FINAL REPORT

A Code of Practice for the on-board handling of shark from Western Australian demersal gillnet and demersal longline fishery.

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Western Australian Fishing Industry Council Inc.

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2000/401	*A CODE OF PRACTICE FOR THE ON-BOARD HANDLING AND PROCESSING OF SHARK FROM WESTERN AUSTRALIAN DEMERSAL GILLNET AND DEMERSAL LONGLINE FISHERY.*

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OBJECTIVES

1. In consultation with Industry, formulate a code of practice that sets out best practice in the fishery and satisfies current and projected food safety standards.
2. Print and distribute the code of practice, encouraging adherence to the code.

NON TECHNICAL SUMMARY

The project advanced the recognition of the need for better on-board handling of shark. This will lead to improved fish quality and seafood safety. It will allow the vessel crews to bring their work practices to a standard that will conform to the Australian Seafood Standard and thus comply with their responsibilities under the mandatory Primary Production and Processing Standard for seafood.

The project produced a written Code of Practice for the on-board handling of Shark and a handbook for use by new recruits and junior deck crew. It also produced an ice ready-reckoner that is useful for other fishermen. Fishermen were introduced to the Code via formal and informal training sessions.

KEYWORDS: SHARK, POST HARVEST, ON-BOARD HANDLING, BEST PRACTICE.

BACKGROUND

The Demersal Gillnet & Demersal Longline Fishery targets Bronze Whaler, Whiskery and Gummy Sharks, with a small amount of scalefish as a bycatch. The fishery is located on the Southern and Western coasts of Western Australia. Most of the sixty six licence holders' boats operate by leaving their nets or lines overnight and either steaming into port, or staying at sea and pulling the nets or lines in the morning. Some boats may be at sea for a period of 5-6 days.

The fishery is considered to be fully exploited. The catch trend has been declining recently, in some part this may be explained by the management of the fishery to ensure its sustainability. To ensure the viability of a fishery that has a GVP in excess of $7 million annually the quality of product must be consistently at a level that will command a price that maximises the return from the resource.
The SQMI has been approached by Shark Fishing industry and its Management Advisory Committee (MAC) to examine the on board handling of the catch, with view to the formulation of a code of practice that will achieve this objective.

NEED

The shark fishing industry needs a framework of Good Manufacturing practices to make sure it complies with existing and future health, and food safety regulations.

Shark fishing involves a level of processing that is no longer common practice in the fishing industry, it needs a framework of good manufacturing practices so that it is able to demonstrate due diligence in the case of a food related health incident.

The fishery wants to know where quality needs to be improved how this may be achieved in practice to improve the landed value of its product, reduce waste and extend the shelf life of fresh shark meat.

METHODS

Discussions with fishermen

The project used the input from fishermen in each of the three (Northern, Western and Southern) demersal gillnet fisheries to determine the most effective method design and implementation of a code of practice for the on-board handling of shark and scalefish. This was vital if the Code was to be adopted, and continued, both formally and informally, at each stage of the project. That is, the design of the sampling regime, the draft of both the code and the handbook and the training sessions in the adoption of the Code.

Sampling Regime (Field methods and questionnaire)

1. Swabs of vessel before going fishing
   - Gutting table
   - Storage place (brine/ice/bins)

2. Swabs 2 places 3 vessel 12 samples
   SPC/Total coliforms / *E. coli* / *Pseudomonas*

   Same on return 12 Samples

3. 4 Species of Shark 2 boats x 2 times x 2 samples
   - point of capture (after processing)
   - point of delivery to wharfs & scalefish control
   - 5 Fish x 2 times x 2 boats x 2 duplicates
     = 40 samples for 4 tests

4. Swabs from trip vessel 3 days prior to landing
   - prior to catch 2 swabs 2 places 1 vessel
   - 4 samples x 4 tests maybe samples of brine too.
   - = 2 more samples

   Plus 2 samples of ice from day boat.

5. Fish from trip boat
   - 1 of each species on each day if 8 day trip = 5 species 8 days 40 fish
   - 2nd sample @ point of landing = 80 samples x 2 duplicates = 160 samples x 4 tests
   - Plus 30 swabs x 4 tests

6. Total is 200 fish samples x 4 tests on fish
   Plus 32 swabs x 4 tests

On board
- sampling regime time ½ way through each day
- sampling as practicable

Observe
- sea surface temperature
- Fish temperature (+ additional samples)
- Observation of fish condition
- Fish length & sex & core temperature
- Air temperature and general climate observations

Questionnaire

PLEASE ANSWER THE QUESTIONS AS ACCURATELY AS POSSIBLE. IF YOU HAVE MORE THAN ONE ANSWER, PUT DOWN THE PRACTICE THAT YOU MOST OFTEN OR USUALLY CARRY OUT -

Usual Home Port.....

Length of trip: less than 1 day...1-2days.....3-5 days.....6-8 days.....

Total length of nets.....m

Position of net when fishing

Bottom.....Off-bottom.....Surface.....

Time to clear net.....Hrs

Method of killing live shark?.....

How processed on board

None.....H&G only.....H&G and fin.....Skinned trunks.....

Are shark chilled.....Y/N

If so, how chilled?

Ice slurry.....Ice alone.....brine.....brine with ice slurry

Temperature if known

How Stored

On deck.....Below deck.....

Loose or in sacks.....in fish bins.....in brine.....

Other comments

What do you do to manage quality?

Sampling Program

The project aimed to take observations from three boats and gather 270 samples for analysis (i.e. 135 duplicates). Observations have been taken from three boats including:

- 1 Day trip / day boat Jurien
- 2 Day trip Hamelin Bay
- 3 Day trip Fremantle

The on-board sampling included gathering flesh samples, water samples, and swabs. An estimated 165 samples have been gathered for analysis and reported in three separate 'Vessel Reports'. (Appendices I, II & III). There was scope to gather further samples including swabs, water samples (for ammonia), and flesh samples (for microbiology and ammonia). In taking the opportunity, additional data was collected to analyse shark pH, sex, length, and condition upon landing, which is presented in the appendix.

Table 1. NUMBER OF SAMPLES COLLECTED & REPORTED TO DATE

	Day Boat Jurien	3 Day Trip Hamelin Bay	2 Day Trip Fremantle	TOTAL TO DATE	PROJECT BUDGET	VARIANCE
SWABS	12	16	16	44	60	16
WATER SAMPLES (MICRO)	3	8	6	17	20	4
WATER SAMPLES (AMMONIA)	0	0	0	0	10	10
SHARK SAMPLES (MICRO)	18	18	22	58	80	22
SHARK SAMPLES (AMMONIA)	0	18	22	40	90	50
CONTROL FISH SAMPLES	2	2	2	6	10	4
TOTAL	35	62	68	165	270	106

RESULTS

Flesh Sample Results from Three Boats.

Thirteen of the ninety-eight flesh samples (13%) resulted in bacterial counts above recommended levels. These were from two of three boats. This included four flesh samples with excess Coliform counts, six with excess *Pseudomonas* counts, and three with excess Standard Plate Counts. These are presented on the following page in red font showing results above recommended levels.

Flesh Sample Results From Three Boats:

ONE-DAY BOAT Sea Temp.20~22. Deg.C.; Air Temp 19~25 deg.C)
(***Italic cells*** **denote results above acceptable limits)**
BOAT 1 AT BIG FRESHWATER BAY 19th OCTOBER 2000. DAY TRIP.

Sample Details	Elapsed Time	Core Temp. Deg. C	Standard Plate Count CFU/g	Coliforms CFU/g	E. coli MPN/g	Pseudomonas species CFU/g
Whiskery - M - 1.2m	0000	19.8	31 000	< 10	< 3	< 1 000
Whiskery - M - 1.2m	0000	19.8	39 000	< 10	< 3	< 1 000
Whiskery - M - 1.2m	0400	4.0	***1 200 000***	< 10	< 3	< 1 000
Whiskery - M - 1.2m	0400	4.0	***1 400 000***	< 10	< 3	< 1 000
Thickskin - F - 1.1m	0000	19.8	4 700	< 10	< 3	< 1 000
Thickskin - F - 1.1m	0000	19.8	1 600	< 10	< 3	< 1 000
Thickskin - F - 1.1m	0400	0.8	580 000	< 10	< 3	< 1 000
Thickskin - F - 1.1m	0400	0.8	170 000	< 10	< 3	< 1 000
Bronze Whaler - F - 1.8m	0000	20.0	5 600	< 10	< 3	< 1 000
Bronze Whaler - F - 1.8m	0000	20.0	13 000	< 10	< 3	< 1 000
Bronze Whaler - F - 1.8m	0300	8.0	260000	< 10	< 3	< 1000
Bronze Whaler - F - 1.8m	0300	8.0	540000	< 10	< 3	< 1000
Black Tip - M - 2.2m	0000	20.0	48 000	< 10	< 3	< 1 000
Black Tip - M - 2.2m	0000	20.0	190 000	< 10	< 3	< 1 000
Black Tip - M - 2.2m	0200	16.0	***1 000 000***	< 10	< 3	< 1 000
Black Tip - M - 2.2m	0200	16.0	390 000	< 10	< 3	< 1 000
Dhufish	0000	20.8	29 000	< 10	< 3	< 1 000
Dhufish	0300	20.8	33 000	< 10	< 3	< 1 000
RECOMMENDED LEVELS			**<1,000,000**	**<100**	**<100**	**<1,000**

F-female. M-male. A-alive at landing. D-dead at landing. TVN-total volatile nitrogen. CFU-colony forming units

The higher-than-recommended bacteria levels from the Day Boat (shown above) included a sample that had reached 'critical temperature' of 4 degrees C. within four hours and a sample that had failed to reach critical temperatures within 2 hours. On the day of observations indicate the vessel has insufficient ice to attain critical temperatures for all the catch.

TWO-DAY BOAT (Sea temp 20~21 deg.C; Air temp 19~25 deg.C)						
BOAT 2 AT HAMELIN BAY 16~17 JANUARY 2001 (2 DAY TRIP)						
Sample Details	Elapsed Time	Core Temp. Deg. C	Standard Plate Count CFU/g	Coliforms CFU/g	E. coli MPN/g	Pseudomonas species CFU/g
Dusky Whaler - F - 1.5m	0000	19.9	3 200	< 10	< 3	< 100
Dusky Whaler - F - 1.5m	0000	19.9	2 800	< 10	< 3	< 100
Dusky Whaler - F - 1.5m	2700	-0.7	62 000	< 10	< 3	200
Dusky Whaler - F - 1.5m	2700	-0.7	72 000	< 10	< 3	500
Dusky Whaler - F - 1.3m	0045	20.0	5 500	< 10	< 3	< 100
Dusky Whaler - F - 1.3m	0045	20.0	1 500	< 10	< 3	< 100
Dusky Whaler - F - 1.3m	2700	-0.6	93 000	< 10	< 3	800
Dusky Whaler - F - 1.3m	2700	-0.6	96 000	10	< 3	600
Bronze Whaler - F - 1.0m	0110	20.1	13 000	< 10	< 3	< 100
Bronze Whaler - F - 1.0m	0110	20.1	16 000	< 10	< 3	< 100
Bronze Whaler - F - 1.0m	2700	-0.6	69 000	70	< 3	200
Bronze Whaler - F - 1.0m	2700	-0.6	44 000	10	< 3	< 100
Dusky Whaler - F - 0.9m	0110	20.3	18 000	< 10	< 3	< 100
Dusky Whaler - F - 0.9m	0110	20.3	47 000	< 10	< 3	< 100
Dusky Whaler - F - 0.9m	2700	-0.9	210 000	< 10	< 3	< 100
Dusky Whaler - F - 0.9m	2700	-0.9	26 000	< 10	< 3	400
Dhufish	0100	20.4	87 000	< 10	< 3	< 100
Dhufish	0100	20.4	160 000	< 10	< 3	< 100
RECOMMENDED LEVELS			<1,000,000	<100	<100	<1,000
F-female. M-male. A-alive at landing. D-dead at landing. TVN-total volatile nitrogen. CFU-colony forming units						

THREE-DAY-BOAT (Sea temp 22 deg.C; Air temp 19~25 deg.C)							
BOAT 3 AT FREMANTLE 6th & 8th FEB 2001 (DAYS 1 & 3) (*Italic cells* denote results above acceptable limits)							
Sample Details	Elapsed Time	Core Temp. Deg. C	Standard Plate Count CFU/g	Coliforms CFU/g	E coli MPN/g	Pseudomonas species CFU/g	(Ammonia) TVN mg/kg as N
Thick skin - F - 0.8m - A	0000	20.7	43 000	<10	< 3	< 100	250
Thick skin - F - 0.8m - A	0000	20.7	29 000	<10	<3	<100	250
Thickskin - F - 0.8m - A	5900	0.3	77 000	<10	<3	<100	300
Thickskin - F - 0.8m - A	5900	0.3	81 000	20	<3	*1 800*	280
Gummy Shark - F - 1.2m	0035	20.4	25 000	<10	<3	<100	350
Gummy Shark - F - 1.2m	0035	20.4	10 000	<10	<3	<100	260
Gummy - F - 1.2m	5930	0.1	26 000	*760*	<3	*3 500*	340
Gummy - F - 1.2m	5930	0.1	130 000	50	<3	<100	300
Thick skin - F - 1.1m	0240	19.8	7 400	<10	<3	<100	320
Thick skin - F - 1.1m	0240	19.8	3 000	<10	<3	<100	290
Thick skin - F - 1.1m	5930	0.3	26 000	<10	<3	300	310
Thick skin - F - 1.1m	5930	0.3	43 000	10	<3	700	280
Thick skin - F - 0.8m - D	0200	19.9	2 800	<10	<3	<100	340
Thick skin - F - 0.8m - D	0200	19.9	4 300	<10	<3	<100	320
Thickskin - F - 0.8m - D	5900	0.2	49 000	30	<3	*7 300*	300
Thickskin - F - 0.8m - D	5900	0.2	170 000	*110*	<3	*13 000*	240
Thickskin - M - 0.9m	5900	8.6	140 000	<10	<3	<100	*560*
Thickskin - M - 0.9m	5900	8.6	200 000	<10	<3	<100	*910*
Gummy - M - 0.8m	5930	6.4	720 000	<10	<3	<100	*2200*
Gummy - M - 0.8m	5930	6.4	*1 100 000*	<10	<3	<100	*2200*
Pink Snapper	5900	4.2	30 000	*590*	<3	*22 000*	180
Pink Snapper	5900	4.2	110 000	*1 400*	<3	*62 000*	200
RECOMMENDED LEVELS			<1,000,000	<100	<100	<1,000	<400
F - female. M - male. A - alive at landing. D - dead at landing. TVN - total volatile nitrogen. CFU - colony forming units							

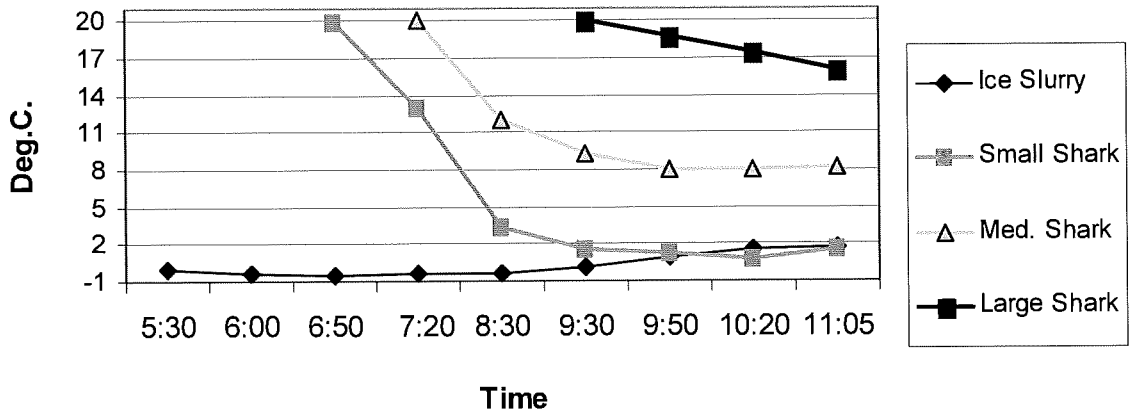
Bacteria levels for the two-day boat shown above indicate all samples were within acceptable limits.

Bacteria levels for the three-day boat shown above indicate that ten samples from day three were at unacceptable levels (i.e. 59 hours after sampling began). Four of the samples had reached critical temperatures and six samples (landed and sampled on day three) had not reached critical temperatures. The vessel had landed comparatively large catches during the observation period and had otherwise managed temperatures reasonably well.

Temperature Control

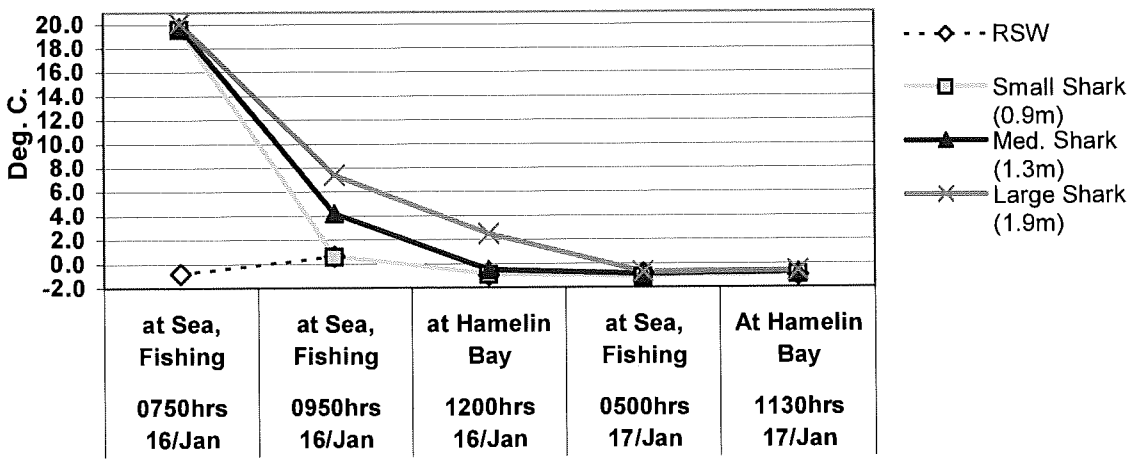
Temperature profiles of ice slurries and or refrigerated sea water (RSW) as well as core temperatures of sharks were taken periodically aboard each boat during observations to create temperature profiles. The temperature profiles indicate that two of the boats had acceptable practices to ensure critical (core) temperatures were achieved and maintained within best practice guidelines. This is shown in the following graphs.

ICE SLURRY & SHARK CORE TEMPERATURES
DAY-BOAT TEE NEE DEE

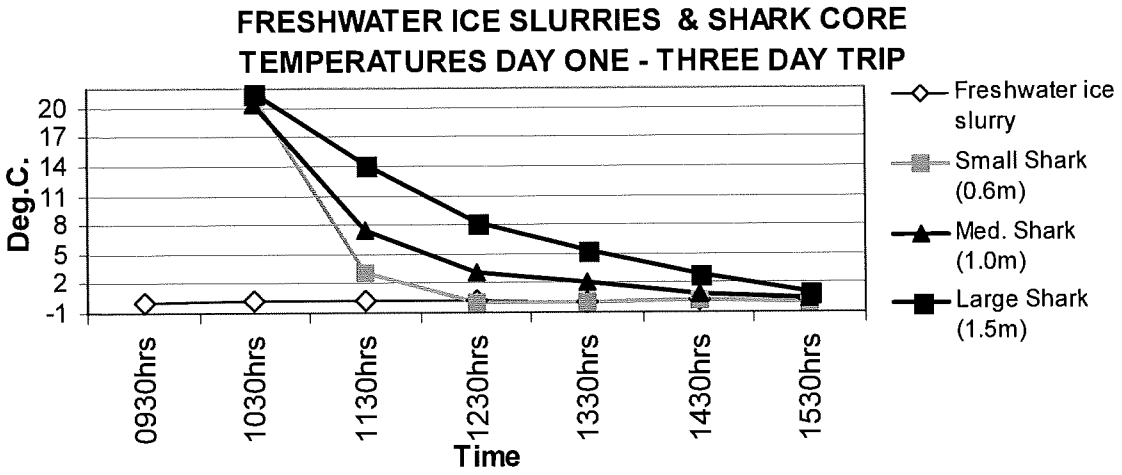


On the day of observations aboard the day-boat show the ice slurries had insufficient ice to achieve critical core temperatures for all the landed catch. The medium and large shark (shown above) failed to reach critical temperatures until placement into a shore-based chiller approximately 5~6 hours after being caught / landed. This would be expected to contribute to higher than recommended bacteria counts.

Refrigerated Seawater and Shark Core Temperatures
over two days fishing (ie two-day boat)



Observations taken aboard the two-day boat indicate that core temperatures were reduced to critical levels within two to four hours and that these temperatures were maintained over two days. Bacteria levels for this boat indicated that no samples were above recommended levels. Shark core temperatures were generally well managed.



Observations taken aboard the three-day-boat indicate that critical temperatures were achieved in two to five hours after landing. Core temperatures of the previous days catch were maintained at critical levels for the duration of the trip. However, large catches on day three resulted in some core temperatures not reaching critical temperatures up to six hours after landing. These included six of ten samples taken from the vessel with bacteria counts above the recommended levels. The vessel was otherwise able to reduce core temperatures within the required time (e.g. 2~4 hours after landing).

Swab Results From Three Boats.

Swabs were taken pre and post fishing from four places including the fish bin, gutting table, ice box, and RSW tank / hold. Almost all the results from the three boats were within recommended levels with no noticeable difference between pre and post fishing. The exception being the icebox of the day-boat that had bacterial counts pre and post fishing in excess of the recommended levels. The analysis of swabs indicates no discerning problem with bacteria levels in the areas sampled. This is contrary to expectations given that the vessels did not use detergents or anti-bacterial solutions within their cleaning programs. The swab results from three vessels are presented on the following page.

Results of Bacterial Swabs Taken Aboard Three Vessels

DAY-TRIP BOAT			
Site	**Total Microbial**	**Coliforms**	**E. coli**
Pre-fishing:	**Count**		
Fish bin 0550	50	< 10	< 10
Fish bin 0600	40	< 10	< 10
Gutting table 0550	< 10	< 10	< 10
Gutting table 0600	40	< 10	< 10
Ice box 0550	*> 10 000*	< 10	< 10
Ice box 0600	*> 10 000*	< 10	< 10
Post fishing:			
Fish bin 1100	360	< 10	< 10
Fish bin 1100	520	< 10	< 10
Gutting table 1100	470	< 10	< 10
Gutting table 1100	< 10	< 10	< 10
Ice box 1100	*> 10 000*	< 10	< 10
Ice box 1100	*> 10 000*	< 10	< 10
RECOMMENDED	**< 10,000**	**<100**	**<100**
2 DAY TRIP			
Site	**Total Microbial**	**Coliforms**	**E. coli**
Pre-fishing:	**Count**		
Gutting table 0515	> 1 000	< 10	< 10
Gutting table 0515	> 1 000	< 10	< 10
Ice box 0515	> 1 000	< 10	< 10
Ice box 0515	> 1 000	< 10	< 10
Fish bin 0515	470	< 10	< 10
Fish bin 0515	> 1 000	< 10	< 10
Brine tank 0500	> 1 000	< 10	< 10
Brine tank 0500	> 1 000	< 10	< 10
Post fishing:			
Gutting table 1000	> 1 000	< 10	< 10
Gutting table 1000	> 1 000	< 10	< 10
Ice box 1000	> 1 000	< 10	< 10
Ice box 1000	> 1 000	< 10	< 10
Fish bin 1000	> 1 000	< 10	< 10
Fish bin 1000	> 1 000	< 10	< 10
Brine tank 1000	> 1 000	< 10	< 10
Brine tank 1000	> 1 000	< 10	< 10
RECOMMENDED	**< 10,000**	**<100**	**<100**
3 DAY TRIP BOAT			
Site	**Total Microbial**	**Coliforms**	**E. coli**
Pre-fishing:	**Count**		
Gutting table 0530	340	< 10	< 10
Gutting table 0530	>1 000	<10	<10
Fish bin 0530	>1 000	<10	<10
Fish bin 0530	10	<10	<10
Deck Ice box 0530	>1 000	<10	<10
Deck Ice box 0530	>1 000	<10	<10
Below D Ice box 0530	>1 000	<10	<10
Below D Ice box 0530	>1 000	<10	<10
Post fishing:			
Gut table 1530	>1 000	<10	<10
Gut table 1530	>1 000	<10	<10
Fish bin 1540	>1 000	<10	<10
Fish bin 1540	>1 000	<10	<10
Deck ice box 1550	>1 000	<10	<10
Deck ice box 1550	>1 000	<10	<10
Below D ice box 1600	570	<10	<10
Below D ice box 1600	>1 000	<10	<10
RECOMMENDED	**< 10,000**	**<100**	**<100**

Water Sample Results From Three Boats.
Water sampling included seawater taken at the commencement of fishing, and from ice slurries / RSW taken from iceboxes upon the completion of fishing. Post-fishing bacteria levels of ice slurries increased twenty-fold compared to pre-fishing, although remaining below recommended levels. The results of water samples indicate that bacteria counts increase rapidly in 24~48 hours given the absence of antibacterial concentrates added to slurries / RSW of all three boats. The Heterotrophic Plate count was consistently higher post fishing whilst *Pseudomonas* counts were higher mid-way through the two day trip. Results are shown on the following page.

Results of Tests for Volatile Nitrogen (Ammonia)
Twenty-two of the forty flesh samples gathered for ammonia analysis gave valid results with four samples (18%) indicating above recommended nitrogen levels from a three day trip. The reported nitrogen levels from day one of the three-day trip were well below recommended levels. Samples from larger sharks have not reported higher nitrogen levels. Nitrogen analysis results are limited in scope due to a small number of samples. Further sampling for ammonia could be undertaken.

Samples were gathered to analyse mercury levels although no results have been received to date. Further sampling could be undertaken for the analysis of mercury levels.

Results from On-board Observations
The following summary focuses on practices observed on-board the vessels. Observations taken from three vessels have identified a range of *common* practices that training should address to improve industry standards including;

- Personal hygiene practices varied. Fishers should be encouraged to wash and rinse their hands in between hauls and especially prior to handling processed fish and trunks. This should include the use of antibacterial disinfectants and detergents.
- No detergents with disinfectant anti-bacterial properties are used for cleaning and sanitising the deck, equipment, or facilities. This should be a standard practice across all boats using detergents / disinfectants with alkaline-tolerant formulations (pH 7.5~8.5).

RESULTS OF WATER SAMPLES TAKEN FROM THREE BOATS

One-Day Trip / Boat Type of Sample	Seawater Off Greenhead	Seawater Off Greenhead	Ice box slurry Post-fishing	Ice box slurry Post-fishing	
Physical Appearance	Clear; colourless	Clear; colourless	Turbid; straw coloured; debris	Turbid; straw coloured; debris	**RECOMMENDED**
Heterotrophic Plate Count at 210C CFU per mL	< 100	< 100	86 000	110 000	**<1,000,000**
Coliforms CFU per 100mL	0	0	40	4	**<100**
Thermotolerant Coliforms CFU per 100mL	0	0	< 10	< 10	**<100**
E. coli CFU per 100mL	0	0	< 10	< 10	**<100**
Pseudomonas species CFU per 100mL	110	20	0	150000	**<1,000,000**

Two-Day Trip / Boat Type of Sample	Seawater Pre Fishing Day 1	**Below deck RSW Pre Fishing Day 1**	Below deck RSW Pre Fishing Day 1	**Below deck RSW Post Fishing Day 1**	Below deck RSW Post Fishing Day 1	Scalefish Ice Slurry Post fishing Day 2	Below deck RSW Post fishing Day 2	Below deck RSW Post fishing Day 2
Physical Appearance	Clear; colourless	**Clear; colourless**	Clear; colourless	**Slightly turbid; pale straw colour; debris**	Slightly turbid; pale straw colour; debris	Turbid; pale straw colour; debris	Slightyl turbid; red / brown colour; debris	Slightyl turbid; red / brown colour; debris
Heterotrophic Plate Count at 210C CFU per mL	300	30 000	28 000	39 000	44 000	410 000	610 000	640 000
Coliforms CFU per 100mL	0	**500**	80	**100***	6*	2	<10*	<10*
Thermotolerant Coliforms CFU per 100mL	0	14	11	4	3	2	<10	<10
E. coli CFU per 100mL	0	0	0	0	0	2	<10	<10
Pseudomonas species CFU per 100mL	0	> 70 000	> 100 000	150 000	330 000	<10	<10	<10

Three-Day Trip / Boat Type of Sample	Sea water Rottnest Day 1	**Shark Ice Slurry Pre-fishing Day 1**	Shark Ice Slurry Pre fishing Day 1	Scalefish Ice Box Post-fishing Day 3	Shark Ice slurry Post-fishing Day 3	Shark Ice slurry Post-fishing Day 3	
Physical Appearance	Clear; colourless	**Slightly turbid; pale straw colour; debris**	Slightly turbid; pale straw colour; debris	Turbid; pale straw coloured; debris	Slightyl turbid; red/ brown colour; debris	Slightyl turbid; red/ brown colour; debris	**RECOMMENDED**
Heterotrophic Plate Count at 210C CFU per mL	<100	**>10 000 000**	28 000	410 000	610 000	640 000	**<1,000,000**
Coliforms CFU per 100mL	0	2	0	2	<10*	<10*	**<100**
Thermotolerant Coliforms CFU per 100mL	0	2	0	2	<10	<10	**<100**
E. coli CFU per 100mL	0	2	0	2	<10	<10	**<100**
Pseudomonas species CFU per 100mL	<10	<10	20 000	<10	<10	<10	**<1,000,000**

- In the course of the day's fishing, scalefish and shark were routinely left on deck or a holding area for up to 20~30 minutes waiting to be processed. Storage in a plastic moulded bin or tank of ice slurry / RSW would significantly reduce core temperatures and reduce bacteria build-up.
- Processed shark trunks were often stored in fish bins (with either no water or non-circulating water) for up to three hours at ambient temperatures. Either RSW or ice slurry in the fish bin would enable core temperatures to be reduced by 5~6 deg. C over 1~2 hours. This would help reduce potential for bacteria to develop and increase.
- Dead shark were generally treated no differently to live shark. It should be standard practice that dead shark are processed immediately and stored in ice slurry / RSW immediately after processing.
- Bleeding of shark was not always practiced. Severing the caudal fin or head would accelerate bleeding and help reduce potential for ammoniation.
- Plastic crates were used to transport trunks and scalefish ashore. Most boats used plastic crates that were often soiled and had noticeable odours. There was no cleaning program for plastic crates that might otherwise be a potentially significant bacteria trap unless thoroughly and regularly disinfected.
- Live scalefish were not always given an ikijimi spike and often remained on deck in the elements for up to 15~30 minutes waiting to be processed.
- Deck hoses were mostly standard gauge 50mm hose with relatively low pressure. There are hose attachments and pumps available that could increase water pressure and improve the effectiveness of cleaning programs. Combined with detergents / disinfectants this would significantly reduce bacteria build up aboard the vessel.
- Cleaning programs invariably used a deck hose, and often without the aid of brushes or scrubbing equipment. The cleaning programs were at a minimum standard and relied largely on sunshine and seawater.
- Two boats used black rubber mats on the deck and as a lining on gutting tables. The mats were neither cleaned with detergents / disinfectants nor given any priority in the cleaning program. The mats are potentially high-level bacteria traps, for example cross-contamination when used at days-end for sorting the catch into baskets.
- There were no formal practices or means to differentiate catches from day 1, 2 3, etc. Separating catches in a hold or ice box with a non-porous liner or using baffles for separate compartments would be a marked improvement. Labelling crates would be required once it became possible to separate catches by date caught. There was generally no program to support traceability.

Practices *not common* to all three boats and that may apply to other boats in the industry include;

- Processed shark trunks should be transferred to the icebox / RSW more frequently during the days processing rather than remaining in a fish bin for 3~4 hours at 21~22 deg. C (i.e. ambient temperature).
- There was often insufficient or barely enough ice for *all* the catch to attain or maintain critical temperatures before unloading ashore.
- Shark bleeding *and* processing was sometimes performed simultaneously. This promotes bacteria build-up and does little to reduce ammoniation.
- Critical and core temperatures were not monitored and often unknown. The use of portable probes or fixed gauges would be an improvement in managing temperature.

A summary of the on-board practices compared to suggested guidelines is presented on the following page. This includes a rating of observed practices on a scale ranging from poor, satisfactory, to good, as well as comments on specific practices that require improvement.

Summary of On-board Practices from Three Boats

PRACTICE COMPONENT	OBSERVED STATUS	COMMENTS
FISHING		
The fishing gear is always kept in the water for the minimum possible time.	*SATISFACTORY*	
All the fishing gear is thoroughly cleaned once fishing has ceased.	*POOR - SATISFACTORY*	
PROCESSING		
Sharks unsuitable for human consumption or otherwise are immediately returned to the water.	*SATISFACTORY*	
Landed shark is neither piled high, trampled, or exposed to the wind, spray, or sun.	*POOR - SATISFACTORY*	*OFTEN PILED ON DECK IN THE ELEMENTS FOR 15~30 MINUTES.*
Dead shark are immediately bled, headed, gutted, dressed, rinsed in acetic acid & chilled.	*POOR*	*PROCESSED NO DIFFERENTLY, NO QUICKER THAN LIVE SHARK*
Sharks are immediately stunned or killed upon landing, to avoid thrashing / struggling on deck.	*POOR - SATISFACTORY*	*NOT ALWAYS STUNNED OR KILLED, NO REGULARITY OF PRACTICE*
Bleeding – by severing the lower caudal (tail) fin or beheading – is carried out immediately upon landing.	*POOR*	*EITHER IRREGULARLY, INADEQUATELY OR NO BLEEDING AT ALL*
Shark is headed & gutted after bleeding, then washed in seawater and laid belly-down on ice.	*POOR - SATISFACTORY*	*SHARK PROCESSED & STORED IN SEAWATER FOR 2~3 HOURS*
Shark is placed in a circulated tank or refrigerated seawater if unable to be processed immediately.	*POOR*	*SHARKS ARE OFTEN LEFT ON DECK FOR 20~30 MINUTES*
Shark is in-rigor before filleting or freezing, or they are chilled & monitored until rigor sets in.	*POOR - SATISFACTORY*	
Fins are removed at the earliest opportunity, sorted, and either stored in refrigerated seawater or frozen.	*POOR - SATISFACTORY*	*OFTEN ACCUMULATED AT AIR TEMP OVER A DAYS FISHING*
Processed trunks or fillets are stored in refrigerated seawater (-1deg.C) for 12 hours then frozen.	*POOR*	*3+ DAYS IN RSW AND ICE SLURRY IS COMMON PRACTICE*

PRACTICE COMPONENT	OBSERVED STATUS	COMMENTS
STORAGE FACILITIES		
Holding wells/ tanks have baffles/dividers, adequate circulation, central drainage, and are easily cleaned.	*SATISFACTORY - GOOD*	*PLYWOOD IS OFTEN USED, BARELY PAINTED, PERMEABLE*
Refrigerated sea water or slurry for chilling / stowing fresh shark is maintained at –1 deg.C (30 deg.F).	*SATISFACTORY*	*NO THERMOMETERS ON BOARD, OFTEN NO TEMP GAUGES*
Chill / cold storage facilities are of sound construction, well insulated, and in good working order.	*SATISFACTORY*	
Brine refrigeration systems are made of or coated with corrosion-resistant material & easily cleaned.	*SATISFACTORY-GOOD*	
Processing utensils & equipment are in good order, maintained well, and cleaned after each cycle of use	*POOR - SATISFACTORY*	*RINSED IN SEAWATER, RARELY DISINFECTED, CLEANED DAILY*
HYGIENE & SANITATION		
Deck hoses supply clean seawater at pressure from intakes opposite & for'ard of all other discharging.	*SATISFACTORY - GOOD*	
All surfaces are impervious, smooth, and easily cleanable.	*POOR - SATISFACTORY*	*PERMEABLE RUBBER MATS ARE BACTERIA TRAPS*
Ice is supplied fresh daily or made daily on-board from potable water or clean seawater.	*SATISFACTORY - GOOD*	
Poisonous & harmful materials are labelled and stored in a separate compartment.	*SATISFACTORY - GOOD*	
Processing & cleaning equipment is thoroughly cleaned and disinfected after each cycle of use.	*POOR*	*NO DISINFECTANTS USED, NO CLEANING BETWEEN CYCLES*
There are deck areas used exclusively for shark handling & processing purposes only.	*POOR - SATISFACTORY*	*MIXING OF SCALEFISH & SHARK IS COMMON*
Before any shark is landed, and between each haul, all decks & equipment are thoroughly cleaned.	*POOR - SATISFACTORY*	*NO DETERGENTS USED, CLEANING IS SCANT / LIMITED*
Measures are in place to protect the vessel from insects, rodents, birds, and vermin.	*POOR*	*NO REGULAR PRACTICES, NO ROUTINE CHECKING*
Dogs, cats, and birds are excluded from shark processing and handling areas.	*SATISFACTORY - GOOD*	
Deck & all equipment is cleaned & disinfected in alkaline-detergent solution, & rinsed after unloading.	*POOR*	*NO REGULAR PRACTICES, NO ROUTINE CLEANING*

PRACTICE COMPONENT	OBSERVED STATUS	COMMENTS
OTHER		
A system exists for automatically introducing chlorine into seawater used for processing and cleaning.	*POOR*	*ALKALINE DETERGENTS NOT USED*
A stowage plan is used when trips of more than a day or two are undertaken.	*POOR*	*NO PRACTICES TO SORT CATCHES BY DAY CAUGHT / AGE*
There is a sanitary control program, involving all crew with assigned tasks, for cleaning & disinfecting.	*POOR*	*SANITARY PROGRAM IS ALMOST NON-EXISTENT*
Hand brushes are cleaned & disinfected in 50ppm - chlorine solution after each use, dried & stored.	*POOR*	*SANITARY PROGRAM IS ALMOST NON-EXISTENT*
Scouring pads or high pressure spraying equipment is used for cleaning, but not steel wool.	*POOR*	*BRUSHES ARE USED, BUT WITH NO DETERGENTS*
Baskets are not used for storing & transferring shark trunks, due to the difficulty of cleaning & disinfecting.	*POOR*	*PLASTIC CRATES ARE USED, BUT NO CLEANING PROGRAM*
Poor quality (ammoniated) shark is stored separately from higher quality shark.	*POOR*	*NO CHECKING FOR AMMONIATION, NO SEPARATE STORAGE*
Holding wells and butchering areas are cleaned and disinfected regularly during processing cycles.	*POOR*	*NO REGULAR PRACTICES, NO ROUTINE CLEANING*

SUMMARY AND RECOMMENDATIONS.

Key issues from the observations and sampling completed to date and presented in this Progress Report include;

- Observations and samples taken from three boats total 60% of the projected sampling.
- Thirteen percent of the flesh samples, originating from two boats, resulted in bacteria counts above recommended levels. The majority (87%) were within the recommended levels.
- Post-fishing bacteria levels of slurry / RSW water increased twenty-fold compared to pre-fishing. Storing scalefish and trunks in 'ageing' slurries would be highly susceptible to rapidly increasing bacteria levels based on these results. The use of antibacterial additives to ice slurries would be expected to reduce the increase in bacteria.
- Swab results suggest no discernible difference between pre and post fishing bacteria levels from the areas sampled. Bacteria analysis form the areas sampled were within the recommended levels suggesting comparatively 'clean' facilities.
- Four of the twenty-two samples analysed for ammonia returned higher than recommended nitrogen levels, and all came from a three-day trip. Results are otherwise limited on ammoniation and nitrogen levels due largely to under sampling. Further sampling could be undertaken with relative ease and cost efficiency.
- On-board practices were noticeably deficient in the areas of personal hygiene, sanitation, traceability, and quality control (monitoring).
- On-board practices and facilities were generally good to satisfactory in the areas of storage facilities, fishing practices, and handling-storage.
- Preliminary analysis of forty observations taken of shark pH, sex, length, and condition suggests no significant patterns affecting practices or suggested guidelines. The gathered data will be reported separately.

Recommendations include;

1. Commence drafting a preliminary code of practice based on the observations taken from three boats as presented in this report.
2. Collect additional flesh and water samples from nine-day boats (two in particular) that are often fishing from Albany for the analysis of nitrogen (ammonia), mercury, and bacteria / microbiology. Samples could be gathered from the two fishing vessels as they return to port (after a nine-day trip).
3. Review the observation data on pH / sex / length / condition as support material for training and development initiatives such as port meetings with shark fishers.
4. Initiate an industry-wide research project into the pH of small, medium, large sized sharks to gauge the types of specie and sizes that deliver the lowest pH (i.e. lowest potential for ammoniation) and use this as a basis for selecting 'preferred' species in a program of sustainable fishery practices. Fishers could be provided with a logbook, pH strips, and instructions on how to 'swipe' five sharks daily and record sex, length and pH for reporting quarterly.

Shark Gender, Size and pH.

On-board observations included gender, size and pH recordings for a selection of landed shark. The aims of the observations were to trial the use of pH strips to test surface and gut pH of landed and processed shark. These observations were based on the premise that a higher pH is expected to lead to the earlier onset of ammoniation and spoilage in shark. Lower pH is expected to provide longer shelf life through delayed onset of ammoniation. The measurements aimed to identify if certain species, lengths or gender were more likely to have consistently higher pH levels. This would have implications for labelling of shark distributed to the market and or the selection of fishing grounds and species being targeted by fishers.

The key findings include;

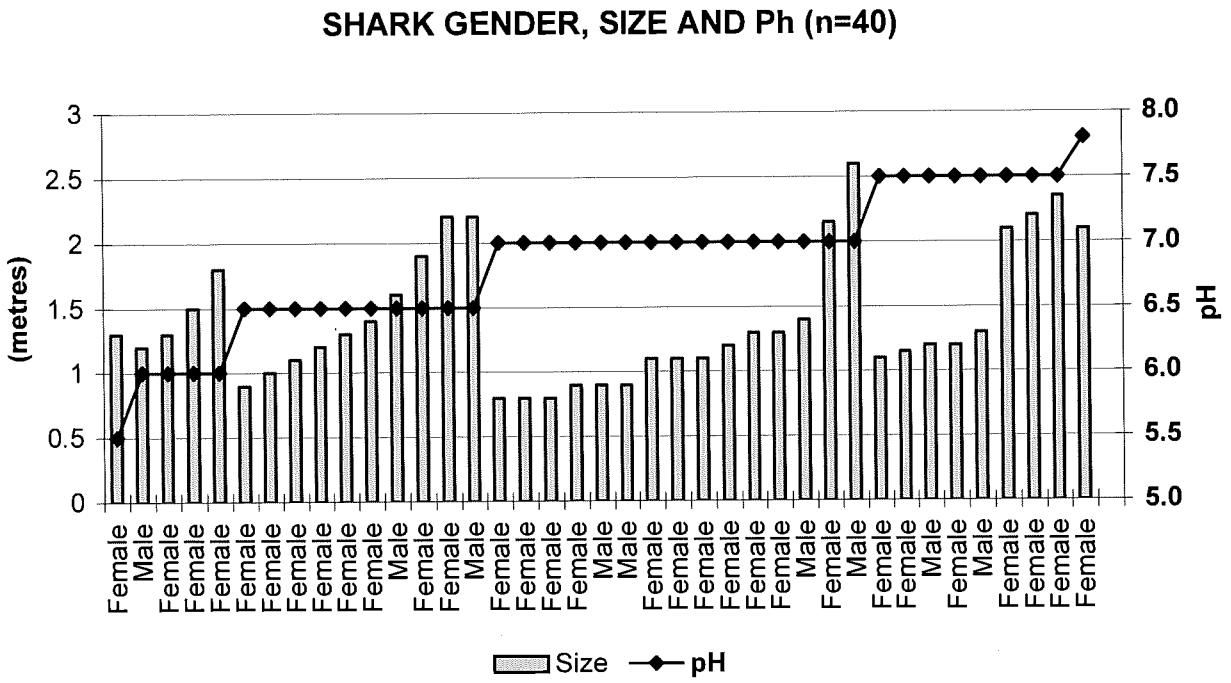
- From 40 samples there were nine species, including 30 female (75%) and ten male (25%), with 13 or 30% landed alive and 27 or 70% landed dead,
- Sizes ranged from 0.8m to 2.6m, with gut pH ranging from 5.5 ~ 7.5, and core temperatures ranging from 19.4 to 22.1,
- 40% of the sharks had comparatively low gut pH of 5.5 ~ 6.5, with the remaining 60% having a gut pH of 7.0 to 7.5,
- Three prominent 'bands' of pH were evident including 6.5, 7.0 and 7.5. Bronze Whalers were prominent among the 6.5 pH band, Thickskin's were prominent among the 7.0 pH band, and Dusky Whalers were prominent among the 7.5 pH band,
- Dusky Whalers generally had the highest surface pH, although some smaller Dusky Whalers (<1.5m) had moderately low surface pH,
- Bronze Whalers generally had the lowest gut pH, whilst Thickskin and Gummy sharks generally had the lowest surface pH,
- Males were the most likely to be landed alive (e.g. 1 in 2 males compared to 1 in 4 females),

A table and chart of the gender, size and pH data follows.

Gender, Size and pH continued.

Species	Sex	Condition at landing	Size (metres)	Core Temp. at landing	pH (gut)	pH (surface)
Hammerhead	Male	Dead*	1.0	19.6	5.5	6.5
Whiskery	Female	Dead	1.3	19.8	5.5	
Whiskery	Male	**Alive**	1.2	19.8	6.0	
Hammerhead	Female	Dead	1.3	19.4	6.0	6.0
Bronze Whaler	Female	Dead	1.5	19.8	6.0	
Bronze Whaler	Female	Dead	1.8	20.0	6.0	
Dusky Whaler	Female	**Alive**	0.9	20.3	6.5	7.5
Bronze Whaler	Female	Dead*	1.0	20.1	6.5	6.0
Thickskin	Female	Dead	1.1	19.8	6.5	
Bronze Whaler	Female	**Alive**	1.2	20.0	6.5	
Bronze Whaler	Female	Dead*	1.3	19.8	6.5	7.5
Dusky Whaler	Female	Dead*	1.4	19.9	6.5	8.0
Wobbegong	Male	**Alive**	1.6	19.9	6.5	7.5
Dusky Whaler	Female	Dead	1.9	20.0	6.5	7.5
Grey Nurse	Female	Dead	2.2	19.7	6.5	
Blacktip	Male	Dead	2.2	20.0	6.5	
Gummy	Female	**Alive**	0.8	20.3	7.0	6.0
Thickskin	Female	**Alive**	0.8	20.7	7.0	7.0
Thickskin	Female	Dead*	0.8	19.9	7.0	6.0
Thickskin	Female	**Alive**	0.9	20.1	7.0	6.5
Thickskin	Male	Dead	0.9	20.1	7.0	6.5
Bronze Whaler	Male	Dead*	0.9	19.8	7.0	7.0
Thickskin	Female	Dead	1.1	19.8	7.0	7.0
Thickskin	Female	Dead*	1.1	19.8	7.0	6.0
Whiskery	Female	Dead*	1.1	19.9	7.0	7.0
Gummy	Female	Dead*	1.2	20.4	7.0	6.0
Thickskin	Female	Dead	1.3	20.4	7.0	6.5
Thickskin	Female	Dead*	1.3	19.6	7.0	7.0
Blacktip	Male	Dead	1.4	19.6	7.0	7.0
Dusky Whaler	Female	Dead	2.15	22.1	7.0	7.5
Wobbegong	Male	**Alive**	2.6	20.4	7.0	
Thickskin	Female	**Alive**	1.1	20.3	7.5	6.5
Whiskery	Female	Dead	1.15	19.8	7.5	7.0
Blacktip	Male	**Alive**	1.2	20.2	7.5	7.0
Whiskery	Female	Dead	1.2	20.0	7.5	7.0
Dusky Whaler	Male	**Alive**	1.3	20.0	7.5	7.5
Dusky Whaler	Female	Dead*	2.1	21.0	7.5	6.5
Dusky Whaler	Female	**Alive**	2.2	21.4	7.5	7.5
Dusky Whaler	Female	Dead*	2.35	20.4	7.5	7.5
Dusky Whaler	Female	**Alive**	2.1	21.2	7.8	7.5

Gender, Size and pH.



APPENDIX 1

WA SHARK FISHING INDUSTRY

CODE OF PRACTICE PROJECT

VESSEL REPORT

DAY TRIP BOAT- VESSEL #1

BIG FRESHWATER BAY

THURSDAY 19TH OCTOBER 2000

Introduction

This report presents the findings of observations taken during a day-trip aboard a commercial shark fishing vessel. The results form part of a broader study developing a code of practice for the Western Australian shark fishing industry.

The Vessel

Vessel #1 is a 14 metre glass fibre commercial shark fishing vessel, built 1992 for the West Australian lobster fishery, with modifications to operate in the West Coast Demersal Gillnet fishery as a day-fishing vessel. The fishery provides catches of scalefish (20%) and shark (80%)[1].

The crew include an owner/skipper with the assistance of two deck hands using gillnet to catch mainly whiskery, black tip, bronze whaler and gummy sharks from the offshore waters of Safety Bay, Greenhead and the central lower west coast of Western Australia.

On the day of the observations the vessel was boarded at Big Freshwater Bay at around 5:30am (Thursday 19th October 2000).

On boarding the vessel the overall cleanliness appeared to be good. The decks and fish handling areas were clean with no noticeable smells. The fish bin for washing processed fish comprised a 300 litre plastic tub that was clean with no apparent smell. The fibreglass ice box (approximately 300 litres) was clean, dry and in good condition with no apparent bacteria traps.

The vessel had an aft-deck mounted spool/drum for hauling and shooting the net, a gunwale mounted roller-feeder to guide the net aboard, and two gunwale mounted gutting tables for eviscerating and beheading fish. The vessel had the equipment and storage facilities to produce high-grade fresh, chilled shark and scalefish. As a day-trip vessel it was not equipped with refrigerated brine or storage systems.

Fishing Practices

Two crew are utilised to operate the deck and processing operations. On hauling the net, one crew member guides the net evenly onto the spool and assists in removing fish from the net. A second crew member removes fish and debris from the net and processes fish at the first reasonable opportunity. Hauling the net took 160 minutes whilst re-setting the net took 55 minutes.

The vessel works 495m (5 units) of gillnet which had been positioned 15 miles off the coast (S29°44', E114°41') in 21 fathoms during the previous afternoon (19 hours prior to hauling). Once a shark or scalefish nears the surface the haul speed is decreased and fish are eased over the roller-feeder onto the deck. The entangled shark and scalefish are positioned so the crew can immediately untangle the catch and transfer it (by dragging) to the process area.

In setting the net, the anchors and floats are launched over the stern and the gillnet rolls freely off the drum. One crew controls the drum brake while another checks for twists and snags in the launching net. The 495 metres of gillnet took approximately 55 minutes to shoot and set. The net was positioned for retrieval the following day (approximately 20 hours later). The net soak time is largely determined by the time required to haul and process the days catch and the distance travelled to locate a suitable fishing area.

[1] Fisheries Western Australia, Sharks, Commercial Fisheries, No. 7, May 1991

Fish Handling Practices - Processing

Around 80% of all landed fish were dead. Around 20% of all landed fish were affected either due to lice or being entangled in the net. The affected fish is generally processed and placed in the ice slurry as quickly as possible (although some exceptions were observed).

The order of processing shark was observed as stunning, bleeding, finning, beheading, gutting, scrubbing, rinsing and chilling. The processing used single blade knives, a gutting table, a high pressure sea water hose, and a plastic filament brush. The processing area and equipment (net, gutting tables) were regularly rinsed with fresh sea water. No scrubbing, detergents or disinfectants were used to clean the gutting tables, knives or deck areas in between hauling and processing.

Fish processing is done on open deck forward of the fish bin, exposed to the sun and wind. The fish are neither graded nor sorted into different species. All processed fish including shark and scalefish of varied quality and condition are stored in the ice box.

Live scalefish were immediately spiked (ikijimi) before being placed into the ice slurry, while dead scalefish were often left on deck for up to five minutes before gutting, rinsing and storing in the ice slurry. Most sharks were dead and very few required stunning – a hammer to the head - or killing upon landing. Rarely were sharks seen thrashing about and no apparent bruising or lacerations occurred on the day. Bleeding of sharks was achieved by severing the tail and some sharks remained bleeding on deck for up to ten minutes before finning, eviscerating and beheading. Some sharks were bled and processed simultaneously. The shark were then placed in the fish bin, scrubbed and washed in clean sea water for a few minutes, before being transferred to the ice slurry.

Shark is sometimes stored on deck in the elements for up to 20 minutes before bleeding and processing. On average, it took between 9-17 minutes (28 minutes maximum) for shark to be landed, processed and placed into the ice slurry.

After bleeding and eviscerating (sometimes simultaneously), shark is transferred to the fish bin for 3-4 minutes to scrub the skin, gut cavity and remove loose flesh and lining. Processed shark is then placed into the ice slurry until the vessel is almost at anchor (ashore) – maximum chill time of 5.5 hours was observed.

Both crew used the high-powered deck hose, with clean seawater, to rinse the net and deck area intermittently throughout the days fishing. Wood (five ply) lines the surface of the gutting tables. No other wood or permeable surfaces were evident in the fish handling areas. The ikijimi spike comprised a small rusted screwdriver.

Fish Handling Practices – Storage & Transportation

Three bags of ice (approx. 20kg crushed ice) were stowed in the ice box upon boarding and later mixed with 1:2 clean sea water before fishing commenced. The ice slurry recorded a temperature of –0.4 deg.C prior to arriving at the fishing area, approximately 16 miles offshore. There were no anti-bacterial solutions added to the fish bin or ice box (e.g. 'PuroFresh' active ingredient 2% chlorine dioxide). There was no thermometer fitted to the ice box.

Fish bin water was monitored to determine if pH and temperature fluctuated. A typical set of readings for a full days work (approximately 300 kilograms of fish landed) are shown in tables 1 and 2 in the appendix to this vessel report.

Without re-charging the ice slurry with additional ice during the day, Vessel #1 can barely hold up to 300kgs of fish for 5-6 hours provided that the fish came aboard at a steady rate. Critical temperatures for holding fresh fish is between -1 and 4C, with core temperature targets of around -1 and 2C whereas the vessel landed fish ashore ranging from 1.8 to 16 deg.C (and higher again at Greenhead). The fish bin water temperature was constant at 20 deg. C and the ice slurry ranged from –0.4 to 1.8 deg. C. All fish were processed with core temperatures ranging between 19.8 and 20.1 deg. C.

The first-caught and smaller fish in the ice slurry reached critical temperatures within 45 minutes. This was generally good except that fish were also sloshing in the slurry for 20-30 minutes until further fish were added. Medium sized fish and those caught mid-way through the day reached critical temperatures within 140 minutes. Larger fish and especially those caught later in the day generally did not reach target temperatures and remained above 8.0 deg. C. (refer to chart 3, page 7). All shark and scalefish were stored in the ice slurry, and later mixed in ice bins/freezer ashore, with no system for identification and traceability.

For all fish to reach critical temperatures (0~1 Deg. C.) within 2.0 hours and to be maintained at critical temperatures, would require a higher ice / seawater mix to increase the chilling capacity of the present system. For example, if the catch rate per day were 500kgs the ice slurry would require additional 8-10 bags of ice (e.g. 60-70kg). Alternatively, a small ice slurry positioned between the gutting table and ice box would greatly assist by taking the initial heat out of the fish making it easier for the ice slurry to chill the fish. This would also help to remove surface bacteria from the fish, especially if the small slurry was replaced regularly and an anti-bacterial agent added.

Plastic crates were used to transfer the scalefish and shark ashore. These were stored in a clean condition in a forward locker. The cleaning of baskets was not observed and there was no indication of anti-bacterial solutions being used to clean the crates.

For transporting the fish ashore, smaller and medium sized fish were placed into plastic crates whilst larger fish and trunks were stored on top of otherwise full crates with wet Hessian bags placed on top. The same Hessian bags were used throughout the day to line the deck and to place over chilled fish for storage on the deck (at 31 deg.C) before going ashore. The Hessian bags were not treated with anti-bacterial solutions whilst fishing or before going ashore.

Fish were transported from the vessel at Big Freshwater Bay to the ice bins / freezer at Greenhead on the back of a ute (and covered with wet Hessian bags). Core temperatures increased considerably during transport to well above the critical (ideal) temperatures as shown in the following table.

Table 6. Core Temperature (deg. C) Readings upon Arrival at Greenhead

	Highest	Lowest
Shark	10.1	4.8
Shark	7.0	5.2
Shark	6.2	5.8
Dhufish	7.8	4.9

Summary of Sampling & Observations

The conditions on the day of observations were low-moderate swell, low seas, light-moderate (NE-N) winds, and nil cloud.

On the way to the fishing grounds portable probe thermometers were calibrated using fresh water ice. Neutralit indicator strips (pH 5-10) were used throughout the day to monitor the pH of seawater, ice slurry, scalefish (surface or gut lining) and shark (head-brachial region). Sea water pH and temperatures were monitored along with air and deck temperatures. A schedule of temperature and pH readings is presented in the following charts and appendix 1 (page 11).

Chart 1. Temperature Readings

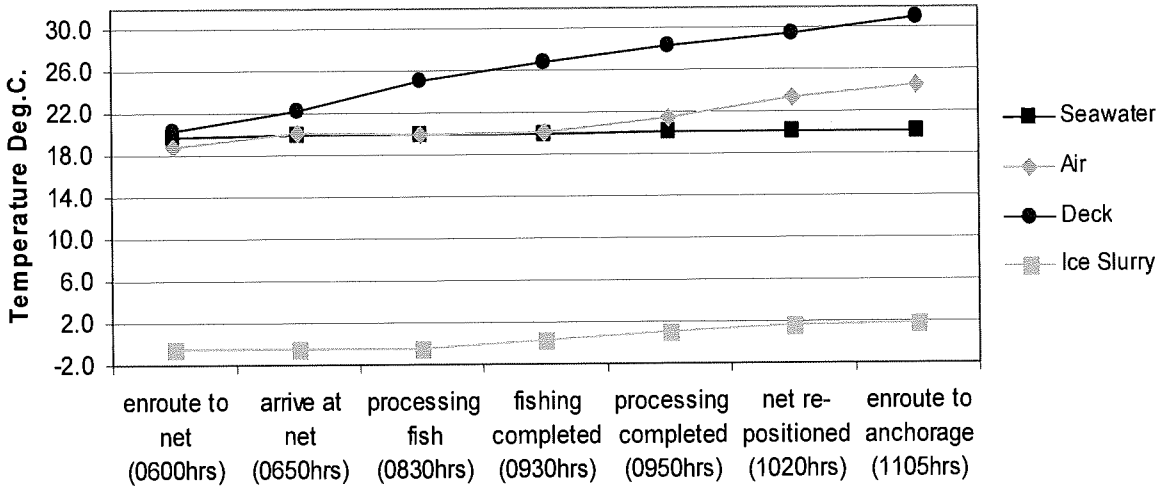
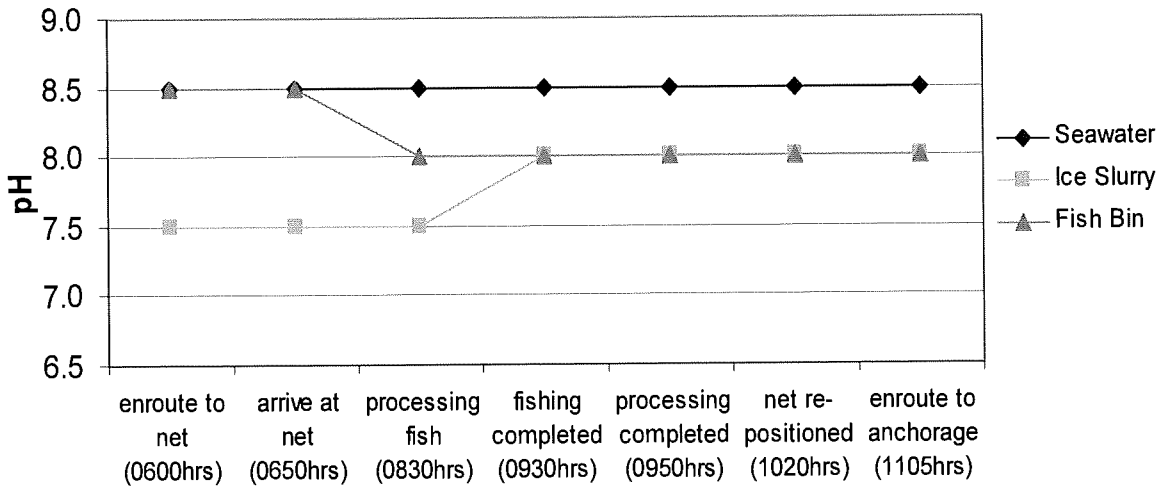


Chart 2. pH Readings



Core temperatures of fish arriving on deck ranged from 19.8 deg.C to 20.1 deg.C – given the seawater temperature (20 deg.C.). Air temperatures ranged from 18.8C (early morning) to 23.8C (midday, at sea). The deck temperature ranged from 20.4 deg.C to 31.0 deg.C. (Refer to tables 1and 2 in the appendix, page 11).

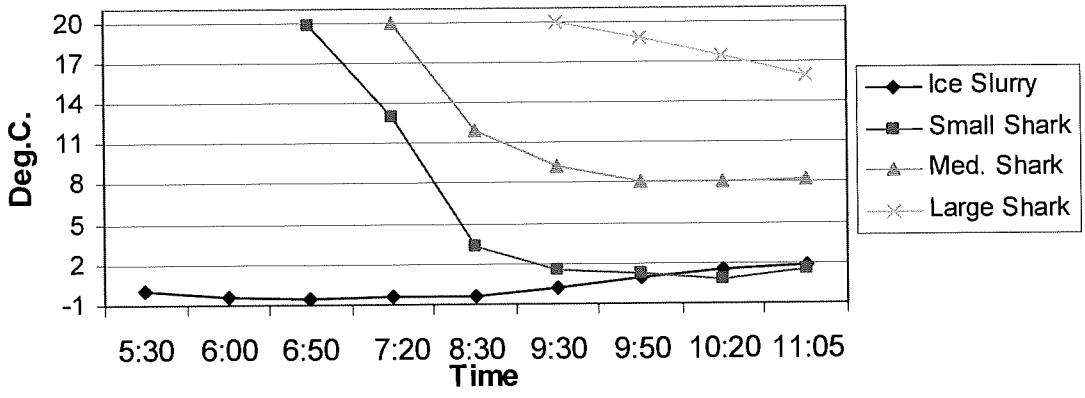
The holding tank was regularly over-flowing with clean sea water from the deck hose and was generally a clear colour with a pH of 8.0-8.5, and a temperature of 20 Deg.C. with a minimal amount of viscera in the water.

The number of scalefish and shark hauled aboard during 0650hrs and 0930hrs was approximately 35. This was less than expected and could have otherwise resulted in unacceptably higher core temperatures for many of the fish upon arrival at shore.

All scalefish (approx. 20) were removed from the net and placed in the ice slurry within five minutes. All sharks (approx 15) were bled, finned, eviscerated, headed, cleaned and placed in the ice slurry within 5-25 minutes.

Processed fish were transferred to the ice box and stored in the ice slurry at temperatures ranging from –0.4 to 1.8 deg.C. Fish that were landed / hauled later in the day were chilled the least (e.g. core temperature of 16 deg.C) and vice versa (refer to chart 3).

Chart 3. ICE SLURRY & SHARK CORE TEMPERATURES IN THE ICE BOX



Hygiene & Sanitation

Clean seawater and ice slurry samples were collected before fishing commenced and upon completion of fishing for bacteria analysis. Duplicate swabs were taken from the fish bin, gutting tables and ice box before fishing commenced and upon completion of fishing for bacteria analysis. Duplicate fish samples were collected from the head-brachial region of four sharks and a Jewfish (control fish) after being processed, to check for bacteria and ammonia. Fish and water samples and swabs were kept on ice and delivered to Microserve Perth for analysis. The results, as presented in the appendix, indicate the vessel was generally of a clean and safe hygiene standard, with low bacteria counts for the swabs, fish, and water samples. Notable exceptions were;

1. Fish sample, Black Tip Shark, 1,000,000 CFU/g – standard plate count
2. Fish sample, Bronze Whaler, 540,000 CFU/g - standard plate count
3. Fish sample, Whiskery, 1,200,000 CFU/g - standard plate count

4. Swab analysis, ice box, > 10,000 microbial count
5. Water sample analysis, ice slurry @ days end, 86,000 heterotrophic plate count

The crew's hygiene habits were generally good. One crew member wore cotton gloves that appeared reasonably clean and the other wore new, clean rubber gloves. All crew wore rubber boots that appeared to be clean and in good order. Bacteria from handling the net, fish, by-product and fish bin were potentially transferred to the ice slurry with no obvious rinsing or washing of hands between cycles, which would otherwise be expected to reduce bacteria build up in the ice slurry.

There were no pets or smoking aboard the vessel and all food was consumed away from the processing area. There was no dedicated program for insects and rodents although it was reported that occasional checks were carried out.

Potential Improvements
From observations throughout the day a number of potential improvements were identified that would be expected to improve fish quality, shelf life, and the general condition of the fish including;

- No disinfectants (anti-bacterial solutions) were used on the boat.
- Fish were often left on deck in the elements waiting processing.
- Insufficient ice for all the catch to attain critical temperatures.
- Shark bleeding *and* processing was sometimes performed simultaneously.
- Fish were transported from the shore to the ice bins/freezer in crates, under wet Hessian bags, on the back of a ute.
- Some sharks / fish were left on deck (31 Deg.C) under wet Hessian bags for 10~15 minutes prior to unloading.
- Plastic crates are potential bacteria traps unless thoroughly and regularly disinfected.
- Ikijimi spike should be clean *and* rust free.
- Cleaning was undertaken with a detergent (Comprox) with no disinfectant qualities.
- Timber is used as a lining / cutting surface on the gutting table.
- Critical temperatures were not attained for all fish, and core temperatures increased considerably when removed from the ice slurry until arrival at the ice bins / freezer at Greenhead (e.g. 1.8 to 10.1 Deg C.).

Overall
The boat is producing a high standard of fish but it has the potential to produce a higher quality on a more consistent basis with relatively minor changes. The crew worked at a high standard that could be further improved with training in basic hygiene, bacteria, and temperature control techniques in relation to fish handling, quality, and shelf life.

Points of General Interest
The bacteria found on fish need to be cared for in handling practices. If the temperature surrounding the bacteria's environment can be quickly reduced then growth of most bacteria can be significantly slowed. The larger the temperature drop, the slower the bacteria multiply. These factors directly impact on the shelf life of the fish.

In the cooler environs of south western Australia it is comparatively easy for fish in ice slurries to reach core temperatures of around 2-4 deg. C within 45~60 minutes. It can be more difficult however for all of a day's catch to achieve critical temperatures (0~1 deg. C.) within 1~2 hours.

This is due to the larger quantities of ice that are generally required as well as the regular opening/closing of the ice box and varying ambient temperatures (refer to Table 5 in the appendix, page 13).

Extra salty ice slurries, combination slurries, and powerful brines are the quickest ways to chill fish. Some bacteria can still multiply in low temperatures. Most of these however, are external and can be controlled by good hygiene practises. Brines and slurries should be kept as clean as possible, treated with an anti bacterial agent and fish should be as clean as possible before entering them.

Another quality concern is fish that are left in slurries and brines for too long resulting in fading colours. For example, the gills have a tendency to lose the deep red colour and become light pink. Fish should not stay in slurries or brine for more than 6 hours. If core temperatures lower than 2C *cannot be achieved* within six hours and maintained at these temperatures, the fish should not be sold as first grade.

The United States 'Fish & Fisheries Products Hazards & Controls Guide' states that *Pristipomoides spp.* (gold band, etc) can be infected with dangerous parasites, ciguatera fish poisoning (CFP) and histamine toxin. It also points out that *Lutjanus spp (*red emperor, saddle tail) and *Epinephelus spp.* (cod) can be in effected with CFP. The CFP concern is easily overcome in this area as there are no official reported cases from the region. The parasite problem is solved if the fish are either frozen or cooked before consumption. So long as the product is labelled 'to be cooked' this covers the concern. Histamine toxin is produced by bacteria that produce the enzyme histidine decarboxylase during growth. These are commonly found in the gills of a number of species especially tuna. This enzyme reacts with free histidine, a naturally occurring chemical in gold band. The result is the formation of histamine. Cooking or freezing will not destroy the toxin once it has been established. In the US it is recommended that histamine prone fish be rapidly chilled to 0C and consumed within 14 days. The 14 days is based on tuna long line fish that have often been dead for more than three hours before hitting the deck. Live trap or drop line fish should have more than double this safe shelf life, if chilled rapidly and held at around 0C.

Appendix

Table 1. TEMPERATURE READINGS (deg.C.)				
Stage of Trip	Deck	Air	Seawater	Ice Slurry
enroute to net (0600hrs)	20.4	18.8	19.8	-0.4
arrive at net (0650hrs)	22.2	20.1	19.9	-0.5
processing fish (0830hrs)	25.1	20.0	19.9	-0.4
fishing completed (0930hrs)	26.8	20.2	20.0	0.2
processing completed (0950hrs)	28.4	21.4	20.2	1.0
net re-positioned (1020hrs)	29.6	23.4	20.2	1.6
enroute to anchorage (1105hrs)	31.0	24.5	20.1	1.8

Table 2. pH Readings			
Stage of Trip	Seawater	Ice Slurry	Fish Bin
enroute to net (0600hrs)	8.5	7.5	8.5
arrive at net (0650hrs)	8.5	7.5	8.5
processing fish (0830hrs)	8.5	7.5	8.0
fishing completed (0930hrs)	8.5	8.0	8.0
processing completed (0950hrs)	8.5	8.0	8.0
net re-positioned (1020hrs)	8.5	8.0	8.0
enroute to anchorage (1105hrs)	8.5	8.0	8.0

Table 3. FISH OBSERVATIONS TAKEN ON-BOARD Vessel #1 19/Oct/00					
Species	Size (m)	Sex	Condition at landing	Core Temp. at landing	pH
Thickskin	1.1	Female	Dead	19.8	6.5
Bronze Whaler	1.5	Female	Dead	19.8	6.0
Bronze Whaler	1.8	Female	Dead	20.0	6.0
Bronze Whaler	1.2	Female	Alive	20.0	6.5
Whiskery	1.3	Female	Dead	19.8	5.5
Whiskery	1.2	Male	Alive	19.8	6.0
Blacktip	2.2	Male	Dead	20.0	6.5
Wobbegong	2.6	Male	Alive	20.4	7.0
Grey Nurse	2.2	Female	Dead	19.7	6.5
Average	**1.7**			**19.9**	**6.3**
Range	**1.5**			**0.7**	**1.0**

Table 4. FISH OBSERVATIONS TAKEN AT CATALANO SEAFOODS 1045 HRS 23/Oct/00 (ie upon delivery to the Processor)

Species	Estimated Time since caught	Appearance / Smell	Condition	Core Temp. (deg.C)	pH
Grey Nurse	96 hours	good / nil	chilled	1.6	6.5
Thickskin	96 hours	good / nil	chilled	1.2	6.0
Thickskin	96 hours	good / nil	chilled	0.9	6.5
Bronze Whaler	96 hours	good / nil	chilled	1.4	6.5
Bronze Whaler	96 hours	good / nil	chilled	0.8	6.0
Whiskery	96 hours	good / nil	chilled	0.8	6.0
Wobbegong	96 hours	good / nil	frozen	-5.5	7.5
Dhufish	96 hours	good / nil	chilled	0.4	7.0
Dhufish	96 hours	good / nil	chilled	2.0	7.0
Dhufish	96 hours	good / nil	chilled	3.1	7.0
Sand Snapper	96 hours	good / nil	chilled	0.8	6.0
Wobbegong	72 hours	good / nil	frozen	-6.5	7.5
Whiskery	72 hours	good / nil	chilled	2.6	6.5
Whiskery	72 hours	good / nil	chilled	1.7	6.5
Whiskery	72 hours	good / nil	chilled	3.1	6.5
Mako	72 hours	good / nil	chilled	1.8	6.0
Mako	72 hours	good / nil	chilled	1.8	5.5
Average				**0.6**	**6.6**
Range				**9.6**	**2.0**

Appendix

Results of Fish Sample Analysis

Lab No.	Sample Details		Sample No.	Standard Plate Count CFU/g	Coliforms CFU/g	*E. coli* MPN/g	*Pseudomonas* species CFU/g
0017614F	Black Tip @ Big Freshwater	Head Brachial	1	1 000 000	< 10	< 3	< 1 000
0017615F	Black Tip @ Big Freshwater	Head Brachial	2	390 000	< 10	< 3	< 1 000
0017616F	Black Tip - Male - 2.2m	Post processing; pre ice	1	48 000	< 10	< 3	< 1 000
0017617F	Black Tip - Male - 2.2m	Post processing; pre ice	2	190 000	< 10	< 3	< 1 000
0017618F	Bronze Whaler @ Big Freshwater	Head Brachial	1	260 000	< 10	< 3	< 1 000
0017619F	Bronze Whaler @ Big Freshwater	Head Brachial	2	540 000	< 10	< 3	< 1 000
0017620F	Bronze Whaler - Female - 1.8m Post processing; pre ice	Head Brachial	1	5 600	< 10	< 3	< 1 000
0017621F	Bronze Whaler - Female - 1.8m Post processing; pre ice	Head Brachial	2	13 000	< 10	< 3	< 1 000
0017622F	Dhufish @ Big Freshwater	Head	1	29 000	< 10	< 3	< 1 000
0017623F	Dhufish @ Big Freshwater	Head	2	33 000	< 10	< 3	< 1 000
0017624F	Thickskin @ Big Freshwater	Head Brachial	1	580 000	< 10	< 3	< 1 000
0017625F	Thickskin @ Big Freshwater	Head Brachial	2	170 000	< 10	< 3	< 1 000

Appendix

Results of Fish Sample Analysis

Lab No.	Sample Details		Sample No.	Standard Plate Count CFU/g	Coliforms CFU/g	*E. coli* MPN/g	*Pseudomonas* species CFU/g
0017626F	Thickskin - Female - 1.1m Post processing; 5 mins in ice	Head Cranial	1	4 700	< 10	< 3	< 1 000
0017627F	Thickskin - Female - 1.1m Post processing; 5 mins in ice	Head Cranial	2	1 600	< 10	< 3	< 1 000
0017628F	Whiskery @ Big Freshwater	Head Brachial	1	1 200 000	< 10	< 3	< 1 000
0017629F	Whiskery @ Big Freshwater	Head Brachial	2	1 400 000	< 10	< 3	< 1 000
0017630F	Whiskery - Male - 1.2m Post processing; before ice	Head Brachial	1	31 000	< 10	< 3	< 1 000
0017631F	Whiskery - Male - 1.2m Post processing; before ice	Head Brachial	2	39 000	< 10	< 3	< 1 000
	METHODS			MMM 2.1F	MMM 2.2F	MMM 2.3F	MMM 4.9W

Appendix

Results of Swab Analysis

Site	Swab No	Total Microbial Count	Coliforms	*E. coli*	*Pseudomonas* species
Pre-fishing:					
Fish bin 0550	1	50	< 10	< 10	< 10
Fish bin 0600	2	40	< 10	< 10	< 10
Gutting table 0550	3	< 10	< 10	< 10	< 10
Gutting table 0600	4	40	< 10	< 10	< 10
Ice box 0550	5	> 10 000	< 10	< 10	< 10
Ice box 0600	6	> 10 000	< 10	< 10	< 10
Post fishing:					
Fish bin 1100	7	360	< 10	< 10	< 10
Fish bin 1100	8	520	< 10	< 10	< 10
Gutting table 1100	9	470	< 10	< 10	< 10
Gutting table 1100	10	< 10	< 10	< 10	< 10
Ice box 1100	11	> 10 000	< 10	< 10	< 10
Ice box 1100	12	> 10 000	< 10	< 10	< 10
	METHODS	MMM 6.1SW	MMM 2.2F	MMM 6.2SW	MMM 6.4SW

Appendix

Results of Water Sample Analysis

Lab No.	0017609W	0017610W	0017611W	
Sample Details				
-Source				
-Site	Pre Fishing - Deck Hose 0650	Pre Fishing - Deck Hose 0650	Pre Fishing - Deck Hose 0700	
-Temperature				
-Appearance	Clear; colourless	Clear; colourless	Clear; colourless	
TEST	**RESULT**	**RESULT**	**RESULT**	**METHOD**
Heterotrophic Plate Count				
at 21^0C CFU per mL	< 100	< 100	< 100	MMM 4.1W
Coliforms CFU per 100mL	0	0	0	MMM 4.2W
Thermotolerant Coliforms CFU per 100mL	0	0	0	MMM 4.3W
E. coli CFU per 100mL	0	0	0	
Pseudomonas species CFU per 100mL	< 10	110	0	MMM 4.5W

Appendix

Results of Water Sample Analysis

Lab No.	0017612W	0017613W		
Sample Details				
-Source				
-Site	Processing - Deck Hose 0930	Brine Tank Water 1110		
-Temperature				
-Appearance	Clear; colourless	Turbid; straw coloured; debris		
TEST	**RESULT**	**RESULT**		**METHOD**
Heterotrophic Plate Count				
at 21^0C CFU per mL	< 100	86 000		MMM 4.1W
Coliforms CFU per 100mL	0	40		MMM 4.2W
Thermotolerant Coliforms CFU per 100mL	0	< 10		MMM 4.3W
E. coli CFU per 100mL	0	< 10		
Pseudomonas species CFU per 100mL	20	0		MMM 4.5W

APPENDIX II

WA SHARK FISHING INDUSTRY

CODE OF PRACTICE PROJECT

VESSEL REPORT

TWO DAY BOAT- VESSEL #2

HAMELIN BAY

TUESDAY 16TH - WEDNESDAY 17TH

JANUARY 2001

Introduction

This report presents the findings of observations taken over two days on a commercial shark fishing vessel. On both days the vessel returned to its' mooring at Hamelin Bay. The first days catch remained onboard overnight and was unloaded at the end of fishing on day two. Shark trunks were stored overnight in brine tanks/RSW and scalefish were stored overnight in freshwater ice in an icebox. Temperatures, pH and onboard practices were monitored over two days. The observations and findings presented in this report form part of a broader study to develop a code of practice for the Western Australian shark fishing industry.

The Vessel

Vessel #2 is an 18 metre fibreglass commercial shark fishing vessel, purpose built in 1996 for the West Coast Demersal Gillnet fishery as a five-day fishing vessel. The fishery provides catches of scalefish (20%) and shark (80%)[2].

The crew included an owner/skipper with the assistance of two deck hands using gillnet to catch mainly whiskery, bronze whaler and dusky whaler sharks from offshore waters extending from Albany to Carnarvon.

For observations, the vessel was boarded at Hamelin Bay at around 4:00am, Tuesday 16th January 2001.

On boarding the vessel the overall cleanliness appeared to be good. The decks and fish handling areas were clean with no noticeable smells or accumulated bacteria traps. The fish bin for temporarily storing processed shark comprised a 400 litre aluminium tank with a hinged lid (incorporating the gutting table), that was clean with no apparent smell or bacteria traps. The fibreglass icebox used for temporarily storing processed scalefish (300 litres capacity) was clean, dry and in good condition with no apparent smells or bacteria traps.

The below deck brine tank (5,000kg capacity), already one-quarter full with refrigerated seawater (RSW at -0.8 ~ -0.2 degrees C), was clean and in good condition with no apparent smells. The brine tank, constructed of fibreglass, comprised two hatches with three storage compartments (separated by aluminium cold plates / baffles), and a central well for draining.

The vessel had a central, aft-deck mounted spool/drum for hauling and shooting the net, a port gunwale mounted roller-feeder to guide the net aboard, a fish bin / gutting table (mid-deck, starboard side) with a holding tray adjoining, and two 500 litre moulded plastic ice boxes on the aft deck for ice and scalefish storage. Black rubber mats lined the deck forward of the spool / drum where fish were removed from the net.

The vessel was of a high standard and had the equipment and storage facilities to catch and supply high-grade fresh, chilled shark and scalefish. The vessel's refrigerated brine tank and iceboxes appeared adequate for extended trips of up to six or eight days.

[2] Fisheries Western Australia, Sharks, Commercial Fisheries, No. 7, May 1991

Fishing Practices
Two crew operated the deck including clearing the net, processing and storing fish, and setting the net. The skipper operated the vessel and drum-haul speed from a port side-station adjacent to the roller-feeder. The drum/spool was fitted with an auto-feeder operated by the skipper to ensure an even distribution of net on the spool. As the net was being hauled, the haul speed was controlled (i.e. stopped, slowed) to allow one crew member to remove fish and debris from the net whilst also ensuring a tangle-free entry onto the spool. A second crew member processed fish and helped remove fish (especially larger sized fish) from the net as required. Hauling the net took on average 120~140 minutes whilst re-setting the net took 45~55 minutes.

Net hauling ceased intermittently to repair breakages in the surface and weighted lines. Whilst an essential task, it invariably meant that unprocessed fish and shark remained on deck at high temperatures (20+ deg.C) for 10~15 minutes longer than otherwise necessary.

The vessel operates 7000m (~80 units?) of gillnet which had been positioned 15 miles off the coast (i.e. in the vicinity of S33°57', E114°56') in 26 fathoms during the previous afternoon (17 hours prior to hauling). As shark or scalefish neared the surface the haul speed was reduced and fish were eased over the roller-feeder onto the deck. The entangled shark and scalefish were immediately untangled from the net (often by stretching or tearing mesh, removing fins) and transferred to the adjacent holding tray. Larger sized shark (e.g. >1.5m) were dragged adjacent to the gutting table (forward of the drum/spool) and remained on deck in the elements to wait processing.

In setting the net, anchors and floats were launched over the stern and the gillnet rolled freely off the drum. One crew member controlled the vessel speed and drum brake using controls mounted on the drum/spool, while the other crew checked for twists and snags in the launching net. The 7000 metres of gillnet took approximately 45~55 minutes to shoot and set. The net was positioned for retrieval the following day (approximately 20 hours later). The net soak time was largely determined by the time required to haul and process the days catch and the distance travelled to locate a suitable fishing area.

The fishing practices appeared similar in almost all respects to that of the previous vessel observations.

Fish Handling Practices - Processing
Around 70% of all landed fish were dead. Approximately 30% of all landed fish were lice affected or damaged (including attacked) from being entangled in the net. All landed fish and shark were accumulated in the holding tray or concentrated on deck to await processing, and were generally processed within 15-25 minutes after retrieval from the net.

Processing of shark and scalefish used single blade knives (regularly sharpened) and a high pressure (50mm) sea water hose that was permanently flowing over the gutting table. The gutting table had a waste-chute attached to discard viscera etc over-board.

Live and dead scalefish were retrieved from the net and placed onto the holding tray for up to 20 minutes before gutting, rinsing and storing in the icebox/RSW at 1~4 deg.C. There were no indications that live scalefish were spiked (i.e. ikijimi). Scalefish were gutted, rinsed, and placed into the ice box/RSW at the first reasonable opportunity. The ice box, generally one-third full of RSW, was occasionally topped up with fresh RSW during the day's processing.

The order of processing shark was observed as stunning, finning, beheading, gutting, rinsing, and storing in the fish bin, re-rinsing, and chilling in RSW.

After retrieval from the net, smaller shark (0.8m ~ 1.6m) were accumulated in the holding tray while larger shark (1.7m ~ 2.4m) remained on deck adjacent to the gutting table waiting to be processed. Most sharks were dead and very few, mostly large sharks, required stunning – a clubbing to the head - upon landing. Very rarely was shark seen thrashing about and hence no bruising or lacerations were observed. Bleeding by severing the caudal fin was very rarely practiced, on two occasions live sharks were severed on the underside of the head and remained bleeding on deck for 15~25 minutes before processing commenced (often until semi-rigor set in).

The lid of the fish bin also served as the gutting table, and had a central port (approximately 1.2m x 0.4m) as an open access to the fish bin. The fish bin floor was lined with slatted jarrah. A deck hose provided a stream of seawater into the fish bin whilst a drain port was permanently open enabling a constant flushing of the fish bin (i.e. almost constantly near-empty throughout the days processing).

Processing of large shark (1.7m ~ 2.4m) was undertaken on open deck exposed to the sun and wind (largely due to the difficulty of handling such large fish).

Once processed, sharks were lowered (dropped ~0.8m) into the near-empty fish bin. Processed shark trunks were removed from the near-empty fish bin around 60 minutes after processing and re-rinsed (particularly the gut cavity and skin/surface) with a high powered deck hose. The re-rinsed, processed trunks were accumulated on the for'ard deck for 5~10 minutes before placement (dropping ~1.5m) into the brine tank/RSW.

The scalefish and shark were neither graded, sorted into different species, labelled nor separated for traceability purposes.

The processing area and equipment (net, gutting tables, deck) were rarely rinsed with sea water during net-hauling, processing or net-launching. No scrubbing brushes, detergents, or disinfectants were used to clean the gutting tables, knives, deck, icebox or fish bin in between hauling and processing, or after the days' fishing was completed. There were no detergents or disinfectants on board.

A high-powered seawater deck hose, with a spray-nozzle attachment, was used to rinse the net and deck area upon completion of the days fishing, after all fish had been placed into storage. The gutting table was lined with wood (five ply). No other wood or permeable surfaces were evident aboard the vessel. No ikijimi spike was evident, although sharp knives possibly doubled as ikijimi spikes (but not observed).

Fish Handling Practices – Storage & Transportation

Several bags of ice (approx. 6~7 x 20kg crushed ice) were stowed in ice boxes upon the aft deck. The for'ard icebox, approximately one-third full of RSW, was used to *temporarily* store processed scalefish and averaged a temperature of 1.0~4.0 deg.C. There were no anti-bacterial solutions added to the fish bin or for'ard ice box (e.g. 'PuroFresh' active ingredient 2% chlorine dioxide).

Sharks were often stored on deck or in the holding tray (minor exposure to the elements) for up to 20 minutes before processing. On average, it took between 15-20 minutes (25~30 minutes maximum) for shark to be landed, processed and placed into the fish bin where they remained at sea/air temperature (i.e. ~20+ deg. C) for up to 90 minutes before being transferred to the RSW (at -1.5 ~ -0.5 deg.C).

Upon completion of the days fishing and after all cleaning had ceased the processed scalefish were transferred from the for'ard icebox/RSW, packed in ice in plastic crates, and stored in the icebox on the aft deck.

Topping-up the for'ard icebox with additional RSW during the day enabled the temperature to remain between 1.0 ~ 6.0 deg. C, after introducing around 100kg of scalefish (with initial core temperatures of 19~20 deg.C). Similarly, the brine tank / RSW temperature remained at -0.1 ~ -0.8 deg.C after introducing around 100~150kg of shark trunks (initially at 19~21 deg.C) over a 5~10 minute period.

The scalefish placed into the for'ard icebox (RSW) generally reached critical temperatures (around 1.5 deg.C) within 45~60 minutes. Scalefish introduced to the icebox later in the morning had a reduction of core temperatures from 19.5 to 3.8 deg.C (over 30~45 minutes) before being re-packed in ice within the aft icebox. The temperature of scalefish was generally well managed.

Chart 5. BRINE TANK RSW & SHARK CORE TEMPERATURES DAY ONE

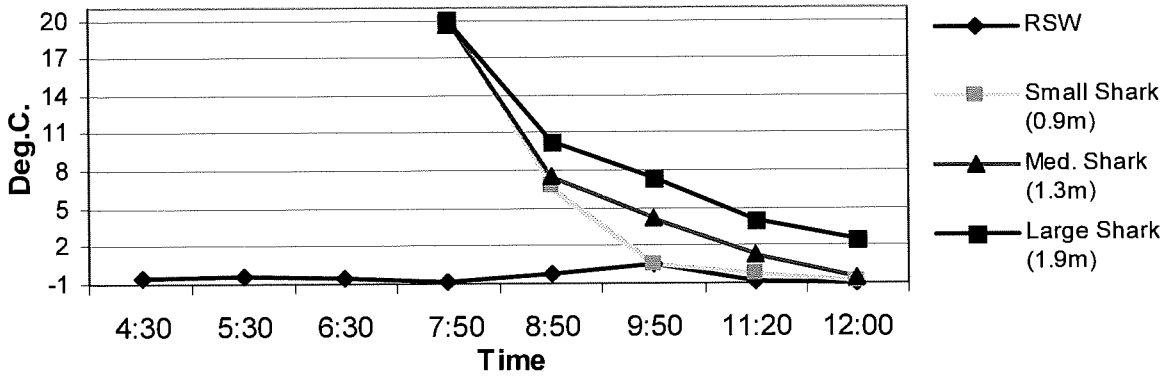


Chart 6. Shark Core Temperatures in RSW over two days fishing

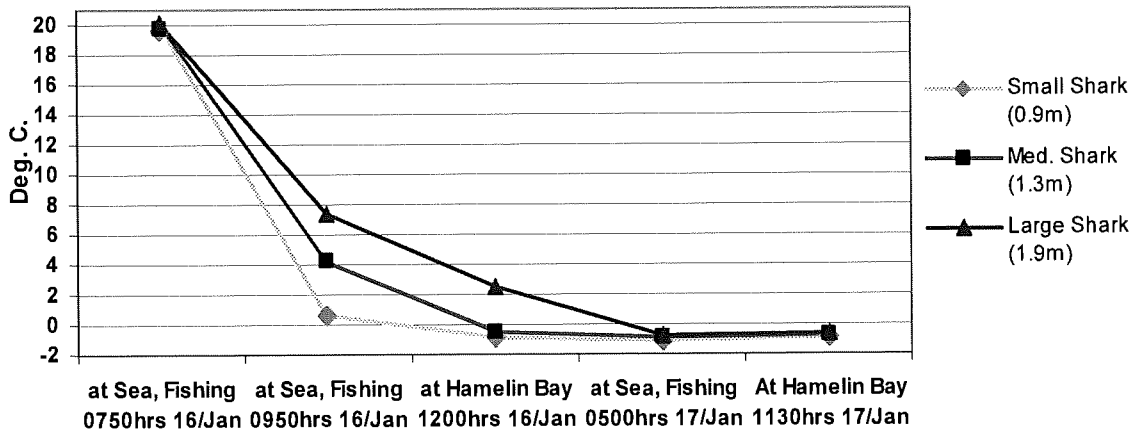
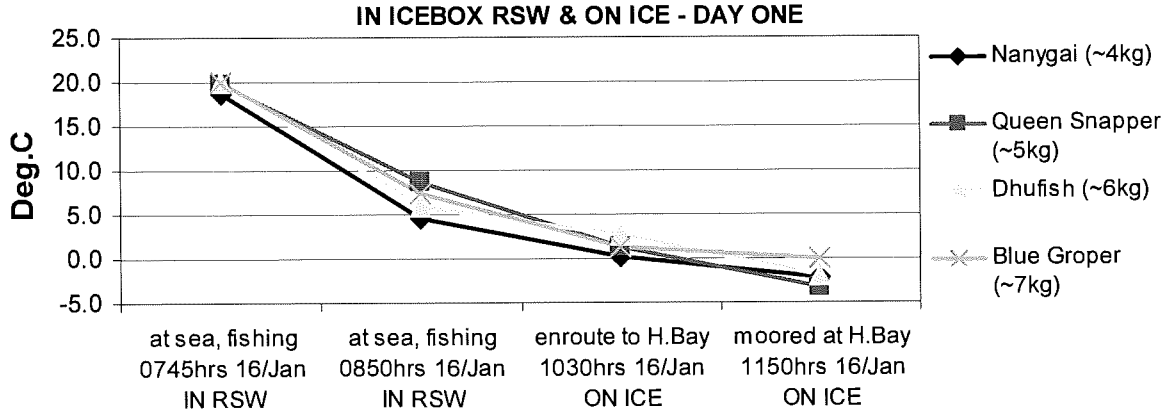


Chart 7. SCALE FISH CORE TEMPERATURES IN ICEBOX RSW & ON ICE - DAY ONE



Scalefish generally reached critical temperatures within 90~120 minutes after landing on deck. Shark generally reached critical temperatures within 120 ~ 180 minutes after landing on deck. Scalefish and shark maintained critical temperatures (i.e. 0~3 deg.C) after being placed on ice or in the brine tank respectively.

Sharks were stored in the brine tank, separate compartments for day 1 and day 2, while scalefish were stored in crates (first in, last out) in the aft icebox. There was no labelling or form of identification for traceability purposes. The two-day catch was later combined and transported from Hamelin Bay to Bunbury in the one ice box.

Filling the fish bin daily with RSW and freshwater ice would greatly reduce the core temperature of processed trunks, reducing the time required for shark to reach critical temperatures in the brine tank. Adding an anti-bacterial agent to the fish bin, ice box and brine tank would also help to reduce bacteria levels especially over 3~4 day trips.

Plastic crates were used to transfer scalefish and shark ashore. The crates were stored on deck. There was no indication of anti-bacterial solutions or detergents being used to clean the crates. Some of the crates appeared well used, worn and partially soiled (i.e. dust, salt, scales, grime).

For transporting the fish ashore, small and medium sized fish and trunks were placed into crates whilst larger fish and trunks were stored on top of otherwise full crates. A canvas cover was placed over the crates. Prior to packing into crates, trunks remained on deck (26~28 deg.C) for 10~15 minutes. Black rubber mats lining some sections of the deck were often 5~10 degrees higher than the deck temperature.

Fish were transported from Hamelin Bay to Bunbury in a large, plastic moulded ice box with a canvas cover, on the back of a ute. Approximately one 20kg bag of ice was poured on top of the fish before closing the lid. Almost all fish had been chilled to temperatures of 0~3 deg.C.

Summary of Sampling & Observations

Conditions on the two days of observations were low swell, low seas, light-moderate (SE-S) winds, nil cloud, and 'friendly' for observing and collecting data.

On the morning of observations two portable probe thermometers were checked in fresh water ice slurries (i.e. recording 0.2~0.3 degrees over 2 minutes). Sea water temperatures were monitored

along with air, deck, brine/RSW, fish bin, and icebox/RSW temperatures. Neutralit indicator strips (pH 5-10) were used to monitor the pH of seawater, brine tank/RSW, fish bin, icebox/RSW, scalefish (gut lining) and shark (surface, head-brachial region and gut lining). A schedule of temperature and pH readings is presented in the following charts and appendix 1.

Chart 1. DAY ONE TEMPERATURE READINGS

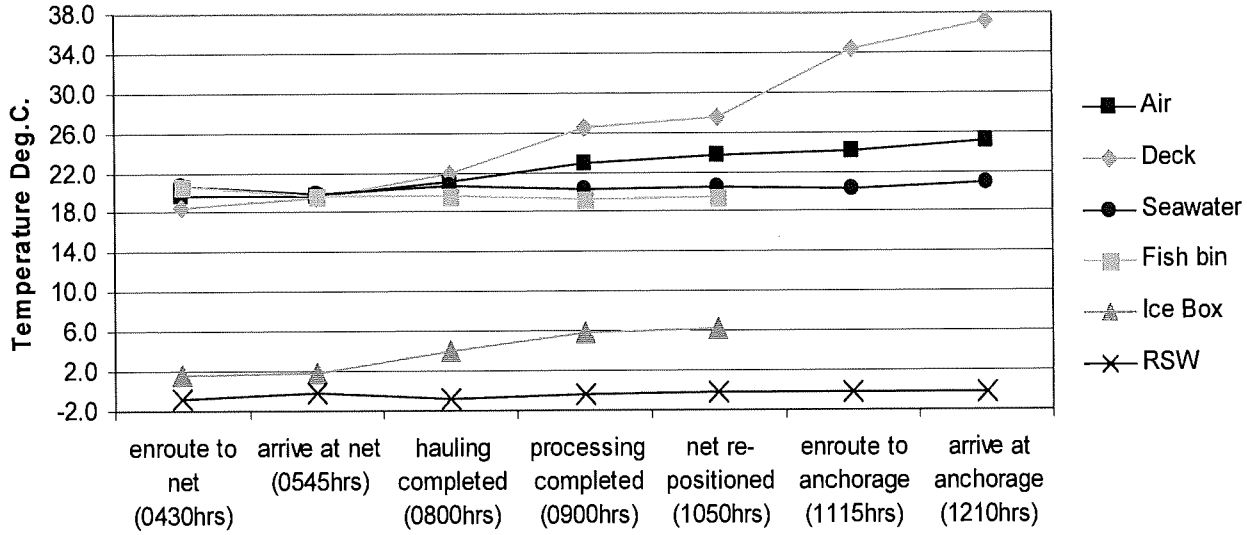


Chart 2. DAY ONE pH READINGS

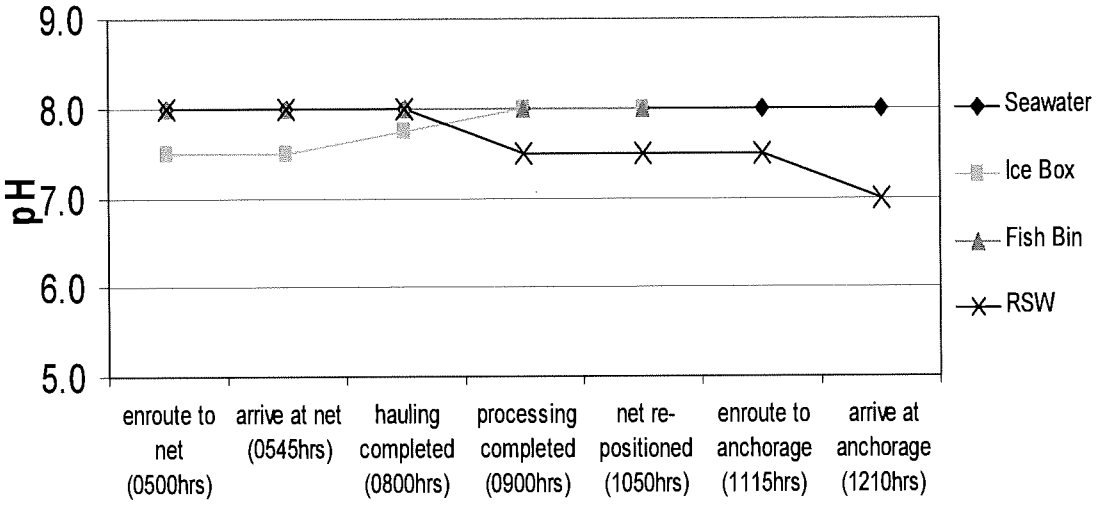


Chart 3. DAY TWO TEMPERATURE READINGS

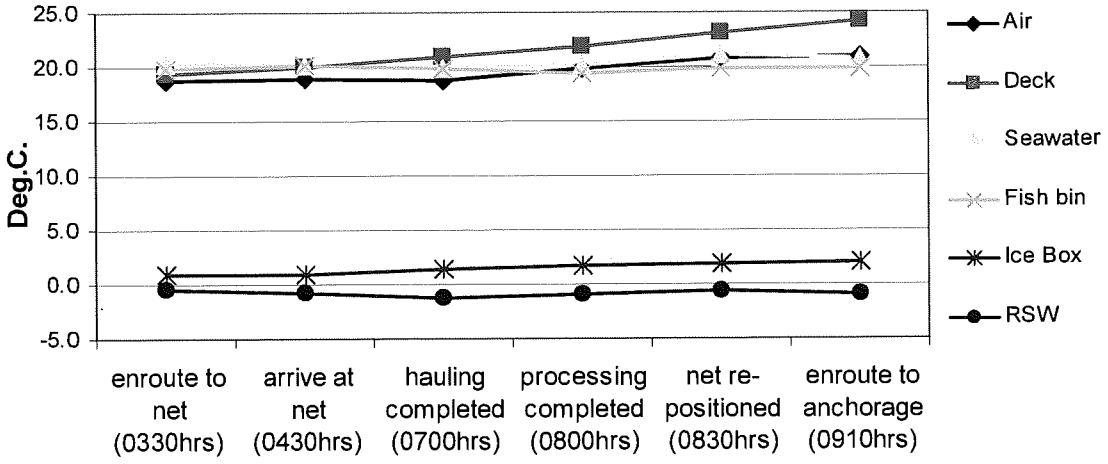
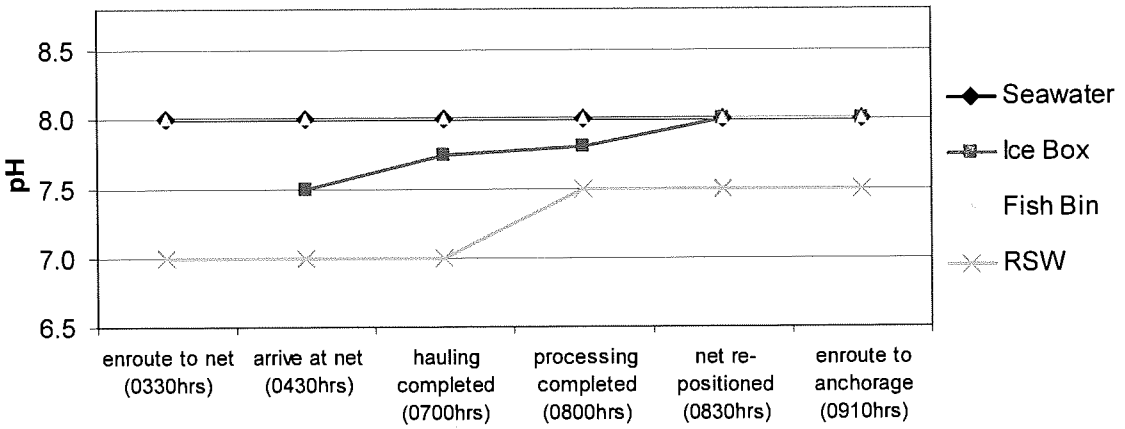


Chart 4. DAY TWO pH READINGS



Over two days of fishing, core temperatures of fish arriving on deck ranged from 19.3 to 22.1 deg.C – with seawater temperature averaging 20.2 deg.C. Air temperatures ranged from 18.8C (early morning) to 25.2C (midday, at sea). The deck temperature ranged from 18.6 deg.C to 37.1 deg.C.

The fish bin was draining as quickly as it was filling, and subsequently near-empty throughout its' entire use. Whilst constantly flushing with clean sea water, it was generally a clear colour with a pH of 8.0, and a temperature of around 20 Deg.C. with a minimal amount of viscera in the water.

The for'ard icebox was filled to one-third capacity with RSW upon commencement of fishing each day, and topped up with RSW during the days fishing. The icebox RSW temperature averaged 1.0~5.0 deg.C throughout both days. The pH ranged from 7.5 ~ 8.0 on both days. As the fishing neared completion (i.e. 4~5 hours after commencement), the temperature was generally at 5~6 deg.C, and the water became discoloured with viscera and blood. Fish were re-rinsed before being re-packed into ice in the aft icebox.

Approximately 30 scalefish and shark were hauled aboard on day one and around 40 on day two. This was less than expected. A larger catch on day two could have resulted in higher core temperatures upon arrival at shore for some of the catch, particularly fish/shark caught later in the day.

Over two days of fishing, all scalefish (approx. 40) were removed from the net, placed in the holding tray, processed, and placed into the icebox RSW within 15~25 minutes of being landed. All sharks (approx 30) were finned, headed, eviscerated, cleaned and placed in the fish bin within 20-25 minutes of being landed.

Processed fish were transferred to the aft icebox at temperatures ranging from 1.4 to 5.8 deg.C and stored on freshwater ice. Fish that were landed later in the day were chilled the least (e.g. core temperature of around 6 deg.C) before being packed into ice and vice versa.

Clean seawater and brine tank / RSW samples were collected before fishing commenced and upon completion of fishing for bacteria analysis. Duplicate swabs were taken from the fish bin, gutting table, brine tank, and ice box before fishing commenced and upon completion of fishing for bacteria analysis. Duplicate fish samples were collected from the head-brachial region of four sharks and a Jewfish (control fish) after being processed, to check for bacteria and ammonia. Fish and water samples, and swabs, were kept on ice and delivered immediately to Microserve for analysis. The

results, as presented in the appendix, indicate the vessel was generally of a clean and safe hygiene standard, with low bacteria counts. Notable exceptions include;

1. Fish sample, Dhufish Wing, 160,000 CFU/g – standard plate count
2. Fish sample, Dusky Whaler, 210,000 CFU/g - standard plate count
3. Water analysis, RSW, pre-fishing 30,000 CFU/ml heterotrophic plate count
4. Water analysis, RSW, pre-fishing 100,000 CFU/ml *Pseudomonas* Species
5. Water analysis, RSW, post-fishing 44,000 CFU/ml heterotrophic plate count
6. Water analysis, RSW, post-fishing 330,000 CFU/ml *Pseudomonas* Species

Changes in bacterial counts during the processing and storage of shark and scalefish were examined. *Pseudomonas* on flesh samples were less than 100,000 CFU/g and Standard Plate Counts increased five-fold in 24 hours from day one to two. Swabs taken from the gutting table, fish bin and ice box recorded *Pseudomonas*, Coliforms, and E. coli less than 10 CFU/g and total microbial counts above 1,000. Water samples generally recorded below critical limits for *Pseudomonas*, Coliforms and E. coli. with the exception of brine tank RSW at day two (post-fishing). The brine tank RSW recorded a three-fold increase in *Pseudomonas* species over 24 hours. Findings indicate that comparatively low levels of bacteria were present in the fish and boat environment. The practices and procedures observed would be expected to contribute to low levels of spoilage in shark over 2~3 days and higher levels over 4~5 days.

Hygiene & Sanitation

The crew's hygiene habits were generally good. Both crew members wore disposable rubber gloves that appeared reasonably clean and in good condition. All crew wore rubber boots that appeared to be clean and in good order. Bacteria from handling the net, fish, and by-product were potentially transferred to the icebox RSW and brine tank RSW with no washing of hands between cycles or during the days fishing, which might otherwise reduce bacteria build up. All crew used a domestic-household strength antibacterial hand cleanser at the end of each days fishing.

There were no pets aboard the vessel. All food was consumed away from the processing area. There was no smoking during the processing or transferring of fish. There was no dedicated program for insects, rodents, and birds although it was reported that occasional checks were carried out. The toilet facilities were in good condition. There were separate compartments for the storage of solvents and solutions used in the engine room and bilge.

Potential Improvements

From observations throughout the day a number of potential improvements were identified that would be expected to improve fish quality, shelf life, and the general condition of the fish including;

- No disinfectants (anti-bacterial solutions) were used on the boat.
- No detergents were used for cleaning the deck, equipment, and storage facilities.
- Fish were often left in the holding tray or on deck for 15~25 minutes waiting to be processed. Storage in a crate of ice slurry or RSW would be an improvement.
- Shark bleeding was rarely carried out, and never *immediately upon landing* shark.
- Shark bruising was likely from dropping trunks into the near-empty fish bin and later from dropping trunks into the below-deck brine tank.
- Shark trunks were stored in a near-empty fish bin for 1.5~2.0 hours at 19~20 deg.C. Using RSW in the fish bin, core temperatures could be reduced to 3~4 deg.C over 60~90 minutes.

- Dead shark are treated no differently to live shark, both are processed similarly. Dead shark could be processed immediately and stored in RSW immediately.
- Live shark, especially large shark, often remained on deck alive for 20~30 minutes after clubbing / stunning. Severing the caudal fin would bleed and possibly kill the shark more effectively.
- Re-rinsing of shark and scalefish was undertaken on deck, in the same location where unprocessed shark had moments before been stored and processed.
- During preparation to go ashore, shark trunks remained on deck (26~37 deg.C) for 10~15 minutes prior to loading onto the dinghy.
- Plastic crates are potential bacteria traps unless thoroughly and regularly cleaned with antibacterial agents (i.e. disinfected).
- Not all the live scalefish were given an ikijimi spike.
- Cleaning was undertaken with a high-powered deck hose, with no detergent, no antibacterial agents, and no brushing/scrubbing.
- Plywood used as a lining / cutting surface on the gutting table, and the black rubber mats used on the deck, are potentially high-load bacteria traps.
- There are no formal practices or means to differentiate catches from day 1, 2 3, etc. A simple means of labelling crates or trunks could be introduced.
- After unloading of fish/shark into the dinghy a brief wash-down would reduce bacteria remaining on the deck and remove any viscera, blood etc.

Overall

The boat is producing a high standard of fish. There is potential to improve fish quality with relatively minor changes, particularly in regard to shark processing, handling, and wash-downs. The crew worked at a high standard that could be improved with minor training in bacteria, handling, and temperature control. The dedicated design of the vessel provides for a high standard in relation to fish storage, quality, and shelf life.

Points of General Interest

The bacteria found on fish need to be cared for in handling practices. If the temperature surrounding the bacteria's environment can be quickly reduced then growth of most bacteria can be significantly slowed. The larger the temperature drop, the slower the bacteria multiply. These factors directly impact on the shelf life of the fish.

Spoilage in fish is caused by bacteria, enzymes, and chemical action. Bacteria are mostly found in the surface slime, gills, and the gut of living seafood species. Enzymes are abundant in helping to build tissue, contract and relax muscles, and digest food. When seafood species die, enzymes continue to work, digesting or breaking down the flesh and bacteria invade through the gills, along blood vessels, and directly through the skin and gut cavity lining. These changes are affected by temperature and for many species increasing the temperature from zero to five degrees Centigrade doubles the rate of spoilage and cuts the shelf life in half.

In the cooler environs of south western Australia it is comparatively easy for fish in ice slurries to reach core temperatures of around 2-4 deg. C within 45~60 minutes. It can be more difficult however for all of a day's catch to achieve critical temperatures (0~1 deg. C.) within 1~2 hours. This is due to the larger quantities of ice that are generally required as well as the regular opening/closing of the ice box and varying ambient temperatures (refer to Table 5 in the appendix, page 13).

Extra salty ice slurries, combination slurries, and powerful brines are the quickest ways to chill fish. Some bacteria can still multiply in low temperatures. Most of these however, are external and can be controlled by good hygiene practices. Brines and slurries should be kept as clean as possible, treated with an anti bacterial agent and fish should be as clean as possible before entering them.

Another quality concern is fish that are left in slurries and brines for too long resulting in fading colours. For example, the gills have a tendency to lose the deep red colour and become light pink. Fish should not stay in slurries or brine for more than 6 hours. If core temperatures lower than 2C *cannot be achieved* within six hours and maintained at these temperatures, the fish should not be sold as first grade.

Scrombotoxin forms as a result of time/temperature abuse of certain fish and is mostly linked to the formation of histamine (i.e. 200 ~ 500ppm). Certain bacteria produce the enzyme histidine decarboxylase during growth. This enzyme reacts with free histidine, a naturally occurring chemical in fish, which results in the formation of histamine. Upon death, the defence mechanisms of fish no longer inhibit bacterial growth, and histamine-forming bacteria start to grow, producing histamine. With harvesting practices such as long lining and gill nets, death can occur before the fish is removed from the water. Histamine development is more likely in raw, unfrozen fish. The potential for histamine formation is further increased when the flesh of fish is exposed to the enzyme-forming bacteria during processing (e.g. eviscerating, beheading, filleting / dressing).
Rapid chilling of fish immediately after death is important in preventing the formation of scrombrotoxin. For example, fish with temperatures below 28 deg. C should be placed in refrigerated seawater or chilled brine (<10 deg.C) within nine hours of death – or placed in ice within twelve hours of death. This will prevent the rapid formation of the enzyme histidine decarboxylase – the precursor to scrombrotoxin / histamine.

Appendix

Table 1. DAY ONE TEMPERATURE READINGS (deg.C.)

Time	Stage of Trip	Air	Deck	Seawater	Fish bin	Ice Box	RSW
4:30	enroute to net (0430hrs)	19.8	18.6	20.8	20.8	1.6	-0.8
5:45	arrive at net (0545hrs)	19.8	19.5	19.9	19.8	1.8	-0.1
8:00	hauling completed (0800hrs)	21.2	22.0	20.8	19.8	4.1	-0.8
9:00	processing completed (0900hrs)	23.0	26.6	20.4	19.4	5.9	-0.4
10:50	net re-positioned (1050hrs)	23.8	27.6	20.6	19.6	6.2	-0.2
11:15	enroute to anchorage (1115hrs)	24.1	34.4	20.4			-0.1
12:10	arrive at anchorage (1210hrs)	25.2	37.1	20.9			-0.2

Table 2. DAY ONE pH READINGS

Time	Stage of Trip	Seawater	Ice Box	Fish Bin	RSW
5:00	enroute to net (0500hrs)	8.0	7.5	8.0	8.0
5:45	arrive at net (0545hrs)	8.0	7.5	8.0	8.0
8:00	hauling completed (0800hrs)	8.0	7.8	8.0	8.0
9:00	processing completed (0900hrs)	8.0	8.0	8.0	7.5
10:50	net re-positioned (1050hrs)	8.0	8.0	8.0	7.5
11:15	enroute to anchorage (1115hrs)	8.0			7.5
12:10	arrive at anchorage (1210hrs)	8.0			7.0

Table 3. DAY TWO TEMPERATURE READINGS (deg.C.)							
Time	Stage of Trip	Air	Deck	Seawater	Fish bin	Ice Box	RSW
3:30 AM	enroute to net (0330hrs)	18.8	19.4	20.3	19.9	0.9	-0.5
4:30 AM	arrive at net (0430hrs)	18.9	20.0	20.1	20.1	1.0	-0.8
7:00 AM	hauling completed (0700hrs)	18.7	20.9	19.8	19.8	1.4	-1.2
8:00 AM	processing completed (0800hrs)	19.8	21.8	20.1	19.4	1.7	-1.0
8:30 AM	net re-positioned (0830hrs)	20.8	23.2	21.1	19.9	1.8	-0.7
9:10 AM	enroute to anchorage (0910hrs)	20.9	24.2	20.8	19.9	2.0	-0.9

Table 4. DAY TWO pH READINGS					
Time	Stage of Trip	Seawater	Ice Box	Fish Bin	RSW
3:30 AM	enroute to net (0330hrs)	8.0		8.0	7.0
4:30 AM	arrive at net (0430hrs)	8.0	7.5	8.0	7.0
7:00 AM	hauling completed (0700hrs)	8.0	7.8	8.0	7.0
8:00 AM	processing completed (0800hrs)	8.0	7.8	8.0	7.5
8:30 AM	net re-positioned (0830hrs)	8.0	8.0	8.0	7.5
9:10 AM	enroute to anchorage (0910hrs)	8.0	8.0	8.0	7.5

Appendix

Note, the following observations are part of a broader study to determine if certain shark species, size, sex, and condition at landing influence pH levels and the potential for ammoniation. The results may help in determining which species of shark can be expected to offer higher quality flesh for consumer markets.

Table 4. SHARK OBSERVATIONS TAKEN ON-BOARD VESSEL #2 16-17/Jan/01						
Species	Size (m)	Sex	Condition at landing	Core Temp. at landing	Surface pH	Gut pH
Bronze Whaler	0.9	Male	Dead*	19.8	7.0	7.0
Bronze Whaler	1.0	Female	Dead*	20.1	6.0	6.5
Bronze Whaler	1.3	Female	Dead*	19.8	7.5	6.5
Dusky Whaler	1.3	Male	Alive	20.0	7.5	7.5
Dusky Whaler	2.1	Female	Dead#	21.0	6.5	7.5
Dusky Whaler	2.1	Female	Alive	21.2	7.5	7.8
Dusky Whaler	2.35	Female	Dead*	20.4	7.5	7.5
Dusky Whaler	2.2	Female	Alive	21.4	7.5	7.5
Dusky Whaler	2.15	Female	Dead	22.1	7.5	7.0
Dusky Whaler	1.9	Female	Dead	20.0	7.5	6.5
Dusky Whaler	0.9	Female	Alive	20.3	7.5	6.5
Dusky Whaler	1.4	Female	Dead*	19.9	8.0	6.5
Whiskery	1.1	Female	Dead*	19.9	7.0	7.0
Whiskery	1.15	Female	Dead	19.8	7.0	7.5
Whiskery	1.2	Female	Dead	20.0	7.0	7.5
Hammerhead	1.3	Female	Dead	19.4	6.0	6.0
Hammerhead	1.0	Male	Dead*	19.6	6.5	5.5
Wobbegong	1.5	Male	Alive	19.9	7.5	6.5
Average	**1.5**		*lice affected	**20.3**	**7.1**	**6.9**
Range	**1.45**		#attacked-bled	**1.0**	**2.0**	**1.8**

Appendix

Results of Fish Sample Analysis

MICROSERVE LABORATORY PTY LTD **FOOD REPORT** **NATA Accreditation No. 10642**

Client: **WAFIC** *SHARK TRIAL RUN 2*

Date Collected: **16/1/01 - 17/1/01** **Date Received: 17/1/01** **Date Tested: 18/1/01**

Lab No.	Sample Details	Sample No.	Standard Plate Count CFU/g	Coliforms CFU/g	*E. coli* MPN/g	*Pseudomonas* species CFU/g
0100920F	Dusky Whaler – Female - 1.4m Cranial/Trunk 16/Jan 0735hrs	1	3 200	< 10	< 3	< 100
0100921F	Dusky Whaler - Female - 1.5m Cranial/Trunk 16/Jan 0735hrs	1	2 800	< 10	< 3	< 100
0100922F	Dusky Whaler - Female - 1.3m Cranial/Trunk 16/Jan 0810hrs	1	5 500	< 10	< 3	< 100
0100923F	Dusky Whaler - Female - 1.3m Cranial/Trunk 16/Jan 0810hrs	2	1 500	< 10	< 3	< 100
0100924F	Dhufish Wing 16/Jan 0830hrs	1	87 000	< 10	< 3	< 100
0100925F	Dhufish Wing 16/Jan 0830hrs	2	160 000	< 10	< 3	< 100
0100926F	Dusky Whaler - Female - 0.9m Cranial/Trunk 16/Jan 0840hrs	1	18 000	< 10	< 3	< 100
0100927F	Dusky Whaler - Female - 0.9m Cranial/Trunk 16/Jan 0840hrs	2	47 000	< 10	< 3	< 100
0100928F	Bronze Whaler - Female - 1.0m Cranial/Trunk 16/Jan 0840hrs	1	13 000	< 10	< 3	< 100
0100929F	Bronze Whaler - Female - 1.0m Cranial/Trunk 16/Jan 0840hrs	2	16 000	< 10	< 3	< 100
0100930F	Dusky Whaler - Female - 0.9m Cranial/Trunk 17/Jan 1030hrs	1	210 000	< 10	< 3	< 100
0100931F	Dusky Whaler-Female - 0.9m Cranial/Trunk 17/Jan 1030hrs	2	26 000	< 10	< 3	400
0100932F	Dusky - Female - 1.3m Cranial/Trunk 17/Jan 1030hrs	1	93 000	< 10	< 3	800
0100933F	Dusky - Female - 1.3m Cranial/Trunk 17/Jan 1030hrs	2	96 000	10	< 3	600

Appendix

Results of Fish Sample Analysis

MICROSERVE LABORATORY PTY LTD **FOOD REPORT**

NATA Accreditation No. 10642

Client: **WAFIC** *SHARK TRIAL RUN 2*

Date Collected: **16/1/01 - 17/1/01** **Date Received: 17/1/01** **Date Tested: 18/1/01**

Lab No.	Sample Details	Sample No.	Standard Plate Count CFU/g	Coliforms CFU/g	*E. coli* MPN/g	*Pseudomonas* species CFU/g
0100934 F	Dusty Whaler - Female - 1.5m Cranial/Trunk 17/Jan 1030hrs	1	62 000	< 10	< 3	200
0100935 F	Dusty Whaler - Female - 1.5m Cranial/Trunk 17/Jan 1030hrs	2	72 000	< 10	< 3	500
0100936 F	Bronze Whaler - Female - 1.0m Cranial/Trunk 17/Jan 1030hrs	1	69 000	70	< 3	200
0100937 F	Bronze Whaler - Female - 1.0m Cranial/Trunk 17/Jan 1030hrs	2	44 000	10	< 3	< 100
	METHODS		MMM 2.1F	MMM 2.2F	MMM 2.3F	MMM 4.9W

Appendix

Results of Swab Analysis

Results of Swab Analysis WAFIC

Client Details

PO Box 55
Mt Hawthorn 6016

Sampling Location **Fishing Vessel - Vessel #2**

Date Collected 16/1/01 - 17/1/01
Date Received 17/1/01 **Date Tested** 18/1/01

Site	Swab No	Total Microbial Count	Coliforms	*E. coli*	*Pseudomonas* species
Pre-fishing – 16/Jan					
Gutting table 0515	1	> 1 000	< 10	< 10	< 10
Gutting table 0515	2	> 1 000	< 10	< 10	< 10
Ice box 0515	3	> 1 000	< 10	< 10	< 10
Ice box 0515	4	> 1 000	< 10	< 10	< 10
Fish bin 0515	5	470	< 10	< 10	< 10
Fish bin 0515	6	> 1 000	< 10	< 10	< 10
Brine tank 0500	7	> 1 000	< 10	< 10	< 10
Brine tank 0500	8	> 1 000	< 10	< 10	< 10
Post fishing – 17/Jan					
Gutting table 1000	9	> 1 000	< 10	< 10	< 10
Gutting table 1000	10	> 1 000	< 10	< 10	< 10
Ice box 1000	11	> 1 000	< 10	< 10	30
Ice box 1000	12	> 1 000	< 10	< 10	< 10
Fish bin 1000	13	> 1 000	< 10	< 10	< 10
Fish bin 1000	14	> 1 000	< 10	< 10	< 10
Brine tank 1000	15	> 1 000	< 10	< 10	< 10
Brine tank 1000	16	> 1 000	< 10	< 10	< 10
	METHODS	MMM 6.1SW	MMM 2.2F	MMM 6.2SW	MMM 6.4SW

Appendix

Results of Water Sample Analysis

Client Details WAFIC
PO Box 55
Mt Hawthorn 6016

Date Collected 16/1/01
Date Received 17/1/01
Date Tested 18/1/01

Lab No.	0100915W	0100916W	0100917W	
Sample Details				
-Source	Vessel #2	Vessel #2	Vessel #2	
-Site	Pre Fishing Deck Hose 0630	Pre Fishing RSW 0530	Pre Fishing RSW 0530	
-Temperature				
-Appearance	Clear; colourless	Clear; colourless	Clear; colourless	
TEST	**RESULT**	**RESULT**	**RESULT**	**METHOD**
Heterotrophic Plate Count				
at 21^0C CFU per mL	300	30 000	28 000	MMM 4.1W
Coliforms CFU per 100mL	0	500*	80*	MMM 4.2W
Thermotolerant Coliforms CFU per 100mL	0	14	11	MMM 4.3W
E. coli CFU per 100mL	0	0	0	
Pseudomonas species CFU per 100mL	0	> 70 000	> 100 000	MMM 4.5W

Appendix

Results of Water Sample Analysis

Client Details WAFIC
PO Box 55
Mt Hawthorn 6016

Date Collected 16/1/01
Date Received 17/1/01
Date Tested 18/1/01

Lab No.	0100918W	0100919W		
Sample Details				
-Source	Vessel #2	Vessel #2		
-Site	Post Fishing RSW 0930	Post Fishing RSW 0930		
-Temperature				
-Appearance	Slightly turbid; pale straw colour; debris	Slightly turbid; pale straw colour; debris		
TEST	**RESULT**	**RESULT**		**METHOD**
Heterotrophic Plate Count				
at 21^{0}C CFU per mL	39 000	44 000		MMM 4.1W
Coliforms CFU per 100mL	100*	6*		MMM 4.2W
Thermotolerant Coliforms CFU per 100mL	4	3		MMM 4.3W
E. coli CFU per 100mL	0	0		
Pseudomonas species CFU per 100mL	150 000	330 000		MMM 4.5W

APPENDIX III

WA SHARK FISHING INDUSTRY

CODE OF PRACTICE PROJECT

VESSEL REPORT

THREE DAY BOAT- VESSEL #3

FREMANTLE

TUESDAY 6TH & THURSDAY 8TH

FEBRUARY 2001

Introduction

This report presents the findings of observations taken from two days of a commercial shark fishing vessel's three day trip. Observations including samples, swabs, temperatures, pH and on board practices were collected during day one. Day three observations were collected upon the vessel's return to the fishing boat harbour at Fremantle. The first days catch was re-sampled; water samples and swabs were taken, as well as temperature and pH recordings where possible. The vessel had stored shark trunks and scalefish for two nights / three days in freshwater ice slurries. The observations and findings presented in this report form part of a broader study to develop a code of practice for the Western Australian shark fishing industry.

The Vessel

Vessel #3 is a 15 metre commercial shark fishing vessel, purpose built of aluminium in 1978 for the West Coast Demersal Gillnet fishery as a 3~5 day fishing vessel. The fishery provides catches of scalefish (20%) and shark (80%)[3].

The crew included a skipper with the assistance of one deck hand. The vessel uses gillnet to catch mainly Thickskin, Blacktip, and Gummy sharks from offshore waters extending from Mandurah to Jurien Bay.

For day one observations on Tuesday 6th February 2001, the vessel was boarded at Fremantle at around 4:00am, and returned at around 5:00pm. Day three observations on Thursday 8th February 2001 were collected aboard whilst unloading a three-day catch in the Fremantle Fishing Harbour 5:00~7:00pm.

On boarding the vessel on day one the overall cleanliness was fair - reasonable. The decks and fish handling areas were fairly clean with some minor smells and a few noticeable bacteria traps. The fishing, processing and storage equipment appeared to be in reasonably good condition given the relative age of the vessel (i.e. 20+ years).

The storage facilities included;

1. A fish bin comprising of a fabricated aluminium tank (300kg capacity) for temporarily storing processed shark that was reasonably clean with no apparent smell or bacteria traps,
2. A baffled fibreglass icebox for storing processed scalefish (1,000kg capacity) was clean, in good condition, with no apparent smells or bacteria traps, containing 3 bags (75kg) of freshwater ice (crushed).
3. A moulded plastic icebox (200kg capacity) for storing processed scalefish was clean, in good condition, with no apparent smells or bacteria traps,
4. a below deck, baffled, fibreglass ice box (approx 2,000kg capacity), was one-eighth full with a slightly turbid freshwater ice slurry (0.1 ~ 0.3 degrees C) and 6 bags of freshwater ice (150kg), was clean and in fairly good condition with a slight smell. The below deck icebox had one hatch, two compartments (separated by painted plywood baffles), a central well for draining, and was exclusively for storing processed trunks.

The vessel deck layout comprised a port gunwale mounted roller-feeder to guide the net aboard, a central, aft-deck mounted spool/drum for hauling and shooting the net, a fibreglass icebox forward of the spool/drum, a raised engine hatch centre / midship that doubled as a holding area for shark and scalefish waiting to be processed, a plastic moulded icebox forward of the engine hatch for

[3] Fisheries Western Australia, Sharks, Commercial Fisheries, No. 7, May 1991

storing scalefish, a gutting table (gunwale mounted, starboard side), an aluminium fish bin forward of the gutting table for temporarily storing processed trunks, and a below deck icebox located aft of the wheelhouse for storing trunks.

Given its age, the vessel was of a relatively good standard with equipment and storage facilities to catch and supply high-grade chilled shark and scalefish. The vessel's storage facilities (i.e. iceboxes) appeared adequate for trips of up to four to five day's duration.

Fishing Practices

The skipper and deckhand operated the deck including hauling and clearing the net, processing and storing fish, and setting the net. The skipper operated the vessel and drum-haul speed from a port side-station adjacent to the roller-feeder. The drum/spool was fitted with a pre-feeder that was operated by the skipper to ensure an even distribution of net on the spool. As the net was being hauled, the haul speed was controlled (i.e. stopped, slowed) to allow the skipper to remove fish and debris from the net whilst also ensuring a tangle-free entry onto the spool. The deckhand processed fish almost continuously and occasionally helped remove fish (mostly larger sized fish) from the net as required. Hauling the four nets (approximately 1,300m each) required 340 minutes whilst re-setting the net (5,200m) required 45-50 minutes.

Net hauling ceased intermittently to repair breakages in the surface and lead-weighted lines, and to remove badly tangled shark and scalefish. This invariably meant that some unprocessed fish and shark remained on deck in the elements at temperatures of 20~22 deg.C for 10~15 minutes longer than necessary. Temporary storage in an ice slurry or circulating seawater (e.g. in the plastic moulded icebox, forward of the engine hatch) would help reduce core temperatures and exposure to the elements.

The vessel operates 5200m (~60 units) of gillnet which had been positioned 8~10 miles west of Rottnest Island (i.e. in the vicinity of 32°03'S, 115°14'E) in 40 fathoms during the previous afternoon (i.e. 16 hours prior to hauling). As shark or scalefish neared the surface the haul speed was reduced and fish were eased over the roller-feeder onto the deck. The entangled shark and scalefish were immediately untangled from the net by stretching mesh, removing fins, or severing heads and then transferred to the adjacent engine hatch (doubling as a holding area). Larger sized shark (e.g. >1.5m) were dragged adjacent to the gutting table (forward of the drum/spool) and remained on deck in the elements for 10~15 minutes to await processing.

In setting the net, floats were launched over the stern and the gillnet rolled freely off the drum. The skipper controlled the vessel course and speeds from the wheelhouse while the deckhand controlled the drum-mounted brake and checked for twists and snags in the launching net. The net was positioned for retrieval the following day (approximately 16 hours later). The net soak time was largely determined by the time required to haul and process the days catch and the distance travelled to locate a suitable fishing area.

The fishing practices appeared similar to previous vessel observations. There were no marked differences in fishing practices other than the absence of anchors, and instead the vessel was using lead-weighted ropes and a series of weights to hold the net to the bottom.

Fish Handling Practices - Processing

Around 80% of all landed fish were dead. Approximately 20% of all landed fish were lice affected or damaged (including attacked) from being entangled in the net. All landed fish and shark were accumulated in the holding area to await processing, and were generally processed within 15-25 minutes after retrieval from the net.

After retrieval from the net, smaller shark (0.8m ~ 1.3m) were accumulated in the holding area while larger shark (1.4m ~ 1.8m) remained on deck forward of the scalefish icebox waiting to be processed. Most sharks were dead upon landing. Rather than stunning, the top-side of the head of live shark were severed (laterally) and remained bleeding on deck for up to 25 minutes. Sharks were rarely seen thrashing with no bruising or lacerations observed. Approximately 30% of the landed sharks were in semi-rigour state before processing began.

Live and dead scalefish were retrieved from the net and placed in the holding area for 5-10 minutes before processing and storing in an icebox at -1~2 deg.C. Scalefish were processed as a priority, before processing shark. Live scalefish were spiked (i.e. ikijimi) with a filleting knife, rinsed in seawater, and placed into the icebox almost immediately upon retrieval from the net. Dead scalefish were almost immediately gutted, rinsed under running seawater, and placed into the ice box. The scalefish ice box was generally one-third full of a dense, freshwater ice slurry and was topped up with additional ice at the day's end (i.e. back in the harbour before disembarking).

Processing of shark and scalefish used single blade knives (regularly sharpened) and a standard pressure (50mm) sea water hose that was permanently flowing over the holding area (engine cover). The gunwale-mounted gutting table enabled waste to be discarded overboard.

From observation, the order of processing shark was bleeding (if alive), finning, gutting, beheading, rinsing, storing in the fish bin, re-rinsing, and then stored below deck in a freshwater ice slurry. Shark fins were removed, rinsed and collected in a bucket (for up to three hours, ambient temperatures) before placing into plastic bags, sealing, and storing in the below deck ice box (at -1 ~ 2 deg.C).

Upon commencement of fishing, the aluminium fish bin was one-third filled with fresh seawater. Shark trunks were added throughout the day. There was no regular flushing or draining of the fish bin. The fish bin water was generally turbid, with blood and viscera etc and a temperature of 21~23 deg. C. The addition of freshwater ice would help reduce the temperature; alternatively a drain port would enable a constant flushing of the fish bin.

Processing of large shark (1.5m ~ 1.8m) was undertaken on the open deck exposed to the sun and wind (largely due to the difficulty of handling large fish on a comparatively small gutting table).

Once processed, shark trunks were placed in the fish bin until it became full, approximately four hours after processing began. Processed shark trunks (approximately 300kg) were removed and briefly re-rinsed with a deck hose before placing in the below deck icebox. The re-rinsed, processed trunks were layered into the below-deck icebox before 2 bags (50kg) of freshwater ice were strewn on top.

The scalefish and shark were neither graded, sorted into different species, nor labelled for traceability purposes. Scalefish and trunks were stored separately.

The holding area for unprocessed fish was near-constantly awash from a deck hose. The processing area and equipment (gutting tables, deck, net) were otherwise not routinely rinsed with sea water. There were no scrubbing brushes, detergents, or disinfectants used to clean the gutting tables, knives, deck, icebox or fish bin in between hauling and processing, or after the days' fishing was completed. There were no detergents or disinfectants on board (other than ~150ml of Citra-fresh that was added to the below-deck icebox). A typical 50mm seawater deck hose was used to rinse the net and deck area upon completion of the days fishing, after all fish had been placed into storage.

The gutting table was lined with unpainted, unsealed wood (five ply). Icebox baffles were also made of plywood, although painted. No other wood or permeable surfaces were evident aboard the vessel.

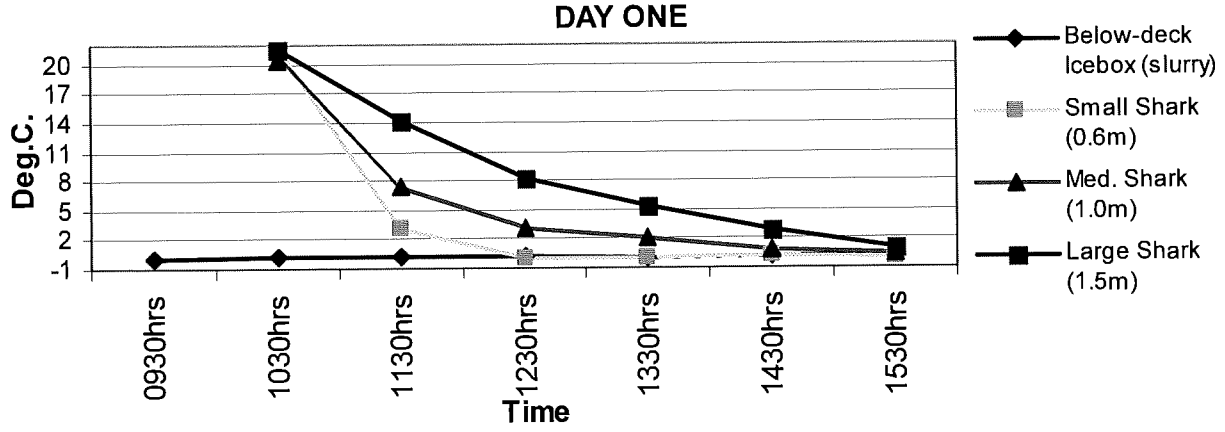
Fish Handling Practices – Storage & Transportation

Eight bags of ice (approximately 200kg crushed ice) were already in ice boxes upon boarding the vessel. The scalefish icebox was approximately one-third full of a dense, freshwater ice slurry with an average temperature of -1.0~2.0 deg.C. There were no anti-bacterial solutions added to the scalefish ice box (e.g. 'PuroFresh' active ingredient 2% chlorine dioxide).

Upon boarding, the below deck icebox was approximately one-eighth full of day-old slurry (slightly turbid, some odour) and contained six bags of freshwater (crushed) ice (approximately 150kg). There were no anti-bacterial solutions added to the below deck icebox (e.g. 'PuroFresh' active ingredient 2% chlorine dioxide) – other than at the end of day one.

Dead and alive shark remained on deck or in the holding area (minor exposure to the elements) for up to 25 minutes before processing. On average, it took between 15-20 minutes for shark to be landed, processed and placed into the fish bin where they remained at a temperature of 20~22 deg. C for up to three hours before being transferred to the below deck icebox at 0~1 deg.C. It took between one and four hours for shark to reach critical temperatures in the below-deck icebox (refer to figure 1 below).

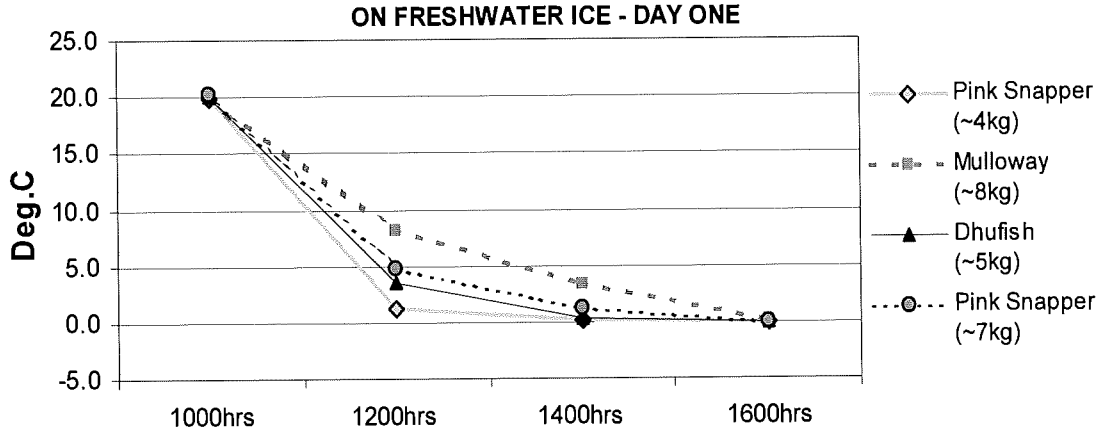
Figure1. BELOW DECK ICE BOX & SHARK CORE TEMPERATURES DAY ONE



Most scalefish placed into the scalefish icebox reached critical temperatures (around 1.0 deg.C) within 45~65 minutes. Larger scalefish had a slower reduction of core temperatures, for example, from 19.8 to 11.2 deg.C after 90 minutes in the icebox and generally required 120~140 minutes to

reach critical temperatures. The temperature of scalefish was otherwise well managed (refer to figure 2 below).

Figure 2. SCALE FISH CORE TEMPERATURES ON FRESHWATER ICE - DAY ONE



Scalefish generally reached critical temperatures within 100~150 minutes after landing on deck. Shark generally reached critical temperatures within 150 ~ 180 minutes after landing on deck. Scalefish and shark generally maintained critical temperatures (i.e. 0~2 deg.C) after being placed in freshwater ice slurries.

Sharks were stored in the below-deck icebox, although not in separate compartments for day 1 and day 2. Scalefish were stored in the deck icebox (first in, last out) with freshwater ice placed between layers of fish. There was no labelling or form of identification for traceability purposes. The three-day catch was combined and later handed to fish merchants upon arrival at the fishing harbour.

Flushing the fish bin regularly throughout the day, and occasionally adding some freshwater ice, would help reduce the core temperature of processed trunks, reducing the time required for shark to reach critical temperatures in the below deck icebox. Adding an anti-bacterial agent to the below-deck icebox would also help to reduce bacteria levels especially over 3~4 day trips.

Plastic crates were used to transfer scalefish and shark ashore. The crates were stored on deck. There was no indication of anti-bacterial solutions or detergents being used to clean the crates. Some of the crates appeared used, worn and partially soiled (i.e. dust, salt, scales, grime). Fish and trunks were transferred from crates into the fish merchants bulk bins – adjacent to the vessel. The balance of fish and trunks were loaded into plastic bulk bins with lids, on the back of a flat bed truck, and transported to a fish merchant. Approximately two 25kg bags of freshwater ice were poured on top of the fish and trunks. All fish and trunks that were unloaded had been pre-chilled to temperatures of 0~3 deg.C.

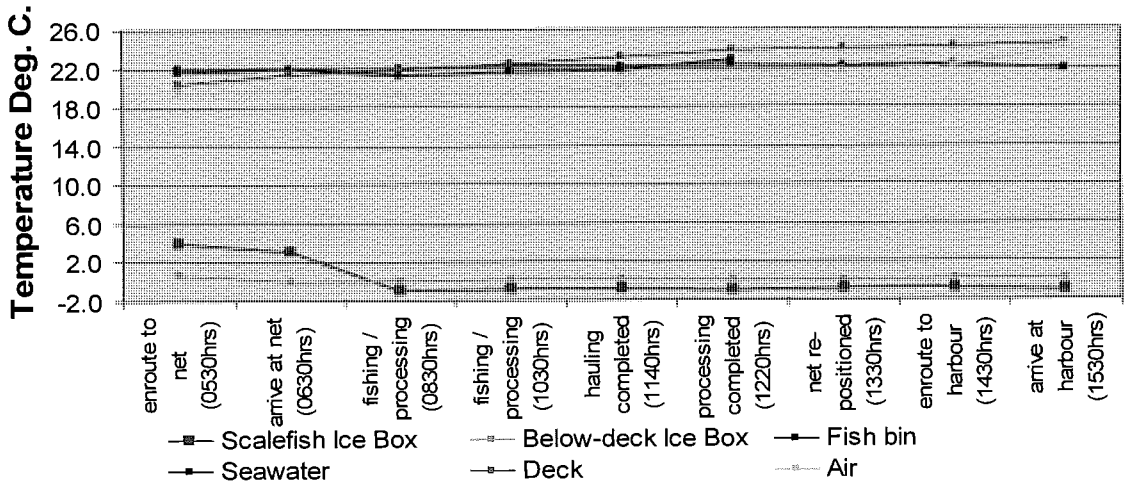
Summary of Sampling & Observations

Conditions on the day of observations were low swell, low seas, light-moderate (NE-SW) winds, nil cloud, and 'friendly' for observing and collecting data.

On the morning of observations two portable probe thermometers were checked in fresh water ice slurries (i.e. recording 0.1~0.2 degrees over 2 minutes). Sea water temperatures were monitored along with air, deck, brine/RSW, fish bin, and icebox/RSW temperatures. Neutralit indicator strips

(pH 5-10) were used to monitor the pH of seawater, brine tank/RSW, fish bin, icebox/RSW, scalefish (gut lining) and shark (surface, head-brachial region and gut lining). A schedule of temperature and pH readings is presented in the following charts and appendix 1.

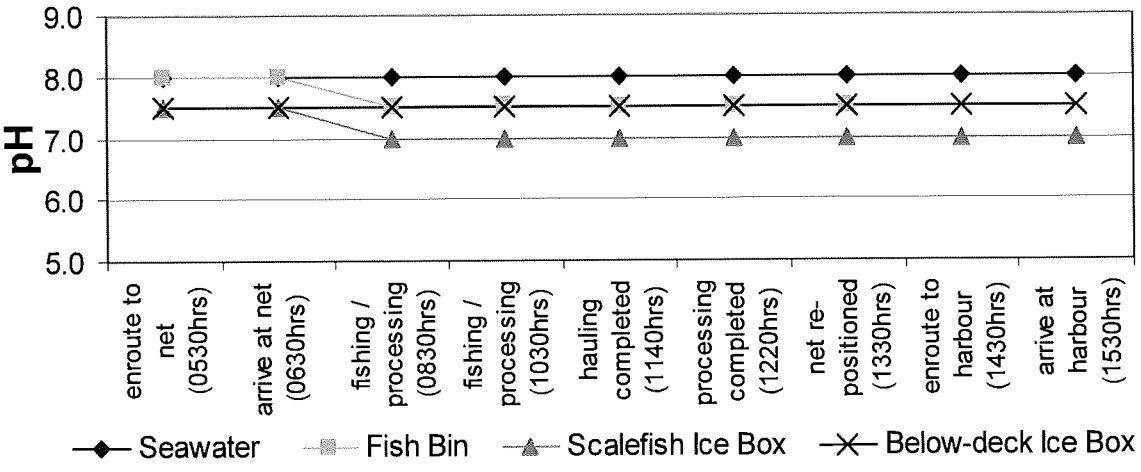
Figure 3. Day One Temperature Readings



On the day of observations, core temperatures of fish arriving on deck ranged from 19.6 to 21.6 deg.C – with seawater temperature averaging 22.0 deg.C. Air temperatures ranged from 19.4C (early morning) to 24.2C (3:30pm at fishing harbour). The deck temperature ranged from 21.5 deg.C to 23.9 deg.C, which was comparatively low compared to other vessels.

The pH ranged from 7.0 in the freshwater ice slurries to 8.0 in seawater. Reductions in pH were observed due to the addition of freshwater ice (pH 7.0) to the ice box, and the introduction of shark trunks to the fish bin (pH 8.0~7.5). The pH readings were similar to those taken from other vessels (refer to figure 4 below).

Figure 4. DAY ONE pH READINGS



The fish bin was three-quarters filled with fresh seawater upon the commencement of processing, and subsequently remained near-full throughout its' entire use. The fish bin was neither self-draining, flushed, nor re-filled during the first three hours of processing. Four hours after processing began the fish bin became full and was subsequently emptied. The fish bin water was

generally a turbid, reddish-brown colour with a pH of 7.5~8.0, and a temperature of around 22 Deg.C. with a considerable amount of viscera in the water.

The scalefish icebox was approximately one-third full with a freshwater ice slurry upon commencement of fishing, and was topped up with additional freshwater ice after 5~6 hours of fishing. The scalefish icebox temperature was maintained at average of around 1.0 deg.C throughout the day. The scalefish icebox pH ranged from 7.0 ~ 7.5. The ice slurry remained a slightly turbid, pale reddish-brown colour, with minimal viscera. Fish were stored in the scalefish icebox for three days in total.

Approximately 25 scalefish and 50 shark were landed on day one, and from observations on day three, an additional 30 scalefish and 80 shark were landed on days two and three.

Processed scalefish were transferred ashore on day three with core temperatures ranging from 2.1 (most recently caught) to –0.2 (caught two-three days ago). Shark trunks were transferred ashore on day three with temperatures ranging from 5.2 deg.C (large shark, most recently caught) to –0.6 (small shark, caught two-three days ago). Fish and shark were removed from the icebox and placed onto the holding area (engine hatch) whilst they were re-packed into merchant tubs and laced with ice. Fish that were landed latest on day three were chilled the least (e.g. maximum core temperature of 5.2 deg.C).

Clean seawater and brine tank / RSW samples were collected before fishing commenced and upon completion of fishing for bacteria analysis on day one. Duplicate swabs were taken from the fish bin, gutting table, brine tank, and ice box before fishing commenced and upon completion of fishing for bacteria analysis. Duplicate fish samples were collected from the head-brachial region of four sharks and a Pink Snapper (control fish) after being processed, to check for bacteria and ammonia. Fish and water samples, and swabs, were kept on ice and delivered on completion of day one to Microserve for analysis.

Changes in bacterial counts during the processing and storage of shark and scalefish were examined. Day one flesh samples recorded *Pseudomonas*, Standard Plate Counts, and Coliforms below recommended levels (i.e. at safe levels), however, these increased significantly in the 60 hours from landing fish on day one to unloading fish on day three. Swabs taken from the gutting table, fish bin and ice box generally recorded *Pseudomonas*, Coliforms, and E. coli less than 10 CFU/g on days one and three, however total microbial counts remained greater than 1,000 on days one and three. Water samples generally recorded below the critical limits for Coliforms and E. coli. However, the below deck ice slurry recorded high heterotrophic plate counts on days one and three and high levels of *Pseudomonas* Species on day one. Findings indicate that moderate to high levels of bacteria were present in the processing and storage environment. The reported bacteria levels could contribute to low-moderate levels of spoilage in shark over 2~3 days and moderate-higher levels of spoilage over 4~5 days.

The results, presented in the appendix, indicate the vessel was operating at low-moderate hygiene / safety levels with widely varying and sometimes high bacteria counts. Findings above the recommended levels – presented on the following page - include;

1. Gummy shark sample, day three, standard plate count 1,100,000 CFU/gm,
2. Pink snapper sample, day three, Coliforms 590~1,400 CFU/gm and *Pseudomonas* species 22,000~62,000 CFU/gm
3. Thickskin shark sample, day three, *Pseudomonas* species 7,300~13,000 CFU/gm
4. Gummy shark sample, day three, *Pseudomonas* species 3,500 CFU/gm and Coliforms 760 CFU/gm
5. Gummy shark sample, day three, *Pseudomonas* species 1,100,000 CFU/gm
6. Swab Analysis pre and post fishing, Total Microbial Count >1,000 CFU/ml, for ice boxes, gutting table and fish bin.
7. Swab analysis, above deck ice box, *Pseudomonas* species >1,000 CFU/ml
8. Water analysis, below-deck icebox, day one, Heterotrophic plate count 28,000~10,000,000 CFU/ml
9. Water Analysis, below deck icebox, day one, *Pseudomonas* species 20,000CFU/ml
10. Water analysis, below-deck icebox, day three, Heterotrophic plate count 610,000~640,000 CFU/ml

Recommended 'safe' levels for bacteria on board shark fishing vessels are;

Standard Plate Count	<1,000,000 CFU/gm (i.e. for shark / fish samples)
Pseudomonas species	<100,000 CFU/ml (i.e. for RSW, ice slurry, seawater)
Pseudomonas species	<1,000 CFU/gm (i.e. for shark & fish samples)
Coliforms & E. coli.	<100 CFU/ml (i.e. for RSW, ice slurry, seawater)
Heterotrophic plate count	<1,000,000 CFU/ml (i.e. for RSW, ice slurry, seawater)
Total Microbial Count	<1,000 CFU/gm (i.e. for swabs)

Note- CFU – Colony Forming Units

Hygiene & Sanitation

The on board hygiene habits were 'fair-poor' with scope for improvement. The deckhand and skipper wore disposable cotton gloves that appeared reasonably clean and in good condition. Both crew wore aprons and rubber boots that appeared to be clean and in good order. Bacteria from handling the net, fish, and by-product were potentially transferred to fish/trunks stored in the iceboxes with no routine washing of hands throughout the days fishing. The crew did not use any antibacterial solvents or detergents for personal use.

There were no pets aboard the vessel. All food was consumed away from the processing area. There was no smoking aboard the vessel. There was no dedicated program for insects, rodents, and birds and no regular checks were carried out. Solvents for use in the engine room and bilge were stored in a forward compartment, below the wheelhouse.

There was no dedicated cleaning program, for example, no solvents or detergents were used for cleaning the deck and equipment. The occasional rinsing of the deck and equipment with fresh seawater during processing was often brief with limited effect. The deck hose was operating at a low-moderate pressure, with potentially low effect on bacteria traps and the like.

Potential Improvements

From observations throughout the day a number of potential improvements were identified that could improve fish quality, shelf life, and the boat's overall hygiene and cleanliness including;

- Washing hands in between hauls and especially prior to handling processed fish and trunks to reduce the potential for bacteria build up.
- Rinsing the equipment and deck more regularly between hauls and during processing, possibly with a higher powered deckhose (i.e. by attaching a nozzle on the deckhose)
- Disinfectants (anti-bacterial solutions) should be used for rinsing equipment and facilities daily, preferably with the aid of a stiff-bristled brush.
- Alkali detergents (preferably antibacterial) should be used for cleaning the deck, equipment, and storage facilities at the completion of each day.
- Fish waiting to be processed could be stored in a bulk bin full of ice slurry, or circulating seawater rather than remaining in the elements on deck for 20~25 minutes.
- Shark trunks in the fish bin could be transferred to the below-deck icebox more frequently rather than remaining in the fish bin for 3~4 hours at 21~22 deg.C.
- Using ice slurry in the fish bin could help reduce core temperatures by 3~4 deg.C over 60~90 minutes, rather than remaining at 21~22 Deg. C for 3~4 hours.
- Dead shark are not bled or processed any quicker than live shark. Dead shark could be processed immediately upon landing and stored in a separate ice slurry immediately after processing – before placement into the below-deck hold.
- Re-rinsing of shark and scalefish was undertaken on deck, in the same location where unprocessed shark had moments before been stored and processed. A more regular and rigorous cleaning program would help.
- Plastic crates are potential bacteria traps unless they are thoroughly and regularly cleaned with antibacterial agents (i.e. disinfected).
- Cleaning of the deck area and equipment was undertaken with a low pressure deck hose, with no detergent, no antibacterial agents, and no brushing / scrubbing.
- The black rubber mats used as liners on gutting tables are potentially bacteria traps. These should be disinfected daily or replaced with less permeable liners.
- There are no formal practices or means to differentiate catches from day 1, 2 3, etc. Placing dividers / baffles between each days catch could suffice.
- Wooden – plywood – baffles used in iceboxes could be resealed (re-painted) to reduce permeability and potential bacteria build-up.

Overall

The boat is producing a moderate standard of fish. There is potential to improve fish quality with some relatively minor changes, particularly in regard to personal hygiene, handling and storage, and wash-downs. The crew worked at a high standard although improvements could be achieved with minor training in bacteria, handling, and temperature control. The layout and design of the vessel provides for a potentially high standard in relation to fish storage, quality, and shelf life.

Points of General Interest

The bacteria found on fish need to be cared for in handling practices. If the temperature surrounding the bacteria's environment can be quickly reduced then growth of most bacteria can be significantly slowed. The larger the drop in temperature, the slower bacteria multiplies. These factors directly impact on the shelf life of fish.

Spoilage in fish is caused by bacteria, enzymes, and chemical action. Bacteria are mostly found in the surface slime, gills, and the gut of living seafood species. Enzymes are abundant in helping to build tissue, contract and relax muscles, and digest food. When seafood species die, enzymes continue to work, digesting or breaking down the flesh, and bacteria invade through the gills, along blood vessels, and directly through the skin and gut cavity lining. These changes are affected by

temperature and for many species decreasing the temperature from five to zero degrees Centigrade halves the rate of spoilage and improves the shelf life.

In the cooler environs of south western Australia fish in ice slurries can reach core temperatures of around 2-4 deg. C within 45~60 minutes. It can be more difficult however for all of a day's catch to achieve critical temperatures (0~1 deg. C.) within 1~2 hours. This is due to the larger quantities of ice that are generally required as well as the regular opening / closing of the ice box and varying ambient temperatures (refer to Table 5 in the appendix, page 13).

Extra salty ice slurries, combination slurries, and powerful brines are the quickest ways to chill fish. Some bacteria can still multiply in low temperatures. Most of these however, are external and can be controlled by good hygiene practices. Brines and slurries should be kept as clean as possible, treated with an anti bacterial agent and fish should be as clean as possible before entering them.

Another quality concern is fish that are left in slurries and brines for too long can exhibit a fading of colours. For example, the gills have a tendency to lose the deep red colour and become light pink. Fish should not stay in slurries or brine for more than 6 hours. If core temperatures lower than 2C *cannot be achieved* within six hours and maintained at these temperatures, the fish should not be sold as first grade.

Scrombotoxin forms as a result of time/temperature abuse of certain fish and is mostly linked to the formation of histamine (i.e. 200 ~ 500ppm). Certain bacteria produce the enzyme histidine decarboxylase during growth. This enzyme reacts with free histidine, a naturally occurring chemical in fish, which results in the formation of histamine. Upon death, the defence mechanisms of fish no longer inhibit bacterial growth, and histamine-forming bacteria start to grow, producing histamine. With harvesting practices such as long lining and gill nets, death can occur well before the fish is removed from the water. The potential for histamine formation is further increased when the flesh of fish is exposed to the enzyme-forming bacteria during processing (e.g. eviscerating, beheading, filleting / dressing). Histamine development is more likely in raw, unfrozen fish.

Rapid chilling of fish immediately after death is important in preventing the formation of scrombrotoxin. For example, fish with temperatures below 28 deg. C should be placed in refrigerated seawater or chilled brine (<10 deg.C) within nine hours of death – or placed in ice within twelve hours of death. This will prevent the rapid formation of the enzyme histidine decarboxylase – the precursor to scrombrotoxin / histamine.

Spoilage of shark is often caused by the formation of ammonia in the flesh. Ammonia is often formed in animal tissues (flesh) due to the breakdown of nucleic bases, proteins, amino acids, amines and the build-up of bacteria. However, the high urea content of shark (2% by weight) is a unique and contributing factor in ammoniation. As shark ages in ice there is a significant increase in urease-producing bacteria, causing urea to be converted into carbon dioxide and ammonia. As the urea is hydrolysed and ammonia is produced the level of urease-producing bacteria gradually decreases (i.e. there is a peak then it declines). It is expected that 'good' quality shark with a pH of 6 will become ammoniated after 10-12 days on ice, compared to 'average' shark with a pH of 7-8 becoming ammoniated after 4-6 days on ice. Freezing does not stop the ammoniation process and subsequently fish quality prior to freezing determines the quality after it is defrosted / thawed.

Shark that have lost considerable blood due to lice or being attacked while in the net often have low pH (6-6.5), opaque flesh and in semi-rigour upon landing. The effect this has on ammoniation is

unclear although larger shark would be expected to maintain higher levels of ammoniation. Similarly, shark that has died whilst in the net, sometimes up to 12 hours before processing, is expected to have higher bacteria levels (including urease-producing bacteria) contributing to a higher rate of ammoniation and a potentially shorter shelf life. Rapid chilling of dead shark would help to reduce the onset and rate of ammoniation.

Appendix

Temperature and pH readings from Day One (on-board observations).

Table 1. DAY ONE TEMPERATURE READINGS (deg.C.)

Time	Stage of Trip	Air	Deck	Seawater	Fish bin	Scalefish Ice Box	Below-deck Ice Box
5:30	enroute to net (0530hrs)	19.5	20.4	21.6	22.0	4.0	0.8
6:30	arrive at net (0630hrs)	19.7	21.5	22.0	22.0	3.1	0.1
8:30	fishing / processing (0830hrs)	19.4	21.8	22.0	21.3	-1.0	0.1
10:30	fishing / processing (1030hrs)	19.4	22.4	22.3	21.6	-0.8	0.2
11:40	hauling completed (1140hrs)	20.3	23.1	22.1	21.7	-0.8	0.2
12:20	processing completed (1220hrs)	20.8	23.8	22.3	22.8	-0.9	0.2
13:30	net re-positioned (1330hrs)	21.6	23.9	22.1		-0.8	0.1
14:30	enroute to harbour (1430hrs)	22.1	24.1	22.2		-0.8	0.2
15:30	arrive at harbour (1530hrs)	24.2	24.4	21.8		-0.9	0.2

Table 2. DAY ONE pH READINGS

Time	Stage of Trip	Seawater	Fish Bin	Scalefish Ice Box	Below-deck Ice Box
5:30	enroute to net (0530hrs)	8.0	8.0	7.5	7.5
6:30	arrive at net (0630hrs)	8.0	8.0	7.5	7.5
8:30	fishing / processing (0830hrs)	8.0	7.5	7.0	7.5
10:30	fishing / processing (1030hrs)	8.0	7.5	7.0	7.5
11:40	hauling completed (1140hrs)	8.0	7.5	7.0	7.5
12:20	processing completed (1220hrs)	8.0	7.5	7.0	7.5
13:30	net re-positioned (1330hrs)	8.0	7.5	7.0	7.5
14:30	enroute to harbour (1430hrs)	8.0		7.0	7.5
15:30	arrive at harbour (1530hrs)	8.0		7.0	7.5

Note, there are no temperature and pH readings for Day Three. There was no on-board observation and hence no data to report.

Fish & Shark Core Temperatures – On Ice – Day One.

DAY ONE: BELOW DECK ICE BOX & SHARK CORE TEMPERATURES - Degrees C.

TIME	0930hrs	1030hrs	1130hrs	1230hrs	1330hrs	1430hrs	1530hrs
Below-deck Icebox	0.1	0.2	0.2	0.2	0.1	0.2	0.2
Small Shark (0.6m)		21.2	3.2	0.1	0.1	0.2	0.1
Med. Shark (1.0m)		20.4	7.4	3.2	2.1	0.9	0.4
Large Shark (1.5m)		21.6	14.1	8.3	5.4	3.0	1.1

SCALEFISH CORE TEMPERATURES IN ICEBOX (FW ICE SLURRY) - DAY ONE

	1000hrs	1200hrs	1400hrs	1600hrs
Scalefish Icebox	-0.8	-0.9	-0.8	-0.9
Pink Snapper (~4kg)	19.8	1.2	0.2	-0.1
Dhufish (~5kg)	20.1	3.6	0.3	-0.1
Pink Snapper (~7kg)	20.2	4.7	1.2	-0.1
Mulloway (~8kg)	19.9	8.2	3.4	0.1

Appendix

Note, the following observations are part of a broader study to determine if certain shark species, size, sex, and condition at landing influence pH levels and the potential for ammoniation. The results may help in determining which species of shark can be expected to offer higher quality flesh for consumer markets.

Table 3. SHARK OBSERVATIONS TAKEN ON-BOARD VESSEL #3 6/Feb/01

Species	Size (m)	Sex	Condition at landing	Core Temp. at landing(deg.C)	Surface pH	Gut pH
Thickskin	0.8	Female	alive	20.7	7.0	7.0
Blacktip	1.4	Male	dead	19.6	7.0	7.0
Thickskin	0.9	Female	alive	20.1	7.0	6.5
Thickskin	1.1	Female	dead	19.8	7.0	7.0
Thickskin	1.3	Female	dead*	19.6	7.0	7.0
Gummy	1.2	Female	dead*	20.4	7.0	6.0
Thickskin	0.9	Male	dead	20.1	7.0	6.5
Gummy	0.8	Female	alive	20.3	7.0	6.0
Thickskin	1.1	Female	dead*	19.8	7.0	6.0
Thickskin	0.8	Female	dead*	19.9	7.0	6.0
Blacktip	1.2	Male	alive	20.2	7.5	7.0
Thickskin	1.1	Female	alive	20.3	7.5	6.5
Thickskin	1.3	Female	dead	20.4	7.0	6.5
Average	**1.1**			**20.1**	**7.1**	**6.5**
Range	**0.6**		*lice affected	**1.1**	**0.5**	**1.5**

Appendix

Results of Fish Sample Analysis – Day One (6/Feb/01)

Date Collected: 6/2/01 **Date Received: 6/2/01** **Date Tested: 7/2/01** **Vessel: Vessel #3** **Location: Fremantle**

Lab No.	Sample Details	Sample No.	Standard Plate Count CFU/g	Coliforms CFU/g	*E. coli* MPN/g	*Pseudomonas* species CFU/g
0102061F	0.8m Thick skin - Female 0700hrs 6/Feb/01 (alive)	1	43 000	<10	< 3	<100
0102062F	0.8m Thick skin - Female 0700hrs 6/Feb/01 (alive)	2	29 000	<10	<3	<100
0102063F	1.2m Gummy Shark - Female 0735hrs 6/Feb/01 (dead)	3	25 000	<10	<3	<100
0102064F	1.2m Gummy Shark - Female 0735hrs 6/Feb/01 (dead)	4	10 000	<10	<3	<100
0102065F	0.8m Thick skin - Female 0900hrs 6/Feb/01 (dead)	5	2 800	<10	<3	<100
0102066F	0.8m Thick skin - Female 0900hrs 6/Feb/01 (dead)	6	4 300	<10	<3	<100
0102067F	1.1m Thick skin - Female 0940hrs 6/Feb/01 (alive)	7	7 400	<10	<3	<100
0102068F	1.1m Thick skin - Female 0940hrs 6/Feb/01 (alive)	8	3 000	<10	<3	<100
	RECOMENDED LEVELS		**<1,000,000**	**<100**	**<100**	**<1,000**

Laboratory Comments: The test results relate specifically to the samples as received in the laboratory.
CFU = Colony forming units MPN = Most probable number, < denotes less than, > denotes greater than.

Appendix

Results of Fish Sample Analysis – Day Three (8/Feb/01)

Date Collected: 8/2/01	**Date Received: 8/2/01**		**Date Tested: 9/2/01**	**Vessel: Vessel #3**	**Location: Fremantle**	
Lab No.	**Sample Details**	**Sample No.**	**Standard Plate Count CFU/g**	**Coliforms CFU/g**	***E. coli* MPN/g**	***Pseudomonas* species CFU/g**
0102263F	Pink Snapper 1800hrs 8/Feb/01	1	30 000	590	<3	22 000
0102264F	Pink Snapper 1800hrs 8/Feb/01	2	110 000	1 400	<3	62 000
0102265F	0.8m Thickskin – Female alive 1800hrs 8/Feb/01	3	49 000	30	<3	7 300
0102266F	0.8m Thickskin - Female alive 1800hrs 8/Feb/01	4	170 000	110	<3	13 000
0102275F	1.2m Gummy - Female dead 1800hrs 8/Feb/01	13	26 000	760	<3	3 500
0102276F	1.2m Gummy - Female dead 1800hrs 8/Feb/01	14	130 000	50	<3	<100
0102267F	0.8m Thickskin – Female dead 1800hrs 8/Feb/01	5	77 000	<10	<3	<100
0102268F	0.8m Thickskin - Female dead 1800hrs 8/Feb/01	6	81 000	20	<3	1 800
0102271F	1.1m Thickskin - Female alive 1800hrs 8/Feb/01	9	26 000	<10	<3	300
0102272F	1.1m Thickskin - Female alive 1800hrs 8/Feb/01	10	43 000	10	<3	700
0102269F	0.9m Thickskin - Male 1800hrs 8/Feb/01	7	140 000	<10	<3	<100
0102270F	0.9m Thickskin - Male 1800hrs 8/Feb/01	8	200 000	<10	<3	<100
0102273F	0.75m Gummy - Male 1800hrs 8/Feb/01	11	720 000	<10	<3	<100
0102274F	0.75m Gummy - Male 1800hrs 8/Feb/01	12	1 100 000	<10	<3	<100
	RECOMENDED LEVELS		**<1,000,000**	**<100**	**<100**	**<1,000**

Appendix

Results of Swab Analysis – Day 1 (6/Feb/01) & Day 3 (6/Feb/01)

Date Collected 6 & 8/2/01 **Date Received 6 & 8/2/01** **Date Tested 7 & 9/2/01** **Vessel: Vessel #3** **Location: Fremantle**					
Site	**Swab No**	**Total Microbial Count**	**Coliforms**	***E. coli***	***Pseudomonas* species**
Pre-fishing – 6/Feb/01:					
Gutting table 0530hrs	1	340	< 10	< 10	< 10
Gutting table 0530hrs	2	>1 000	<10	<10	<10
Fish bin 0530hrs	3	>1 000	<10	<10	<10
Fish bin 0530hrs	4	10	<10	<10	<10
Above Deck Ice box 0530hrs	5	>1 000	<10	<10	73
Above Deck Ice box 0530hrs	6	>1 000	<10	<10	>1 000
Below Deck Ice box 0530hrs	7	>1 000	<10	<10	<10
Below Deck Ice box 0530hrs	8	>1 000	<10	<10	<10
Post Fishing – 8/Feb/01					
Gut table 1800hrs	1	>1 000	<10	<10	<10
Gut table 1800hrs	2	>1 000	<10	<10	<10
Fish bin 1800hrs	3	>1 000	<10	<10	<10
Fish bin 1800hrs	4	>1 000	<10	<10	<10
Above Deck ice box 1800hrs	5	>1 000	<10	<10	<10
Above Deck ice box 1800hrs	6	>1 000	<10	<10	<10
Below Deck ice box 1800hrs	7	570	<10	<10	<10
Below Deck ice box 1800hrs	8	>1 000	<10	<10	<10
RECOMMENDED LEVEL		**<1,000**	**<100**	**<100**	**<1,000**

Appendix

Results of Water Sample Analysis – Day One (6/Feb/01) and Day Three (8/Feb/01)

Date Collected 6 & 8/2/01 Date Received 6 & 8/2/01 Date Tested 7 & 9/2/01 Vessel: Vessel #3 Location: Fremantle

-Source	Sea water	Below Deck Icebox	Below Deck Icebox	**Above** Deck Ice Box	Below Deck Ice Box	Below Deck Ice Box
-Site	At sea, fishing 0630hrs 6/Feb/01 Day One	Pre fishing 0630hrs 6/Feb/01 Day One	Pre fishing 0630hrs 6/Feb/01 Day One	Post fishing 1800hrs 8/Feb/01 Day Three	Post fishing 1800hrs 8/Feb/01 Day Three	Post fishing 1800hrs 8/Feb/01 Day Three
-Appearance	Clear; colourless	Slightly turbid; pale straw colour; debris	Slightly turbid; pale straw colour; debris	Turbid; pale straw coloured; debris	Slightly turbid; red/brown coloured; debris	Slightly turbid; red/brown coloured; debris

TEST	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RECOMMENDED**
Heterotrophic Plate Count							**LEVEL**
at 21^{0}C CFU per mL	<100	>10 000 000	28 000	410 000	610 000	640 000	**<1,000**
Coliforms CFU per 100mL	0	2	0	2	<10*	<10*	0
Thermotolerant Coliforms CFU per 100mL	0	2	0	2	<10	<10	0
E. coli CFU per 100mL	0	2	0	2	<10	<10	0
Pseudomonas species CFU per 100mL	<10	<10	20 000	<10	<10	<10	<1,000

APPENDIX IV

Shark Industry Code of Practice

CHECKLIST OF PRACTICES

PRACTICE COMPONENT	PRACTICED	CURRENT STATUS	ACTION REQUIRED
Fishing			
The fishing gear is always kept in the water for the minimum possible time.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
All the fishing gear is thoroughly cleaned once fishing has ceased.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Processing			
Sharks unsuitable for human consumption or otherwise are immediately returned to the water.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Landed shark is neither piled high, trampled, or exposed to the wind, spray, or sun.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Dead shark are immediately bled, headed, gutted, dressed, rinsed in acetic acid & chilled.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Sharks are immediately stunned or killed upon landing, to avoid thrashing / struggling on deck.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Bleeding – by severing the lower caudal (tail) fin or beheading – is carried out immediately upon landing.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Shark is headed & gutted after bleeding, then washed in seawater and laid belly-down on ice.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Shark is placed in a circulated tank or refrigerated seawater if unable to be processed immediately.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Shark is in-rigor before filleting or freezing, or they are chilled & monitored until rigor sets in.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Fins are removed at the earliest opportunity, sorted, and either stored in refrigerated seawater or frozen.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Processed trunks or fillets are stored in refrigerated seawater (-1deg.C) for 12 hours then frozen.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	

PRACTICE COMPONENT	PRACTICED	CURRENT STATUS	ACTION REQUIRED
Storage Facilities			
Holding wells/ tanks have baffles/dividers, adequate circulation, central drainage, and are easily cleaned.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Refrigerated sea water or brine for chilling / stowing fresh shark is maintained at –1 deg.C (30 deg.F).	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Chill / cold storage facilities are of sound construction, well insulated, and in good working order.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Brine refrigeration systems are made of or coated with corrosion-resistant material & easily cleaned.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Processing utensils & equipment are in good order, maintained well, and cleaned after each cycle of use	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Hygiene & Sanitation			
Deck hoses supply clean seawater at pressure from intakes opposite & for'ard of all other discharging.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
All surfaces are impervious, smooth, and easily cleanable.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Ice is supplied fresh daily or made daily on-board from potable water or clean seawater.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Poisonous & harmful materials are labelled and stored in a separate compartment.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
Processing & cleaning equipment is thoroughly cleaned and disinfected after each cycle of use.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	
There are deck areas used exclusively for shark handling & processing purposes only.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY☐ GOOD☐	

Shark Industry Code of Practice

CHECKLIST OF BEST PRACTICES

PRACTICE COMPONENT	PRACTICED	CURRENT STATUS	ACTION REQUIRED
Hygiene & Sanitation			
Before any shark is landed, and between each haul, all decks & equipment are thoroughly cleaned.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
Measures are in place to protect the vessel from insects, rodents, birds, and vermin.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
Dogs, cats, and birds are excluded from shark processing and handling areas.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
Deck & all equipment is cleaned & disinfected in alkaline-detergent solution, & rinsed after unloading.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
Other			
A system exists for automatically introducing chlorine into seawater used for processing and cleaning.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
A stowage plan is used when trips of more than a day or two are undertaken.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
There is a sanitary control program, involving all crew with assigned tasks, for cleaning & disinfecting.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
Hand brushes are cleaned & disinfected in 50ppm-chlorine solution after each use, then dried & stored.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
Scouring pads or high pressure spraying equipment is used for cleaning, but never steel wool.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
Baskets are not used for storing & transferring shark trunks, due to the difficulty of cleaning & disinfecting.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
Poor quality (ammoniated) shark is stored separately from higher quality shark.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
Holding wells and butchering areas are cleaned and disinfected regularly during processing cycles.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	
Where bait is used, it is stored on ice or chilled separate to the catch, in easily cleaned facilities.	YES☐ NO☐ N/A☐	POOR☐ SATISFACTORY ☐ GOOD☐	

Based on FAO 1991 Draft Code of Practice for the Full Utilisation of Sharks, FAO Fish. Circular No. 844.

APPENDIX V

SHARK INDUSTRY - CODE OF PRACTICE PROJECT
DATA RECORDING SHEET

DATE		BOAT		SET / DRIFT	
ETD/ETA LAND		LOCATION		WIND	
ETA/ETD FISHERY		DEPTH		CLOUD	
AT SEA		PROCESSING	PROCESSING		AT SEA
TEMP. - AIR					
TEMP. - SEA					
TEMP. - SHARK					
TEMP. - DECK					
WATER SAMPLES x 2	AT SEA x 1	DURING PROCESSING x 1			
pH - seawater					

CHECKLIST **SWABS - 12** **TOTAL**	COMMENCEMENT OF FISHING - 2 EACH FROM	COMPLETION OF FISHING - 2 EACH FROM
NET **DECK ?????**		
GUTTING TABLE		
FISH BIN & **ICE BOX????**		
WATER SAMPLES x 2 SEA WATER		

SHARK SAMPLES **HEAD-TRUNK - 32 TOTAL**	AT PROCESSING x 2 (AFTER DEHEADING)			AT LANDING x 2 (DURING UNLOADING)		
	for ammonia	for bacteria		for ammonia	for bacteria	
BRONZE WHALER						
BLACKTIP						
WHISKERY						
GUMMY						
CONTROL FISH (WHITE FLESH)						
2 SAMPLES FOR AMMONIA PLUS 2 SAMPLES FOR BACTERIA FROM EACH OF FOUR FISH. TOTAL 32.						
FISHING TECHNIQUES						
METHOD OF RETRIEVAL FROM NET						
PROCEDURES & TIME TAKEN TO CLEAR NET						

PROCESSING TECHNIQUES & EQUIPMENT USED & TIME TAKEN
PROCESS - QUALITY CONTROL
HYGIENE & SAFETY PRACTICES

SURFACE pH OF FISH SEX SIZE pH	SEX	SIZE	pH	SEX	SIZE	pH

APPENDIX VI

ICE RECKONER

The amount of ice needed to cool fish depends on:

1. Weight of fish to be chilled
2. The temperature reduction required
3. The specific heat of fish (eg 3.6 x 1000 j/kg deg. C) 3.6
4. The latent heat of ice 335

The "Ice Reckoner" table provides a general guide to the amount of freshwater ice required to chill an amount of fish in an ice slurry given the respective sea temperature (which is assumed to be very similar to the core temperature of fish).

For example, you estimate 600kg of fish will be landed, from a sea temperature of 20 Deg.C. You require 129kg of freshwater ice to chill the anticipated catch (i.e. 0-1Deg.C in 1-2 hours). Additional ice might be required to keep the fish at 0~1 Deg.C. depending on the length of fishing trip.

Table 5. RECOMMENDED ICE USAGE RATES FOR ICE SLURRY TANKS

		SEA TEMPERATURE (Deg.C)							
		12	**14**	**16**	**18**	**20**	**22**	**24**	**26**
FISH LANDINGS Kg	**100**	13	15	17	19	21	24	26	28
	200	26	30	34	39	43	47	52	56
	300	39	45	52	58	64	71	77	84
	400	52	60	69	77	86	95	103	112
	500	64	75	86	97	107	118	129	140
	600	77	90	103	116	129	142	155	168
	700	90	105	120	135	150	165	181	196
	800	103	120	138	155	172	189	206	224
	900	116	135	155	174	193	213	232	251
	1000	129	150	172	193	215	236	258	279
	1100	142	165	189	213	236	260	284	307
	1200	155	181	206	232	258	284	309	335
	1300	168	196	224	251	279	307	335	363
	1400	181	211	241	271	301	331	361	391
	1500	193	226	258	290	322	355	387	419
	1600	206	241	275	309	344	378	413	447
	1700	219	256	292	329	365	402	438	475
	1800	232	271	309	348	387	426	464	503
	1900	245	286	327	368	408	449	490	531
	2000	258	301	344	387	430	473	516	559

APPENDIX VII

Southern Demersal Longline and Gillnet Meetings

Post Harvest Shark Code of Practice

Tuesday December 3, Bay of Isles Motel, Esperance

Present

Lee Warner	Ph. 907 13531
Richard Warner	Ph. 907 17640
Grant Martin	Ph. 907 16016
Ben Martin	Ph. 907 16016
Paul Retsas	Ph. 907 15693

- Grey Nurse out of target species
- Maximise Pictures
- Temperature Range too narrow, extend to –1°C to 4 °C
- Ask the question "Would You Eat This?"
- Soak Times max. 8 hrs
- NW Shark different, Recommended contact with Ray Davies (Up Top Fisheries) or Peter Nicholls (CSIRO)
- Traceability an issue. Whole catch in same brine all likely to be contaminated if part of load has been.
- Catch kept chilled until SA where processed and frozen and transported for sale in Victoria.
- Finning procedure is immediate chilling necessary. Some boats dry fins.
- Process is nets emptied into slop tubs where bled > processed> into rinse tub > brine.
- Chilling some use same water, some change water from spare tank set up. Discussed anti bacterial agent "PuroFresh".
- 95% non-target species returned live.
- No pound boards used.
- Doubt value of scombroid inclusion.

Wednesday December 4, Esplanade Hotel Albany.

Bryan Sell	Ph 98416142
Graeme Sell	Ph. 9841 6142
Gary Colville	Ph. 9842 5305
Greg Sharp	Ph. 9844 8159

- Traceability issue. Same RSW. Tagging difficult to identify.
- RSW water temp on board one boat –4°C to –6°C. Quantity of catch demands this temperature for chilling capacity.
- Question raised as to what impact this COP will have on end of supply chain. i.e. Restaurants / chefs, as training is needed.
- 12 hr shot time max for some. 20 hr soak for 1 other. Some fishers critical of damaged product being a waste.

- Sanitiser being used Jasol "Multi-zyme" Eco-Zyme for Northern Waters. Comment that it works 'really well"
- Anecdotally one operator prefers fish directly into slurry, rather than Ikijimi and slurry.
- Concerns with date marking that if 3 day trip who wants first days catch
- Comment that price premium for fish at auction from fisher with reputation for "quality".
- Comment on bringing in legal size for Wobbegong
- Do not routinely have a thermometer on board.
- Poundboards not used, however another Albany operator does use.
- WA Quality Finfish Guide. On checklist include days at sea. One operator was requesting this type of document before produced. Recommended a checklist in COP.
- Most boats same flow as Esperance. 1 small (21ft) boat, pulls by hand, fish out of net into slurry, process at home, said 3-4 similar operators.
- Question on whether any research has been done on what types of seafood make people sick? Commitment that question would be raised at FSANZ seminar December 6.

December 4 , Vasse River Resort, Busselton.

Nick Soulos
Brian Scimone
Jeff Cooke
Peter Warrilow
Allan Hadley
Jim Robb

- Mostly Day boats, 18 hour soak time considered appropriate.
- Traceability a problem for these operators, all in same RSW.
- 99% of non-target species returned live.
- 12 – 15% scalefish catch, depends on seasons, times area.
- Request for information on types of effective sanitisers. Related brands that had been discussed by other fishers.
- Not all boats carry a probe thermometer.
- Agreed with the majority of issues raised at other port meetings in Albany and Esperance.

APPENDIX VIII

WA DEMERSAL GILLNET FISHERY TRAINING REPORT

ALBANY MEETING
30 MARCH 2004

Attendance;
Geoff Campbell, Alistair Mason, Mark Bull, Ryan Graeme, Phil Dyer

The presentation was delivered in an open forum concept, allowing the participant to comment on the different stage as we progressed through. I established market trends of were their products settled, the general trend was to the smaller operator i.e. Fish mongers fish & chippers and some local restaurants. Larger volume made there way across the boarders to Victoria and occasionally to Canning Vale markets.

Part of my delivery highlighted how March 2003 started changes for access into the European market. The response was, "considering we don't export to Europe why are we bothering". This was a common theme that constantly erupted throughout the balance of the meeting. The, "We're not going to bother unless they bother". The "They are the smaller retailers" and so on. "We've even been to the fish markets and seen our fish being spilled on the floor collectively with other boats catch".

The fishery works from refrigerated brines, bagged ice supply, no ice machines on board. This is a difference to the longliners, I think it's still worth keeping this information in the COP & handbook. "We don't need to take core temps. Because we know they are cold".

The group indicated that they have had hold of the Codes for so long that they been working with them, and understood the benefit of quality. They are having hard time accepting the concept of having to record information on a regular basis. Once again "Why should we bother if they don't, anyhow we've never killed anyone". Suggestion was to include the daily chiller Temp. as a check box question instead of the chart.

Traceability proved a stumbling block in the sense of "we have too many fish to handle and we'd rather do it on a total trip basis indicating the block location were they where caught".

As for positives, we hit an accord in relation to Sanitisers.
"What's available apart from chlorine?" They were given 3 company names and asked to do their own research in regards to cost efficiency. It was requested that we continue to survey the Food Safety aspects. "But we won't use it if it's too expensive" or this one "Yeah I used it all the time, but I didn't get paid any extra for my fish, so I stopped, and I'm still getting the same money".

Tough bunch to convert, but they are not ignorant of the requirements for Food Safety. They'll come around in time.

BUSSELLTON
31 MARCH 2004

Attendance
Terry Adams, Nick Soulas, Jeff Cook

This was a full house, thankfully Janet Howieson was with us, later Felicity from WAFIC joined us. Great location just low numbers. Nevertheless it proved to be the most successful visit (my opinion) Terry & Nick the thrust of conversation and occasionally Jeff would throw his 5½ worth in. Well aware of the benefit of the COP but as per Albany very critical of the other end. Jeff probably considered documentation to be a great impost on his operation, the other reluctant.

Cold chain controls seemed to be in action, using Seawater Ice / RSW and packing in ice. Can the state health authorities tell us what the residual content of some of these anti-bacterial agents?
Nick sourced a product himself through the Water corp. Monoperoxide, lithium based, he vouches it adds at least 12 hours to his catch, and reduces pH.

Terry asked, can the ammonia problems be dealt with safely, compared to the imported product from Vietnam there must be some product that can expel it. Otherwise Australia would not import in.

We learnt that the Bunbury Shire Health inspectors actually visit the fishermen's premises assessing the hygiene status of the tubs etc. and occasionally been known to be onboard the vessels. We should highlight this very rare occurrence and commend this Shire for it regard to our industry.

Date coding for traceability once again proved a big issue, the only suggestion was a food stamp like the meat industry marking the carcasses. Basically, there are too many fish to tag. Another suggestion was to tell the buyer that the quality of all the fish should be caged from the first days catch. This location is also still fishing to transportation availability up to Perth.

Sun drying equipment was discussed and it was suggested that it would be safer to sanitise then place in chiller until required for use. This would avoid any airborne contamination and pre-chill some equipment ready for use.
Throughout the session but not as regular as Albany, the buyers' ability for correct handling procedures was being questioned.

Nick presented the suggestion of product liability insurance, and touted the thought it probably was not widely know about. He added it was relatively cheap for the cover offered.

Encouraging group, unfortunately small.

FREMANTLE.
1 ST. APRIL 2004

Attendance
Geoff Diver, Terry Gorman, Daniel Deng, Norman Deng

Judging by the date maybe the industry thought it was an "April fool's joke". The only challenge here was Terry, but he was only kicking tyres. He is considering activating his licence so could not impart how the COP would benefit his operation.

Geoff was taking note to refer back to the interested parties, and once again little input. And the Deng's are only interested in the fins.

Unfortunate waste of time and expense, I suppose these happen. Overall this task is going to be fairly fruitless until the authorities sink their teeth in. But in the mean time we can continue to pepper away at suggestions and by final implementation we may have it right for them.

Thank you and regards,

Ralph Minervini