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The Ocean Pout: An Example of Underutilized Fisheries Resource Development

DANIEL J. SHEEHY, SOLIMAN Y. K. SHENOUDA, AARON J. ALTON,
SAUL B. SAILA, and SPIROS M. CONSTANTINIDES

ABSTRACT–The results of a coordinated research and development effort, which addressed the biological, processing, and marketing problems involved in the development of a food fishery for ocean pout, are described. Fishery investigations indicated that the ocean pout is a substantial resource in southern New England waters, and suggest that there are unit stocks which experience little mixing. The combination of a relatively slow growth rate and a low fecundity make careful monitoring and stock management essential to the continued growth of this fishery. Chemical analysis and taste panel evaluation demonstrated that ocean pout is a lean fish, low in cholesterol content, and is highly acceptable to the U.S. consumer. Lesion occurrence was about 6 percent (for fillets) and candling is considered essential to insure a high quality product. Marketing efforts which concentrated on a fresh fillet product have met with considerable success at both the retail and wholesale level. While only small amounts of pout for human consumption were landed in previous years, the 1976 landings in Pt. Judith, R.I., alone approximated 1 million pounds. An extensive marketing program has been successful in expanding the marketing area and in significantly increasing sales volume.

INTRODUCTION

Due to the intense fishing pressure on species in the northeast Atlantic region traditionally consumed by the public, the majority of these stocks are currently exploited near or beyond their sustainable yield levels (Rathjen, 1974). It has been suggested that one of the most promising strategies to revitalize and strengthen the U.S. fishing industry is through the development of underutilized fishery resources (Government Accounting Office, 1975). Ocean pout, *Macrozoarces americanus*, which make up about 35 percent (by weight) of the industrial ground fish landed in southern New England and 46 percent of that landed in the Middle Atlantic States (Holmsen, 1973), is a prime example of an underutilized resource. While only 14×10^6 pounds were landed in both regions commercially in 1973, recent investigations (Orach-Meza, 1975) suggest the maximum sustainable yield (MSY) may be as high as 72×10^6 pounds in the region of its geographic distribution.

Previous efforts to market ocean pout as a food fish were conducted during 1943 and 1944 as a result of the war conditions (Olsen and Merriman, 1946). The incidence of parasitic lesions and a concomitant public health embargo caused ocean pout to be relegated to a trash fish. Recent investigations (Sheehy et al., 1974) reexamined the incidence and distribution of the lesions and suggested that proper candling of fillets together with improved

Sheehy Shenouda Alton Saila

Constantinides

Daniel J. Sheehy, Aaron J. Alton, Saul B. Saila, and Spiros M. Constantinides are with the Graduate School of Oceanography, University of Rhode Island, Kingston, RI 02881. Soliman Y. K. Shenouda is with the Northeast Utilization Research Center, National Marine Fisheries Service, NOAA, Gloucester, MA 01930.

processing practices could serve to reinstate ocean pout as a food fish.

The current situation of declining coastal fish stocks, increased prices for imported fishery products, and forthcoming implementation of the 200-mile zone of economic jurisdiction serve to focus attention on the need for rational and efficient use of our available fishery resources. It is the purpose of this paper to describe a coordinated effort by fishery, food science, processing, and marketing staffs at the University of Rhode Island (URI), in cooperation with commercial interests, to develop the ocean pout fishery.

FISHERY INVESTIGATIONS

Methods and Materials

A tagging study was initiated in order to determine the growth and movements of ocean pout found at one specific site. Survey trawling, begun in early March 1975, was conducted in several areas of Block Island and Rhode Island sounds in order to locate a concentration of ocean pout that was dense enough for efficient tagging (Fig. 1). Small numbers of ocean pout were encountered off Charlestown, R.I. (A), the "east edge of the southwest grounds" (B), and "the Torpedo Range" (C). High concentrations were found east of Sandy Point, Block Island, in the area known as "Cow Cove" (D), and this site was selected for the tagging study.

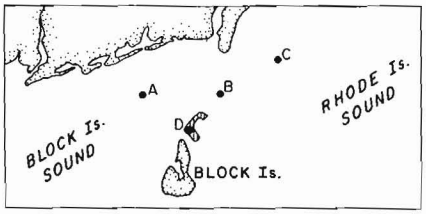

Figure 1.—Sampling locations in Block Island and Rhode Island sounds.

A total of 3,000 fish were collected and tagged. With the exception of 86 fish tagged off Charlestown, all were collected on identical 75-minute trawls in Cow Cove made during the period of 5 March to 11 April 1975.

The RV *Dulcinea,* a 13-m trawler equipped with a scaled down "Yankee 35" trawl net was used for the study. The net had a spread of about 6.1 m and lifted about 1.2 m off the bottom. The wings were fabricated of 10.2-cm mesh, and a 8.8-cm mesh bag liner was used to retain small specimens.

A numbered yellow dart tag 9 cm long bearing the legend "Reward-GSO 21 URI" was used. The tag was inserted in the dorsal musculature somewhat anterior to the midpoint of the fish on the left side (Fig. 2). The last 100 fish were also tagged with a yellow Peterson disk tag (2.5-cm diameter) in order to get a field estimate of tag loss. The Peterson tags were applied through the dorsal musculature just posterior to the dart tag.

Quinaldine was used as an anesthetic during tagging. It was mixed with an equal portion of acetone and diluted to a concentration of 1 part per 300,000. With this dosage, immobilization occurred in about 7 minutes, at which point the fish were tagged and measured to the nearest millimeter. Recovery time was about 15 minutes and fish were then returned to the sea in the same area in which they were captured.

Laboratory tests were undertaken in order to estimate tag retention and tagging mortality. On 18 March 1975, 100 fish selected from the catch by using a table of random numbers were anesthetized, measured, and tagged at sea in the normal manner. The fish were then transported in a fiberglass tank equipped with air and running seawater to the Marine Experiment Station, Rhode Island, and placed in four 535-liter running seawater tanks. This experiment was terminated on 19 May when a breakdown in the seawater system caused some mortality. The fish were then sacrificed to determine the sex ratio in the 18 March 1975 catch.

A $5.00 reward was offered for the return of tagged fish. Reward posters were widely distributed from Canada to New Jersey with the assistance of the Point Judith Fisherman's Cooperative, National Marine Fisheries Service (NMFS) port agents, bait shops, charter boat captains, Marine Advisory Service agents, and personal communication with local fishermen. Publicity generated by the other aspects of the project also included a reference to the tagging program.

A series of eight survey scuba dives were conducted at several sites near Cow Cove during the period of May to August 1975 to determine if ocean pout remained in the area during the summer months. Rocky areas not vulnerable to commercial trawling were chosen. The sites ranged from a depth of 12 - 34 m and were monitored on a biweekly basis.

Figure 2.—Ocean pout with dart tag.

All fish returned via commercial trawlers during both 1975 and 1976 were examined and sexed when possible. In addition a random sample for sex determination was taken from the RV *Dulcinea* catch on 15 April 1975 and 22 March 1976.

Results and Discussion

Movement

At the end of the first season, 1 June 1975, a total of 247 tagged ocean pout were recovered. One hundred and twenty-five of these fish were recovered during the later phases of the tagging operation in Cow Cove. The tag numbers of these fish were recorded and they were rereleased. In addition, 122 fish were recovered after 11 April when tagging operations were complete: 120 by local commercial trawlers, 1 by a sport fisherman, and 1 from a lobster trap. Ninety-six percent of these 122 recaptures occurred before 15 May 1975 and were within 2 nautical miles of Cow Cove, indicating little movement during the fishing season. Some of the later (after 15 May 1975) returns seemed to indicate some small scale dispersion from the Cow Cove area, mostly to the northeast. However, these returns were few in number and no significant conclusions can be drawn.

Divers observed some ocean pout in the rocky areas near Cow Cove through mid-June 1975. These later surveys recorded ocean pout only in the deeper areas (>25 m). Ocean pout were observed under rocks and in depressions in the sand. While actual sightings were few in number, ocean pout were present in nearby areas later in the season than they occurred in inshore commercial trawl catches. No pout were observed in Cow Cove trawls after late May and none were observed by divers after July 1975.

Oviatt (pers. commun.) reported that ocean pout were observed during submersible dives 9 miles SE of Block Island in 93 m during dives in June, July, and October 1970. The pout were observed around collections of scallop shells and near boulders on a fine sandy bottom. In addition juvenile pout 7.6 cm in length and less were seen inside a number of scallop shells. Sheehy (1975, 1976) has noted that ocean pout have occupied artificial lobster shelters in the Charlestown and Block Island areas into late May.

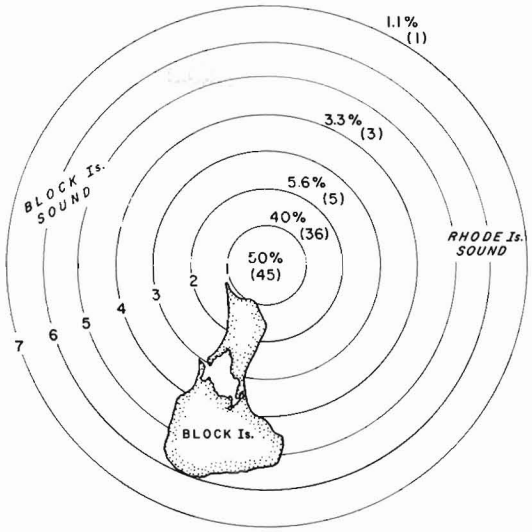

Figure 3. 1976 tag returns. Percent and number ( ) fish returned; concentric circles are nautical miles.

Returns of tagged ocean pout during the 1976 season began in early February and continued through mid-May. Again, the majority of the 106 tagged fish returned were caught by commercial trawlers operating in or near Cow Cove. Figure 3 shows the distribution of returns around the original tagging site. Ninety percent of the recovered fish were captured within 2 nautical miles of the tag point and none were recovered more than 8 miles away.

Results demonstrate little long-term movement of ocean pout during the 1-year period. This supports studies done by Orach-Meza (1975) using meristic and morphometric variations, which suggested that distinct unit stocks of ocean pout existed with little apparent mixing. While the whereabouts of ocean pout during the period from June to December is still not completely clear, it seems likely that they make local movements to deeper water in areas not vulnerable to trawling due to rocks and boulders.

Growth, Size, and Sex Composition

Ninety-six of the fish returned during 1976 were useable for growth calculations. A computer program developed by Fabens (1965) was utilized to fit the von Bertalanffy (1960) growth curve to the size at recapture data in order to establish the rate of growth. This program takes advantage of the special properties of the exponential growth curve which permits k (a measure of the intrinsic growth rate) and a (asymptotic length) to be determined from data only on sizes at known time differences with no knowledge of absolute age. The parameter b (which is related to the size of the fish at birth) cannot be estimated from recapture observations alone and some observations of sizes at known ages must be supplied to determine b. This program computes the parameters k and a by an iterative least squares technique and then accepts additional data to compute the parameter b. The average estimated sizes at birth, 6 months, and 1 year (3.0, 6.5, and 13.2 cm, respectively) used in this study were based on Olsen and Merriman's (1946) study. The growth curve resulting from this analysis is presented in Figure 4. The computed values of the parameters are $a = 69.3$ cm, $k = 3.43 \times 10^{-4}$, and $b = 0.95$ cm.

The results indicate a relatively slow growth rate for ocean pout from Rhode Island waters. The mean lengths by age differ significantly from those reported previously by Sheehy et al. (1974), Draganik and Zukowski (1966), and Olsen and Merriman (1946) but compared favorably with the work of Clemens and Clemens (1921). All of these

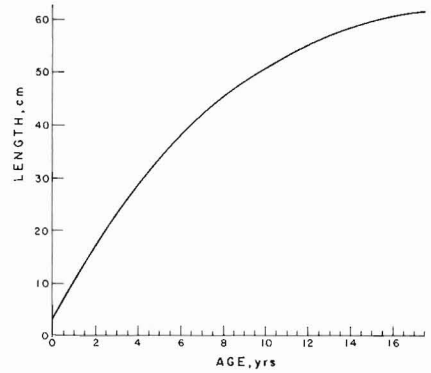

Figure 4.—Rate of growth of *Macrozoarces americanus* from tag return data.

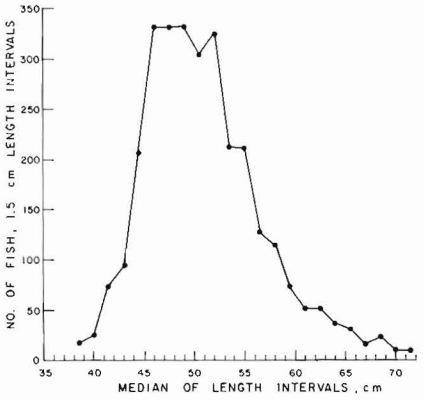

Figure 5.—Length frequency plot of tagged ocean pout, *Macrozoarces americanus*.

other studies were based on age determinations made by otolith analysis which are subject to some variation in the interpretation of the central kernal. The variation may also be attributable to geographic (Draganik and Zukowski, 1966) and/or temporal (Olsen and Merriman, 1946) differences in the rate of growth as well as to the influence of variable fishing pressure.

The length data on the original 3000 fish tagged was used in the BMD 05D General Plot Computer Program (Dixon, 1974) to construct the length frequency plot presented in Figure 5. The results indicate that the bulk of the catch is between 43 and 60 cm in length. The plot is slightly positively skewed. Based on the growth curve in Figure 4 this would indicate that most of the catch is composed of individuals between 7.5 and 16 years old.

Table 1 presents the sex composition of samples in Rhode Island waters from various sources. The samples taken on

Table 1.—Ocean pout sex ratios.

Sample date(s)	Sample size	Males	Females	% males in sample
Feb. and Mar. 1976	531	241	290	45
15 Apr. 1975	401	185	216	46
19 Apr. 1975	120	55	65	46
22 Mar. 1976	67	31	36	46
all 1976 returns[1]	61	18	43	30

[1]All returns which could be sexed.

15 April 1975 and 22 March 1976 were selected at random from the catch taken from Cow Cove by the R V *Dulcinea*. The 19 April 1975 sample was selected at random from the catch taken from Cow Cove by the FV *Two Brothers*. The 1972 data was taken from a previous study (Sheehy et al., 1974). The 1976 returns are the sum of all tagged fish returned during 1976 from which the sex could be determined. All samples were taken with trawls which had a 3.8 cm bag liner. The data indicate a slight preponderance of females which is consistent over all samples except for the 1976 returns. This slight preponderance of females may be due to the increase in girth of these females due to egg development which would cause a greater number of smaller females to be retained in the mesh of the net. Females may thus be vulnerable to fishing effort for a longer period.

Tag Mortality and Retention

Laboratory tag loss and mortality studies indicated that ocean pout were quite hardy. No mortality attributable to handling or tagging was experienced. A 5 percent tag loss appeared to be primarily the result of feeding activity and abrasion on tank fixtures. Several tags were observed while being pulled out by other fish during daily feeding.

The returns of those fish which were originally doubly tagged are presented in Table 2. The returns are broken down by year and by whether or not a tag was missing, as well as by indications as to the relative age of scars. While only 3.3 percent of the tagged fish had double tags, almost 15 percent of the fish returned (after tagging operations were complete) were originally double-tagged. This clearly demonstrates that the addition of the Peterson tag significantly increased the probability of return. This could be due either to the increase in net retention caused by the tag or to the increased visibility of these tags. The ratio of dart tag loss to Peterson tag loss was about 3:1 for both years. Eighty percent of Peterson losses were recent (probably in capture) while 57 percent of the dart tag losses were recent. Sixty-one percent of the double-tagged fish returned had a tag missing.

Summary and Conclusions

A recent survey of available data by Orach-Meza (1975) confirmed earlier studies which indicated that ocean pout are a substantial resource off the coast of southern New England. An indirect estimate, based on studies of trawl efficiency, of the percentage of ocean pout which are discarded from the commercial and NMFS survey trawls suggests a maximum sustainable yield of about 72 $\times$ 10^6 pounds (Orach-Meza, 1975).

The tagging studies described in this paper support meristic and morphometric analysis (Orach-Meza, 1975) by providing evidence that there are distinct stocks of ocean pout which undergo little mixing. Apart from the seasonal movements into deeper or rocky, nontrawlable areas, there is no evidence of any large-scale movements by ocean pout.

Results of this study demonstrate that ocean pout are a relatively slow growing, long lived species in Rhode Island waters and are vulnerable to fishing effort for up to 10 years. The fact that they also have a low fecundity (Olsen and Merriman, 1946) and that females may be vulnerable longer than males strongly suggest that careful monitoring of the catch may be vital to the

Table 2.—Return of double tagged ocean pout.

		Number missing dart tag				Number missing Peterson tag				
		Scar type				Scar type				
Year	Number with both tags	Recent	Old	None	Subtotal	Recent	Old	None	Subtotal	Total
1975	10	3	0	0	3	1	0	0	1	14
1976	4	5	4	2	11	3	1	0	4	19
Total	14	8	4	2	14	4	1	0	5	33

effective management of this resource.

If a significant fishery for ocean pout develops, additional information on this species should be obtained. In particular, a direct, more accurate estimate of the biomass and MSY are recommended. In addition, efforts to more completely identify unit stocks and to define the age-fecundity relationship should be undertaken.

CHEMICAL ANALYSIS, PROCESSING AND ACCEPTABILITY

Methods and Materials

The chemical characteristics, processing time, yield, and acceptability of ocean pout for human consumption were examined.

Labor and Rate

A rate study to determine the required processing time for ocean pout was accomplished by using skilled filleters and a commercial deskinning machine normally used in deskinning flounder. No adjustment to the blades was needed to accommodate ocean pout on the deskinning machine. One operator was used to operate each machine.

A batch of about 550 kg of ocean pout was used in this study and the rates of the following steps were recorded:

1) Filleting: The process included picking up the fish from the feeding conveyor belt, filleting the two longitudinal fillets (the cut started 7.5 cm behind the head bone), delivering the fillets onto the conveyor, and discarding the waste into the waste slot. One knife sharpening period of 4-5 minutes was also included.

2) Deskinning: The work included feeding the fillet into the machine and monitoring machine operation.

Candling and Lesion Occurrence

Candling was accomplished with a specially designed candling box which used a variable intensity (22-94 W) fluorescent light source. The box was fabricated of Plexiglas[1] and had a frosted Lexan top which permitted lesions to be cut out while the fillet was on the box (Fig. 6). The unit was electrically insulated to prevent shock and could be placed directly on the conveyor line. Three boxes were made locally at the Engineering Instrument Shop at URI.

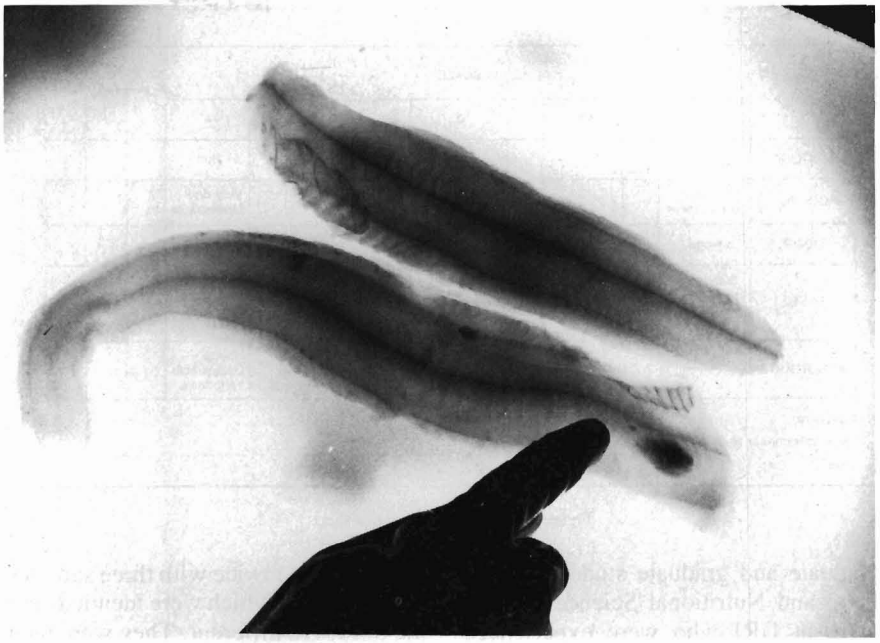

Figure 6.—Photograph of candling box. Finger pointing to a lesion (dark spot) in lower fillet.

Figure 7.—Commercial filleting operation.

A random sample of 204 ocean pout fillets was examined by candling to determine the average occurrence of parasitic lesions.

All ocean pout landed during the study for human consumption were candled and visible lesions were removed.

Yield

The yield, in terms of deskinned fillets, was determined both in the laboratory and on a commercial filleting run conducted at the Point Judith Fisherman's Cooperative Association in Galilee, R.I. (Fig. 7). Laboratory processing was used to determine the yield for each of the following three steps: 1) beheading and eviscerating, 2) filleting and deskinning, and 3) removal of lesions. The commercial test run was conducted to determine the normal production yield of deskinned and candled fillets which could be expected in regular processing operations.

Taste Panel Evaluations

Samples of ocean pout fillets were organoleptically evaluated through a series of taste panel tests, with flounder fillets (*Pseudopleuronectes americanus*) used as reference samples. These tests were conducted with under-

[1]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

	SCALE									SAMPLE CODE		
	+4	+3	+2	+1	0	−1	−2	−3	−4			
TEXTURE	Hard				Optimum				Soft			
COLOR	Very pale Undesirable				Desirable				Very dark Undesirable			
ODOR	None		Slight		Moderate		Intense		Undesirable			
TASTE	Bland Faint Lacking the taste		Slightly desirable		Pleasant		Slightly undesirable		Very fishy Bitter Rancid Undesirable			
AFTERTASTE					No aftertaste Pleasant aftertaste				Strong Undesirable aftertaste			

Comments:

Panelist Name (or Number):

Date:

Figure 8.—Organoleptic score sheet.

graduate and graduate students of the Food and Nutritional Science Department at URI who were experienced with taste panel procedures. The recommendations for selecting panelists, performing the taste tests, and analyzing the data statistically were performed according to Larmond (1970).

Fresh fish (landed the same day) were used for all tests. Ocean pout and flounder fillets were cut into 6 × 8 cm portions, then steamed or battered and fried (according to the test procedure), and presented warm to the panelist. Each panelist received a tray with the prepared samples for his or her evaluation.

Three separate tests were conducted, with a different scoring procedure used in each. The first test was designed to determine the general acceptability of ocean pout fillets. Batter fried samples (Run A) were evaluated using a descriptive 9-point hedonic score sheet with 9 as "extremely acceptable".

In order to investigate specific characteristics of ocean pout, a special score sheet (Fig. 8) was designed for the second test. This sheet had descriptive terms accompanying numerical scores from +4 to −4, with the most desirable properties rated 0 and the extremes on either side. Steam cooked ocean pout and flounder (Run B) were tasted by 11 panelists.

A triangle test was conducted (Run C) to determine if panelists could distinguish between ocean pout and flounder. In this test each of the 11 panelists was presented twice with three samples of fish, two of which were identical and the third was different. They were then asked to distinguish which sample was different.

Chemical Analysis

Protein, moisture, and ash content of whole fish were determined according to Association of Official Analytical Chemists methods. Nonprotein nitrogen was measured as cited by Shenouda (1966). Total lipids were determined using the method of Bligh and Dyer (1959). A composite ground sample was used for each month's analysis. The sample consisted of 10-12 fresh fillets which were passed through a meat grinder three times.

Fatty acid composition was evaluated by esterifying the extracted lipids for gas liquid chromatography (GLC) according to Metcalf et al. (1966), and was separated by using an 8 ft × ⅛ in internal diameter stainless steel column packed with chromosorbe-W (80-100 mesh) and impregnated with 10 percent diethyl glycol succunate. The conditions of separation, using a Varian GLC with a hydrogen flame detector, were as reported by Hornstein et al. (1967). Standard references for fatty acid esters (Supelco Inc., Pa.) were used in identifying the fatty acids.

Total cholesterol in the fillets was determined spectrophotometrically as described by Tu et al. (1967) and modified by Wybenga et al. (1970).

Results and Discussion

Labor and Rate

The results of the processing time study were as follows: the rate recorded for the filleting operation was 160 fish/h/laborer or 150 kg/h/laborer. This filleting rate is considered exceptionally high when compared to other fish species such as flounder, 45-55 kg/laborer/h, or white fish (cod, haddock, pollock), 60-65 kg/laborer/h.

The rate recorded for the deskinning operation (one laborer per machine) was 600 fish/h/machine/laborer. This rate is dependent, of course, on the type of machinery used. The direct use, without readjustment for ocean pout, of deskinning machines such as those used for flounder will enable processors to alternate from one species to another without complicating the daily flow rate.

Candling and Lesion Occurrence

Parasitic lesions were detected in 12 of the 204 fillets examined by candling. This represents a 6 percent occurrence in fillets. This value was comparatively lower than earlier reported values (Olsen and Merriman, 1946; Sheehy et al., 1974) which is probably attributed to differences in filleting, processing, and candling techniques as well as variation in fishing grounds and season.

While this study did not investigate the localization of lesions in a specific region of the fillets, Sheehy et al. (1974) reported that the incidence of lesions in the anterior ventral portion of the fillet was significantly higher than elsewhere. Similar observations were made by Olsen and Merriman (1946).

The infected areas, detected by candling, were cut out (with surrounding flesh) as narrow strips in such a way as to maintain the regular shape of the fillets. Consequently, the occurrence of lesions did not greatly affect the final yield. Similar candling and removal procedures are currently used in the processing of ocean perch and cod.

Yield

Laboratory processing of ocean pout with an average weight of 894 g/fish resulted in an average of 45 percent loss in the beheading and eviscerating steps. Filleting and deskinning (by hand) re-

Table 3.—Means of scores of organoleptic evaluation of deep-fried ocean pout and flounder fillets.

	Ocean pout	Flounder
Taste	8.2	7.9
Texture	8.8	7.2
Appearance	8.9	7.6
Odor	8.1	7.9

Hedonic scale of 9 points.
Number of panelists = 9.
Samples were battered and deep-fried in vegetable oil.

Table 4.—Means of scores of organoleptic evaluation of steam-cooked ocean pout and flounder fillets.

	Flounder (x)	Ocean pout (y)
Texture	+0.03	−0.03
Color	+0.55	+0.05
Odor	+0.09	0.00
Taste	+0.50	−0.11
Aftertaste	−0.30	−0.49

Samples were wrapped in aluminum foil, and steamed at 250°F for 17 minutes.
Number of panelists = 11.
Score (+4 to −4) with maximum acceptance at zero.
Statistical analysis: Taste, $xy\,t_{(57)} = 1.72$; texture $xy\,t_{(56)} = 0.89$. Therefore there is no significant difference ($t_{0.04\,(57)} = 2.39$)

Table 5.—Triangle test, difference analysis. Ocean pout versus flounder. R = right; X = wrong.

Panelists	First run	Second run
1	R	R
2	R	R
3	X	R
4	X	R
5	R	R
6	R	X
7	R	R
8	R	R
9	R	R
10	R	X
11	R	R
Total 11	9 R	9 R

First run: Two ocean pout samples and one flounder.
Second run: Two flounder samples and one ocean pout.
Consulting statistical charts (Larmond, 1970), for 22 panelists in triangle test, 18 correct judgments are significant at 5 percent level.

sulted in an additional 25-30 percent loss in weight. Thus the maximum yield in terms of carefully deskinned fillets was 30 percent of the original whole fish weight. Weight loss on removal of occasional lesions due to parasites was less than 1 percent.

A commercial filleting run was performed with 114.3 kg of fresh ocean pout, with an average weight of 1.09 kg/fish. The average yield in terms of deskinned fillets was 22 percent of the original whole fish weight. The yield could be increased up to 30 percent by starting the cut closer to the head; however, this resulted in an increase in labor time.

The yield of fillets varies with the fish species, but generally ranges from 20 to 40 percent of whole fish weight. Fish characterized by a large head and belly, such as ling cod and ocean pout, would be expected to fall in the lower part of the scale. For comparison, the yield of other species was 23 percent for cod, 30 percent for English sole, and 31 percent for flounder (Martin, 1976).

Table 6.—Chemical analysis of ocean pout fillets during the catch season. Values are averages of duplicate runs.

	Moisture (%)	Protein[1] (%)	Lipid (%)	Ash (%)
January (1975)	81.75	17.35	0.81	1.13
February	83.20	14.60	0.77	1.10
March	82.05	15.94	0.83	1.08
April	80.62	16.67	0.86	1.14
May	78.32	18.64	1.29	1.21
Average (variance)	81.19 (2.73)	16.64 (1.47)	0.91 (0.03)	1.13 (0.00)

Nonprotein nitrogen	314 mg NPN/100 g flesh
NPN/TN	11.76%
Cholesterol, fillets	52 mg/100 g fillets
Cholesterol, liver	197 mg/100 g liver (13.03% lipid)

[1]Protein = total nitrogen × 6.25.

Taste Panel Evaluations

The results of the first taste panel evaluation of ocean pout, prepared in the way common to the American consumer, i.e., battered, breaded, and deep fried (Run A), are presented in Table 3. Ocean pout fillets were rated over 8 points on a 9 point hedonic scale and were equally acceptable as flounder fillets in terms of taste, texture, appearance, and odor.

Table 4 contains the results of the second taste panel test which used steam-cooked fillets (Run B) to evaluate the unmasked characteristics of ocean pout. Results clearly demonstrate that ocean pout exhibits the desirable organoleptic parameters of taste, aftertaste, odor, texture, and color as their mean values were centered around zero and no objectionable remarks (extreme − or +) were reported by the panelists (standard deviation of 0.66). There was no significant difference in acceptability between ocean pout and flounder in the parameter tested.

Triangle test results (Table 5) indicate that the panelists generally could distinguish between ocean pout and flounder fillets. This demonstrates that the high acceptability of ocean pout was due to its own organoleptic characteristics rather than by its close resemblance to flounder.

Chemical Analysis

Analysis of ocean pout fillets for protein, lipids, ash, and moisture is presented in Table 6. Ocean pout is considered a very lean fish with an average of 1 percent lipid content. The average moisture, protein, and ash composition was 81.2 percent, 16.9 percent, 1.1 percent, respectively. It was also observed that there was no significant variation in the chemical composition of the fillets during the fishing season (January-May).

Table 7.—Fatty acid composition of lipids extracted from ocean pout fillets. Values are from a single run.

Fatty acid[1]	Percent
8:0	8.03
14:0	4.39
15:0	traces
16:0	24.86
16:1	11.53
17:1	3.72
18:0	7.95
18:1	34.92
18:2	4.58

Total saturated fatty acids = 45.24%
Total unsaturated fatty acids = 54.75%

[1]Number of carbon:number of double bonds

The amount of nonprotein nitrogen (NPN) was 314 mg NPN/100 g fillets, giving the NPN/TN (total nitrogen) ratio a value of 11.76 percent. This value is in agreement with that cited in the literature (Simidu, 1961) where teleosts such as ocean pout contained 9.2-18.3 percent NPN of the total nitrogen, while the elasmobranch possess higher values (33-57 percent). Nonprotein nitrogen contributes to fish odor, flavor, and acceptability, and is also considered a good substrate for bacterial attack. No attempts were made at this stage to identify the constituents of this nitrogenous fraction.

The fatty acid composition of ocean pout lipids extracted from the fillets is presented in Figure 9 and Table 7. It is noticeable that the saturated fatty acids constitute 42.24 percent of the total fatty acids and the unsaturated fatty acids sum up to 54.75 percent, i.e., roughly a 1:1 ratio. The results could have a significant application in the product development of ocean pout. While ocean pout is a very lean fish, 50

percent of these lipids are in unsaturated form, which makes the fish vulnerable to rapid rancidity if oxidation conditions are propagated during processing.

There have been a number of investigations concerning the composition of fish muscle lipids. In general the fat consists almost entirely of mixed triglycerides. The present analysis of ocean pout indicates that there was little or no fat accumulation and in this respect it is similar to cod or haddock. In these latter two white-fleshed species, most of the total lipids (less than 1 percent) occur as phospholipid and are mostly phosphatidylcholine and phosphatidylethanolamine.

Ocean pout are similar in fatty acid composition when compared to other lean fish such as ocean perch and rockfish in that the major fatty acids present in these species are 16:0 and 18:1 (no. of carbon:no. of double bonds) which together constitute about 60 percent of the total fatty acids (Gruger et al., 1964).

Ocean pout fillets show a low cholesterol concentration (53 mg cholesterol/100 g fillets). This value is similar to or slightly lower than some popular food fish species such as haddock and pollock which are 90 and 75 mg/100 g, respectively (Kritchevsky et al., 1967). Ocean pout has a considerably lower cholesterol content than shellfish such as oysters (150), shrimp (200), lobster (170), clams (190), and crabs (140 mg/100 g flesh) (Kritchevsky et al., 1967). Interest in cholesterol content in food has been stimulated by the concern for designing low cholesterol diets and ocean pout could provide a useful addition in these diets.

Summary and Conclusions

Ocean pout, an underutilized fish species, exists in New England waters and produces a lean, highly acceptable fillet.

The fish is potentially a good resource for the commercial fish market since it is abundant in the winter, it does not require special filleting machinery or major alterations in existing filleting lines used for other fish, and it gives a yield and labor rate which is commercially acceptable.

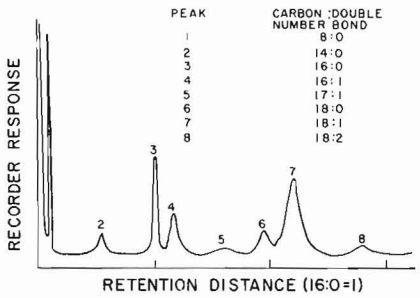

Figure 9.—Fatty acids of ocean pout lipids.

Work is now in progress covering the shelf life of fresh fish and the stability of frozen items. Studies are also underway for developing different product forms and investigating the heating and shrinkage patterns of the fish flesh and the proteolytic activity of the parasitic lesions.

MARKETING

Methods and Materials

The 2-year goal of the marketing project was to develop a viable demand for fresh ocean pout fillets within a limited geographical area. The development of a reasonable degree of sales volume was considered necessary in order to indicate the potential for success in an expanded marketing program covering a larger area.

The marketing program consisted of two phases. During the first year of the project the important areas of concern were the determination of the target market and assessment of product acceptability by the target market. The major emphasis during the second year was on expansion of test marketing through normal distribution channels and consideration of pricing and promotional plans. Throughout the project, a concerted effort was made to insure that the name "ocean pout" was used consistently, rather than any of a variety of local terms which could have detrimental connotations.

First Year Preliminary Evaluation

Initial results from the laboratory taste panel studies, which were conducted in the Food Science Department, gave strong indications of the high quality and potential consumer acceptability of ocean pout fillets. The target market was defined as those households in which fresh fish was consumed. The first year's testing concentrated on two critical aspects: 1) consumer reaction to an unidentified ocean fish (pout) served within the home, and 2) consumer and industry reaction to ocean pout merchandised in selected retail fresh fish markets.

Consumer reaction to fresh (unidentified) ocean pout fillets A random sample of 29 households was selected from the telephone directory serving the two adjacent towns of South Kingstown and Narragansett, R.I. A second random sample of 27 households was selected in a similar fashion from North Kingstown, R.I.

The homemakers, who were contacted by phone, agreed to cook and serve the test fish (ocean pout, not identified to the homemaker) in his or her customary fashion. The fresh fillets were delivered free to each household. A telephone interview was conducted the day after consumption to determine the response of household members. During the interview the homemaker was also asked, "What price per pound would you be willing to pay for the fish you prepared yesterday?" As points of reference, the following actual average prices per pound of fresh fish fillets were quoted: pollock, $1.19; cod, $1.69; and flounder, $1.99. The test fish remained unidentified to the homemaker until the close of the interview.

Test marketing of ocean pout in fresh fish retail markets A limited test marketing of fresh ocean pout fillets in five Rhode Island fish retail markets was conducted. Reputable markets which were willing to cooperate in this study were chosen by the Marine Advisory Service, URI. The five markets were geographically distributed throughout the State of Rhode Island and were located in Westerly, Point Judith, Newport, North Kingstown, and Johnston.

The test market period covered 5 weeks during which time four weekly deliveries of ocean pout were made, each being on a Thursday. Each delivery consisted of a 9 kg tub of fresh fillets that was given free of charge to the markets.

Ocean pout fillets were placed on sale at prices which were based on agreements between the market manager and the marketing project research coordinator. The coordinator's point of reference was $1.69/pound. This was based on prices which homemakers had indicated that they would be willing to pay, an assessment of the price necessary to assure a reasonable fair price to the fisherman, and the typical margins for all members of the normal chain of distribution. The final price decisions with the five markets ranged from $1.19 to $1.89, and reflected an attempt to provide some insight into consumer reaction to price.

A single sheet flyer which described the ocean pout project and contained general cooking instructions as well as two suggested recipes was prepared and distributed to all the markets. One of the recipes described a quick and easy batter fried fillet method and the other was for pout almandine. A note which solicited consumer reaction and recipe suggestions was also included.

Second Year Expanded Test Marketing and Profit-Loss Comparison of Cutting Methods

Expanded test marketing The second year marketing efforts were designed to cover a geographically larger market area and used normal commercial channels of distribution. Independent retail fish markets and supermarket chain headquarters were contacted and asked to merchandise ocean pout. Backed with the results from the pilot test of the first year, presentations were made to fish market owners and supermarket chain executives. This presentation included detailing the complete in-store merchandising program and in the case of supermarket chains, preparation of ocean pout recipes at market headquarters' kitchens. The in-store merchandising program included posters, free recipe booklets, and the assistance of URI students majoring in Home Economics to prepare samples of ocean pout and talk with consumers. Students offered bite-size samples to customers, described the ocean pout project, and answered any consumer questions.

Figure 10.—Cooking demonstrations were conducted to introduce consumer to ocean pout.

Most supermarket chains and independent fish markets featured ocean pout at $1.69/pound. In other instances ocean pout was sold at $1.79 and $1.99/pound.

A publicity and public reactions program was established as part of the promotional mix. Print and broadcast media were contacted and project personnel appeared on radio and television to describe the project. Cooking demonstrations and exhibits were arranged for various groups through the cooperation of the Rhode Island Home Economics Association (Fig. 10). Food editors of newspapers in the areas in which pout was being marketed were contacted and provided with nutritional information and recipe suggestions for ocean pout.

A new information and recipe leaflet was developed which included a brief story about the project and six suggested recipes which included, "New England Style Chowder," "Rice Stuffed Pout Fillets," "Fish and Chips," "Barbecued Pout," "Ocean Pout Poached in Wine," and "Ocean Pout Skillet Dinner." These recipes provided a variety of preparation methods from which to choose and went into a little more detail than the first year flyer. In addition a blue and white logo, created by a prominent advertising agency as a public service, was developed.

Profit-loss comparison of cutting methods Based on the results of the yield analysis conducted during the first year processing study an economic evaluation of cutting methods was conducted. The original yield investigation suggested that a significant increase in yield could be obtained by making the initial cut closer to the head than was normally done in commercial processing. Because this resulted in an increase in labor time, a cost-benefit analysis of the two cutting techniques was undertaken to determine which was the most profitable.

Two replicate filleting runs were made on 22 and 23 March 1976 for each cutting method in order to determine the variation in labor, time, and fillet yield. The first method was to make the initial cut from about 7.5 cm behind the head bone (near the anal opening). The second method was to make the initial cut directly behind the head bones. Each run was made with about 137 pounds of fish and used two cutters. The yield of fillets and labor time required for each method were recorded and the data used to develop a profit and loss statement comparison of the two methods.

Results and Discussion

First Year Preliminary Evaluation

Consumer reaction to fresh (unidentified) ocean pout fillets The major findings during the first year's study may be categorized as: 1) reaction to ocean pout as a menu item; and 2) reaction to retail prices. Table 8 summarizes the reaction by family units to fresh ocean pout as a menu item. Eighty percent of the households had a positive reaction to ocean pout. The results strongly suggest that many individuals find ocean pout fillets desirable as a menu item. It is interesting to note that the results for the North Kingstown and Narragansett-South Kingstown studies are almost identical.

Table 9 presents the results of the reactions of homemakers in terms of what they would be willing to pay for the fish that they tasted. Half of the responses to "What price per pound would you be willing to pay for the fish you prepared yesterday?" indicated they would pay $1.39 or more and 44 percent of this number said they would pay $1.69 or more.

It should be noted that 67 percent of the responses were directly related to the three prices which were included for reference points during the interview. Twenty-five percent said they would pay $1.19/pound (pollock), 27 percent said they would pay $1.69/pound (cod), and 15 percent said they would pay $1.99/pound (flounder).

A positive conclusion was warranted after analysis of the family reaction to pout as a menu item and of price data. The majority of families enjoyed ocean pout, commented favorably about it, and were willing to pay a moderate price for it.

Test marketing of ocean pout fillets in fresh fish retail markets The prices of ocean pout and other fresh fish in the five markets selected for retail studies during the first year are shown in Table 10. Pout was priced at $1.19, $1.69, and $1.89/pound. Since, with rare exception, all markets sold their total allotment (about 9 kg) each week it was not possible to determine any variation in consumer response either to price or by geographical area. Although 5 weeks is not a sufficient period of time to determine the total extent of repeat purchases and inquiries concerning the availability of ocean pout by consumers, market managers did report a number of repeat purchases and inquiries. Market managers also expressed enthusiasm about the recipe flyer made available to consumers and stated that they considered it a valuable merchandising item.

The results of the test marketing of fresh ocean pout fillets in retail markets was judged to be positive. The fact that ocean pout was consistently moved at several prices at all the markets was encouraging. The repeat purchases and inquiries which developed during the 5-week period suggested that expanded marketing efforts could be successful in developing a larger, sustained market for fresh ocean pout.

Table 8.—Reaction by family units to fresh ocean pout.

	North Kingstown		South Kingstown and Narragansett		Total	
Reaction	No.	%	No.	%	No.	%
Positive	22	81	23	79	45	80
Negative	5	19	6	21	11	20
Total	27	100	29	100	56	100

Table 9.—Prices homemakers volunteered to pay for unidentified fish (ocean pout). (Number of times mentioned.)

Price per pound	North Kingstown homemakers	South Kingstown and Narragansett homemakers	Total	%	Cumulative % of total
$1.99 (flounder)	3	4	7	15	15
1.80	1	0	1	2	17
1.69 (cod)	7	6	13	27	44
1.59	1	0	1	2	46
1.50	1	0	1	2	48
1.39	0	1	1	2	50
1.35	2	0	2	4	54
1.29	0	1	1	2	56
1.19 (pollock)	8	4	12	25	81
1.09	0	1	1	2	83
1.05	0	1	1	2	85
1.00	1	1	2	4	89
0.90	1	1	2	4	93
0.79	0	3	3	6	99
Total	25	23	48		

Table 10.—Prices of ocean pout and other fresh fish fillets in selected fresh fish retail markets in Rhode Island communities.

Fish species	Johnston	Middletown	North Kingstown	South Kingstown and Narragansett	Westerly
Ocean pout	$1.19	$1.89	$1.69	$1.19	$1.69
Pollock	1.29		1.19		
Cusk			1.39		
Cod	1.89	1.79	2.09	1.59	1.89
Flounder	2.39	1.99	1.99	1.99	
Haddock	2.49		2.09		

Second Year Expanded Test Marketing and Profit-Loss Comparison of Cutting Methods

Expanded test marketing Coordination throughout the distribution channel was achieved prior to the 1976 ocean pout season. A pricing strategy which reflected adequate margins for the fishing vessels, primary handler, cutting house, wholesaler, and retailer was established. The marketing coordinator carefully monitored the distribution channel on a weekly basis throughout the season and made suggestions to the trade, participated in advertising programs, and solicited additional retail establishments.

Industry cooperation during the second year expanded study was excellent. Four major food chains and about a dozen independent markets agreed to merchandise ocean pout. Rhode Island was the initial market area. Subsequently, Long Island, nearby southern Massachusetts, and Boston were included. Additional areas were covered as other industry members began to market ocean pout of their own accord.

The complete marketing plan proved to be highly successful. Whereas no significant amount of ocean pout was landed as edible fish in previous years at Point Judith, R.I., approximately 1 million pounds were landed for human consumption during 1976. This increase was a direct result of the demand generated through this project. During

the 4-week period between 15 March and 10 April 1976, ocean pout was the most abundant species landed in Point Judith. Ocean pout accounted for 25 percent of the total tonnage during this period and accounted for as much as 61 percent of some of the 2-day landing reports.

Profit and loss comparison of cutting methods The yield data indicate that the normal cutting method (7.5 cm behind the head bone) gave an average fillet yield of 23 percent. The second method in which the cut is made directly behind the head bone gave an average yield of 33 percent. These yields are similar to the results previously cited in the processing study for commercial and laboratory filet runs, respectively.

The results of the profit-loss comparison of the two cutting methods are presented in Table 11. These calculations were made by using the current information on the cost of whole fish to the processor ($1.17/pound), the cuttinghouse price of fillets ($1.05/pound), and the labor wage of $4.00/h for an order of 119 pounds of fillets (the amount of fillets which can be cut in 1 h under the standard method [a 23 percent yield]). The data demonstrate that while the new method (B, 33 percent yield) required an additional 34 minutes of labor time (costing $2.28), the increase in yield reduced the initial cost of goods required and resulted in a $24.58 increase in the profit margin. This clearly demonstrates the economic benefits which could be derived from the adoption of this cutting method. In addition the overall yield of fillets from a fixed amount of landed fish could thus be increased by 43 percent.

Table 11.—Profit and loss statement comparison for two fillet methods.

	Cutting method A (23% yield)	Cutting method B (33% yield)
Sales	124.95	124.95
Cost of goods sold	88.06	61.20
Gross margin	36.89	65.75
Expenses (labor)	4.00	6.28
Margin	32.89	57.47

Constants: $0.17—cost of round fish/pound.
$1.05—cuttinghouse price of fillets.
$4.00.h—hourly labor wage.

Summary and Conclusions

Consumer reaction to fresh ocean pout fillets has been positive. Results indicate that consumers consider ocean pout a desirable menu item and are willing to pay a moderate price for it.

A complete marketing program has proven successful in developing a market for ocean pout. While in previous years there had been no significant landings of ocean pout for human consumption at Point Judith, R.I., approximately a million pounds were landed in 1976.

It has been demonstrated that an increased profit can be realized by changing the traditional cutting method. When processing time is increased, the yield and profit margin are significantly improved. Adoption of this method is suggested.

The seafood industry in New England has been responsive to the marketing program and cooperation has been excellent. Although considerable success has been achieved during the expanded test marketing of ocean pout in a limited area, continuation of the marketing effort is strongly recommended to insure a final success involving all sectors of the industry in a self-sustaining effort.

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