (mm)	S.D.
1/6/89	A	30	556.2	167.1	106.2	15.0
	B	30	588.6	123.0	112.0	13.0
	C	30	519.5	124.2	102.3	10.0
	D		No Harvest			
1/29/89	A	35	700.6	182.3	113.7	15.2
	B	35	593.7	94.3	112.3	10.9
	C	35	620.3	179.7	108.0	21.1
	D		No Harvest			
2/22/89	A	35	474.7	60.6	110.3	9.0
	B	35	586.5	91.3	120.6	11.8
	C		Not Sampled			
	D	35	665.8	97.5	105.8	14.2
Mean, all samples		300	592.4	142.0	110.5	13.0
Mean, 1987-1988		495	595.2	140.2	104.0	13.5

TABLE 2. Summary of Mean Trimmed Roe-on-Kelp Data.

Harvest date	Permittee	n	Blade length (mm)	S.D.	Blade width (mm)	S.D.	Blade weight (g)	S.D.
1/6/89	A	30	257.5	107.6	74.2	12.8	80.3	31.6
	B	30	355.8	108.6	106.8	15.4	94.8	40.2
	C	30	274.6	99.9	70.9	18.3	68.7	25.6
	D	No Harvest						
1/29/89	A	35	351.6	113.5	133.2	12.7	227.0	100.8
	B	35	293.1	106.5	130.4	12.6	162.0	77.2
	C	35	539.9	106.3	137.6	9.6	230.7	73.2
	D	No Harvest						
2/22/89	A	35	357.9	112.8	93.0	12.8	92.1	26.6
	B	35	254.8	110.8	81.6	15.7	63.4	27.3
	C	Not Sampled						
	D	35	325.9	110.7	119.8	23.4	103.9	57.6
Mean, all samples		300	339.2	135.6	109.1	15.6	123.8	81.1
Mean, 1987-88		495	365.8	129.0	111.5	55.2	155.8	113.9

TABLE 3. Roe-on-Kelp Densities (g/cm²) by Permittee.

Harvest date	Permittee			
	A	B	C	D
1/6/89	0.283	0.362	0.354	No Harvest
1/29/89	0.528	0.669	0.668	No Harvest
2/22/89	0.322	0.250	Not Sampled	0.394

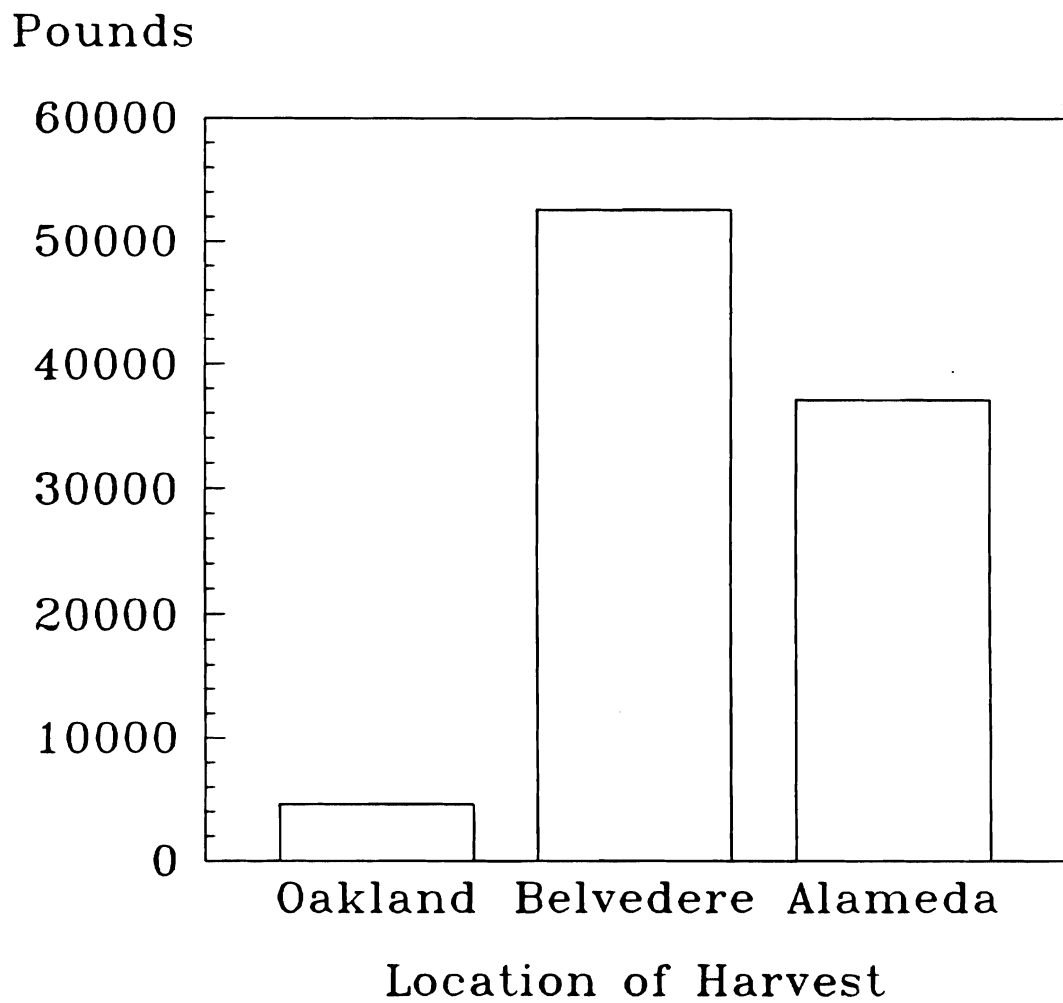


FIGURE 4. Roe-on-kelp landings by harvest.

The fourth operation made one harvest. ROK product averaged 42.3% of the average gross weight of the tote. This average ranged from a low of 36.9% to a high of 46.1% (Table 4).

DISCUSSION

Moore and Reilly (1989) reported on data collected during the 1987-1988. There were some differences between the 1987-1988 season and the 1988-1989 season. Three spawns were fished successfully in 1988-1989 compared to five in 1987-1988. Spawn intensity was heavier for 1987-1988 harvests, as reflected by lower average percent product per tote this season. The quota in 1987-1988 was met by the permittee's last harvest which was also heavily trimmed for quality (Moore and Reilly 1989). The quota this season was not met by any permittee.

ROK densities were surprisingly consistent among permittees, considering that all but one permittee was new to the ROK fishery. There may have been differences in the quality of product (i.e. uniformity of egg layers on both sides of the kelp blade, presence of silt, and kelp blade dimensions) between permittees, but determining product quality was not a study objective.

Apparently, more trimming of product took place this season than last. Several factors may have influenced this procedure. High-quality giant kelp was difficult for harvesters to obtain this season from the

TABLE 4. Roe-on-Kelp Tally Sheet Summary: 1988-1989
Herring Season.

Harvest date	Spawn location	# of totes	Total gross wt. (lbs)	Total net wt. (lbs)	Net wt. as % of gross	Avg gross/ tote	Avg net/ tote
1/6/89	Oakland	7	12,516.0	4618.0	36.9	1788.0	659.7
1/29/89	Belvedere	63	113,871.0	52,530.8	46.1	1807.5	833.8
				58,148.8			
2/22/89	Alameda	57	96,667.0	37,109.4	38.4	1695.9	651.0
Totals		127	223,054.0	94,258.2	-	-	-
Averages		-	-	-	42.3	1756.3	742.2

Channel Islands. Some samples of ROK were found in poor condition with tattered tips and torn blades. Winter storms may have limited the availability of high-quality kelp for open pounds in British Columbia, Canada (Shields et al. 1985).

The timing involved in collecting, trucking, stringing kelp on pounds and intercepting a spawn is critical. Giant kelp suspended from rafts in San Francisco Bay will deteriorate in 8-10 days (Moore and Reilly 1989). Much of the logistical difficulty could be eliminated if a nearby supply of high-quality giant kelp was available. A permittee is exploring the feasibility of culturing giant kelp for use on open pounds.

Other problems permittees experienced, during the 1988-1989 season, were created by the environment. Product siltation continued to be a problem, particularly in south bay (Figure 3) harvests. Product condition reportedly ranged from a light siltiness to a noticeable grittiness. Some siltation could be reduced by avoiding spawns in known problem areas or making changes in technique. One change would be to shorten the lengths of line that kelp is strung on, to keep ROK as far away from the bottom as practical.

Permittees reported oil spots on product harvested near Oakland. Shields et al. (1985) indicated product contaminated with sand, silt, or oil would generally be rejected by buyers in Canada.

Strong winds, 50-60 kn, on December 15-16, 1988 caused considerable damage to rafts moored in the south bay.

Gear conflicts were reported by ROK and herring roe permittees. Due to the multiple fishing methods existing in San Francisco Bay during herring season and the manner in which herring spawn, the potential for conflicts between permittees is great. Reports of ROK permittees having rafts blocked by gill nets, and gill net permittees' access to fishing areas restricted by rafts and ROK vessels, were inevitable.

Future sampling needs will include: improving the precision of the estimate used in converting herring roe quotas to ROK quotas, and continuing to determine variations in ROK harvested among permittees.

LITERATURE CITED

- Moore, T.O. and P.N. Reilly. 1989. Pacific Herring, Clupea harengus pallasii, experimental roe-on-kelp open pound fishery studies in San Francisco Bay, December 1987 to February 1988. Calif. Dept. Fish and Game, Mar. Resources Admin. Rep. No. 89-3: 1-27.
- Reilly, P.N. and T.O. Moore. 1986. Pacific Herring, Clupea harengus pallasii, studies in San Francisco Bay, central and northern California, and Washington March 1985 to May 1986. Calif. Dept. Fish and Game, Mar. Resources Admin. Rep. No. 86-6: 1-88.
- Shields, T.L., G.S. Jamieson, and P.E. Sprout. 1985. Spawn-on-kelp fisheries in the Queen Charlotte Islands and northern British Columbia Coast- 1982 and 1983. Can. Tech. Rep. Fish. Aquat. Sci. No. 1372: 53 p.
- Spratt, J.D. 1981. Status of the Pacific Herring, Clupea harengus pallasii, resource in California 1972 to 1980. Calif. Dept. Fish and Game Fish Bull. 171: 1-107.