

## Mixed Species Utilization

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### INTRODUCTION

Traditionally, in the New England trawl fisheries, that portion of the catch which is not considered marketable as food fish, due to the small size of the fish or the lack of an established market, is discarded, or in some cases is taken ashore for use as industrial fish in the manufacture of fish meal or pet food. These discards represent a sizable portion of the total catch (often as high as 20 to 30 percent) (Rathjen, 1974). In most cases where they are utilized as industrial fish, the handling practices are less than acceptable by human food standards.

In light of decreasing world food supplies, it is evident that the traditional species resource is being depleted beyond its capacity to regenerate and we can ill afford to continue to discard these underutilized species. Studies designed to assess the potential utilization of the many species now discarded and increase their availability by diverting fishing effort to this resource

can relieve the pressure on the traditional resource and aid the industry in solving this problem. Improved methods of bulk holding made possible by the development of effective shipboard methods to enhance the preservation of mixed species and eliminate expensive shipboard handling will allow vessels to land large volumes of good quality, low-valued species.

Three methods of holding fish were considered other than the traditional method of icing, which presented unloading problems. They were: 1) refrigerated seawater using mechanical refrigeration and circulating brine, 2) refrigerated seawater spray requiring essentially the same equipment as in 1), and 3) chilled seawater (CSW) which uses seawater and ice to form a slush mixture requiring no mechanical equipment other than circulating pumps. The first two methods require costly equipment with the risk of mechanical failure, whereas the CSW method requires only ice and seawater

in the proper proportion with little or no maintenance. A CSW system has been successfully used for herring in the United Kingdom for several years (Anonymous, 1972).

Recognizing the fact that commercial fishermen will not sort out small amounts of low-valued species from large mixed catches, it appeared possible that mixed species could be held in CSW to maintain quality at sea. Upon arrival at port the entire mixed catch could be sorted, saving substantial quantities of food-quality fish which would normally be discarded at sea or used for fish meal.

### PRELIMINARY TESTS

Several tests were carried out in the Center to determine the effects of CSW on the quality of mixed species. Commercial samples of mixed species were held in an insulated tank in CSW. The results of these tests indicated that there appeared to be no detrimental effect on individual species when stored unsorted. All these tests showed that good quality could be maintained for several days.

### SEA TRIALS

A commercial fishing trawler was chartered to do bulk holding studies of mixed industrial fish in CSW, and in ice for periods of 1 to 3 days (Tables 1 and 2). The vessel had an insulated fish hold which was divided into two separate compartments. One compartment was to hold fish in CSW, while the other compartment was to hold fish in ice in the traditional manner.



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**Table 1.—Date, time, and temperature (°C/°F) in the CSW mix on the 2 February 1975 cruise.**

Pen no. and position of thermocouple	2/2/75 7 p.m.		2/3/75 9 a.m.		2/3/75 12 noon		2/3/75 6 p.m.		2/4/75 9 a.m.		
	At sea				In port						
1 Top	1.1	34	0	32	0	32	-0.56	31	-1.1	30	
Bottom	2.2	36	0	32	0	32	-0.56	31	-1.1	30	
2 Top	-0.56	31	0	32	0	32	-0.56	31	-1.1	30	
Bottom	0	32	0	32	0	32	-0.56	31	-1.1	30	
5 Top	-0.56	31	0	32	0	32	-0.56	31	-1.1	30	
Bottom	-0.56	31	0	32	0	32	-0.56	31	-1.1	30	
6 Top	-0.56	31	0	32	0	32	-0.56	31	-1.1	30	
Bottom	-0.56	31	0	32	0	32	-0.56	31	-1.1	30	

**Cruise data**

Charter days : 2  
 Date sailed : 2 February 1975  
 Date caught : 2 February 1975  
 Seawater temp. : 4.4°C (40°F)  
 Ambient temp. : <-1.1°C (30°F)  
 Date landed : 3 February 1975  
 Date unloaded : 4 February 1975  
 Weather : Calm during the day, becoming extremely rough throughout the night and return.  
 Ice : 3.2 metric tons (3.5 tons)  
 Total catch : 6,804 kg (15,000 pounds) of mixed species

**Table 2.—Date, time, and temperature (°C/°F) in the CSW mix on the 15 February 1975 cruise.**

Pen no. and position of thermocouple	2/15/75 8 a.m.		2/16/75 8 a.m.		2/16/75 3 p.m.		2/16/75 9 p.m.		2/17/75 9 a.m.		2/17/75 9 p.m.		2/18/75 9 a.m.	
	At sea				In port									
1 Top	0	32	-0.56	31	-1.1	30	-0.56	31	0	32	1.67	35		
Bottom			-0.56	31	-1.1	30	-2.2	28	-0.56	31	-0.56	31	1.1	34
2 Top			1.67	35	1.1	34	0	32	0.56	33	0.56	33	2.2	36
Bottom			0	32	-0.56	31	-1.1	30	0	32	0	32	2.2	36
5 Top			-0.56	31	-0.56	31	-1.67	29	-1.1	30	-1.1	30	0.56	33
Bottom			-0.56	31	-0.56	31	-1.67	29	-1.1	30	-1.1	30	1.1	34
6 Top			-0.56	31	-0.56	31	-1.67	29	-1.1	30	-1.1	30	0	32
			-0.56	31	-0.56	31	-1.67	29	-1.1	30	-1.1	30	1.1	34

**Cruise data**

Charter days : 3  
 Date sailed : 15 February 1975  
 Date caught : 15 February 1975  
 Seawater temp. : 4.4°C (40°F)  
 Ambient temp. : 4.4°C (40°F) < 4.4°C (40°F) at night  
 Date landed : 16 February 1975  
 Date unloaded : 18 February 1975  
 Weather : Fairly calm throughout  
 Ice : 3.6 metric tons (4 tons)  
 Total Catch : 9,435 kg (20,800 pounds) of mixed species

**Table 3.—Total plate counts (TPC) of microorganisms on fish held in CSW before and after unloading and on fish held in ice.**

No.	Sample	TPC/ml
1	Seawater in hold	8.7 × 10 <sup>5</sup>
2	Seawater in hold	1.3 × 10 <sup>6</sup>
3	Fish in CSW	3.2 × 10 <sup>5</sup>
4	CSW fish after unloader	9.0 × 10 <sup>4</sup>
5	Iced control fish	1.5 × 10 <sup>6</sup>

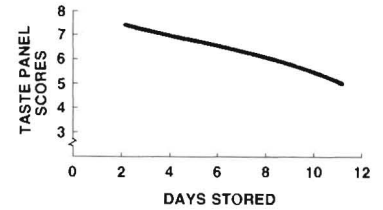


Figure 1.—Average taste panel scores for whiting in CSW.

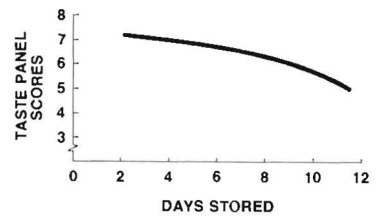


Figure 2.—Average taste panel scores for whiting in iced storage.

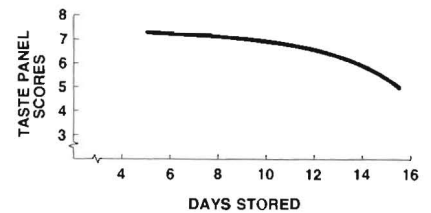


Figure 3.—Average taste panel scores for red hake in CSW.

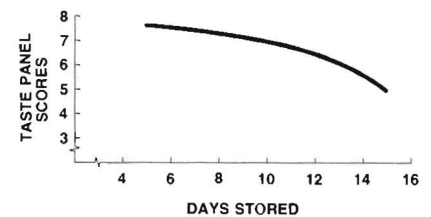


Figure 4.—Average taste panel scores for red hake in iced storage.

**RESULTS AND DISCUSSION**

At the beginning of each cruise, in accordance with previous determinations, 3.2 to 3.6 metric tons (3.5 to 4 tons) of ice were put into the compartment for CSW holding. An equal weight of seawater was then added. This made a slush mix of sufficient quantity to hold 10.9 metric tons (12 tons) of fish.

Iced storage studies to compare the subsequent shelf life of fish held by the two methods were done after the 2 to 3 days of holding on the vessel.

In order to insure cargo stability, it was necessary to fasten each pen board securely in place. However, it was also necessary to leave a gap at the bottom of each pen and drill random holes in the pen boards to assist in equalization and provide for slow circulation of seawater. Without water-tight partitions between pens, it was necessary to alternate loading the pens to insure even

distribution and to minimize the possibility of displacing the water from a pen by overloading it.

A ratio of one part ice to one part of seawater to three parts fish by weight had previously been worked out in the United Kingdom. These ratios provided enough ice to lower the fish temperature to the desired range—enough to last the required time while holding the desired temperature range and still provide a workable slush mix into which the fish were placed (Anonymous, 1972). In our studies, we conformed as nearly as possible to these relative ratios. Temperatures were more uniform during rough weather than during calm weather due to effective, natural mixing.

Iced storage studies were conducted with samples taken from a number of trips of 2 and 3 days duration, and organoleptic evaluations were made throughout the iced storage life of the samples. Whiting and red hake were both used for evaluations, as they were the two most prevalent of the mixed species. Figures 1 and 2 compare average taste panel scores on a 9-point hedonic scale of whiting held in CSW and then stored in

ice with those of whiting stored in ice only. Figures 3 and 4 show the same comparison for red hake.

Statistical analysis of the taste panel results showed no significant difference between the spoilage rates of the fish held in CSW and the fish held by traditional means.

Microbiological tests on samples from a trip where a vacuum unloading pump was used to discharge the catch showed no appreciable difference in total plate counts between fish held in CSW before and after pumping and fish held in ice (Table 3).

The appearance of CSW fish taken out of storage after 2 or 3 days was excellent. Their surfaces were bright with good color, the eyes were clear, and the fish appeared to be in rigor. There was no extension of shelf life beyond that of the traditionally held fish.

As a consequence of their being agitated during rough weather, the fish were scaled prior to landing and, because of this, did not readily meet market acceptance standards for fresh whole fish. However, scaling does not appear to have a detrimental affect on the product and these fish could be used for additional processing.

## CONCLUSIONS

Fish held in CSW are more readily unloaded by pumping than by the traditional basket method. They can also be more economically separated after landing than at sea.

Sea trials resulted in superior quality fish, by visual observation, with shelf life equal to that of traditional icing, therefore proving several advantages to the CSW method. The only questionable disadvantage was the scaling that occurred in rough weather.

## ACKNOWLEDGMENTS

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