The 1995 Experimental Pair Trawl Fishery for Tuna in the Northwest Atlantic

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Report No. MITSG 96-17

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NOAA Grant No.: NA46RG0434
Project No.: 95-A-2

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Abstract:

We conducted an experimental tuna pair trawl fishery in the Northwest Atlantic during the 1995 season. Twelve vessels participated, making 33 paired trips between August 21 and November 5. During 420 tows, we gathered data covering environmental parameters, gear behavior, and gear handling practices and their effects on catch and bycatch. All trips but three carried NMFS observers. In general, there were two tows per night. This paper summarizes our findings.

During the experiment we monitored headrope depth and tow duration and established experimental protocols to minimize the potential for marine mammal and turtle interactions. In addition, bycatch performance criteria were in place, providing individual incentives for zero-bycatch fishing practices.

Ten trips recorded encounters with marine mammals. Only one trip recorded a turtle encounter. This bycatch level was higher than that experienced in the 1994 experimental fishery and the data suggests that new trawl nets employed by three of the pairs may have contributed to the increase. Average bycatch rates do suggest that midwater pair trawling may be the preferred method of exploiting these tuna species. In addition, data on target species size distribution demonstrates that pair trawling lands a larger fish and therefore has advantages from a tuna resource management perspective.

Introduction:

The technique of midwater pair trawling has been employed by New England fishermen on various midwater species for many years. The evolution of the method for use in exploiting large, highly-migratory pelagic fish was presented in a report describing the 1994 experimental fishery (1).

In that 1994 experimental fishery, eleven vessels working in five pairs (one vessel used an alternate vessel for one of the trips) made a total of 28 paired trips. During that season, 369 tows were made and three marine mammal encounters were reported, one of which was released alive.

An experimental fishery was organized for the 1995 season which was carried out under the same protocol developed for the previous season (2). Again, the

principal goal of this experiment was to determine the species and size selectivity of the gear and methods. A second goal was to correlate catch and bycatch levels with fishing parameters. A final goal was to identify gear and methods to reduce the bycatch of marine mammals, turtles, and undersize tunas. Twelve vessels participated in the 1995 experiment and are listed below in Table 1.

Captain	Vessel Name	Home port
John Riemer	Jason & Danielle	Pt. Judith
Jim Thayer	Luke and Sarah	Pt. Judith
Mark Phillips	Illusion	Greenport
Peter Wadelton	Katie & Meg	Greenport
Bob Soleau	Primadona	Shinnecock
Andrew Soleau	Second Generation	Shinnecock
Scott Bode	Bulldog	Pt. Judith
Paul Harvey	Ing Toffer II	Pt. Judith
Scott Trajillo	Patriot	Shinnecock
Gary Yerman	Mystic Way	New London
William Grimm	Perception	Montauk
Richard Jones	Pontos	Montauk

Table 1. Industry participants in 1995 experimental pair trawl fishery.

Gear and Methods:

The participants in this experimental fishery were required to have trawl instrumentation to provide continuous indications of headrope depth. They were required to carry NMFS observers if available and to complete detailed data sheets documenting the performance of the trawl during the tow and accounting for all catch. In addition, they gathered information on weather, water temperature , speed of tow, and course changes. The data sheet that was developed to facilitate the proper recording of this information is included in Appendix I.

All six vessel pairs used similar trawl gear. The nets have very large mesh front ends that graduate down to smaller mesh in the rear ends. The codends of most of these nets are of special twelve-inch square-mesh construction to ensure escapement opportunities for undersized fish.

In Table 2 below, the engineering parameters of the fishing systems of the six pairs are presented. The pair number in this table does not necessarily relate to the order in which the pairs are listed in the previous table.

Pair #	HP#1	HP#2	Fishing Circ.	Sounder
1	850	675	60 x 2000 cm	Furuno CN 10B x 2
2	530	415	34 x 900	Furuno 110-A
3	1000	750	60 x 2000	Furuno CN 10B
4	855	800	88 x 320	Scanmar
5	1500	1500	48 x 1596	Furuno CN 10B x 2
6	750	675	60 x 2000	Furuno CN 10B x 2

Table 2. Engine and trawl gear specifications of the participating pairs

These nets were towed by paired vessels at speeds ranging from 2.5 to 5.0 knots. When the trawl is fully deployed, tow wire lengths can vary from 200 to 300 meters and vessel separation ranges from 150 to 200 meters. Flotation or headrope kites in combination with weights on the lower wing ends provide the vertical gape. The typical design opening for these nets is 30 meters in height and 40 meters in width.

The towing depth varies and is controlled during the tow through a combination of tow wire length and vessel speed. A net-mounted transducer is essential to the proper positioning of the net in the water column. These units are mounted on the footrope aimed upwards, providing indications of the vertical gape of the net and headrope depth below the surface. Water temperature at the footrope is also displayed. In addition, most captains claim some ability to interpret the displays with respect to number and types of fish passing into the net.

Pair trawling for these tuna is a nighttime fishery. Some of the vessels remain idle or steam during the day while others that are suitably rigged engage in bottom fishing.

The 1995 experimental fishery was authorized to begin on August 20 and run until December 31. The first trip started on August 21 and the 33rd trip concluded on November 5. The same experimental guidelines used in the 1994 season were in place with respect to trawling depth and duration. Captains were required to get the net to depth as quickly as possible during the setting process. In addition, a five-fathom headrope ceiling was imposed. If the headrope readings were shallower than five fathoms for longer than 15 minutes, the net was hauled back immediately. A six-hour tow limit was imposed to improve the survivability of discards. Immediate fax transmittal of the data sheets to MIT was required to allow responsiveness to bycatch trends

This season, three of the vessel pairs made significant changes in their trawl nets. New nets were supplied by Nor'Eastern Trawl Systems of Bainbridge Island, Washington that had a 60 mesh x 2,000 cm fishing circle (1200 m circ.). Previously these vessels had used a net with a 58 x 574 cm fishing circle (330 m circ.) from Shuman Trawl of Charlestown, Rhode Island.

Results:

Trip data taken during the experiment is summarized in Table 3. The trip number, number of tows, average tow duration, average depth, number of takes, the presence of an NMFS observer, and the total number of tuna landed of all species is noted.

Trip No.	Date start	Date end	No. of tows	Avg. dur. (min)	Avg. depth (fm)	No. of Takes	Obs? Y/N	Tuna No.
1	8/21/95	8/29/95	15	237	11.2	1	N	301
2	8/22/95	8/31/95	15	246	10.4	6	Y	275
3	8/22/95	8/25/95	6	253	8.0	0	Y	238
4	8/23/95	8/29/95	12	274	11.2	0	Y	153
5	8/23/95	8/30/95	12	226	9.5	0	Y	42
6	8/25/95	8/31/95	15	233	12.0	5	Y	190
7	8/27/95	9/2/95	12	226	9.9	0	Y	397
8	9/2/95	9/9/95	14	257	10.9	0	Y	182
9	9/3/95	9/9/95	11	269	12.4	0	Y	32
10	9/4/95	9/8/95	7	294	11.0	0	Y	66
11	9/4/95	9/9/95	10	287	11.2	0	Y	43
12	9/4/95	9/11/95	16	247	11.7	0	N	108
13	9/6/95	9/16/95	20	246	10.6	0	Y	373
14	9/13/95	9/19/95	13	307	9.0	0	Y	105
15	9/14/95	9/18/95	7	283	10.1	0	Y	103
16	9/15/95	9/19/95	7	315	10.9	0	Y	69
17	9/17/95	9/19/95	6	250	11.8	0	Y	32
18	9/20/95	9/28/95	16	279	10.4	0	N	726
19	9/22/95	9/28/95	13	270	10.0	2	Y	334
20	9/23/95	10/4/95	22	299	10.2	0	Y	856
21	9/24/95	10/2/95	16	270	11.5	0	Y	613
22	9/24/95	10/1/95	15	293	10.2	2	Y	663
23	10/2/95	10/5/95	8	223	10.1	0	Y	427
24	10/3/95	10/13/95	16	299	10.0	0	Y	661
25	10/5/95	10/14/95	19	323	11.5	2	Y	515
26	10/6/95	10/14/95	17	286	11.6	4	Y	437
27	10/9/95	10/14/95	10	308	11.6	2	Y	309
28	10/9/95	10/16/95	14	301	10.6	2	Y	748
29	10/19/95	10/27/95	16	296	11.5	0	Y	686
30	10/19/95	10/25/95	12	334	11.7	0	Y	608
31	10/23/95	10/26/95	5	321	13.8	0	Y	260
32	10/24/95	10/29/95	10	333	11.5	3	Y	386
33	11/1/95	11/5/95	13	294	12.6	0	Y	474
		Sum	420			29		11,412
		Average	12.7	278.1	10.9	0.88		345.8

Table 3. Summary of trip data.

The average trip involved 6.5 days of fishing. The average tow was 4 hours 38 minutes long. The average depth of the headrope was 10.9 fathoms. All but three trips had an NMFS observer aboard at least one of the boats. There was a total of 33 pair trips and a total of 420 tows in the experiment. This represents approximately 500 vessel-days at sea.

Marine mammals or turtles were encountered on 10 of the 33 trips. During August, 11 of the 12 takes were pilot whales caught during two separate trips by two different pairs. Two bottlenose dolphin, two risso dolphin, and one leatherback turtle were caught in September. In October, 13 bottlenose dolphin were caught during five of the trips. None of this bycatch was able to be revived or could be considered viable when returned to the sea.

In reviewing Table 3, it can be seen that the trips involving takes generally were associated with respectable tuna catches, suggesting a direct association possibly based on a common feeding behavior.

Further insight can be gained by looking at data from the individual tows associated with the takes. Table 4 presents data on the date, tow duration, start location, headrope depth, and species of take. In this table, BND is bottlenose dolphin, RD is Risso dolphin, PW is pilot whale, and LBT is leatherback turtle.

Start	Start	Dura.	Location		Depth		BND	Risso	PW	LBT	New
Date	Time	(h:m)	Lat.	Long.	Min.	Avg.	No.	No.	No.	No.	net
8/23/95	20:30	4:45	39.2802	72.1256	12	12.0	1				
8/27/95	19:00	5:00	39.2635	72.1030	N/A	N/A			6		*
8/29/95	20:55	3:35	39.2500	72.0600	12	12.0			5		*
9/24/95	2:35	4:00	39.2706	72.1801	10	10.0	1				
9/25/95	2:00	4:30	39.2735	72.1774	10	10.0				1	
10/1/95	19:05	5:10	39.2900	72.1300	10	10.7		2			*
10/8/95	19:00	6:00	39.2800	72.1600	11	11.0	4				*
10/11/95	18:55	5:05	39.2800	72.0800	7	8.9	2				
10/11/95	19:00	5:30	39.3067	72.2053	9	9.0	2				*
10/14/95	0:30	5:50	39.2970	72.1460	4	14.6	2				*
10/29/95	1:00	5:30	39.2650	72.0560	5	10.5	3				*
						Total	15	2	11	1	83%

Table 4. Data from pair trawl tows involving takes.

From this table we can see that 22 of the 29 takes occurred during the evening tow vs. 7 in the morning tow. We can further note that the average duration of these tows was 295 minutes, only slightly longer than the 278 minute average noted in Table 3 for all tows. In addition, the average depth of the tows in Table 4 was 10.9 fathoms, identical to the overall experimental fishery average.

In Table 4, I have indicated with an asterisk the tows made by pairs using the new, larger trawl nets. We can see that 24 of the 29 takes were from these new nets. Indeed all 11 of the pilot whale takes involved gear in its first season of use.

Location of the takes compared to the general location of the fishery is presented in Figures 1 and 2. Figure 1 presents the latitude and longitude of the start point of all tows not involving marine mammal or endangered species. Figure 2 is a plot of the 11 tows involving takes.

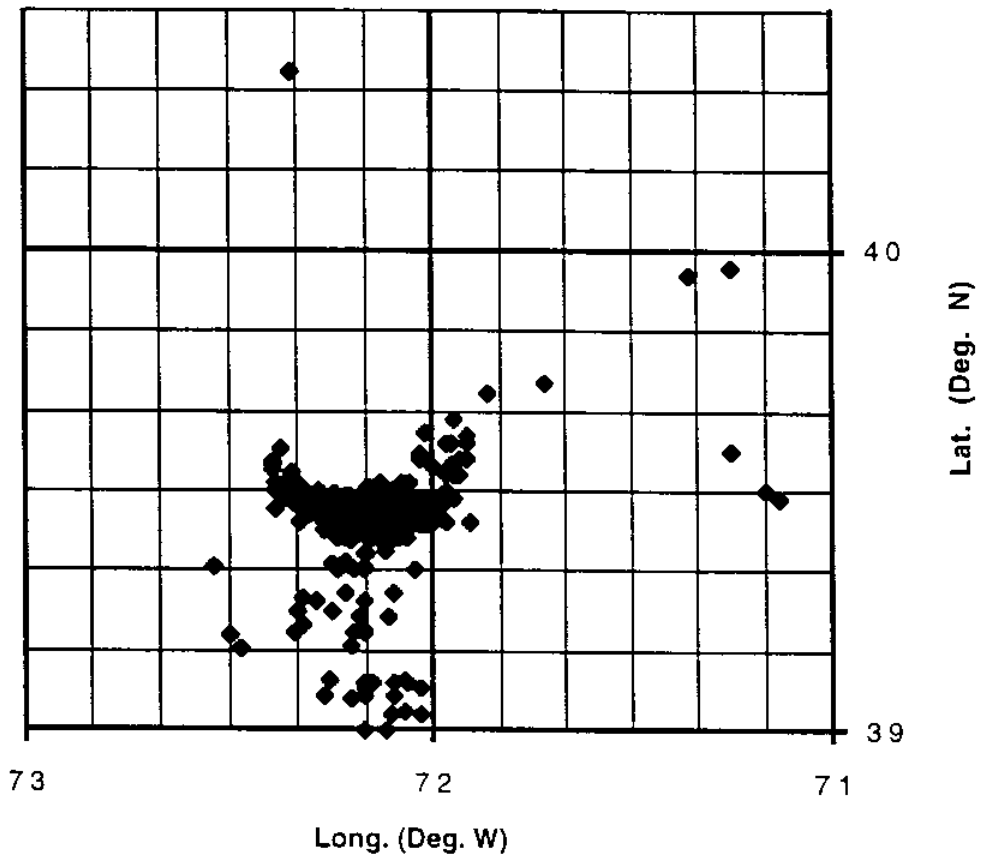

Figure 1. Location of pair trawl tows not involving takes.

The majority of the pair trawl tows shown in Figure 1 occurred along the edge of the continental shelf near the 100-fathom curve. The massing of points in the lower central portion of the figure corresponds with Hudson Canyon. Three points shown to the east of this clump and one to the north are suspect, and probably were recorded one degree off.

Figure 2 presents only the tows involving takes. Again, the clumping is over Hudson Canyon. These figures show that the take locations are within the normal bounds of the productive fishery and not isolated in a lesser portion.

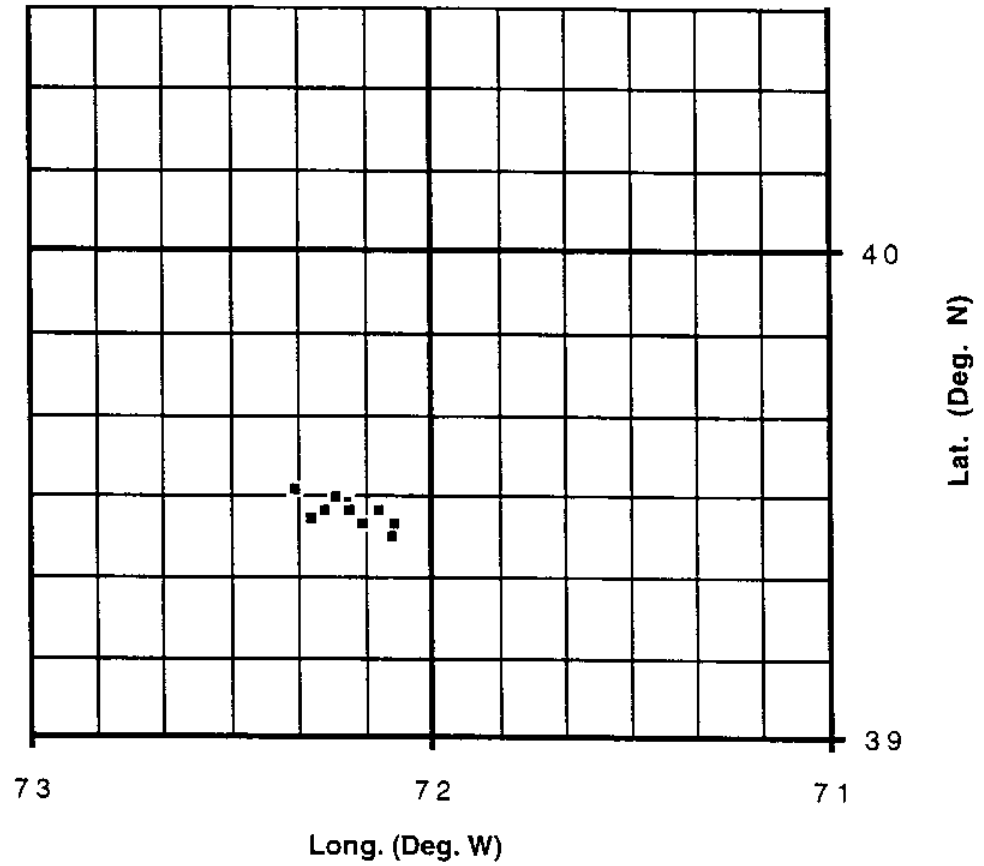

Figure 2. Location of pair trawl tows involving takes.

The tuna and swordfish catch data for this experimental pair trawl fishery is presented in Table 5. The high rate of swordfish discards is due to the two fish per vessel per trip limitation imposed on these vessels.

Species	Number of Fish		Discard Percentage
	Retained	Discarded	
Bigeye	3,853	6	0.16%
Yellowfin	1,353	77	5.38%
Albacore	6,903	338	4.67%
Total tuna	12,109	421	3.36%
Swordfish	128	294	69.67%

Table 5. Tuna and swordfish catch for all vessels, all trips.

To quantify any differences between the tuna size landed by pair trawling and the alternative methods of driftnetting and longlining, NMFS data from all three fisheries in the New England and Mid-Atlantic regions were examined.

Table 6 is based on this landing and size data for the 1995 season (3). From the comparison we can see the relative numbers of tuna landed by the three methods. Pair trawling accounts for 17.8% of the bigeye landings, 3.7% of the yellowfin landings, and 41.7% of the albacore landings.

	Number of tuna landed		
	Pair Trawl	Longline	Driftnet
Bigeye	3,220	14,844	59
Yellowfin	1,452	38,084	162
Albacore	7,110	9,757	165
Total	11,782	62,685	386

	Average tuna weight (pounds)		
	Pair Trawl	Longline	Driftnet
Bigeye	105.2	71.4	107.6
Yellowfin	56.0	43.1	39.1
Albacore	35.1	39.2	32.9

Table 6. Tuna landing data for the 1995 season.

From the average weight data we can see that pair trawling and driftnetting land bigeye which are approximately 50% larger than those landed with the more common method of longlining. For yellowfin, pair trawling yields 30% larger fish than longlining and 43% larger than driftnetting. On albacore, the average pair trawl fish size is 10% smaller than landed by longlining but 7% larger than by driftnetting.

Discussion:

The data on the marine mammal and endangered species bycatch indicate that midwater pair trawling for tuna has a low mortality rate compared to the number of targeted fish landed. The 29 mortalities seen during the 1995 experiment occurred in fewer than 3% of the experimental tows. Based on the targeted tuna catch, this is a take rate of one per 393 tuna. This take rate is considerably higher that the 1 per 3,590 tuna rate seen during the 1994 season. However the 1995 rate remains considerably lower than previously reported by Gerrior (4) or Northridge (5) for earlier seasons.

Comparisons of this take rate with the competing fishing methods is difficult since current data on the other fisheries is not yet published. However, from

earlier reports comparing the driftnet and pair trawl fisheries, the former has a take rate five to eight time greater per haul (5). There is insufficient observed data from the longline fishery (<5%) to make meaningful comparisons.

The significance of the majority of the takes occurring during the evening tow is unclear. The average start of the evening tows involving takes was 7:30 PM, well within the range found for the rest of the experimental tows. In general, early in the season the evening pair trawl tows begin around 8:00 PM. Toward the end of the season those tows start earlier and last longer as the length of daylight decreased.

The headrope depth averages and minimums for the tows involving takes were found typical of the overall fishery practice with the exception of one tow having a minimum depth of 4 fathom for the first 15 minute period. Only one vessel pair had depth recordings less than 5 fathoms and it happened eleven times during the season. While these shallow recordings were only for the first 15 minute segment of the tow, one of those eleven tows yielded two takes, a rate of occurrence that is worse than the fishery-wide rate. This vessel pair may need to be more attentive to getting their net to depth before commencing a tow.

The fact that 83% of the takes occurred with the three trawl nets being used for the first season is particularly noteworthy. Some aspect of these nets may be contributing to increased take rates.

The principal differences in these new nets and the ones the vessels used in the 1994 season is their increased size and the absence of a headrope kite. The Shuman trawls previously used had a kite positioned in the center of the headrope to provide upward lift, making the headrope center the highest part of the net. The new nets had no kites and used removable wing-end floats to provide buoyancy. These floats were inflatable polyballs which provide less buoyancy with increased depth. The result can be a net that is difficult to control vertically. At least one of the vessel pairs placed the floats on long pennants to prevent the net from being inadvertently pulled to the surface. This may be a solution the other pairs should consider if they continue to employ the nets.

A further concern with these new nets is that the wing ends may be pulled shallower than the center of the headrope. Therefore these nets may be fishing with part of the net in violation of the 5-fathom ceiling. The fishing geometry of these new nets needs to be evaluated and, if necessary, a modified headrope ceiling established to insure that all portions of the net stay below the prescribed level to help reduce the chance of encountering marine mammals or turtles near the surface.

The data on tuna and swordfish landings and discards are similar to the findings from the 1994 season (1). Fish are landed of marketable size and in good condition without the waste associated with attack by shark or other predators.

As was noted in the above report, the capture of non-targeted swordfish seems to be unavoidable. Although some can be rerturned alive, the waste associated with the regulatory discard of many of these swordfish remains unfortunate.

The size selectivity of pair trawl gear during this experimental fishery is viewed by the participants as an important measure of its effectiveness in exploiting the Northwest Atlantic tuna stocks. The landing data indicates a disproportionate amount of albacore landings with pair trawls. However, this is probably not due to albacore being particularly vulnerable to the trawl but instead is from a high albacore retention rate compared with the competing fisheries.

The larger size of bigeye and yellowfin captured with the pair trawls may be significant with respect to the wise utilization of the stock. By capturing larger and more mature fish, more value is being extracted and reproduction opportunities are increased. The smaller size of the pair-trawl albacore may again be a result of the retention of these lesser-valued fish by pair trawlers rather than their discard by smaller longliners with limited hold capacity.

It should be noted that the catch data from the experimental fishery data sheets and the NMFS fish counts from landings differ by 370 fish. This difference is only 3% and stands as a reasonable verification of both sets of data.

Conclusions:

Based on the results of the 1995 Northwest Atlantic experimental tuna pair trawl fishery, the following conclusions can be made:

1. The marine mammal take rate is one per 407 fish.

2. The marine turtle take rate is one per 11,412 fish.

3. Three vessels using new trawl nets accounted for 83% of the takes indicating a need to examine the performance of these nets with respect to the protocol in place to minimize takes.

4. Pair trawling has a low discard rate (3.4%) on tuna and yields a fish size significantly larger than the competing methods.

5. Swordfish are caught at a rate of approximately one fish per tow. A two fish per trip regulatory limit results in a discard rate of 70%.

Recommendations:

A rigorous experimental tuna pair trawl fishery has been conducted in the Northwest Atlantic for the past two seasons. The purpose has been to gather data on the method and its impacts on targeted and non-targeted species. The fishery has thus been characterized and has been shown to be effective, resource sparing and have a low take rate of marine mammals and endangered species. Therefore the following recommendations are offered:

1. Pair trawling should be included as an approved gear type for tuna in the Northwest Atlantic.

2. The protocol used during the 1994 and 1995 seasons should remain in place during future seasons.

3. Performance data is needed on the new type of net that was used by three of the pairs during the 1995 season. Until such data is available, those nets should be fished with a 10-fathom ceiling. Any other gear that is substantially different from gear that has been demonstrated to have low take rates should be scrutinized with respect to its fishing depth along the headrope and a depth ceiling imposed accordingly.

4. Any new entrants to this fishery should be required to show competence in handling the gear with a demonstrated ability to observe the take-minimizing protocol.

5. The two swordfish per trip limit imposed on pair trawlers should be reassessed with respect to its formulation. A more responsible method of preventing a directed fishery on this fully-exploited stock would be to establish a limit based on tuna catch. A reasonable criteria could be 5% of all large pelagics landed.

Acknowledgments:

The data analysis and reporting associated with this experimental fishery was supported by the MIT Sea Grant College Program through NOAA grant NA46RG0434 and with support from each of the participating pairs. The observer coverage was provided by NMFS. The cooperation of Gerald Scott, Jean Cramer and Andy Bertolino is also acknowledged. Special appreciation is noted to John Riemer of Finestkind Seafood, Paul Shuman of Shuman Trawl and Glen Cramer of NET Systems.

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Appendix 1

8/15/95

MIT Pelagic Pair Trawl Data Sheet

Center for Fisheries Engineering Research — MIT Sea Grant College Program

Boat name	1995 trip No.	Tow No.	Standard Config? Y / N	If no, describe:

Date tow began	Time tow began	Time haul back	Water temp. Deg. F.	Location (Lat-Long.)	Weather

Was this an observed tow?	Y / N	Name of observer	

Set out	speed kts	boat separation ft	Time on surface min	Comments on tide, wind, gear foul-ups, etc.

Tow	speed	boat separation	Top warp length	Time	H.R. depth	Comments on speed, separation, warp, turns, temp., etc.
First hour	kts	mi.	fm	00 Min.	fm	
				15 Min.	fm	
				30 Min.	fm	
				45 Min.	fm	
Second hour	kts	mi.	fm	00 Min.	fm	Comments
				15 Min.	fm	
				30 Min.	fm	
				45 Min.	fm	
Third hour	kts	mi.	fm	00 Min.	fm	Comments
				15 Min.	fm	
				30 Min.	fm	
				45 Min.	fm	
Fourth hour	kts	mi.	fm	00 Min.	fm	Comments
				15 Min.	fm	
				30 Min.	fm	
				45 Min.	fm	
Fifth hour	kts	mi.	fm	00 Min.	fm	Comments
				15 Min.	fm	
				30 Min.	fm	
				45 Min.	fm	
Sixth hour	kts	mi.	fm	00 Min.	fm	Comments
				15 Min.	fm	
				30 Min.	fm	
				45 Min.	fm	

Haul back	speed kts	boat separation ft	Time on surface min	Comments on tide, wind, gear foul-ups, etc.

Catch	No. kept	Average weight	No. discarded	Average weight	Comments on unusual catch results:
Bigeye		lbs		lbs	
Yellowfin		lbs		lbs	
Albacore		lbs		lbs	
Other tuna:		lbs		lbs	
Swordfish		lbs		lbs	
Other:		lbs		lbs	

Bycatch		No.	Average size	Condition	Comments on reasons for bycatch:
Dolphin	type:		lbs		
Whale	type:		lbs		
Turtle	type:		lbs		
Shark	type:		lbs		
Other			lbs		