Irish Fisheries Investigations No.20/2008

The Japanese bluefin tuna longline fishery in the northeast Atlantic: Report of an Irish observer

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ISSN: 0578-7467

Keywords: Bluefin tuna, Japanese, longliner, North East Atlantic

ABSTRACT

This paper describes an observer trip on a Japanese freezer longliner in the international waters of the North East Atlantic in the autumn of 1997. The observation period was 71 days during which 7 species were recorded as catch and bycatch from 57 sets. Although bluefin tuna was the target species, with 18,894kg gilled and gutted weight (GWT) caught, the most frequently retained species was blue shark, *Prionace glauca*, followed by bluefin tuna. Three shortfin mako shark, *Isurus oxyrinchus*, one swordfish, *Xiphias gladius* and one anglerfish, *Lophius* spp., were also recorded. The most frequently discarded species were lancetfish *Alepisaurus ferox*, and deal fish *Trachipterus arcticus*.

Bluefin tuna ranged from 139cm to 275cm in fork length (FL) and from 64kg to 347kg in round weight (RWT) with clear modes of 190cm and 136kg. Recent ageing results from the North East Atlantic infer ages of 4 to 17 years old. CPUE was lower than Norwegian sponsored trials in the North East Atlantic in 1998 and similar to those computed by the Japanese longline observer programme in 2000, 2001 and 2002. There was no evidence of trend in bluefin CPUE over the course of the observation period. The modelled length weight relationship predicted higher values than established length weight relationships for bluefin tuna in the East Atlantic: ICCAT modelled RWT for East Atlantic bluefin was 87% of the observed round weight and 90% of the predicted RWT value for Koshin Maru #8 tuna. Over the observation period the condition of bluefin tuna was found to decline and examination of stomachs showed that most were empty or contained low numbers of prey items. Declining condition factors and apparent scarcity of prey are discussed in the context of CPUE. Prey scarcity reflected in declining condition may increase the effectiveness of baited hooks causing abundance estimates derived from CPUE series to over-estimate the population of bluefin tuna in the North East Atlantic. Investigation of condition indices has the potential to estimate stock ratios in longline catches in the North Atlantic. All observed blue shark catch were female with lengths ranging from 140cm to 250cm.

Contents

INTRODUCTION

Tuna fisheries have been an important component of Irish pelagic fisheries since the late 1980s, with fishing effort focused primarily on albacore tuna, *Thunnus alalunga,* through gill nets, mid water trawls, trolls and long lines. Awareness of bluefin tuna, *Thunnus thynnus*, in Irish waters developed because of:

- the occurrence of bluefin tuna as bycatch in different pelagic fisheries (albacore, herring, mackerel and horse mackerel) operated by Irish vessels around the Irish coast and in EU waters;
- the bunkering of Japanese freezer tuna long liners in Irish ports from August to January since the mid 1990s;
- the development in the last five to six years of a catch and release sports fishery off the north and west coasts in the late summer and autumn months;
- and tagging programmes from 2002 to 2005 (Stokesbury *et al.*, 2007) in association with the development of a recreational fishery.

The International Commission for the Conservation of Atlantic Tunas (ICCAT) recognises two Atlantic stocks of bluefin tuna. These stocks have widely separated spawning areas, in the Mediterranean and Gulf of Mexico respectively and set the management boundary between them on the 45° degree meridian (Anon., 1994). The Japanese longline fleet in the North East Atlantic has prosecuted an important fishery in the North Atlantic since the 1960s and in the last two decades much of this effort has been in the North East Atlantic, between Iceland and Ireland. Since 1997 longline reported catches for the northeast Atlantic have fallen by about 65% (ICCAT, 2004). This paper presents the results of an observer trip undertaken in autumn 1997 on the Japanese bluefin tuna freezer longliner Koshin Maru #8. The aim of placing an observer on board the vessel was to obtain basic biological data on the catch and bycatch of the fishery and to record details on the locations of fishing stations and the operation of the fishing gear.

MATERIALS AND METHODS

The Koshin Maru # 8 in 1997 was a Japanese tuna freezer longliner of approximately 50m propelled by a 1500hp main engine with a 350hp auxiliary engine supplying the freezer, instrumentation and desalination systems.

Fishing took place from 56° N to 61° N and between 13° W and 25° W (Figure 1). The longline was composed of a braided multifilament mainline suspended from 400 to 420 plastic 300mm buoys on 15m of nylon rope (Figure 2). Hooks were mounted on branch lines of approximately 42m in length and tapering from 400x to 200x monofilament. Between each buoy seven leaders were attached at 40m intervals with an average of 2,880 hooks being baited for each setting of the line. The average length of line shot was estimated at 120,000m and its position in the water was monitored by a series of 12 radio buoys, with a dan buoy marking each end. Bait consisted primarily of squid, *Illex argentinus* with smaller amounts of herring, *Clupea harengus* and mackerel *Scomber scombrus*, also being used. Shooting the gear took place at dawn at an average speed of 12kts being maintained. Hauling started in mid afternoon and continued through the night taking as long as 12 hours.

The start and finish position was recorded for each set. Water temperatures were taken when possible from the console display in the bridge. The length of gear set was calculated by counting out the number of buoys, counting the number of hooks between buoys and estimating the distance between buoys.

When a bluefin tuna was brought on board it was immediately killed by destroying the brain and spinal cord with a spike and chasing wire. After death the standard ICCAT measurement of straight upper jaw to fork length (UJFL or more simply FL) was taken (Miyake, 1990a). The fish was then bled by cutting the lateral veins behind the pectoral fins and just above the caudal peduncle. The temperature of the fish was lowered by flushing the stomach with a high-pressure water jet from the deck hose and this may have also accelerated the bleeding of the fish. When the fluid exiting the vein cuts ran clear the opercular plates were removed and the connective tissue fixing the gills to the operculum were cut. The large intestine was then cut free from the vent and the gills, guts and heart drawn through the operculum in a single action. The reason behind this method is to keep the stomach cavity membranes intact and the muscle tissue uncontaminated by gut bacteria.

The tail was removed just above the caudal keel and the resultant weight (GWT) recorded in the ships log. The total weight or round weight (RWT) was obtained by adding the weight of the viscera, heart, gills, tail and gill plates to the gilled and gutted weight. The volume of blood could not be recorded. Weighing took place on the ship’s flat mechanical balance. The time and location of each capture was recorded. Whenever possible the stomach contents of bluefin tuna were examined and grouped as teleosts, cephalopods, crustaceans and others.

CPUE charts were plotted of the weight and numbers of bluefin tuna caught per thousand hooks, per set and km. The numbers of blue shark were recorded as numbers per set, numbers per 1000 hooks and numbers caught per weight of bluefin tuna. The length frequency of the bluefin tuna was plotted and descriptive statistics computed. Weight data were modelled using linear regression with the equation: $RWT=GWT(m) + c$.

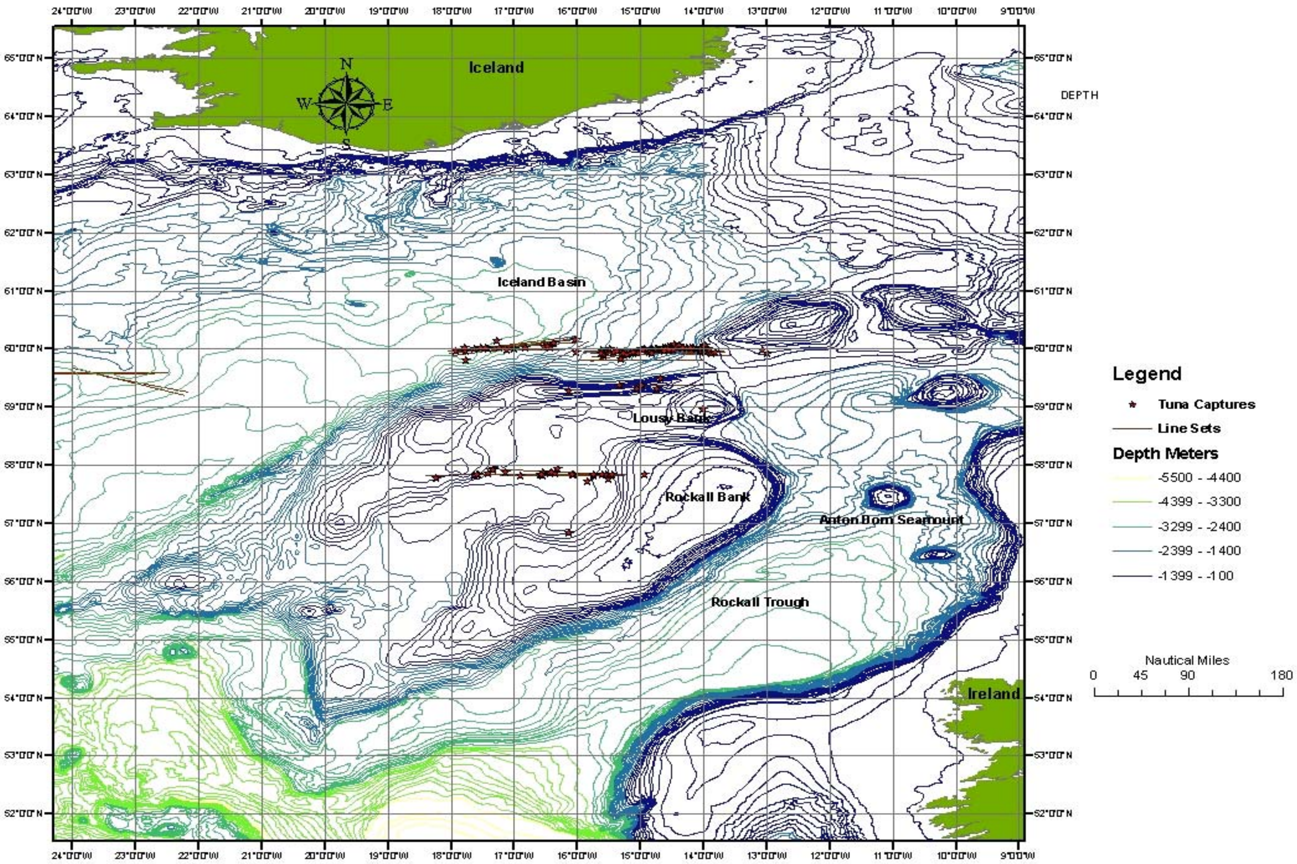


Figure 1. Longline sets and bluefin catches Koshin Maru #8 August to November 1997.

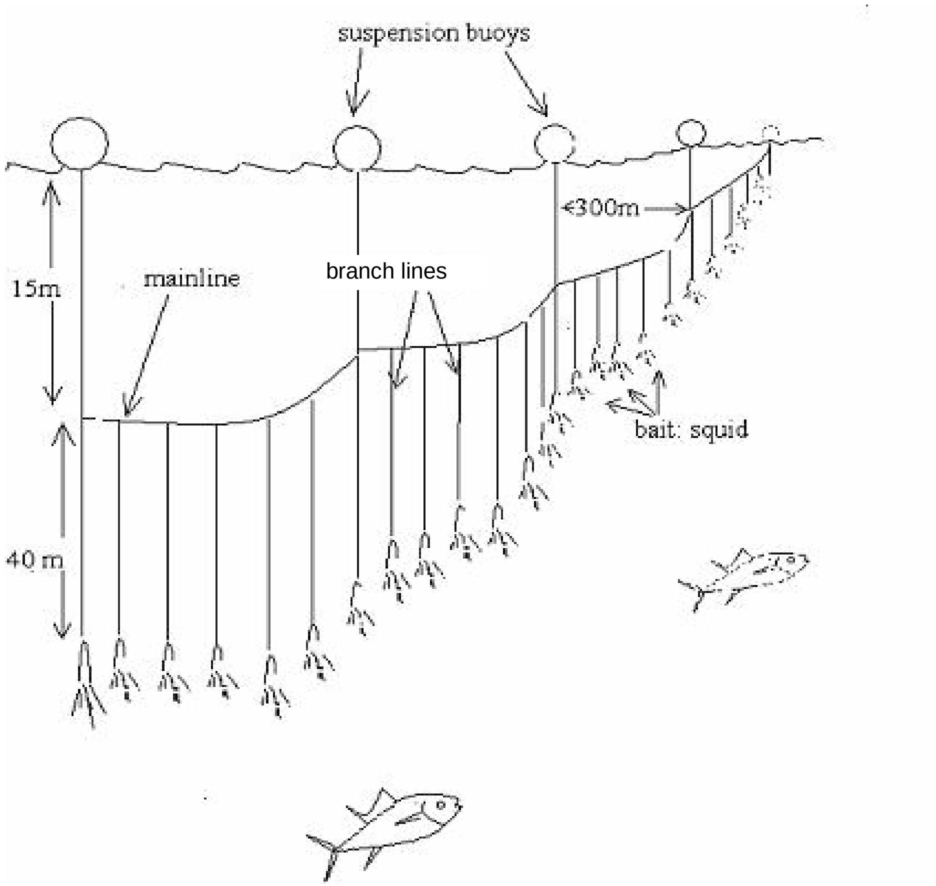


Figure 2: Fishing configuration of long line used by Koshin Maru #8.

Length and weight data were modelled using the power regression equations:

$$RWT=aFL^{b} \quad \text{and} \quad GWT=aFL^{b}.$$

RWT =whole weight of fish
GWT = weight of fish less the tail, viscera, and gills
FL = length from end of upper jaw to fork of tail

These relationships were compared with those established by other studies in the same area and with the established ICCAT length weight relationships for bluefin tuna. Condition indices were calculated for each fish using the methods of Clark and Fulton (Ricker, 1975). These indices were then plotted against the date of capture to investigate trends in condition over the time period.

Fulton's condition index: K=RWT/FL^3
Clark's condition index: K=GWT/FL^3
Fulton's allometric condition index: K=RWT/FL^2.4759
Clark's allometric condition index: K=GWT/FL^2.5782

Where K = condition factor
the exponent 3 expresses the volume of the fish corresponding to "ideal" or isometric growth
the exponent 2.4759 is substituted from the equation $RWT=aFL^{b}$
the exponent 2.4539 is substituted from the equation $GWT=aFL^{b}$

The gilled and gutted weight of each tuna was plotted against the date of capture to investigate if there was any trend in the size of fish available to the fishery over the time period.

Blue sharks were the most numerous species caught and were retained for their fins, while the body was discarded. Fins were stored by layering in fifty kg plastic fish boxes and frozen in the fish hold. There was no record kept of fin or shark weight and it was not possible in every instance to measure shark lengths. A small number of shortfin mako shark (*Isurus oxyrinchus*) were also caught and fins from both were not differentiated and stored together. The primary record of shark bycatch is the number, sex, species and where possible the length of the individuals caught.

RESULTS

Species caught

Seven species were identified in the catch. A species list of catch and bycatch is given in Table 1.

Table 1: Species list of Koshin Maru #8 catch and bycatch .

Scientific Name	Common Name	Number
Prionace glauca	blue shark	186
Thunnus thynnus	bluefin tuna	166
Isurus oxyrinchus	shortfin mako shark	3
Xiphias gladius	swordfish	1
Lophius species	anglerfish, *budegassa* or *piscatorius*	1
Alepisaurus ferox	lancet fish	NA
Trachipterus arcticus	red deal fish	NA

Areas fished and water temperature

Fishing took place in three separate areas between;

1. 59.2° and 59.6° N and 23° and 24° W;
2. 59.8° and 60.2° N and 14° and 17° degrees W; and
3. 57.8° and 58.2° N and 16° and 18° W.

Appendices 1 and 2 tabulate the global position of each set and the positions at which each tuna was caught. There was no evidence of a significant relationship between bluefin catches and seawater temperature. The range of temperatures fished was between 10.5°C and 12.0°C and covered three distinct areas. In all cases the fishing grounds were shared with other longliners.

Bluefin tuna

Gilled and gutted weights were recorded for all tuna caught. A total of 166 tuna were caught with an overall weight of 18,894kg. Round weights totalling 18,441 kg for 139 tuna and fork lengths for 144 tuna were also recorded. The number of fish for which there were corresponding gilled and gutted weights, round weights and lengths was 137. Details of these results are shown in Table 2.

Table 2: Summary statistics for Koshin Maru #8 bluefin tuna catch.

	Length (cm)	Gilled and Gutted Weight (Kg)	Round Weight (Kg)
Mean	186	114	136
Median	183	108	129
Mode	190	115	136
Maximum	275	290	347
Minimum	139	50	64
Range	136	240	283
Sum		18894	18841
N	144	166	139

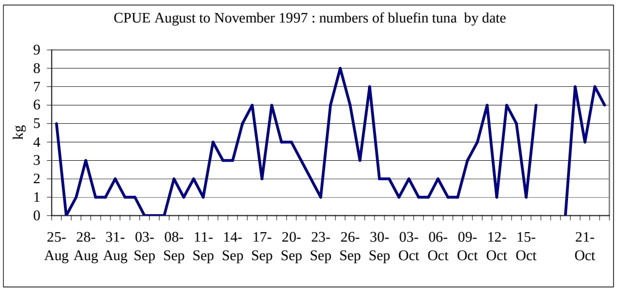
Catch per unit effort (CPUE) results are shown Table 3. The average catch of bluefin tuna per set was 363kg. CPUE as gilled and gutted weight (GWT) per 1000 hooks, gilled and gutted weight per km of line set and number caught per set are shown in Figure 3. CPUE from the Koshin Maru #8 is compared with those reported by the Norwegian trial fishery and Japanese observer programmes in the North East Atlantic for the years 1998 to 2003 (Table 4). Figure 4 displays the relationships between catch and temperature, and weight of fish caught and date. These relationships were not found to be significant (P>0.01). Length and weight frequency distributions are shown in Figure 5 and compared with Norwegian and Icelandic distributions from the North East Atlantic in succeeding years. Koshin Maru #8 fork lengths and round weights were clearly modal at 190cm and 136kg respectively.

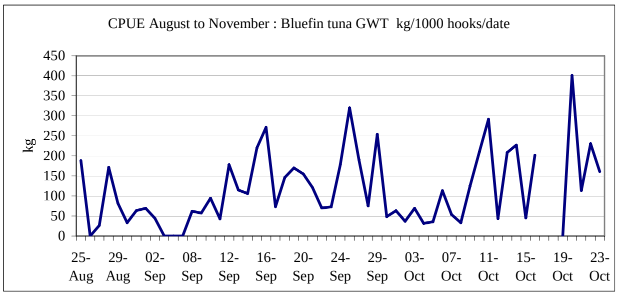
Table 3: CPUE results for Koshin Maru #8 bluefin tuna.

	Bluefin GWT kg/Set	**Bluefin DWT kg/1000 hooks/ set**	**Bluefin DWT kg/km line**	**Bluefin Nos./set**	**Nos. of Bluefin/1000 hooks**
Mean	363	115	2.8	2.9	1.0
Median	314	82	2.0	2	0.7
Mode	96	0	0	1	0.4
Maximum	1158	401	9.7	8	2.8
Minimum	75	0	0	0	0
Range	1083	401	9.7	8	2.8
Total weight/number	18894	18894	18894	166	166
No. Sets	57	57	57	57	57

Table 4: CPUE comparison between Koshin Maru #8 and other longliners in North East Atlantic 1997 to 2003.

	Kg /day	**No. of fish/ 1000 hooks**	**RWT Kg/ 1000 hooks**	**Average RWT of Bluefin**
Koshin Maru #8 August to November '97	331	1	114	136
Norwegian International 1998 (Trondsen *et al*. 1998)	543	1.6		
Norwegian EEZ 1998(Trondsen *et al*. 1998)	225	0.2		185.6
Japanese Longline CPUE 2000 (Matsumoto and Miyabe 2002)		0.9		
Japanese Longline CPUE 2001 (Matsumoto and Miyabe 2003)		1		
Japanese Longline CPUE 2002 (Matsumoto et al 2004)		0.9		
Japanese Longline CPUE 2003 (Matsumoto et al 2005)		0.6		





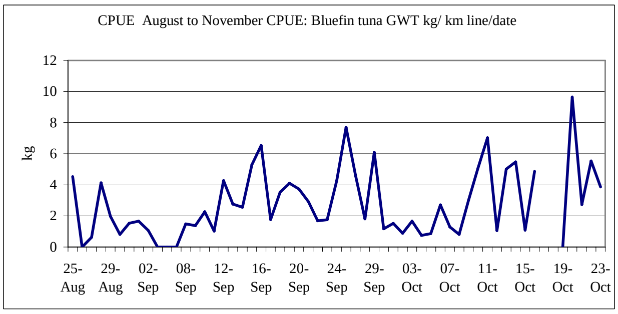
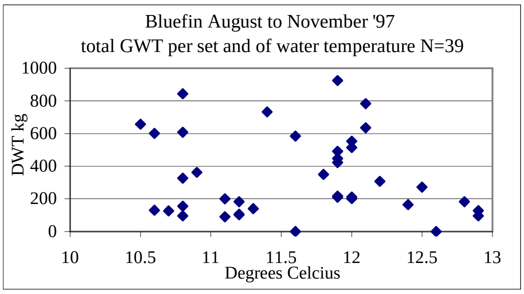


Figure 3: CPUE plots for Koshin Maru # 8 bluefin tuna.



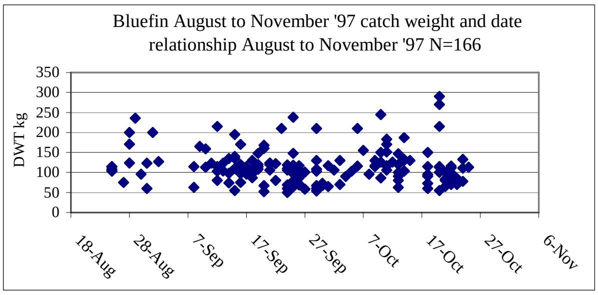
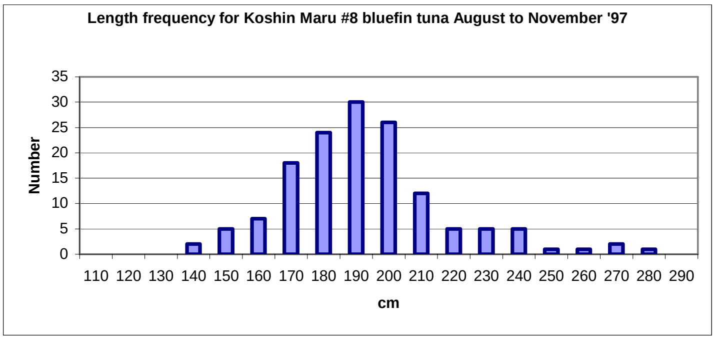
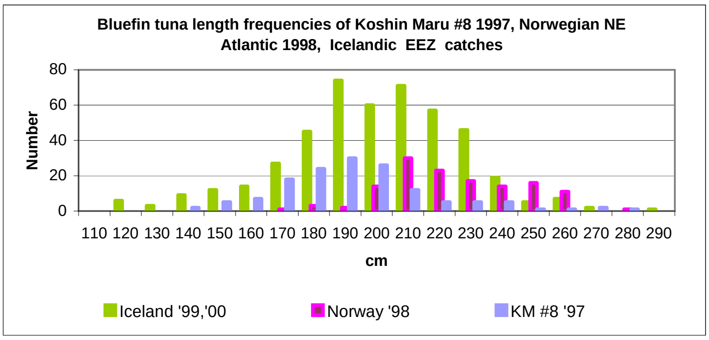


Figure 4: Relationships of Koshin Maru#8 bluefin catches (GWT) to temperature and date. Neither relationship is significant (P >0.01).





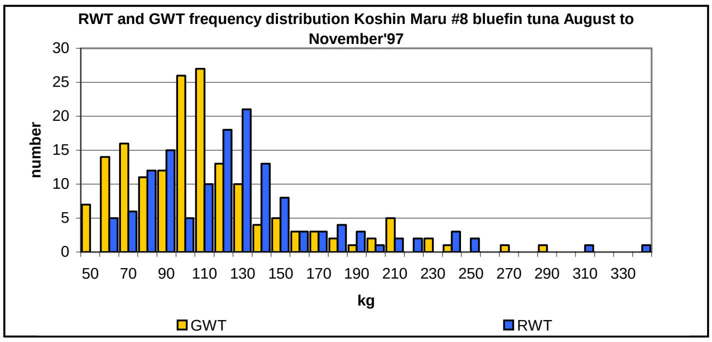


Figure 5: Length frequency distribution of Koshin Maru #8 bluefin tuna, length frequencies from Iceland EEZ 1996 to 2000, (Olafsdottir and Ingimundardottir 2003,) and Norway NE Atlantic '98 (Trondsen *et al.*, 1999), and weight frequency distribution for Koshin Maru #8 bluefin tuna August to November 1997.

The relationship between gilled and gutted weight and round weight modelled with linear regression, and the relationships between gilled and gutted weight, round weight and fork length modelled with power regression are shown in Figure 6. Koshin Maru #8 length weight relationships were compared with ICCAT relationships (Miyake, 1990b), and the Norwegian trial fishery relationship (Trondsen *et al.*, 1999) by fitting these models with Koshin Maru #8 data. Table 5 and Figure 7 show the results of these comparisons.

Condition factors for round weights and gilled and gutted weights over the period 28th August to 27th October are shown in Figure 8. These show a significantly declining trend for both round weight (Fulton's) and gilled and gutted weights (Clark's) $P<0.01$. Frequency distributions of condition factors are also shown and are clearly modal.

A total of 120 stomachs were examined and 63 were found to contain food, while the remaining 57 were empty. Food in the stomachs consisted of well-digested unidentified fish, squids and crustaceans and unidentified matter. These observations are shown in Tables 6 and 7. Otoliths from fish were removed and photographed where possible and some of these are shown in Appendix 3.

Blue Shark

All blue shark observed were female. Catch CPUE statistics for blue shark catches and are shown in Table 8 and with tuna in Figure 9.

Appendix 4 contains the narrative from the preliminary report prepared in 1997.

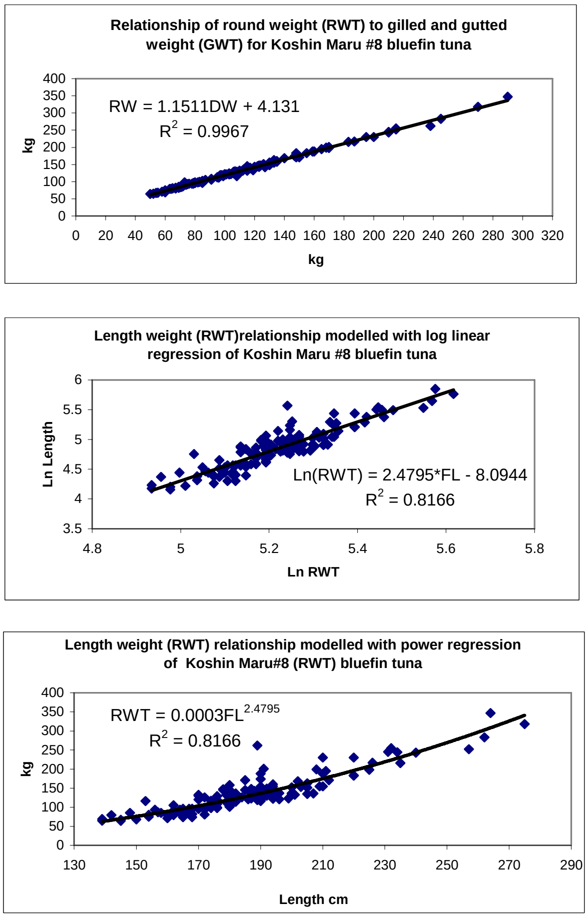


Figure 6: Gilled and gutted weight (GWT) to round weight (RWT) relationship and length weight relationships for Koshin Maru #8 bluefin tuna.

Table 5: Total round weights (RWT) produced from Koshin Maru #8 fork lengths with ICCAT length weight relationships and raising factors compared with total observed round weight. 137 is the number of fish for which there was complete length and weight data.

Koshin Maru #8 Observed RWT n=137			**18582kg**	
N=137	**Author**	**Model**	**Modelled Total weight kg**	**% of observed KM#8 RWT**
KM#8 Expected RWT linear	present study	RWT=EXP(2.4795*lnFL-8.0944)	18502	100
Koshin Maru #8 Observed RWT	present study	RWT=0.0003*FL^2.4795	18071	97
KM#8 Observed GWT	present study		16327	88
ICCAT converted RWT	(Miyake 1990b)	1.16*KM#8 observed DW	18171	98
Norwegian EEZ '98 Trial	(Hareide *et al.*, 2000)	RWT=.0006175*FL^2.3289	16842	91
ICCAT Manual East Atlantic RWT	(Miyake 1990b)	RWT=2.95*10^-5*FL^2.898598	16183	87
ICCAT Manual West Atlantic RWT	(Miyake 1990b)	RWT=2.861*10^-5*FL^2.929	18794	101
ICCAT Manual Mediterranean	(Miyake 1990b)	RWT=1.9607*10^-5*FL^3.0092	19233	104

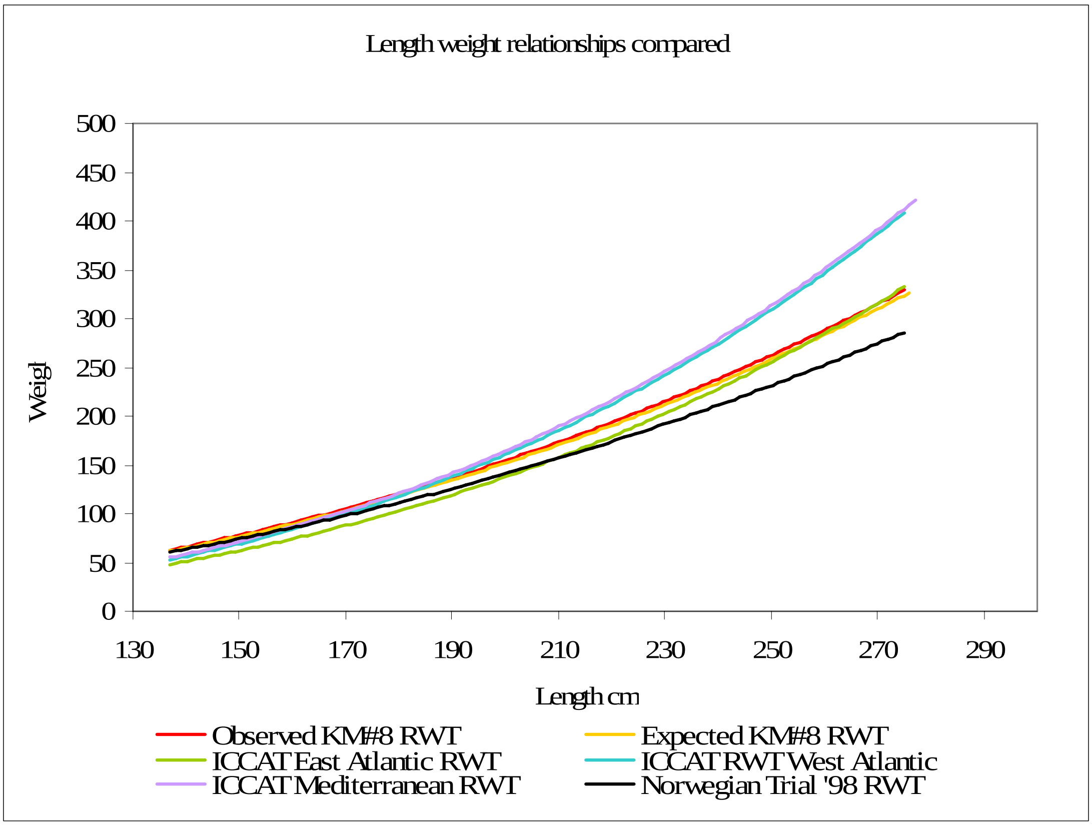


Figure 7: Koshin Maru #8 bluefin tuna fork lengths modelled with ICCAT length weight relationships for different Atlantic fisheries and management areas, and with a Norwegian length weight relationship from a trial fishery in 1998 in the North East Atlantic.

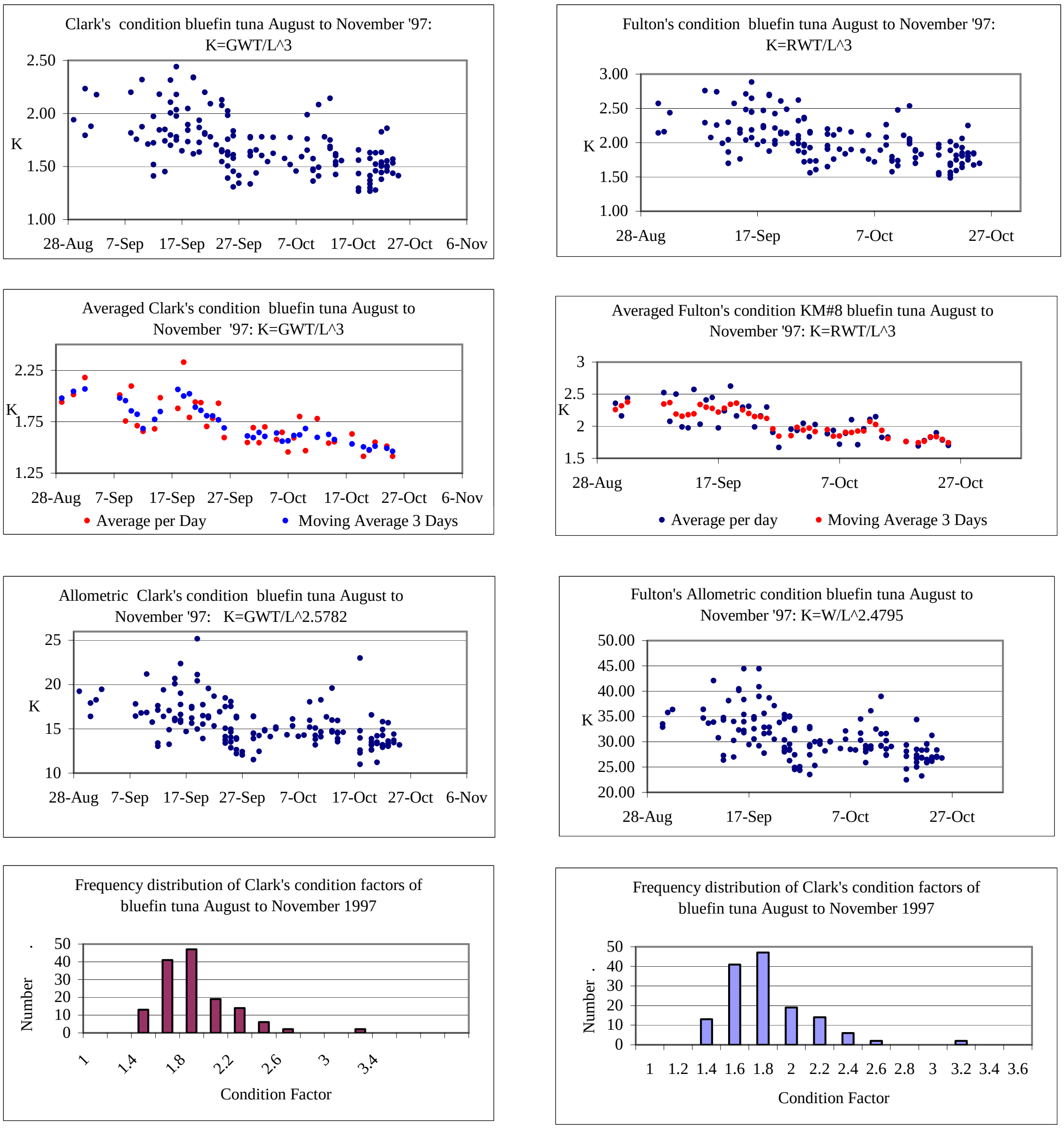


Figure 8: Condition factors of Koshin Maru #8 bluefin tuna. Clark's, Fulton's, and allometric daily condition factors for each fish are plotted against the capture date along with daily average and moving three day average factors. In each case the relationship is significant P<0.01, indicating declining condition. Frequency distribution of condition factors are also shown.

Table 6: Stomach content counts of Koshin Maru # 8 bluefin.

Number of fish observed	**0**	**1 to 10**	**10 to 20**	**20 to 30**	**>30**
No. tuna examined for fish in stomachs	70	17	10	4	4
Total fish observed		59	125	86	382
No. of squid observed	**0**	**1 to 10**	**10 to 20**		
No. of tuna examined for squid in stomachs	83	19	1		
Total squid observed		59	10		

Table 7: Stomach contents of Koshin Maru #8 bluefin tuna.

Date	Length	GWT	RWT	Stomach Contents
30-Aug-97		96	112	4 Well digested slim fish (Paralepis species/blue whiting?) of between 15 and 25cm, 2 Squid
31-Aug-97	190	123	147	2 small well digested slim fish less than 15cm and 2 squid of similar size to bait squid
01-Sep-97	220	200	230	13 very well digested slim fish and two small squid
02-Sep-97	180	127	142	Over twenty slim fish and one small squid
11-Sep-97	193	123	143	10 well digested fish
12-Sep-97	180	115	134	1 well digested fish
16-Sep-97	190	120	142	Very well digested small fish > 10cm
17-Sep-97		115	139	10-15 well digested slim fish up to 30cm
17-Sep-97	180	96	115	Fish bones and a quantity of small fish less than 10cm
18-Oct-97	179	95	113	2 small squid and unidentified crustaceans or crustacean larvae
18-Sep-97	174	97	117	10-15 well digested slim fish
18-Sep-97	190	130	154	More than 10 well digested fish
19-Sep-97	170	115	132	One small fish, >6cm, possibly immature grey gurnard, skin digested but form clear
19-Sep-97	185	148	171	More than 100 small fish, >6cm, possibly immature grey gurnard, skin digested but form clear, and two squid
20-Sep-97	139	52	65	>200 small fish,<6cm, possibly immature grey gurnard, skin digested but form clear
20-Sep-97	208	168	199	6-7 fish very well digested between 10 and 30 cm and 2 small squid
20-Sep-97	160	67	81	9 well digested slim fish, 2 squid <15cm mantle length, 2 small possible grey gurnard
21-Sep-97	180	106	124	3 squid, small less than 20 cm mantle length
23-Sep-97	231	210	245	4 slim fish 15 and 30 cm and 30-40, <6cm possibly gurnard
24-Sep-97	179	119	133	10 well digested fish (Paralepis species), and 5 small fish <6cm (gurnard species)
24-Sep-97	188	110	132	8 well digested, 8-20cm, possibly paralepis/blue whiting species and 3 squid 25-30cm
24-Sep-97	148	69	85	5 well digested fish, 8 possible gurnards < 6cm, 30 small yellow fish< 3cm too well digested to distinguish fins, 1
25-Sep-97	162	64	79	2 squid
25-Sep-97	170	79	96	4 Well digested slim fish of between 15 and 25cm long, 2 Squid and 40 yellow fish <3cm
25-Sep-97	180	118	137	5 well digested slim fish
25-Sep-97	181	97	117	7 well digested slim fish
25-Sep-97	189	238	262	Well digested fish, bones and slurry (best condition fish of the trip)
26-Sep-97	168	69	82	2 squid and 2 otoliths
26-Sep-97	164	71	85	26 fish >6cm possibly immature gurnard species
26-Sep-97	187	117	140	4 squid
26-Sep-97	180	107	126	4 squid and 8 well digested slim fish
27-Sep-97	160	58	71	12 fish < 6cm possibly gurnard species
01-Oct-97	154	65	80	Squid beaks, fish bones and otoliths
04-Oct-97		90		1 Squid 37cm mantle length, dark brown in colour and range of other items unlisted
05-Oct-97	187	103	123	15 well digested slim fish 15-30cm
06-Oct-97	240	210	243	10 squid, 15 slim fish 10-30cm and other unidentifiable fish
06-Oct-97	187	116	138	7 squid, 10-12 slim fish and small unidentified fish
07-Oct-97	220	155	183	4 squid
08-Oct-97	182	96	114	4-5 squid and beaks and well digested unidentifiable fish
09-Oct-97	187	115	136	at least 17well digested slim fish and 4 squid
09-Oct-97	192	117	139	stomach full of well digested bones and slurry
10-Oct-97	262	245	283	1 squid, some bones and otoliths
11-Oct-97	172	106	126	6 small squid
11-Oct-97	235	183	216	8 small squid, some bones and otoliths
12-Oct-97	192	126	149	7 small squid and some bones
13-Oct-97	176	91	108	4 squid and slurry of digested fish
14-Oct-97	226	187	217	4 squid and slurry of well digested fish and bones
14-Oct-97	186	103	121	6 small squid and bones
14-Oct-97	205	133	163	8 small squid and slurry of well digested fish and bones
14-Oct-97	190	104	122	Fish bones
18-Oct-97	168	60	74	1 fish unidentified
18-Oct-97	172	73	98	Squid beaks
20-Oct-97	264	290	347	1 small Myctophidae, 1 squid beak, 4 small crustaceans
20-Oct-97	275	270	318	2 headless well digested fish
21-Oct-97	190	100	120	3 well digested slim fish
21-Oct-97	176	83	99	7 squid beaks and 1 fish <20cm
21-Oct-97	170	80	96	squid beaks and 1 fish spine
24-Oct-97	192	111	130	2 large dark brown squid >40 cm mantle length
24-Oct-97	210	133	155	4 well digested slim fish
25-Oct-97	200	113	136	4 Squid

Table 8: Koshin Maru #8 blue shark catch and CPUE results.

	Mean	Median	Mode	Maximum	Minimum	Range	Sum	No. Sets
Blueshark Nos. / set	3	3	1	14	0	14	193	57
Blueshark Nos./1000 hooks	1.17	1.04	0.35	4.85	0	4.85	193	57

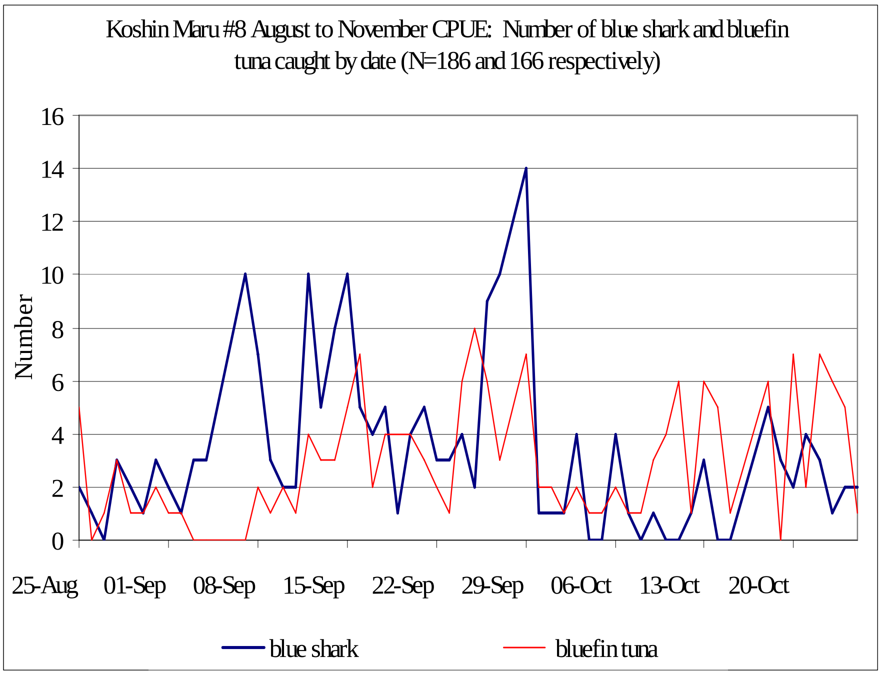


Figure 9: Blue shark and bluefin tuna CPUE compared.

DISCUSSION

Fishing Grounds

Bluefin tuna forage in the North Atlantic before returning to spawning areas in the Gulf of Mexico and the Mediterranean (Nemerson *et al.*, 1998). Tagging experiments (Block *et al*., 2005) show that the area fished by the Koshin Maru # 8 in autumn 1997 overlaps with areas traversed by tuna tagged on the west coast of the USA. The areas fished were shared with other long liners and have been productive fishing grounds for Japanese longliners in the last decade (Miyabe, 2001).

Species Caught

The number of species caught was quite small with a total of seven recorded. Only bluefin tuna were caught in sufficient numbers to be commercially important. While blue shark were caught in greater numbers than tuna their commercial value in comparison was slight. The sale value of blue shark fins is returned to the crew for purchase of tobacco and alcohol. Other commercial species, short fin shortfin mako shark, swordfish, and anglerfish were caught so infrequently as to be of negligible value. Non-commercial species, primarily dealfish and lancetfish were discarded. Other species (may have been caught) caught, but due to the effects of being pulled through the water at speed were not identifiable. The numbers of these individuals was small. There were no avian or cetacean bycatch. The small range of species observed is corroborated by Japanese observers working on freezer longliners in the same sector of the North Atlantic (Matsumoto and Miyabe, 2002).

Fishing Depth

The minimum fishing depth was 55m underneath buoys. The distance between buoys could not be monitored and therefore the range of fishing depths of the different branch lines could not be modelled. These might be expected to fluctuate in response to currents, tides, fouls and traffic through the area of the set. It might reasonably be expected that recent satellite tagging results (Block *et al.*, 2005, Stokesbury *et al.*, 2007) will help to optimise depth setting of long lines. Apart from fishing depth, other factors which are thought to influence fishing results are line material, hook spacing, temperature, fishing area and bait (Matsumoto *et al.*, 2003; Trondsen *et al.*, 1999).

CPUE

CPUE for Koshin Maru #8 was lower than CPUE from a Norwegian sponsored trial fishery in 1998 (Trondsen *et al.*, 1999), but similar to CPUEs presented from Japanese observer programmes in 2000 and 2001 over which time period the relative abundance of bluefin in North Eastern Atlantic is thought to have declined (Miyabe, 2001). The perception of poor fishing that this gives was supported by the crew of the Koshin Maru #8 who said that for most sets fishing was poor in terms of quantity, size and condition of fish caught.

The salient feature of this fishing method is the great linear distance covered by each set, ranging from 80 to 140m with hook spacing of approximately 40m. On average 120km of line was set each day in as straight a line as conditions allowed. CPUE expressed in terms of kg of bluefin per km of line show that they are thinly distributed with a mean value of under 3kg of bluefin per km of line shot. The greatest number of fish caught on any one set was eight. Therefore the experience of the longline fishermen of bluefin tuna in the North East Atlantic suggests that they are widely dispersed and that encounters with them are sporadic. In view of this, the lack of trend in CPUE in terms of catch rate or size of fish is not surprising. If there were obvious trends in CPUE and distribution of fish and catches, a more refined targeting approach might have evolved. At all times the Koshin Maru #8 was part of a fleet, with as many as six other longliners being visible at hauling, so its catch rate may have been affected by the position of each set relative to others in the same area. Certainly a large amount of time spent on the ships radio was information exchange with nearby freezer longliners.

Length and Weight Frequency Distribution

Comparison of the length frequency distribution of bluefin caught by Koshin Maru #8 to recent age-size relationships (Ólafsdóttir and Ingimundisdóttir, 2003a), suggests an age range of four to seventeen years, with the majority of fish between five and ten years old. The length frequency distribution for Koshin Maru #8 bluefin tuna was clearly modal around 190cm and of similar range to frequency distributions of trial catches by Iceland and Norway from 1997 through to 2000. However, Koshin Maru # 8 catches showed clearer modal definition and had smaller proportions of larger individuals than the Norwegian and Icelandic trial series. Weight frequency distribution appears to be bi-modal around 90-100kg and 130-140kg respectively, although the small sample size makes the inference of cohorts from these modes uncertain. The size range and modal properties of bluefin tuna from this study are also comparable to those reported from Japanese observer programmes from the North East Atlantic, (Matsumota and Miaybe, 2002; Matsumoto *et al.,* 2003; Matsumoto *et al.,* 2004; Matsumoto *et al.,* 2005). While a modelled approach to stock dynamics in bluefin tuna suggests that a long lifespan with many spawning year classes confers resistance to recruitment failure (Fromentin and Fontaneau, 2001), comparison of recent catch data from the North East Atlantic with historical data from the North and Norwegian seas (Tiews, 1977, Hamre *et al.*, 1971) show reductions in terms of size range, mean size and modal complexity, indications of weakening resistance to recruitment failure.

Raising Factors and Length Weight Relationships

Landing volumes of frozen gilled and gutted tuna (GWT) are converted into round weight (RWT) by ICCAT with the use of a raising factor of 1.16 (Miyake, 1990a). Observed GWT raised with this factor were 98% of the observed RWT. Length weight relationships for Marine Institute pelagic stock summaries are modelled with log linear regression. This model of the length weight relationship estimates a total RWT that is 99.6% of the observed RWT while power regression modelling estimates a RWT approximately 97% of observed RWT. Additionally ICCAT uses power regression to produce a series of established length weight relationships to model RWT from fork lengths (FL) for bluefin tuna throughout the Atlantic and Mediterranean (Miyake, 1990b). Modelling the observed fork length data with these relationships produces different estimates of total round weight. The most divergent of these from the observed round weight, is the ICCAT east Atlantic model, which estimates a total round weight that is 87% of the observed total. This indicates a requirement for regularly revised models to track changes in the fishery and catch. In the years succeeding this study changes were signalled by considerable inter-annual variability in catch at length data from the Norwegian and Icelandic longline fisheries (Trondsen *et al.,* 1999 and Ólafsdóttir and Ingimundisdóttir, 2003b). Differences between the observed total round weight and the other ICCAT bluefin tuna length weight relationship models are small by comparison, in the range of 2% to 4%. What these relationships show very clearly are that differences in length at weight are greatest for the largest fish indicating that similarities in modelled weights were biased by the low frequency of very large fish in the observed catch of the Koshin Maru #8.

Condition Indices

It is widely reported that Atlantic bluefin tuna gain weight rapidly in summer and autumn (Fromentin and Powers, 2005). This is not supported by the series of condition indices compiled for the fish in this study, which in each case show a significantly declining trend**,** $P < 0.01$. Bluefin tuna spawn in the Mediterranean and in the Gulf of Mexico from April to June and from June to August respectively (Anon, 1994). Therefore it might be expected that recovery from spent condition in fish found in the North East Atlantic would be well advanced by September and October. Condition indices for bluefin tuna in the North Sea and Norwegian Sea through the 1950s show clear trends of improvement in most years and this is attributed to the high biomasses of herring and mackerel then available (Tiews, 1978). In contrast to historical observations the trend in condition and the widely separated catches from this study infer that in the international waters of the North East Atlantic prey is erratically distributed and difficult for tuna to find. Icelandic data from 1996 to 2002 also shows declining condition for tuna inside in the Icelandic EEZ (Ólafsdóttir and Ingimundisdóttir, 2003b), and indicates that condition and availability of prey do not improve with movement to more northern waters. Similarly the length weight relationship for the Norwegian trial fishery in 1998 does not indicate improving condition in waters further east and north. Not all fish caught showed failing condition, and one fish in particular (189cm, 262kg RWT on the 29^{th} September) which appears as the most extreme outlier in the condition data was immediately recognised by the crew as a fish of excellent condition and appearance. For the declining condition observed in Icelandic experimental fisheries from 1996 to 2002 it has been suggested that thriving fish leave the grounds earlier in the season than thin fish (Ólafsdóttir and Ingimundisdóttir, 2003b). Nonetheless the arrival and persistence of lean bluefin tuna in the North East Atlantic months after spawning, suggests a scarcity of feeding opportunities either en-route or in situ. For the North Sea and Norwegian Sea fisheries of the 1950's and 1960's bimodal and elongated distribution of condition factors have been used to infer different possible origins and migration routes (Tiews, 1978). The modal distribution of condition factors of the tuna in this study could therefore be taken as indicators of homogeneity of origin and route. Current understanding of Atlantic bluefin tuna stock size ratios (Anon, 1994 and Anon, 2007), implies a Mediterranean origin for these fish while at the same time satellite tagging results (Block *et al*., 2005 and Stokesbury *et al*., 2005) prove that fish from both stocks traverse management boundaries giving rise to the possibility that western spawned bluefin might appear as outliers in the frequency distribution of condition indices for eastern caught bluefin. Analysis of all recent condition data for bluefin tuna in the North Atlantic might even produce estimates of stock ratios from longline fisheries. Research and analysis of commercial carcass grade data has already led to the production of retrospective condition indices for West Atlantic bluefin tuna (Golet *et al*., 2007).

The directed fisheries in the North Sea and Norwegian Sea for bluefin have not revived since their collapse in 1962 (Pusineri *et al*., 2002), leaving open the question of where lean bluefin in the North Eastern Atlantic waters go to improve condition. The high biomass of herring in the North Sea and Norwegian Sea might reasonably be expected to concentrate bluefin tuna if present. However, there is no evidence in the present day, either from reported bycatch or the development of recreational fisheries around the North Sea and Norway, which indicates any notable level of bluefin tuna biomass. This is in contrast to the shelf waters of Ireland where bluefin tuna are seen in shoals; are reported as bycatch in herring, mackerel and horse mackerel fisheries, and where a small recreational fishery developed between 1999 and 2004 (O' Farrell and Molloy in press). The effect of low prey densities on condition might be exacerbated by the high-energy cost incurred by searching or migrating over wide areas. Declining condition over extended time periods may have implications for estimates of natural mortality of adult Atlantic bluefin. Evidence for elevated natural mortality in larger size classes has been found in other tuna species (Hampton, 1999). An indicator of one possible vector of mortality may lie in the principal of "many wrongs", which hypothesises that navigational accuracy increases with group sizes (Simons, 2004). Could it be that the scattered low density of bluefin tuna in the international waters of the North East Atlantic reduces success in finding both food resources and return routes to distant spawning grounds? Could fishing mortality be elevated by prolonged exposure to the interceptory longline fishery? Additionally do variations in what appear to be punctuated feeding migrations have implications for the fecundity of those fish which undertake them?

The rationale for using Fulton's and Clark's condition indices was to identify possible sources of bias which might arise from a particular index over or under weighting the local availability of prey. A local abundance might positively bias Fulton's round weight condition factor, alternatively a local scarcity might negatively bias it. In the event all indices and versions of them were similarly clear in identifying a declining trend of condition. Indeed, Fulton's, the cruder of the two, adds support to the theory advanced from stomach content observations, that prey was scarce in the international waters of the North East Atlantic in the autumn of 1997.

Stomach Contents

Stomach contents of the fish were examined and the contents grouped in terms of the numbers of teleosts, cephalopods and others found. In most cases the stomachs were either empty, or contained small numbers and arrays of contents. With a few notable exceptions stomach contents were well digested from which it might be inferred that the tuna had not eaten for some time prior to taking the hook. By well digested it is meant that, with the exceptions of one unidentified *Myctophid* specimen, the skin, eyes and viscera of teleosts were not present. In the case of squid, the skin, with the exception of three large specimens of *Todarodes saggitatus* was digested. Most fish of between 10cm and 30 cm found in tuna stomachs were thought to be *Paralepis, Scombersox,* or *Belone* species. In instances where very large numbers of fish, i.e. >30, were found in tuna stomachs these were also very small fish so that high numbers were not an indication of a high degree of repletion. With the exception the squid, *Todarodes saggitatus,* it was not possible to identify prey species with certainty, only to make observations on their size, form and probable family and the number of individuals present. It is possible that stomach contents were voided after hooking but the well digested state of observed contents and the declining condition of the fish were not indicative of the ready availability of prey in the capture area. Furthermore it has been demonstrated that for the closely related southern bluefin tuna, *Thunnus maccoyii*, that fish caught in offshore waters consume a third of the daily intake of their inshore counterparts (Young *et al.,* 1997). Therefore the predominantly empty or low level of repletion of the stomachs indicate a relative scarcity of prey and offer an explanation for the trend of failing condition observed in all indices. The low levels of stomach repletion observed may have implications for longline catchability and consequently for CPUEs constructed from longline catch data. The effect of repletion on readiness to attack longline baits has been investigated for other tuna species. Bard (2001) has observed that stomach repletion rates of longlined tunas are low compared to tuna caught on other gears and proposes that catch rates of longlines are not only dependent on the density of tuna but also on the relative densities of tuna and their prey. Bard's observation implies that, in environments of low prey density the assumed relationship of predator population to CPUE rather than being proportional could in theory be inversely so. In such a scenario, as the density of tuna decreases relative to its prey the likelihood of a baited hook being consumed increases and in this way the catchability co-efficient and its derived CPUE series may be raised above the actual abundance in that environment.

Blue shark

It was not possible to record all the lengths of the blue shark caught. However, the measurements taken reflect the range of sizes present. No male blue sharks were recorded, with many of the females carrying black rake marks indicating that mating had occurred. Compared to bluefin tuna blue shark are not a valuable commercial species. However the data collected on this trip suggests that the longline fishery for bluefin catches them more efficiently than its target species. Only the fins were retained onboard and these are frozen in solid blocks. Frozen blocks contained fins from both species of shark caught. Conversion factors for raising fins to round weight have been produced (Neves dos Santos and Garcia, 2005 and Hareide *et al.*, 2007), but application of these to landed fins would be problematical where different species are stored together unlabelled. In the absence of weights for blue shark, an insightful measure of fishing effort is the number of blue shark females caught per tonne of tuna. This produces a figure of approximately ten females per tonne of bluefin gilled and gutted weight.

CONCLUSION

This study presents considerations arising from a small body of data collected in a fixed area and time, witnessed first hand by the author. The data though scant has a spatial and temporal resolution that the official fishery statistics lack. Condition factors strongly indicated that bluefin did not thrive in that part of the Atlantic at that time of year and that they constituted a homogenous body of fish with a shared experience of scarce prey availability. Comparison with historical data shows that bluefin tuna in the North East Atlantic were fatter and derived from a more complex stock assemblage. Much of this data for size structure and condition comes from the North and Norwegian Seas, and hence might be said not to be comparative at all at least in spatial terms. However, the absence of fisheries in these areas today offers the pessimistic suggestion that the utilised environment of the bluefin tuna in the North East Atlantic has also contracted. The direct experience of the fishermen themselves was of a poor fishery and the CPUE data for the observation period indicates that the fishermen had at that time only a general expertise on the distribution of tuna in the area, i.e. in autumn, thinly and in the top 100m of the water. Satellite tagging data may well hone that expertise through sub-partitioning the depth strata in which bluefin tuna are most effectively targeted. Blue shark were more frequently encountered than bluefin tuna and while not the targeted species, the sale of shark fins nonetheless must be considered as having made a contribution to the viability of the enterprise.

ACKNOWLEDGEMENTS

Many thanks are due to the following: John Molloy (Marine Institute) and Richard Fitzgerald (University College Cork) who facilitated this trip; Maurice Clarke (Marine Institute), for reviewing; Colm Lordan (Marine Institute) extracted and photographed otoliths in UCC; Niamh Slattery and Afra Egan (Marine Institute) for formatting and proof reading and Trevor Alcorn (Marine Institute) for his mapping skills.

I especially thank the crew of the Koshin Maru #8 and in particular: Tomoyoshi Fukuda Fishing Master, Kiotaka Yamazaki Captain, Vesua Tukazawa, Katuhiro Ihoko Ice Master, and Kazue Kojima Boson, whose readily shared knowledge and expertise of bluefin tuna fishing is I hope, reflected in this document.

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APPENDIX 1: Koshin Maru #8 fishing stations and catches

Set #	Date	Start Latitude	End longitude	Start longitude	End latitude	Mean Temp. °C	blue shark	bluefin tuna
1	25/08/1997	59.42		24.17			2	5
2	26/08/1997	59.67	22.22	23.98	59.20		1	0
3	27/08/1997	59.58	24.63	22.80	59.57		0	1
4	28/08/1997	59.57	24.50	22.70	59.57		3	3
5	29/08/1997	59.57	24.90	22.92	59.57		2	1
6	30/08/1997	59.58	22.75	24.82	59.58	12.9	1	1
7	31/08/1997	59.58	0.00	24.77		12.8	3	2
8	01/09/1997	59.58	24.50	24.67	59.45		2	1
9	02/09/1997	59.58	22.47	24.52	59.58	12.9	1	1
10	03/09/1997	59.53	22.17	23.52	59.25		3	0
11	04/09/1997	59.57	0.00	24.28			3	0
12	07/09/1997	59.33	14.88	15.77	59.33	12.6	10	0
13	08/09/1997	59.33	0.00	15.27			7	2
14	09/09/1997	59.37	16.57	14.53	59.37	12.4	3	1
15	10/09/1997	59.37	14.00	16.75	59.37	12.5	2	2
16	11/09/1997	59.80	16.00	14.00	59.82		2	1
17	12/09/1997	60.00	15.90	14.02	59.95		10	4
18	13/09/1997	59.97	13.78	15.87	59.97		5	3
19	14/09/1997	59.97	13.78	15.87	59.97	12.2	8	3
20	15/09/1997	59.98	15.92	13.97	59.95	12.1	10	5
21	16/09/1997	59.78	15.28	15.80	59.90	12.1	5	7
23	17/09/1997	59.97	13.95	15.80	60.00	12	5	4
22	18/09/1997	59.97	13.83	15.77	59.92	11.9	4	2
24	19/09/1997	59.97	13.75	15.90	59.97	11.9	1	4
25	20/09/1997	59.97	13.72	15.88	59.97	11.9	4	4
26	21/09/1997	59.97	13.72	15.88	59.97	11.8	5	3
27	22/09/1997	59.97	13.75	14.98	59.97	12	3	2
28	23/09/1997	59.97	15.77	13.87	59.87	11.9	3	1
29	24/09/1997	59.97	13.55	15.78	59.88	12	4	6
30	25/09/1997	59.97	13.68	15.77	59.97	11.9	2	8
31	26/09/1997	59.97	13.67	15.77	59.97	12	9	6
32	27/09/1997	59.97	13.73	15.78	59.97	11.9	10	3
33	29/09/1997	59.97	14.00	15.68	59.97	11.4	14	7
34	30/09/1997	59.97	15.62	14.00	59.97	11.3	1	2
35	01/10/1997	59.97	15.80	13.93	59.92	11.2	1	2
36	02/10/1997	59.97	13.78	15.60	59.97	11.2	1	1
37	03/10/1997	59.90	15.28	13.77	59.97	11.1	4	2
38	04/10/1997	59.97	13.65	15.62	59.95	11.1	0	1
39	05/10/1997	59.97	13.68	15.83	59.97	11.2	0	1
40	06/10/1997	59.97	15.53	15.75	59.93	10.8	4	2
41	07/10/1997	60.00	17.80	15.77	59.97	10.8	1	1
42	08/10/1997	58.98	15.82	17.73	60.13	10.8	0	1
43	09/10/1997	59.97	16.02	17.87	60.22	10.9	1	3
44	10/10/1997	59.97	15.98	17.85	60.18	10.8	0	4
45	11/10/1997	59.97	16.03	17.78	60.17	10.8	0	6
46	12/10/1997	60.17	18.03	16.08	59.92	10.7	1	1
47	13/10/1997	60.17	17.98	16.08	59.88	10.6	3	6
48	14/10/1997	60.17	18.05	16.03	59.97	10.5	0	5
49	15/10/1997	60.12	17.92	15.92	59.97	10.6	0	1
50	18/10/1997	60.17	18.00	16.08	59.92	11.6	5	6
51	19/10/1997	57.85	15.73	17.67	57.85	11.6	3	0
52	20/10/1997	57.85	16.03	17.93	57.85		2	7
53	21/10/1997	57.85	18.40	17.65	57.82		4	4
54	22/10/1997	57.85	17.73	17.73	57.85		3	7
55	23/10/1997	57.95	15.53	17.43	57.85		1	6
56	24/10/1997	57.83	15.23	17.22	57.83		2	1
57	25/10/1997	57.83	15.22	17.08	57.85		2	1

APPENDIX 2:Koshin Maru #8 Bluefin Tuna Capture Postions

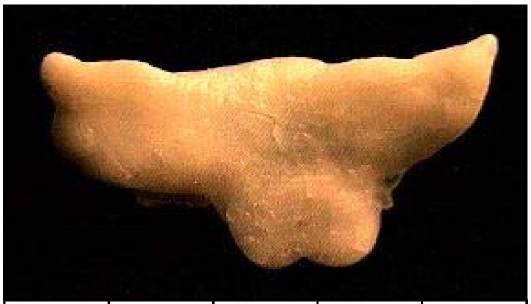
Date	Length cm	GWT kg	RWT kg	Lat.	Long.	Date	Length cm	DWT kg	RWT kg	Lat.	Long.
25/8/97		114				27/9/97	160	58	71		
25/8/97		108				27/9/97	196	101	121	60.07	13.97
25/8/97		104				27/9/97		58		60.07	14.00
25/8/97		103				29/9/97	145	54	67	59.97	14.62
25/8/97		115				29/9/97	165	60	74	59.97	14.62
26/8/97						29/9/97	160	67	80	59.97	14.62
27/8/97		75				29/9/97	234	210	244	59.93	15.62
28/8/97		200				29/9/97	194	130	155	59.92	15.27
28/8/97		171				29/9/97	186	103	123	59.92	15.15
28/8/97		124				29/9/97		108			
29/8/97	230	236				30/9/97	164	73	93	59.93	15.02
30/8/97		96	112			30/9/97	167	67	82	59.98	14.53
31/8/97	139	60	69			1/10/97	154	65	80		
31/8/97	190	123	147			1/10/97	194	117	139		
1/9/97	220	200	230			2/10/97	190	106	126	59.93	14.80
1/9/97						3/10/97	158	70	85	59.95	13.82
2/9/97	180	127	142			3/10/97	200	130	152	59.95	15.10
7/9/97						4/10/97		90		60.03	14.20
8/9/97	185	115	145	59.37	14.97	4/10/97				60.02	14.03
8/9/97	142	63	79	59.32	14.73	5/10/97	187	103	123	60.02	14.32
9/9/97	211	165	195	59.28	16.12	6/10/97	240	210	243	59.97	17.93
10/9/97	190	159	188	59.37	15.32	6/10/97	187	116	138	59.95	16.02
10/9/97	182	113	136	59.32	15.05	7/10/97	220	155	183	59.98	17.77
11/9/97	193	123	143	60.00	14.80	8/10/97	182	96	114	60.00	17.40
12/9/97	174	80	98	60.00	14.02	9/10/97	187	130	148	59.98	17.12
12/9/97	194	103	124	59.98	14.65	9/10/97	187	115	136		
12/9/97	180	115	134	60.00	14.93	9/10/97	192	117	139	60.13	16.27
12/9/97	232	215	255	60.00	14.98	10/10/97	205	126	151	60.00	17.62
13/9/97		104		60.00	14.02	10/10/97	180	86	101	60.10	16.37
13/9/97	178	104		59.83	15.30	10/10/97	212	150	171		
13/9/97	178	123	145	59.98	15.62	10/10/97	262	245	283		
14/9/97	194	135	160	60.00	14.73	11/10/97	235	183	216		
14/9/97	162	74	91			11/10/97	225	170	198		
14/9/97	189	98	119	60.00	13.92	11/10/97	172	106	126		
15/9/97	140	55		60.03	14.33	11/10/97		117		60.03	16.78
15/9/97	202	140	168			11/10/97		116		60.05	16.52
15/9/97	210	195	230	59.93	15.48	11/10/97		151		60.05	16.42
15/9/97	180	135	158	59.92	15.10	12/10/97	192	126	149	60.02	16.82
15/9/97	183	110		59.90	15.20	13/10/97	190	120	141		
16/9/97	191	170	201	59.95	13.97	13/10/97	190	147	174		
16/9/97	156	75	93	59.90	15.28	13/10/97	176	91	108		
16/9/97	170	100	120	60.05	14.42	13/10/97		63		60.02	17.23
16/9/97	170	107	130	60.05	14.42	13/10/97		100	120	60.17	16.03
16/9/97	190	120	142	59.97	15.03	13/10/97	168	80	96	60.03	16.42
16/9/97	176	97	119			14/10/97	186	103	121	60.00	17.00
16/9/97		114		59.93	13.87	14/10/97	209	130	155	59.97	17.92
17/9/97	180	96	115	60.03	14.63	14/10/97	205	133	163	60.00	17.00
17/9/97		115	139	60.00	14.10	14/10/97	226	187	217	61.00	17.43
18/9/97	184	108	126	60.05	14.52	14/10/97	190	104	122	60.02	17.52
18/9/97	162	87	105	60.05	14.52	15/10/97	203	130	153	60.05	16.47
18/9/97	174	97	117	60.02	14.00	18/10/97	168	60	74	57.87	16.33
18/9/97	190	130	154	60.03	14.60	18/10/97	172	73	98	57.87	16.42
19/9/97	153	108	116	59.98	13.90	18/10/97	179	95	113	57.93	17.32
19/9/97	185	148	171	60.08	14.45	18/10/97	180	91	106	57.82	16.53

APPENDIX 2 (Contd.)

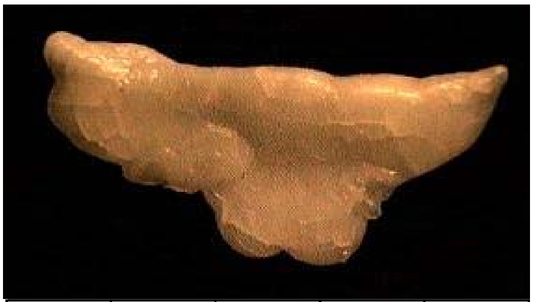
Date	Length cm	GWT kg	RWT kg	Lat.	Long.	Date	Length cm	DWT kg	RWT kg	Lat.	Long.
19/9/97	139	52	65	59.93	15.10	18/10/97	180	150		57.93	17.32
19/9/97	170	115	132	59.98	13.90	18/10/97	207	115	136	57.83	17.57
19/9/97	195	120	139	59.97	14.00	19/10/97					
20/9/97	210	160	188	59.97	14.05	20/10/97	257	215	252	57.78	18.23
20/9/97	Lost			59.98	14.83	20/10/97	200	113	136	57.83	17.58
20/9/97	160	67	81	59.97	14.00	20/10/97	205	115	135	57.90	17.23
20/9/97	208	168	199	59.95	15.42	20/10/97	264	290	347	55.92	17.33
21/9/97	178	124	147			20/10/97	194	100	122	57.88	17.13
21/9/97	180	106	124			20/10/97	275	270	318	57.82	17.62
21/9/97	188	120	143	60.03	14.20	20/10/97	150	55	68	57.87	17.40
22/9/97	165	80	96	60.02	15.48	21/10/97	176	83	99	57.83	16.13
22/9/97	180	122	145	59.93	15.58	21/10/97	172	65	81	57.85	16.58
23/9/97	231	210	245	59.83	14.67	21/10/97	170	80	96	57.83	16.05
24/9/97	154	60	75	60.03	14.17	21/10/97	190	100	120		
24/9/97	145	50	64	60.02	14.00	22/10/97	167	71	86	57.90	15.83
24/9/97	179	119	133	60.05	14.55	22/10/97	190	99	116	57.77	15.50
24/9/97	148	69	85	60.00	14.75	22/10/97	196	116	137	57.82	16.90
24/9/97	190	106	129	59.88	15.58	22/10/97	167	70	84	57.77	15.50
24/9/97	188	110	132	60.03	14.42	22/10/97	190	112	132	57.88	16.40
25/9/97	160	72		59.97	15.35	22/10/97	201	112	133	57.88	16.53
25/9/97	220	148	183	60.03	14.03	22/10/97	167	85	96	57.77	15.50
25/9/97	176	108	129	59.95	14.85	23/10/97	176	82	98	57.83	15.53
25/9/97	189	238	262	60.07	14.38	23/10/97		70		57.83	15.60
25/9/97	181	97	117	60.05	14.27	23/10/97	157	72	87	57.83	15.60
25/9/97	170	79	96	59.98	14.95	23/10/97	172	76	94		
25/9/97	180	118	137	60.03	14.03	23/10/97	180	85	102	57.83	14.93
25/9/97	162	64	79	60.05	14.27	23/10/97	172	79	94	57.85	16.07
26/9/97	164	71	85	59.93	15.50	24/10/97	172	78	94	57.82	15.73
26/9/97	199	103	123	59.97	15.40	24/10/97	192	111	130	57.82	15.73
26/9/97	180	107	126	59.95	15.75	24/10/97	210	133	155	57.98	16.30
26/9/97	168	69	82	59.97	15.43	25/10/97	200	113	136	57.83	15.73
26/9/97	176	86		59.97	15.43						
26/9/97	187	117	140	59.95	15.75						

APPENDIX 3

Otoliths taken from stomach contents of Koshin Maru #8 bluefin tuna.

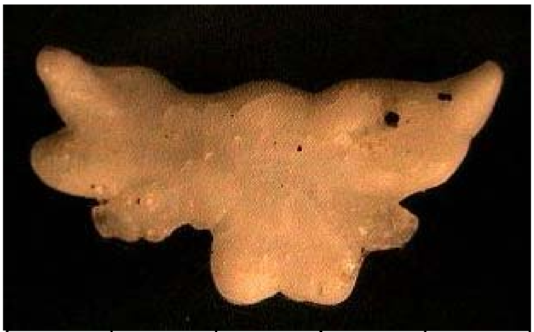


View	OL (mm)	OW (mm)	Type	Notes
Outside	5.45	2.7	A	suggested *Paralepis* sp.

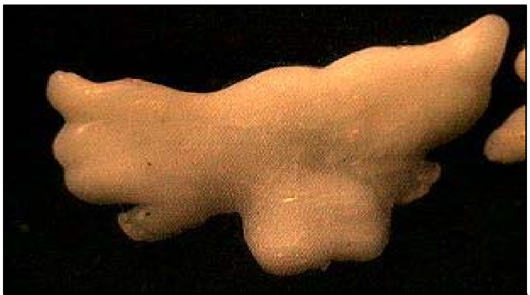


View	OL (mm)	OW (mm)	Type	Notes
Inside	5.45	2.7	A	suggested *Paralepis* sp.

View	OL (mm)	OW (mm)	Type	
Both	4.45	2.15	B	
Identified from partly digested full fish as possibly *Paralepis coregonodes*				



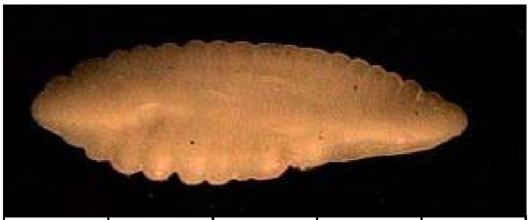
View	OL (mm)	OW (mm)	Type	
Inside	5.97	2.9	C	
Possibly lancet fish *Alepisaurus ferox*				



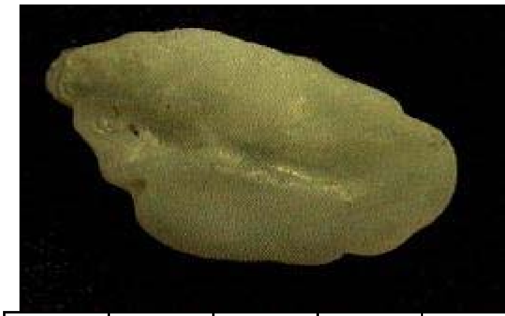
View	OL (mm)	OW (mm)	Type	
Ouside	5.97	2.9	C	
Otolith with lobes on dorsal margin not present in *Paralepis/Alepisaurus* types examined				

View	OL (mm)	OW (mm)	Type	
Inside	5.33	1.99	D	
Otolith removed from green boned fish, garfish or saury species				

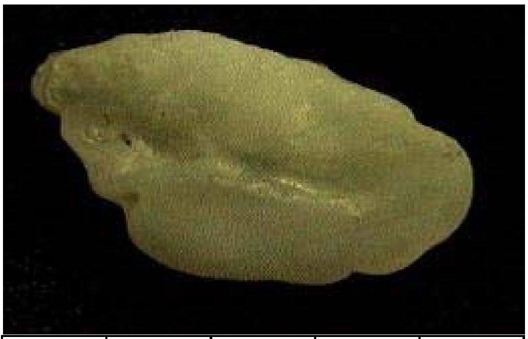
APPENDIX 3 CONTINUED



View	OL (mm)	OW (mm)	Type	
Outside	5.33	1.99	D	
Dorsal & ventral margins with definitive lobes not found in *Belone* sp., the sulcus is also very different with ostium very				



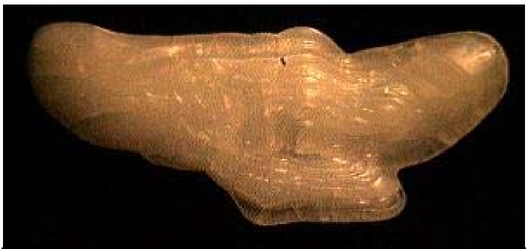
View	OL (mm)	OW (mm)	Type	
Inside	1.96	1.13	E	
Taken from partly digested full fish. Possibly *Scorpaenidae* (Red Fish)				



View	OL (mm)	OW (mm)	Type	
Outside	1.96	1.13	E	
Well rounded antirostrum, lobed margin to the ostium, obvious cauda				

View	OL (mm)	OW (mm)	Type	
InsideX2	1.24	1.05	F	
Taken from partly digested full fish as possibly *Triglidae* species				

View	OL (mm)	OW (mm)	Type
Outside	1.24	1.05	F
Otolith similar to *E. gurnardus*			



Inside	5.97	2.78	L	
unidentified species				

APPENDIX 4

An investigation into the North East Atlantic bluefin tuna longline fishery: A preliminary report December 1997.

Vessel: Koshin Maru #8.
Fishing Gear: Long Line
Date: 23rd August 1997 to 28th October 1997.
Area of Operations:
East to West: 13°00W to 25°00W
North to South: 61°00N to 56°00N
Personnel
John Boyd, Observer and Chief Scientist, John Molloy, Pelagic Team Leader, FRC, Richard Fitzgerald, Manager, ADC, and Elizabeth Barnwall, Senior Technician, FRC.

Objectives

The objective of the trip was to observe the capture and treatment of bluefin tuna and to gather as much biological data as allowed by the impromptu opportunity to go aboard. The bluefin tuna is arguably the most prized of all fish and the criteria that govern and preserve this value during and after capture were of the utmost interest to the author.

The Boat

Koshin Maru #8 is a six year old tuna longliner. She is roughly 50m in length and 12m at the beam. The main engine is 1500hp with an auxiliary engine of 500hp. Gear is hauled from the starboard bow and shot from the stern. In 1997, upwards of 100 boats prosecuted fisheries in the Atlantic, in company with a much smaller number of Korean and Taiwanese boats.

The Main Deck

On Japanese longliners the bridge and wheelhouse overlook the main deck which is partially sheltered on the port side, with the line hauled over the starboard bulkhead. The overall deck length is approximately 15 meters. The most important equipment on the deck in order of usage are the line guide, the hauler, the line conveyor belt and line feeder which conveys the hauled line aft to storage wells in readiness for shooting. In addition to these there are two automatic branchline winders and an automatic reel of backing line for playing fish. Two very important pieces of equipment on the main deck are the water bins containing simmering and cold water respectively. Successive immersion of the branchlines in these straightens out the kinks and knots that develop in these in the course of fishing and hauling. Directly beneath the wheelhouse there is a carpeted area of deck where fish are killed, weighed and prepared for freezing. This is separated from the main working area of the deck by a large raised hatch through which fish are discharged from the main freezer. At the aft end of the hatch there is flat plate balance for weighing the fish. When the boat is underway and working this hatch also serves as a work bench for the tools used in killing and preparing fish and as a time out area for crew during the long hours of hauling. The carpeted area is kept clear of fishing gear and all apparatus superfluous to the fish handling process. The deck is well lighted all through hauling which mostly takes place in the hours of darkness. Line parts and spares and a wide range of carpentry and fitting tools are stored in the forepeak.

The Stern Deck

This deck is fully sheltered and the working area of it from where the gear is shot is around 4 meters in length. The equipment here consists of a conveyor belt, leading from the buoy and branchline storage room to the bulwark and a line feeder that feeds the mainline from the storage wells to the belt. Along the starboard bulwark, radio buoys and antennae are stored in racks. Mounted on the port bulwark is a trap for shooting the baited hooks. Liaison between the line assembly team and the wheelhouse is facilitated by an electronic counter with dual displays on the stern deck and in the wheelhouse.

The Freezer Hold

The freezer hold comprises three compartments and is entered through a heavily insulated steel door directly below the wheelhouse on the main deck. The first compartment consists of blast freezers housed in cabinets around a lobby area with an estimated capacity for up to thirty fish. This space is approximately 8m x 8m. Astern of this is a smaller freezer space used for perishable provisions. Beneath these and accessed by a shoot is the main fish and bait store. This space was estimated at around 25m in length.

The Wheelhouse

The bridge and wheelhouse are equipped with an echosounder, GPS, radar, and radio and telephone communication systems. Just behind the wheelhouse are a small lounge and fax machine and the fishing master’s quarters. In addition to electronic navigation systems there are a chart table and cabinet with a full compliment of admiralty charts covering all reaches of the Atlantic.

Steering the boat is by autopilot when underway and by manual control during fishing operations. During fishing operations, two main dials are used, one to control power output and the other to steer. These are at the starboard side with a clear view of the line guide and deck. From this position the hauler speed can also be controlled but this is usually done from the deck and there is also an alarm that is sounded to warn crew of waves. On all working areas of the deck there are electric billies for coffee.

The Crew

The crew was made up of ten Japanese and 11 Indonesian sailors with a clear divide between both groups in terms of seniority. Japanese crew members explained that young Japanese no longer find the business attractive because the pay and condition of service can no longer compete with land based employment in Japan and that the fishing companies can reduce costs by hiring Indonesian crew for whom lower rates of pay are acceptable. With a constantly increasing cost of living in Japan and dwindling recruitment of young Japanese, it can be foreseen that in future, Indonesians and other non-Japanese will assume senior positions on the boats. For the present, senior and technical positions are the reserve of Japanese.

The Fishing Master takes responsibility for the success or failure of the fishing and the enterprise. Where to fish, the course at shooting, the bait used, and alterations to the gear are solely his decisions. Much of his time is spent on the radio talking about fishing to other fishing masters who form a dispersed though highly communicative caste within the fleet. He takes no part in the manual work of shooting and hauling the gear, playing and preparation of the catch, although he will certainly comment on the skill with which these and other innumerable tasks are carried out. Every activity on board a longline vessel builds towards the catching of tuna and the numbers caught and the quality they are delivered in, is the sole measure of his success.

The chief responsibility of the captain is the immediate leadership of the crew in fishing and sailing duties. He also sets the course to the grounds in consultation with the fishing master. He bears no responsibility for fishing results and is free of the pressure of failure and professional discredit which is ever present on the fishing master.

The long duration of fishing expeditions on long liners demands a considerable inventory of replacement parts, tools and equipment to ensure that the vessel is operating at the optimum level of fish catching efficiency. The recording and dispensing of this inventory is the responsibility of the boson as is the correct use maintenance of deck equipment. In addition to the boson and captain, two deck quarter masters operated in a training and supervisory role. Japanese sailors are presumed to be well versed in the operation of the gear and the playing and capturing of fish and are expected to pass on their knowledge and expertise to the non-Japanese workers on the boats.

The killing and preparation of the fish for freezing and stowing is the responsibility of the icemaster. This is a specialised position and the skill with which is carried out impacts directly on the quality of the landed catch. In the course of these duties the icemaster monitors the hold temperatures so that both bait and fish are held in optimum conditions.

The remaining crew were Indonesian and much younger than the Japanese crew. The hierarchy of responsibility onboard was reflected in the age range of the Japanese and Indonesian crew members. The age range of the Japanese crew was from 32 to 53, while that of the Indonesian was from 23 to 28. Indonesian crew were recruited by agencies and a number of them were in their first year of tuna fishing.

Conditions onboard were as comfortable as the environment and work permitted. Morale was buoyant throughout the 65 days of the trip and very much a credit to the discipline and good humour of the 21 crew members.

Gear

The gear used was a single longline of braided multifilament nylon of approximately 120,000m. The line was suspended from 400-420 hard plastic buoys of approximately 30cm diameter on 15m of thin nylon rope (clothesline) at intervals of around 300m. The terminals of the buoy were weighted for a number of sets. Hooks were galvanised steel, wide gape with a 60mm shank length and attached to the mainline by 42m of tapered nylon monofilament with around 2800 being shot at each set. The distance between hooks was the approximate length of each branchline, i.e. 42m. As well as suspension buoys, 12 radio buoys at intervals of around 10,000m were also shot with a dan buoy at each end of the line.

Braided multifilament is considered the best material for main line as it is cheap, light, and easy to mend and store. Clipping on and unclipping branchlines is much easier with this material than with the solid nylon rope lines formerly used. Being softer and much more pliable, it is easy to splice, mend and store. By comparison nylon rope lines are hard and unforgiving to work with.

Branchlines are made of three sections separated by swivels. The butt of the branchline is thin nylon rope (clothes line) of 2m followed by 20m of 300X nylon monofilament and ending in 20m of 200X of the same material. Hooks are attached with a clamped alloy sleeve.
The most important feature of this gear is that it is taken apart every time it is hauled and has to be reassembled every time it is shot. To make this practical spring clips are used for joining all the components together.

When a fish is brought along side extra purchase is gained with barbed harpoons and gaffes. The construction of the harpoons is interesting. A barbed tip is mounted on a sleeve that slides over the shaft and once set is detached from the shaft by a sharp jerk. The point is connected via steel wire and bungi rubber to a spool of line. Up to three harpoons may be set in the fish in this way making capture a certainty.

The Japanese fishermen thought the gear used was the best available for the deep waters outside national limits. To longline tuna inside the Irish EEZ they suggested that American systems that presented the bait at about 20m below the surface would much more suitable and have proven successful in the shelf waters around Japan.

Bait

Illex argentinus was the preferred bait and used in a ratio of six squid to one mackerel (*Scomber* species) or herring (*Clupea harengus*). Squid is preferred because it is thought to be a "livelier" and more visible bait than mackerel. The bait was supplied by Taiwanese companies and came in three size grades in 20kg and 40 kg frozen blocks. The largest grade was of squid of approximately 30cm mantle length with medium and small grades of 25cm and 20cm also used. Responsibility for storage and rationing of bait was the responsibility of the icemaster and between 75 and 120 blocks were used each day. The quality of squid was human consumption grade and conversations with the crew indicated that bait for each setting cost as much as $2,000. Over the course of the expedition this implied a bait bill approaching $120,000.

Reason for the longline method

Longlining is the preferred fishing method through a combination of two factors. Longlined tuna is considered superior to net caught fish because the fish can be treated to prevent "yake" or tuna burn. Tuna burn or yake occurs after death through the slow dissipation of heat from the body which has the effect of spoiling the flesh around the visceral cavity which in tuna is considered to be prime cut. In longlined fish "yake" is avoided by immediately flooding the body cavity with cold sea water, a process not possible when many fish are caught together as is the case with purse seining. The second factor is that the large fish sought by the longliners are not sufficiently abundant in international waters to support the higher running costs implied by purse seining or pelagic trawling.

Shooting

Shooting the gear follows fast on completion of hauling often with only half and hour elapsing between the completion of the haul and the start of the shoot. All hands with the exception of the fishing, master, chief engineer and cook participated in this activity for which the crew was divided into three teams of six members with each team shooting every third night. The line is assembled as it is shot and the team operate as a six man assembly line. As in all assembly lines there is a conveyor system in this instant a belt running from the depot for buoys and branchlines to the mid point of the (cruiser) stern bulwark. At the depot end of the line the belt is loaded with the buoys and branchlines in the correct ratio (7:1). Immediately downline the hooks are baited in the prescribed fashion. Two methods are used for squid; either through the siphon and out the mantle or through the mantle at end of the tail fin. For fish baits the hook is passed through the pectoral socket which is supposed to present the fish on a plausible horizontal plane. After baiting the coiled branchline is checked for snags (of which there are rarely any) and snapped on to the mainline and set in the trap for shooting. The trap is of identical concept to those used to for firing clay pigeons, and fires the baited hook 10-15m to port uncoiling the line in the process. To ensure a brisk working rhythm the whole process is timed by a two toned “bleeper” which by alternating tones maintains the correct ratio of branchlines to buoys and sets the pace for their attachment to the mainline. The interval of attachment of radio buoys is set by alarm and a digital display unit which counts them on. In the event of a snag or accident in the process the wheelhouse is alerted by an alarm button. All tasks in shooting are done in rotation so that all members become expert in each step of the sequence which is done at the considerable speed of 12 kts with six hours being considered a reasonable timeframe for completion of the task. The stripping of the main line from storage wells is by automatic feeder and in all the time onboard there were no malfunctions or accidents during shooting. When the set was completed the boat steamed well clear of the line to not to the other end and kept contact through radio.

Hauling

The time allowed to haul the gear under normal circumstances was twelve hours though on numerous hauls this was exceeded with some taking over fourteen hours to complete. As a general rule hauling began each day two hours before sunset though often earlier in the event of rough seas being forecast. With the exception of the fishing master and chief engineer all crew took part in the haul. Locating the line began by tuning into the transmission frequency of the radio buoys and then steaming until visual contact was established. The line was brought aboard by throwing a grappling hook across it and feeding it through the line runner into the hauler. Throughout hauling a speed of around 6kts was maintained with a rota of deckhands continually snapping off the branchlines and dropping them onto the automatic winders; kinks and knots were corrected by successive immersions in hot and cold water, frayed ends replaced and new hooks clamped on as required. It is an absolute requirement that every branchline going astern be in perfect readiness for reattachment and every fisherman is expected to scrutinise each piece of the gear he handles. Bluefin tuna are among the strongest of fish and in the course of fighting can be relied to find out any flaws in the gear. Mending the mainline involved cutting out the weakened section and splicing in a fresh section, a procedure which was repeated innumerable times on each haul with each new splice being the work of seconds. At the start of each trip workbenches are set up on the deck for replacing hooks and for replacing frayed end sections of branchlines. It is important that the spring clips used to snap the various line components together do not become relaxed and that buoys and branchlines remain at their fixed positions. To correct looseness in the clips, vices were mounted around the frames where the branchlines were stacked prior to be being sent astern. In the event of a fish taking a hook, fixed positions can change and tangles develop. But of course at that stage the affected gear can be considered to have performed its function.

During hauling the wheelhouse of the Koshin Maru #8 was manned in rotation by the Captain, the Boson and the two quartermasters with the Fishing Master overseeing all these duties. The line was pursued at a tac of between 45 and 70 degrees. In the event of a break in the line the crew gathered on the upper decks and scanned the water with search lights while the wheel house officer steered the boat towards the radio signal.

Capture and treatment of bluefin tuna

The first indication of a fish on the line often comes from the wheelhouse where the officer in control may sight a two or more buoys clustered together; see the line arc off tac or see a fish streaking away from the oncoming boat. Any anomaly on the incoming line might mean a fish and is communicated immediately to the deck via the intercom. During hauling, there was a fisherman at all times standing by at the line runner. Once an indication was confirmed to be a fish the boat was brought to a stop and the line lifted off the hauler and down to the fishgate, and then hauled in manually until the branchline became available. The branchline was then snapped onto the backing line and off the mainline and *always in that exact order.* This was simultaneous to a quick and thorough clearing of the deck of all extraneous material and feeding the mainline clear of snags and tangles back on to the hauler. To avoid the risk of further snags the boat was manoeuvred to an angle of 90 degrees or more off the line which was then hauled taut to ensure maximum clearance of the fish and provide the widest possible arena for the struggle. Apart from maintaining this clearance hauling ceased until the fish was brought aboard.

Playing the fish

The reel was used as a storage unit for the backing line. Pressurising and hauling the fish was done manually and the time taken to defeat a fish varied widely, with freshly hooked fish sometimes proving so strong that they had to be played in relay by teams of two or more fishermen. The initial period of the struggle was often characterised by the fish sprinting in wide arcs close to the surface. As fish were brought closer to the boat they often tried to sound or dive under the keel. As fish came close to the boat the fishermen followed the fight along the bulwark watching for an opportunity to harpoon the fish. The target area for a harpoon is the head, and for a lively fish as many as three harpoons were needed to bring it securely to the gate. It was then pinioned with gaffs while the lifting gaffe was brought into position. This was too clumsy an implement to pierce the hard plates that comprise the greater part of the fishes head and was always routed into the angle between the gill plates and the lower jaw. It was then held tight while the lifting cable was drawn taut and the fish lifted aboard by automatic black and tackle. Not all fish were alive when contact was made and while this lessened the risk of loosing the fish it had implications for the flesh quality if rigour had set in without the fish being properly bled. In the course of the expedition a number of fish were lost either through line breaks or the hook pulling free, perhaps as much as 10-20%. In many instances branchlines were retrieved without hooks. In this latter instance it was impossible to say if the line had been broken by a tuna, a shark or some other fish.

On the subject of harpooning fish it is considered that sticking the fish in the trunk is the height of bad workmanship. A fish with bruising and damaged discoloured tissue may not be acceptable as sashimi and this is precisely the effect of a badly placed harpoon.

Treatment of the fish

Once a fish was brought onboard it was pulled over on to the matted area to be killed. They were always approached head first as even out of water they retain considerable power. Killing the fish was done by piercing the brain with a stainless steel spike entered expertly from a point half way between the fish’s eyes. A steel wire of approximately one meter in length was then fed into the brain and down the spinal column chasing out all the nervous responses and eliminating any thrashing that might damage the flesh or appearance of the fish.

Processing began by removing the tail fin between the third and fourth finlets from the fork. With the exception of the first dorsal fin all remaining fins were cut off flush with the trunk and a deep incision made in each pectoral fin socket. A notch was cut in the gill covers and the deck hose (fitted with a tapered nozzle) pushed through this sending a pressurised stream of water into the stomach and intestines. This remained in place until the fluid exiting at the pectoral incisions and tail was clear signifying that the fish had been properly bled. Following this the ventral peak (belly) was opened from pelvic fin to the vent and the fluid allowed to drain. The gill covers were then sawn away and the gills and all connective tissue between the gills and the body and head of the fish excised neatly. The large intestine was then cut at the vent, and the gills and all internal organs with the exception of the gonads pulled up through the operculum in one clean motion. The significance of this method of dressing the fish is that it does not damage the membranes that separate the muscle mass of the fish from the intestines and their spoiling bacteria. The gonads which lie on either side of the spine remained attached to the walls of the cavity and were pushed up through the operculum after all other material had been removed. They were in all cases empty, containing neither eggs nor milt. On Japanese longliners, the heart, tongue, stomach, and the valves around the gill plates are retained by the crews for eating. Indeed the heart was often eaten, sliced and diced, directly after removal and was said to confer strength and stamina. The valves between the gill plates and the trunk were regarded (not without justification) as one of the best cuts. On vessels where most of the diet is composed of frozen and processed food, these cuts are taken as welcome fresh food. The liver, intestines, and gills were all discarded. Before freezing the fish, any harpoon points still in the head were pushed out. Any harpoon points in the main trunk were left there with a segment of steel wire still attached to indicate their presence to buyers in Japan. Disguising their presence would damage the knives and blades used to section the tuna in Japan and create wariness among buyers. The carcass was then hosed and sponged inside and out, weighed and frozen.

Freezing

Tuna longliners freeze tuna at -55° C. To achieve this the fresh carcass was initially blast frozen for 48 hours. It was then removed from the blast cabinet and any crystals that formed on exposed flesh in the operculum or body cavity were chipped clear. The fish was then glazed by brushing with water which freezes on contact and forms an unbroken film around the fish. This prevents the fish drying out in the freezer and the concentration of salts in the flesh with resultant flavour deterioration. The date of capture is indicated by a colour ribbon attached to the tail stump or eye-socket.

Freezing and managing the fish hold entailed a separated duty roster. Each day before hauling this began by transferring the blast frozen fish from the blast cabinets to the main hold. This implies that the design specifications of freezer longliners far exceeded the availability of the fish resource in the North Atlantic at the time of fishing.

Sharks

According to the Japanese fishermen, bluefin tuna and blue shark, *Prionace glauca*, are closely associated. Despite the numerous halts, tangles in the mainline and inevitable twisting of branchlines caused by hooking sharks they were nonetheless a welcome component of the catch. Sharks were stripped of their fins which were then layered in baskets and blast frozen to form compact blocks of fins, the main ingredient of shark fin soup. Shark fins were said by the captain to fetch as much $30/kg in Gran Canaria with the proceeds going towards the purchase of coffee, tobacco and other luxury goods for the crew. All blue sharks observed were female. The only other shark species caught were Shortfin mako, *Isurus oxyrinchus*.

Conditions onboard

Allowing for the physical limitations of the boat and the arduous nature of the work and environment, conditions onboard were comfortable. Cabins varied from one berth cabins for the most senior crew with a series of two berth and one four berth for the remaining crew. There were good facilities for washing and laundry with unlimited hot water. The diet onboard was essentially piscivorous. Fish were eaten at every meal with as many six different species being offered in one day. Typically the first meal of the day was yellowfin or albacore sashimi with a buffet that invariably included surimi, cold grilled tuna loin and squid. This was the most leisurely meal of the day. Dinner was eaten in shifts usually about three hours into hauling with no more than 15 minutes allowed for its consumption. Even when meat or poultry was offered it was always with side dishes of seafood such as crustaceans, bivalves, or different roes and larvae. Main dishes were representative of every fish family. Supper was essentially dinner repeated with the minor distinction that meat or poultry was never offered. With all meals boiled rice was served, invariably with seafood dressings such as seaweed, dried tuna flakes or fish fermented in saki as well as a range of pickled vegetables. It was related to me that in Japan that traditional foods and diet was increasingly being challenged by the growing predilection of younger Japanese for western trash foods. Compared to the Japanese, the Irish approach to seafood is timidly eclectic and in need of radical revision if we are to enjoy all the benefits of our marine biotic resource both as consumers and exporters.

Cruise Report

Days 1 and 2: 23-8-97 and 24-8-97. Koshin Maru # 8 steams to initial shooting position of 59°25 North 24°10 West.

Day 3: 25-8-97: Haul #1. Small swell and light wind, Force 3 or thereabouts. Five blue fin tuna for a total carcass weight of 544kg were taken. Bycatch was composed of 1 female blue shark (*Prionace glauca*) of approximately 140cm.

Day 4. 26-8-97. Haul #2. Position: 59°40N 23°59W to 59°12N 22°13W. Course: 90°. Time of shoot: 1806 to 2320hrs. Time of haul: 0430 to 1552hrs. Small swell and light wind of Force 3. No bluefin tuna or bycatch was taken.

Day 5. 27-8-97. Haul#3. Position: 59°35N 22°48W to 59°34N 24°38W. Course: 90°. Time of shoot: 1809 to 2345hrs. Time of haul: 0430 to 1713hrs. Sea state and wind state as previous two days. One bluefin tuna of 75kg carcass weight. No bycatch.

Day 6. 28-8-97. Haul #4. Position: 59°34 N 22°42W to 59°34W 24°30W. Course: 90°. Time of shoot: 1823 to 2348hrs. Time of haul: 0430 to 1640hrs. Sea state and wind as for previous haul. Three bluefin tuna for 495kg carcass weight comprised the main catch. Bycatch consisted of three female blue shark.

Day 7. 29-8-97. Haul #5. Position: 59°34N 22°55W to 59°34N 24°54 W. Course: 90°. Time of shoot: 1806 to 2320hrs. Time of haul: 0430 to 1700hrs. Sea state: Small swell and wind of F3. Overcast day with air pressure at 1003 at start of hauling. One bluefin tuna of 236kg carcass weight was taken. Bycatch consisted of two female blue shark of approximately 180cm each. Exact measuring of sharks was not feasible due to speed with which they are addressed and processed by the crew. Processing consists of removing the fins, the remainder being discarded. Two breaks occurred in the line taking approximately 90 minutes to restore. In the event of a line break the officer on the bridge tunes radio into buoy frequency and steams into the signal with search lamps searching sea in wide arc from port to starboard. As many deckhands as can be spared standby on the bridge deck following the search lamps across the sea until a buoy is sighted. The boat is then pulled alongside the buoy which is brought on board by throwing a grappling hook across the line and hauling recommences.

Day 8. 30-8-97. Haul #6. Position: 59°35N 24°49W to 59°35N 22°45W. Course: 90°. Time of shoot: 1833 to 2358hrs. Time of haul: 0430 to 1630hrs. Calm sea and wind of Fl-2. Mean sea surface temperature was 12.9°C from 14 readings taken throughout the haul. Barometric pressure was 1002 at start of haul. During hauling the wheelhouse roster was comprised of four watches of three hours each, with the captain, boson, and two quartermasters on rotation each day. One bluefin tuna of 96kg carcass weight comprised the main catch. The stomach of the bluefin tuna was found to contain four fish approximately 25 to 30 cm in length and one squid. The bycatch was composed of one female blue shark.

Day 9. Haul# 7. 31-8-97. Position: 59°35N, 24°46W to 59°35N, 22°43W. Course: 90°. Time of shoot: 1715 to 2319hrs. Time of haul: 0430 to 1748hrs. Calm sea and wind at around F2-3. Sea surface temperature 12.8°C from 14 readings taken throughout the haul. Barometric pressure was 992 at start of haul. Two blue fin tuna comprised the main catch for a carcass weight of 188kg. Both tuna stomachs were empty. Bycatch comprised of three blue shark females of approximately 160cm, 140cm, and 130cm.

Day 10. Haul#8. 1-9-97. Position: 59°35N 24°40W to 59°35N 22°50W. Course: 90°. Time of shoot: 1850 to 0017hrs. Time of haul: 0500 to 1645hrs. Calm sea and wind at around F2-3. Barometric pressure was 997 at the start of hauling. One bluefin tuna for the haul for a carcass weight of 200kg. Observed stomach contents were 13 fish of between 15 and 20cm, and two squid. Bycatch consisted of three blue shark females of 140cm, 150cm and 140cm.

Day 11. Haul#9. 3-9-97. Position of haul: 59°35N 24°31W to 59°35N 22°28W. Course: 90°. Time of shoot: 1800 to 2327hrs. Time of haul: 0430 to 1630hrs. Calm sea and wind at round F2-3. Water surface temperature derived from thirteen readings taken throughout the haul was 12.9°C. Fishing was poor with one bluefin tuna for a carcass weight of 122kg. Observed stomach contents were at least twenty fish varying from 10cm to 30cm. Fish well into digestive process and difficult to identify. Bycatch comprised of one female blue shark. At all times during fishing there was at least one other tuna longliner operating within sight of us, with radar sometimes showing as many as six.

Day 12. Haul#10. 4-9-97. Position of haul: 59°32N 23°31W to 59°15N, 22°10W. Course: 90°. Time of shoot: 1743 to 2310hrs. Time of haul: 0430 to 1630hrs. Weather disimproved with heavy swell and plenty of water breaking on deck. Wind at start of haul around F7-8 dissipating somewhat to F4-5 at the end. Barometric pressure at start of haul was 1012. No bluefin tuna landed. Bycatch was comprised of one swordfish (*Xiphias gladius*), 290cm long and 184kg filleted weight, and three female blue shark of between 130 and 150cm.

Day 13. 5-9-97. Halfway through shooting, we stopped, hauled and steamed for a new position. One blue shark female of 170cm the sole catch.

Day 14. 6-9-97. A holiday of sorts as we continued steaming to a new position. Holidays such as they are in this business are characterised by one cooked meal in the day.

Day 15. 7-9-97. Haul# 11. Position: 59°20N 15°46W to 59°20N, 14°53W. Course: 90°. Time of shoot: 1438 to 1937hrs. Time of haul: 0030 to 1310hrs. Big swell, perhaps as much as four to five meters and wind around F 8. Fishing on fringes of UK territorial waters. Mean sea surface temperature of 12.6°C from 13 readings taken throughout haul. Barometric pressure was 1012 at start of haul rising to 1017 at the end. Plenty of water breaking onto deck at hauling with quite a few people sick. Plenty of line breaks due to rough seas with plenty of tangles. No bluefin tuna were taken and bycatch was composed of seven female blue shark all between 150 and 200cm.

Day 16. 8-9-97. Haul# 12. Position: 59°20N 16°20W to 59°20N 14026W. Course: 90°. Time of shoot: 1530 to 2110hrs. Time of haul: 0230 to 1430hrs. Sea state much improved with swell down and no water breaking over bulwarks. Wind at around F5. Barometric pressure standing at 1027 at start of haul. Fishing ground covered by line was the George Bligh Bank and Rockall Plateau with water depths in the region of 500 to 1100m. Two blue fin tuna for a carcass weight of 178kg comprised the main catch. The stomachs of both fish were observed to be empty. Sexing the fish was difficult with little apparent sexual differentiation in the gonads of fish caught. The most noticeable features of the fish to this date were the large and muscular ovi or sperm ducts. The method of gutting the fish for freezing did not allow systematic separation of the internal organs. Bycatch was comprised of seven female blue shark.

Day 17. 9-9-97. Haul# 13. Position: 59°22N 16°32 to 59°22N 14°32W. Course: 90°.Time of shoot: 1548 to 2115hrs. Time of haul: 0230 to 1400hrs. Sea state disimproved from previous haul with occasional waves breaking over bulkhead and wind up to around F6. Mean sea surface temperature over the course of the haul was 12.4°C. Barometric pressure down to 1017. Fishing poor with one bluefin tuna for a carcass weight of 165kg. Bycatch comprised of three female blue shark. Blue shark are problematical in certain respects. Because of sharp teeth, many escaped by slicing the branch line. Another problem occasionally encountered with blue shark was where the branch line became entangled around the tail and head of the fish rather like a drogue pulling the mainline astern.

Day 18. 10-9-97. Haul# 14. Position: 59°22N 16°45W to 59°22N 14°00W. Course: 90°. Time of shoot: 1603 to 2053hrs. Time of haul: 0100hrs to 1115hrs. Sea state much the same as previous haul with occasional wave breaking over deck and wind of F5-6. Sea surface temperature over the course of the haul averaging 12.5°C. Barometric pressure at start of haul was 1006. Fishing was poor with two blue fin tuna for a carcass weight of 272kg. Both fish observed to have had empty stomachs. Bycatch was comprised of two female blue shark of approximately 160cm in length each.

Day 19. 11-9-97. Haul #15. Position: 59°58N 15°52W to 59°58N 13°47W. Course: 90°. Time of shoot: 1615 to 2100hrs. Time of haul: 0300 to 1500hrs. Sea state: moderate swell of 2-3m with no water breaking over deck. Wind around F4. Barometric pressure standing at 1000. Change of position from last haul and now fishing on the southern edge of the Lousy Bank in depths of around 1000m. One bluefin tuna for a carcass weight of 123kg comprised the main catch. Stomach observed to contain ten fish 15-30cm in length. Bycatch comprised of two blue shark females of approximately 190cm each.

Day 20. 12-9-97. Haul# 16. Position: 60000N 14°01W to 59°57N 15°54W. Course: 90°. Time of shoot: 1540 to 2115hrs. Time of haul: 0300 to 1500hrs. Sea state disimproved with occasional wave breaking over bulwark and wind at around F5-6. Noticeable drop in air temperature making deck relatively inhospitable. The fishing was reasonable with four bluefin tuna for 513kg carcass weight. All stomachs were observed to be empty with the exception of the third fish whose stomach contained a well digested unidentifiable large fish. Bycatch comprised of ten blue shark females all between 140 and 200cm long. One large lancet fish (*Alepisaurus ferox*) discarded before I had chance to observe it at length. Lancet fish characterised by long pike like mouth with spectacular pair of fangs jutting from lower jaw in addition to an array of smaller teeth. Dorsal fin sail like, with widely separated fin rays and thin covering membrane which may be holed. Body is cylindrical, sinuous and of unvarying sepia tint. The crew call this fish uro.

Day 21. 13-9-97. Haul #17. Position: 59°58N 15°52W to 59°58N 13°47W. Course:90°. Time of shoot: 1530 to 2105hrs. Time of haul: 0300 1500hrs. Sea state and wind same as haul haul#16. Three bluefin tuna for 331kg carcass weight comprised the main catch. Stomachs of all three fish were observed to be empty; bycatch was comprised of four blue shark females, all of lengths between 160 and 200cm; one lancet fish of 153cm; and one shortfin mako shark (*Isurus oxyrinchus*) of 75cm. In all four species were captured on this haul.

Day 22. 14-9-97. Haul #18. Position: 59°58N 15°52W to 59°58N 13°47W. Course: 90°. Time of shoot: 1446 to 2119hrs. Time of haul: 0300 to 1514hrs. Rough weather with water constantly breaking on deck. Wind at F7 and air pressure down to 981. Mean sea surface temperature of 12.2°C for the haul. Fishing ground described on admiral charts as the Lousy Bank. Three bluefin tuna for a carcass weight of 307kg made it a marginal nights fishing. All stomachs were observed to be empty. Two fish were lost due to line snapping during play. Full extent of lost fish is difficult to ascertain as a number of branch lines are retrieved each day without their hooks. It is not possible to see every broken branch line and attribute a cause. Being a hook and line fishery it is to be expected that fish will be lost. Sexing the bluefin tuna remains unresolved due to undifferentiated gonads. Bycatch was comprised of 8 blue shark in the range of 130 to 200cm and all female.

Day 23. 15-9-97. Haul# 19. Position: 59°59N 13°58W to 59°57N 15°55W. Course: 90°. Time of shoot: 1530 to 2105hrs. Time of haul: 0230 to 1510hrs. Haul began with rough weather with boat pitching about in sea and water breaking onto the deck. Weather calmed towards the end of haul with wind dropping from a F8-9 to a more comfortable F5-6. Barometric pressure remains low and falling through haul to 987 from 999. Mean sea surface temperature of 12.1 °C for the haul. Fishing improved with five bluefin tuna for 635kg. All fish were observed to have empty stomachs. Bycatch was comprised of ten blue shark females of between 130 and 200cm, and one angler fish (*Lophius* species) of 17kg. Prior to hauling, a pod of pilot whales appeared 100 to 150 meters to the port. Japanese believe that these whales prey on bluefin tuna which seems unlikely and it is even claimed by them that the whales flip the fish from the water with their tails and swat them on the way down. This seems a rather athletic feat for a pilot whale but the fishermen assure me that this is indeed the case. It might also be construed as a persuasive argument for a dry boat. It is also claimed that the pilot whales strip the bait from hooks which is perhaps more plausible. The ironical term for this activity is depredation.

Day 24. 16-9-97. Haul# 20. Position: 59°37N 13°51W to 59°47N 15°48W. Course: 90°. Time of shoot: 1525 to 2055. Time of haul: 0230 to 1440hrs. Sea state much improved with a small swell. Wind at F5 and sea surface temperature a mean of 12.1 °C for the haul. Barometric pressure rising from 1005 at the start of hauling to 1014 at the end. Catch for this haul was considered good with seven bluefin tuna for a total of 783kg carcass weight. Bycatch was composed of five blue shark females between 150 and 200cm long.

Day 25. 17-9-97. Haul# 21. Position: 59°58N 15°48W to 60000N 13°48W. Course: 90°. Time of shoot: 1520 to 2055. Time of haul: 230 to 1420hrs. Haul began on a beautiful evening, swell up a little from previous evening and wind at F4. Barometric pressure standing at 1022 at start of haul and falling to 1020 by the end. Mean sea surface temperature of 12.1°C. Fishing was poor with only two bluefin tuna for a total 211kg carcass weight. Stomachs observed to contain small fish bones and larger partially digested whole fish. Bycatch was composed of 4 female blue shark, all between 140 and 200cm in length.

Day 26. 18-9-97. Haul #22. Position: 59°58N 15°46W to 59°55N 13°50W. Course: 90°. Time of shoot: 1530 to 2100hrs. Time of haul: 0230 to 1410hrs. Beautiful evening at beginning of haul with only a slight swell and wind at F3. Air pressure remaining high at 1021 to 1020 throughout haul. Mean sea surface temperature of 12°C for the haul. Fishing was reasonable with four bluefin tuna for a total carcass weight of 422kg. Two tuna were observed to have stomach contents composed of around ten partially digested fish. Bycatch of 5 female blue shark, from 140 to 200cm in length.

Day 27. 19-9-97. Haul #23. Position: 59°58N 15°54W to 59°58N 13°45W. Course: 90°. Time of shoot: 1525 to 2100hrs. Time of haul: 0240 to 1415hrs. Again a beautiful evening at the start of hauling. Wind at F3 and air pressure 1030. Mean sea surface temperature of 11.9°C for the haul. Fishing was reasonable with four bluefin tuna for a total carcass weight of 491kg. Two of the stomachs were observed to be empty, with two having contents composed of two squid and as many as 100 small fish around 10mm, suggestive of juvenile grey gurnard (*Eutriglia gurnardus*). Bycatch composed of one female blue shark.

Day 28. 20-9-97. Haul #24. Position: 59°58N 15°53W to 59°58N 13°43W. Course: 90°. Time of shoot: 1537 to 2111hrs. Time of haul: 0250 to 1415hrs. High pressure weather system still here (1027 at start of haul) with very comfortable sea and light winds at F3. Mean sea surface temperature of 11.9°C over length of haul. Fishing was reasonable with five bluefin tuna for a total of 447kg; stomachs observed to contain squid, fish of 15-30cm length, and "gurnard" juveniles. Bycatch was composed of four female blue shark, all between 140 and 200cm.

Day 29. 21-9-97. Haul #25. Position: 59°58N 15°53W to 59°58N 13°43W. Course: 90°. Time of shoot: 1541 to 2116hrs. Time of haul: 0235 to 1430hrs. High pressure system continues with conditions same as previous day. Mean sea surface temperature of 11.8°C for the haul. Fishing was reasonable with three fish for 350kg carcass weight; stomachs of fish were observed to be empty. Bycatch was composed of five blue shark females between 140 and 200cm.

Day 30. 22-9-97. Haul #26. Position: 59°58N 15°49W to 59°58N 13°45W. Course: 90°. Time of shoot: 1533 to 2107hrs. Time of haul: 0231 to l400hrs. High pressure system persists with sea almost at a flat calm. Mean sea surface temperature of l2.0°C.

Fishing was poor with two fish for 202kg for the haul; stomachs were observed to be empty. Bycatch was composed of three blue shark from 150-200cm.

Day 31. 23-9-97. Haul #27. Position 59°58N l6°00W to 59°58N 13°52W. Course: 90°. Time of shoot: 1526 to 2105hrs. Time of haul: 0245 l405hrs. Still in the high pressure system but with a slight swell today. Mean sea surface temperature 11.9°C for the haul. Fishing was poor with one fish for a carcass weight of 2l0kg. Stomach contents were composed of four fish of 15 to 30cm, and forty "gurnard" juveniles. Bycatch was composed of three blue shark females from 160 to 200cm in length and one lancetfish of 150cm.

Day 32. 24-9-97. Haul #28. Position: 59°58N l5°47W to 59°58N 13°45W. Course: 90°. Time of shoot: 1517 to 2057hrs. Time of haul: 0235 to 1515hrs. High pressure was still persisting. Swell increased in height from previous haul and wind up to F4-5. Mean sea surface temperature of 12.0°C for the haul. Fishing improved with a good catch of six fish for a total carcass weight of 514kg. Stomach contents of one fish were too well digested to identify while another stomach contained three squid and eight 15-30cm fish. Bycatch was composed of four blue shark females, all between 130 and 200cm.

Day 33. 25-9-97. Haul #29. Position: 59°58N l5°46W to 59°58N 13°4lW. Course: 90°. Time of shoot: 1607 to 2l45hrs. Time of haul: 0240 to 1600. Weather holding up very well. Small swell with light F3 wind. Mean sea surface temperature of 11.9°C. Barometer reading 1031 at start of haul, dropping to 1024 at the end. Fishing was very good with eight bluefin tuna for 924kg carcass weight. Stomach contents were composed of squid, thin well digested fish 15-30cm length and a number of different unidentified juvenile or very small fish. Bycatch composed of two blue shark females of 140 and 160 cm.

Day 34. 26-9-97. Haul #30. Position: 59°58N l5°46W to 59°58N 13°40W. Course: 90°. Time of shoot: 1540 to 2120hrs. Time of haul: 0247hrs to l6l2hrs. Weather still fine though wind has picked up to a F4 with a chop in the water. Barometer still up at 1020. Mean sea surface temperature for the haul of 12.0°C. Fishing still good with six fish for the haul at 553kg carcass weight. Stomach contents were dominated by squid and juvenile unidentified fish. Bycatch was composed of nine blue shark females.

Day 35. 27-9-97. Haul #31. Position: 59°58N 15°47W to 59°58N 13°44W. Course: 90°. Time of shoot: 1536 to 2112hrs. Time of haul: 0237 to 1600hrs. Moderate swell with a long fetch. Wind around F4 and pressure down at 1006. Mean sea surface temperature of 11.9°C for the haul. Fishing was poor with two blue fin tuna for a carcass weight 217kg. Stomach contents were composed of twelve juvenile "gurnard". Bycatch was composed of ten blue shark between 140 and 200cm, and one dealfish (*Trachypterus articus*) of 140cm.

Day 36. 28-9-97. Holiday of sorts occasioned by storm forecast.

Day 37. 29-9-97. Haul #32. Position: 59°58N 14°00W to 59°58N 15°37W. Course: 90°. Time of shoot: 1746 to 2243hrs. Time of haul: 0315hrs to 1705hrs. Blowing a storm. Water all over the deck and wind up to F8-9. Barometer down to 998. Mean sea surface temperature of 11.4 °C. Fishing was good with seven bluefin tuna for 732kg carcass weight. Too much water on deck to sort through stomachs. Bycatch was composed of 14 blue shark females and one unusual pipefish species.

Day 38. 30-9-97. Haul #33. Position: 59°58N 15°43W to 59°58N 13°56W. Course: 90°. Time of shoot: 1630 to 2209hrs. Time of haul: 0240 to 1721hrs. Weather remains bad with a big sea. Wind moderating through haul from F8-9 to F6-7 and air pressure 1000 at the start of hauling moving up to 1005 by the end. Mean sea surface temperature of 11.3°C throughout haul. Fishing was poor with two bluefin tuna for 140kg carcass weight. Bycatch composed of one female blue shark.

Day 39. 1-10-97. Haul #34. Position: 59°58N 15°36W to 59°58N 13°47W. Course: 90°. Time of shoot: 1847 to 2341hrs. Time of haul: 0400 to 1550hrs. Weather conditions much improved with wind down to F4 and pressure up to 1016. Mean sea surface temperature of 11.2°C for the haul. Fishing was poor with two bluefin tuna for 182kg; stomachs were observed to be empty. Bycatch comprised of one blue shark female.

Day 40. 2-10-97. Haul #35. Position: 59°58N 13°46W to 59°58N 15°17W. Course: 90°. Time of shoot: 1551 to 2118hrs. Time of haul: 0230hrs to 1420hrs. Weather much the same as previous haul. Wind up slightly to F5, barometer reading 1013. Mean sea surface temperature of 11.2 °C for the haul. Fishing was poor with one bluefin tuna of 106kg carcass weight. Bycatch was composed of two sharks, one blue shark female of 160cm and one shortfin mako shark female of 160cm.

Day 41. 3-10-97. Haul #36. Position: 59°58N 15°37W to 59°58N 13°37W. Course: 90°. Time of shoot: 1624 to 2143hrs. Time of haul: 0240 to 1425hrs. Weather disimproved with wind up to F6-7. Occasional water breaking on deck and mean sea surface temperature of 11.1 °C for the haul. Fishing was poor with two bluefin tuna for 200kg carcass weight. Stomachs were observed to be empty. Bycatch was composed of four blue shark females between 160 and 200cm.

Day 42. 4-10-97. Haul #37. Position: 59°58N 15°50 to 59°58N 13°41W. Course: 90°. Time of shoot: 1552 to 2145hrs. Time of haul: 0240 to 1430hrs. Weather slightly improved from previous haul. Wind at F5 and barometer at 998 at the start of hauling. Mean sea surface temperature of 11.1 °C for the haul. Fishing continues poor with one fish for 90kg carcass weight. No bycatch of any kind was taken.

Day 43. 5-10-97. Haul #38 Position: 59°58N 15°45 to 59°58N 13°38W. Course: 90°. Time of shoot: 1515 to 2052hrs. Time of haul: 0240 to 1430hrs. Sea calm and very close evening. Wind dropped to F2 and barometer down to 990 at start of hauling. Mean sea surface temperature of 11.2 °C. Fishing continuing poor with one bluefin tuna for 103kg carcass weight. Stomach contents include ten to twelve thin fish of 15-30cm. No bycatch of any kind was taken.

Day 44. 6-10-97. Haul #39. Position: 59°58N 15°46W to 59°58N 17°48W. Course: 90°. Time of shoot: 1524 to 2051hrs. Time of haul: 0210 to 1400hrs. Wind picked up from previous haul to F4-5. Deck dry with only very occasional water breaking over it. Air pressure at 998. Mean sea surface temperature of 10.8°C for the haul. Fishing continuing poor with two bluefin tuna for 326kg carcass weight. Observed stomach contents were, squid, thin 15-30cm fish, and a large volume of small partially digested fish. Bycatch was composed of four female blues sharks.

Day 45. 7-10-97. Haul #40. Position: 58°59N 17°44w to 60008N 15°49W. Course: 90°. Time of shoot: 1510 to 2044hrs. Time of haul: 0225 to 1357hrs. Wind at F3, barometer down to 983 with a mean sea surface temperature of 10.8°C. Fishing was poor with one bluefin tuna for 155kg carcass weight; stomach contents consisted of four squid. Bycatch was comprised of one blue shark female

Day 46. 8-10-97. Haul #41. Position: 59°58N 17°52 to 60013W 16°01W. Course: 260°. Time of shoot: 1425 to 1955hrs. Time of haul: 0145 to 1400hrs. Small swell with a chop. Wind F3-4 and barometer reading 989 at the start of hauling. Mean sea surface temperature of 10.8°C for the haul. Fishing was poor with one tuna for 96kg carcass weight. Observed stomach contents were four squid and a large volume of heavily digested fish. No bycatch was taken.

Day 47. 9-10-97. Haul #42. Position: 59°58N 17°51W to 60011N 15°59W. Course: 260°. Time of shoot: 1423 to 1959hrs. Time of haul: 0135 to 1340hrs. A fine evening at the beginning of the haul with wind at F4 and barometer low at 992. Mean sea surface temperature of 10.9°C for the haul. Fishing improved with three bluefin tuna for a carcass weight of 362kg. Two stomachs were observed to contain a large amount of partially digested fish. Bycatch was composed of two sharks, one a female blue shark 180cm, the other a female shortfin mako of 210cm.

Day 48. 10-10-97. Haul #43. Position: 59°58N 14°47W to 60010N 16°02W. Course: 260°. Time of shoot: 1403 to 1938hrs. Time of haul: 0110 to 1330hrs. Weather remains good with wind at F3 and barometer up to 1009. Mean sea surface temperature of 10.8°C for the haul. The fishing was good with four bluefin tuna for a carcass weight of 607kg; stomachs were observed to be empty except for one squid. Bycatch was composed one large lancetfish with only the head coming aboard. Lancetfish come apart easily on being towed through the water and offer no real resistance to the line.

Day 49. 11-10-97. Haul #44. Position: 60°10N 16°05W to 59°55N 18°02N. Course: 260°. Time of shoot: 1412 to 1948hrs. Time of haul: 0120 to 1304hrs. Mean sea surface temperature of 10.8°C for the haul. Weather very good with F3 wind and barometer at 1020 at the start of hauling. The fishing was good with six bluefin tuna for 843kg. The stomachs of two of these were full with squid. No bycatch was taken.

Day 50. 12-10-97. Haul #45. Position: 60°10N 16°05W to 59°53N 17°59W. Course: 260°. Time of shoot: 14214 to 1950hrs. Time of haul: 0115 to 1350hrs. Weather continued fine, wind F4-5, and barometer at 1027 at start of haul. Mean surface temperature 10.7°C for the haul. Fishing was poor with one fish for 126kg carcass weight. Bycatch consisted of one blue shark female.

Day 51. 13-10-97. Haul # 46. Position: 60°10N 16°02W to 59°58N 18°03W. Course: 260°. Time of shoot: 1453 to 1953hrs. Time of haul: 0150 to 1305 hrs. Weather continuing fine with wind at F3 and barometer reading 1028. Mean sea surface temperature of 10.6°C. Fishing was good with six fish for a carcass weight of 601kg. Stomach contents were observed to be squid and well digested fish. Bycatch of three blue shark females and three lancetfish.

Day 52. 14-10-97. Haul # 47. Position: 60°07N 15°55W to 59°58N 17°55W. Time of shoot: 1456 to 1954hrs. Time of haul: 0112 to 1300hrs. Course 260°. Mean sea surface temperature of 10.5°C. Weather exceptionally fine with wind at F2 and barometer reading 1002. Fishing was good with six tuna for 657kg carcass weight. No bycatch was taken.

Day 53. 15-10-97. Haul #48. Position: 60°10N 16°05W to 59°55N to 18°00W. Course: 260°. Time of shoot: 1422 to 1955hrs. Time of haul: 0115 to 1230hrs. Mean sea surface temperature was 10.6°C for the haul. Weather disimproved with wind up to F4-5 and barometer slipping down to 996. Fishing disimproved with one fish for 130kg carcass weight. No bycatch was taken.

Day 54. 16-10-97. Haul #49. Position: 60°12N 15°51W to 59°58W 17°58W. Course: 260°. Time of shoot: 1430 to 2006hrs. Time of haul: 0118 to 1308hrs. Mean sea surface temperature of 10.7°C. Wind at F5 and barometer reading 995 with occasional water breaking over the deck. Fishing was poor with no blue fin tuna for the haul. Bycatch was composed of two blue shark females.

Day 55. 17-10-97. Holiday occasioned by a change of position.

Day 56. 18-10-97. Haul #50. Position: 57°51N 17°40W to 57°51N 15°44W. Course: 90°. Time of shoot: 1457 to 2028hrs. Time of haul: 0152 to 1352hrs. Wind at F3-4 and barometer reading 1004. Sea choppy but comfortable. Mean sea surface temperature of 11.6°C for the haul. Fishing improved with six bluefin tuna for 584kg carcass weight. Bycatch was composed of five female blue shark.

Day 57. 19-10-97. Haul #51. Position: 57°51N 17°56W to 57°51N 16°02W. Course: 90°. Time of shoot: 1459 to 2015hrs. Time of haul: 0210 to 1410hrs. Wind at F4 and barometer up to 1025. Small chop but not enough to wet the deck. Mean sea surface temperature of 11.6°C for the haul. No bluefin tuna were taken; bycatch comprised of three blue shark females.

Day 58. 20-10-97. Haul #52. Position: 57°51N 17°39W to 57°49N 18°24W. Course: 90°. Time of shoot: 1515 to 2054hrs. Time of haul: 0204 to 1344hrs. Wind at F4-5 with barometer reading 1025. Sea choppy with medium swell, deck largely dry and overall conditions pleasant. Mean sea surface temperature of 11.6°C. Fishing was very good with seven fish for 1158kg carcass weight. Stomachs were observed to be empty with the exception of two unidentifiable headless fish found in one tuna. Bycatch composed of two blue shark females.

Day 59. 21-10-97. Haul #53. Position: 57°51N 15°52W to 57°51N 17°44W. Course: 90°. Time of shoot: 1454 to 2022hrs. Time of haul: 0205 to 1320hrs. Wind at F3, barometer reading 1023 and sea calm with low swell. Mean sea surface temperature of 11.6°C. Fishing marginal with four bluefin tuna for 328kg carcass weight. Stomachs observed to contain squid beaks and three fish, lancetfish and/or blue whiting. Bycatch was composed of four blue shark females.

Day 60. 22-10-97. Haul #54. Position: 57°51N 15°30W to 57°51N 17°47W. Course: 90°. Time of shoot: 0450 to 2020hrs. Time of haul: 0155 to 1335hrs. Wind at F3 and barometer reading 1020. A beautiful evening at the beginning of the haul, with conditions remaining pleasant throughout the haul. Mean sea surface temperature of 11.5°C. Fishing good with seven bluefin tuna for 665kg carcass weight; stomachs all observed to be empty. Bycatch consisted of three blue shark females.

Day 61. 23-10-97. Haul # 55. Position: 57°57N 17°26W to 57°51N 15°32W. Course: 90°. Time of shoot: 1509 to 2037. Time of haul: 0200 to 1335hrs. Wind at F3 and barometer reading 1025. Conditions remain pleasant. Mean sea surface temperature of 11.5°C. The fishing was good with six bluefin tuna for 464kg carcass weight. Bycatch of one blue shark female was taken.

Day 62. 24-10-97. Haul #56. Position: 57°50N 15°14W to 57°50N 17°13W. Course: 90°. Time of shoot: 1455 to 2030hrs. Time of haul: 0210 to 1345hrs. High pressure system persists with 1027 on the barometer and wind at F3. Conditions on deck very comfortable. Fishing was reasonable with five blue fin tuna for a carcass weight of 362kg. Stomachs were observed to contain squid and fish. Bycatch was composed of two blue shark females.

Day 63. 25-10-97. Haul #57. Position: 57°50N 17°05W to 57°51N 15°13N. Course: 90°. Time of shoot: 1451 to 2012hrs. Time of haul: 0210 to 1315hrs. High pressure system remains with calm sea and barometer 1025. Wind at F3. Fishing was poor with one bluefin tuna for 113kg carcass weight; stomach was observed to contain four squid. The bycatch was composed of two female blue shark. This being the final haul of the trip all gear was made fast on completion of hauling.

Day 64 and 65. 26-10-97 to 27-10-97. Steaming for the port of Cork.

Day 66. 28-10-97. Arrived in Cork at 1200hrs Japanese time, 0900hrs local time. All fish were unloaded onto containers for road and ferry transport to Amsterdam and subsequent tramper ship transport to Tokyo.