

This report may not be cited without reference to the authors

CSIRO Division of Fisheries

Cruise report: FRV Southern Surveyor SS 1/91

Cruise title: Exploratory fishing survey of the Western Deepwater Trawl Fishery

**Staff**

T. Koslow (Cruise leader)  
A. Williams (Assistant cruise leader)  
P. Last  
C. Bulman  
R. Kloser  
C. Stanley  
M. Sherlock  
C. Liron  
G. Johnson (Leg I)  
D. Evans (Leg II)  
S. Rainer (Leg I)  
S. Braine (Leg II)  
V. Wadley (Leg I)  
P. Jernakoff (Leg II)  
J. Paxton (Australian Museum) (Leg I)  
M. Gomon (Victorian Museum) (Leg II)

CSIRO  
MARINE LABORATORIES

14 OCT 1992

LIBRARY, HOBART

**Duration**

**Leg I:** Departed Port Hedland on Monday 21 January 1991 at 2245 hr. Docked at Geraldton on Monday 4 February 1991 at 1500 hr.

**Leg II:** Departed Geraldton on Tuesday 5 February 1991 at 1330 hr. Docked at Albany on Tuesday 19 February at 1700 hr.

**Location**

The survey covered the area known as the Western Deep-water Trawl Fishery (WDWTF) off the west coast of Western Australia (Attachment 1). This is a developmental fishery which is bounded in the north by the 114° E meridian (North West Cape), in the south by the 115°08' E meridian (Cape Leeuwin) and by the 200 m isobath and the AFZ boundary. The Southern Surveyor entered the fishery at the latitude of the first fishing station on the Exmouth Plateau (lat. 20°20' S) and left the fishery at approximately latitude 35°06' S. The survey was carried out primarily through 16 zig-zag transects, each of

which spanned ~50 nautical miles of latitude and extended from the 200 to 1400 m isobaths.

### **Relationship to ongoing research**

This cruise supported the 'Fisheries Resources of the West and North West Slope' research program currently being undertaken by the CSIRO Division of Fisheries in Western Australia.

### **Cruise objectives**

- 1) Identify the distributions of potentially commercial stocks of fish in the Western Deep-water Trawl Fishery by latitude and depth.
- 2) Map the distribution of fishing grounds.
- 3) Provide information on catch rates, abundance and catch composition of dominant fish species in relation to depth and locality.
- 4) Provide a description of the Western Australian slope fish community.
- 5) Obtain taxonomic specimens and photographic records of slope fish species.
- 6) Record the distribution of squid and crustacean species by latitude and depth, and to collect specimens.

### **Gear details**

The fishing gear used throughout the survey was a combination of 'Polyvalent' trawl doors and a 'High-rise' Engel trawl fitted with heavy ground gear and a 40 mm cod-end liner. Scanmar transducers permitted the monitoring of net geometry and trawl door spread for all trawls made in <1200 m. In deeper water a Furuno FNR 700 net recorder was used to monitor headline height and no trawl door transducers were used. The echo sounders used during the survey were a Furuno FE 881 50KHz, a Simrad EK 500 with 38KHz transceiver and Simrad EK 400 with 12KHz, 50 KHz and 120 KHz transceivers. A Photosea 2000 stereo camera was used for underwater photographic surveying.

### **Narrative - Leg 1**

On leaving Port Hedland, there was a 28 hr steam to the first exploratory fishing area, the Exmouth Plateau, a large off-shore platform between 20° and 21° S latitude in 800-1000 m depth

(Attachment 21. As no fishing records and very little bathymetric data were available for the Plateau region it was decided to search the highest area of the Plateau first and then move in a south-easterly direction towards the coast and the start of the first transect. We were unable to locate a ridge and hill feature shown on our charts near the Plateau's centre and found only an undulating, featureless bottom. No evidence of fish concentrations were detected by the sounders or in 2 trawls made in this central area between 854 m and 914 m. On January 23rd we proceeded in a south-easterly direction and completed 2 further exploratory trawl shots in 1022-1123 m. We passed over several deep bottom features (including a canyon and ridge feature south of the Montebellow Trough), but no significant acoustic fish marks were encountered until we reached the upper slope (200-300 m) whilst approaching the beginning of the first survey transect station at 21° 45' S lat in 200 m depth.

The remaining 11 days of the first leg of the cruise were devoted to a systematic trawl survey along 8 transects extending from North West Cape to Geraldton (Lat. 21°45' S to Lat. 28°45' S) at depths from 200-1400 m. There were 6 depth strata at 200 m intervals, all of which were fished once in each pair of transects (seaward and landward). An important aspect of the survey design was the allocation of a substantial proportion of the cruise time for searching for, and fishing, bottom features and acoustic marks. This allotment of time also provided a buffer against time lost due to bad weather and gear repairs.

Generally the fishing operations ran smoothly (although net deployment and retrieval took longer than anticipated) and despite moderate sea conditions (wind Force 4-6), no time was lost due to the weather.

In total, 54 trawls were completed during the first leg (Attachment 2); 38 of these were predetermined transect stations (which included replicates and repeats), 9 were exploratory shots (i.e. not on fish marks) and the remaining 7 were target shots. Sixteen shots were aborted, due mainly to gear fouling on rough bottom, and in the process 2 nets were damaged irreparably. In addition, 5 salinity/ temperature profiles were completed.

### Results - Leg 1

The fish catches were highly diverse and contained up to 39 species per shot with most species represented by small numbers of individuals. For each catch all fish species were identified to the species level or as an 'operational taxonomic unit' and their numbers

and weights recorded. Lengths, weights, sex and gonad maturation stages were recorded for samples of potentially commercial species.

Most of the standard 30 min trawl shots yielded very small quantities of fish (often less than 20 kg). No fish species of potential commercial interest were caught in anything approaching commercial quantities (Attachment 3). To the contrary, the species identified as being of interest prior to the cruise and that were expected to be in catches during the first leg, i.e. alfonsino (*Beryx spendens*), Darwin's roughy (*Gephyroberyx darwini*), deep-sea snapper (*Dentex tumifrons*), gemfish (*Rexea solandri*), John dory (*Zeus faber*), mirror dory (*Zenopsis nebulosus*), nannygai (*Centroberyx australis*), oreo dory (*Allocyttus verrucosus*), and ruby snapper (*Etelis carbunculus*), were caught only in small quantities. That several of these species were represented by only very small individuals was notable. The greatest catch rate of any of the above-mentioned species was 42 kg per hr of mirror dory.

The EK 400 and EK 500 sounders ran continuously during the survey and provided permanent records (printed echograms) of the bottom and acoustic targets. These records will be used to provide information on bottom features to industry. No large acoustic fish marks were recorded during this period except in the shallower reaches of the upper slope (<350 m). In this shallower zone, bottom and mid-water fish aggregations were evident as strong acoustic marks but these were apparently comprised of predominantly small surface and mid-water 'bait fishes'. The largest single catch of the first leg (1706 kg) was taken during a 53 min target shot in 318 m in one such aggregation, and this was almost entirely made up by a small (~15 cm) 'sea-bass', *Malakichthys* sp.

A comprehensive fish identification catalogue was updated with Polaroid photographs and diagnostic characters on a shot by shot basis to ensure consistency in identification and recording of catch composition over the duration of the survey. Representatives of each species were photographed on 35 mm film and retained for museum collections; these included several new species and new records of fish species in Australian waters. The fish species represented a predominantly sub-tropical biological community and most were different from those known from the deep-water trawl fisheries of the Great Australian Bight (GAB) and southeastern Australia (SET). There were, however, several exceptions amongst the mid-water and deep-water bottom and near-bottom fishes which were represented in particular depths along the range of the survey. One example was *Allocyttus verrucosus*, the oreo dory, which is common in the GAB and SET and which was caught in ~1160 m at the low latitude of 22° S.

Crustaceans and cephalopods were also recorded by species, weight and number at all stations and in total 59 species of crustaceans and 30 species of cephalopods were identified. The crustaceans caught on the upper continental slope (200-800 m) included several commercial species that are currently being fished in the North West Slope Deep-water Trawl Fishery. These included 2 species of scampi (*Metanephrops boschmai* and *M. velutinus*), the 'pink stripe' prawn (*Aristeus virilis*) and 'pink' prawn (*Haliporoides sibogae*). A variety of crustaceans, including potentially commercial species were caught in mid-slope depths (800-1700 m). Two species of bugs, *Ibacus alticrenatus* and *I. ciliatus pubescens*, were trawled in moderate numbers at depths of less than 400 m. The most common cephalopod caught was the pelagic Gould's arrow squid, *Notodarus gouldi*. The number of crustaceans captured was higher than expected given the characteristics of the fishing gear (large net meshes and heavy bobbin gear) and suggested that some species may have been present in significant numbers in the mid- and upper- slope depths of the area surveyed.

In summary, whilst a great diversity of fishes, crustaceans and cephalopods were caught, there were no large catches to indicate the presence of significant resources. With the exception of some strong acoustic marks from apparently small fish species in the shelf-break region (200-300 m) nothing of note was detected by echo sounders during this leg. Of interest were the catches of crustaceans in the upper slope depths towards the northern end of the fishery.

## Narrative - Leg 2

Following a period of nearly one day in the port of Geraldton, during which refuelling and change of some crew took place, we steamed to our first station on transect 9 on February 5th. Weather conditions deteriorated during this time (winds increasing to Force 8 on a moderate swell) which caused fishing operations to be delayed until the following day.

Due to the departure of one of the two Fishing Masters in Geraldton, (on compassionate grounds), the fishing operations contracted to a 16-18 hr stretch between approximately 0700 hr and 2400. A night-time rostered sounder watch was established for scientific staff during this leg to utilise the non-fishing time for searching. This proved useful on occasions when marks of interest found at night could be fished first thing in the morning. However, it was often not possible to retrace our course because the distances involved were prohibitive.

During the first 5 days, during which the weather was consistently rough, 17 trawls were made between latitudes 29°16' S and 32°02' S (Attachment 2). The bottom over this stretch of the fishery was rough for large distances and considerable time was spent searching for fish marks and enough trawlable ground for 30 min tows. Particular difficulty was experienced in trawling the deepest depth strata (1000-1400 m) in this area due to soft mud, in which the gear tended to bog, and to limestone slabs on which the gear came fast. During this period, some strong acoustic marks were found in upper-slope waters (350-500 m) and some moderately successful catches made.

On February 10th we arrived at the Perth Canyons, an area of particular interest for exploration due to its topography, depth range and latitude. The main arm of the canyon and the surrounding slope area, in depths from around 200 m to in excess of 1500 m, were systematically surveyed on a transect grid over 3 days. In addition, the 850-1100 m depth range was searched over most of the canyon area as it was of interest to know if the distribution of orange roughy extended this far north. Nine trawls were completed in this time; 5 of these were targetted at marks in 225-510 m and 4 were exploratory in 320-1200 m. The underwater camera was deployed in the main canyon during a break in the weather on the second night. By February 13th the weather conditions had deteriorated, making target shots on the steep canyon walls extremely difficult. As the surveying had been completed we departed this area and continued with the remaining transect stations.

The last part of the second leg was a disappointing end to the survey: weather conditions were generally difficult and built to Force 6 on a 6-7 m swell, and an early return to port was necessitated due to the medical condition of one of the scientific staff. During approximately 5 days, 15 trawls were made; 5 were targetted shots and 10 were on predetermined stations. A further 2 camera drops were made successfully. A greater proportion of rough ground was found as we progressed south and several trawls were aborted due to gear fouling. Almost an entire day was lost to one hook-up with the gear taking several hours to get off the bottom and a further 8 hours to fit a new net and ground gear. One of the main interests in the southern area was the extent of the orange roughy resource, and accordingly 9 of these trawls and the majority of the searching conducted during this time occurred in waters between 900 m and 1100 m. Several bottom features of interest such as small hills and ridges, and what were thought to be coral lumps, were encountered but no encouraging marks were seen. The absence of fish marks on the

sounders was reflected in trawl catches with no fish species being caught in quantity.

In total, 41 trawls were completed during the second leg (Attachment 2); 24 were on predetermined transect stations, 13 were target shots on marks and 4 were exploratory shots in the Perth Canyons. Eight shots were aborted due to gear becoming fouled or bogged and 1 net was damaged irreparably. Three camera drops were made and 7 salinity / temperature profiles were completed.

## Results- Leg 2

Some larger catches were made during the second leg but in general terms the trawls and acoustic returns were disappointing. Many of the potentially commercial fish species identified from this part of the fishery prior to the survey were caught, however, others, including blue grenadier (*Macruronus novaezelandiae*), ling (*Genypterus blacodes*), and smooth dory (*Pseudocyttus maculatus*) were not caught.

In general terms, the best catches were made in upper slope depths between 275-500 m (Attachment 3). In these catches, big-spined boarfish (*Pentaceros decacanthus*) and mirror dory (*Zenopsis nebulosus*), 2 potentially commercial species, were often the dominant components of the catch. Highest catch rates for the 2 species were 519 kg per hr and 536 kg per hr respectively. The rock cod (*Epinephelus septemfasciatus*) was also caught in appreciable quantity (559 kg per hr) in one shot.

A range of other potentially commercial species was caught in the shallower strata of the survey including alfonsino (*Beryx spendens*), black-spotted boarfish (*Zanclistius elevatus*), conway (*Oplegnathus woodwardi*), Darwin's roughy (*Gephyroberyx darwini*), king dory (*Cyttus traversi*), deep-water flathead (*Platycephalus conatus*), gemfish (*Rexea solandri*), latchet (*Pterygotrigla polyommata*), morwong (*Nemadactylus macropterus*), nannygai (*Centroberyx australis*), oilfish (*Ruvettus pretiosus*), ocean perch (*Helicolenus* sp.), deep-sea snapper (*Dentex tumifrons*) and tusk (*Dannevigia tusca*), but none were caught in large quantities.

On the mid-slope, in depths greater than 800 m, catches were particularly disappointing with the species of commercial interest in these depths, orange roughy (*Hoplostethus atlanticus*), oreo dory (*Allocyttus verrucosus*), spiky dory (*Neocyttus rhomboidalis*), deep-sea perch (*Trachyscorpia capensis*), and ribaldo (*Mora moro*), caught in very small quantities. In fact only one orange roughy, the species of principal interest, was caught.

The poor catches in the deeper water mirrored the lack of marks and interesting topography detected on the echo sounders. Although areas with bottom features such as small hills, ridges and 'coral lumps' were found, these tended to be relatively localised. Not until we reached the most southerly extreme of the fishery, just west of the border with the GAB fishery, were any diffuse fish marks found consistently on the bottom in the mid-slope depths. The Perth Canyon area which was searched fairly extensively showed no signs of containing concentrations of fish in depths greater than 800 m - although it should be noted that in the canyon area no successful trawls were made in depths greater than 850 m. Again, all bottom features have been recorded on permanent echograms and details of these will be included in the formal cruise report.

All species caught during the second leg were identified for inclusion in catch composition data, and length and biological data were collected on potentially commercial species.

Fish communities changed markedly during this leg with an apparent rapid shift towards temperate species in the Geraldton region, and, particularly in deep-water, the appearance of a typical southern Australian fauna south of Perth.

Crustaceans and squid were collected during this leg but identifications on many of these are awaiting verification. Bugs were caught in modest quantities in depths less than 400 m with the best catch rate being 50 kg per hr.

In summary, with the exception of some encouraging catches on the upper-slope, indications of fish in trawl catches and on echo sounders were disappointing. The 16 survey transects were completed but gear and operational problems, as well as inclement weather, did not permit as many exploratory and target trawls to be made as was hoped. In particular, there was limited coverage of the most southerly part of the fishery.

### **Miscellaneous collections**

Extensive collections of fish were made for the CSIRO Fish Collection, the Australian Museum, the Victorian Museum and the Western Australian Museum.

Collections of fishes which are commercial in the SET and GAB fisheries were made for CSIRO scientists for genetic stock discrimination work.

### **Major problems with gear and fishing operations**

The acoustic towed body could not be used during the survey because the chain drive used to move the body along the stern overhead-beam stretched during the first deployment for trials and broke after being retensioned.

The hull mounted transducers for the echo sounders were very susceptible to noise created from turbulence along the hull and this created problems with definition of echo returns during bad weather.

The lack of a replacement Fishing Master during leg 2 restricted the ability of the vessel to move efficiently between stations and to fish opportunistically. This amounted to a considerable loss of survey time and the main cause of the limited number of trawls completed in the southern part of the fishery.

### **Publicity and communication**

A formal invitation to tour the Southern Surveyor in Albany was made to industry representatives involved in deep-water trawling in Western Australia and the GAB, to the Western Australian Fisheries Department and to local dignitaries and the media. About 20 people attended the tour which comprised an introductory talk by Tony Koslow, a tour led by Tony and Alan Williams and refreshments on the bridge. On the basis of the very positive response from the people that attended, the exercise was judged to have been worthwhile. The media coverage included a live radio interview (ABC), a television news program (GWN) and several newspaper articles. The accuracy of reporting in one of the newspaper articles, despite the issue of a 'media release', is a cause for some concern as the headline, "Canyons of fish off WA", is misleading.

### **Final summary**

1. Ninety-five trawls were made in the largely unexplored WDWTF during 30 days in January and February. Sampling was carried out along 16 predetermined transects between 200 m and 1400 m, on bottom features of interest and on acoustic marks. All transect stations were attempted but, due to a combination of adverse factors, the number of successful exploratory and target shots completed in the most southerly reaches of the fishery (south of 33° S) was less than planned.

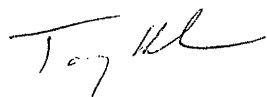
2. Catches of potentially commercial fish species were generally poor. Some encouraging catches of upper-slope species, especially mirror dory, big-spined boarfish and rock-cod, were made, however, catches on the mid-slope were, without exception, disappointing. The generally small trawl catches mirrored the generally poor acoustic returns recorded by echo sounders. Echograms from depth sounders were printed for the entire duration of the survey. These will be summarised together with acoustic data to provide information on the distribution of trawl grounds.

3. Scampi and deep-water prawns were caught on the upper-slope in the most northerly reaches of the fishery. This was of particular interest because the quantities taken using a large-mesh fish net and heavy ground gear indicated that some species may have been present in significant numbers.

4. Extensive collections of fish, crustaceans and squid, including many undescribed and rare species, were made for CSIRO and museum collections (AMS, VM, WAM). The composition of each catch was recorded by species for each station and will enable an analysis of community structure to be made.

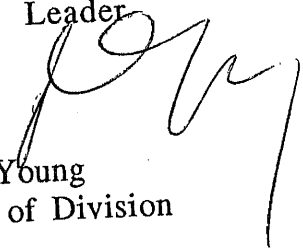
5. Several problems were encountered during the survey which contributed to loss of operational time. Some of these, such as inclement weather and gear damage, were anticipated and absorbed by flexibility in the survey design. The absence of a second Fishing Master during the second leg was unanticipated and resulted in operational inefficiency and lost fishing time.

6. An account of the preliminary results of the survey will be circulated to the relevant industry representatives by early April; these results will be discussed at a meeting of the Industry / Government Advisory Committee at the Marmion Laboratories in April.



T. Koslow  
Cruise Leader

A. Williams  
Assistant cruise leader



P. C. Young  
Chief of Division

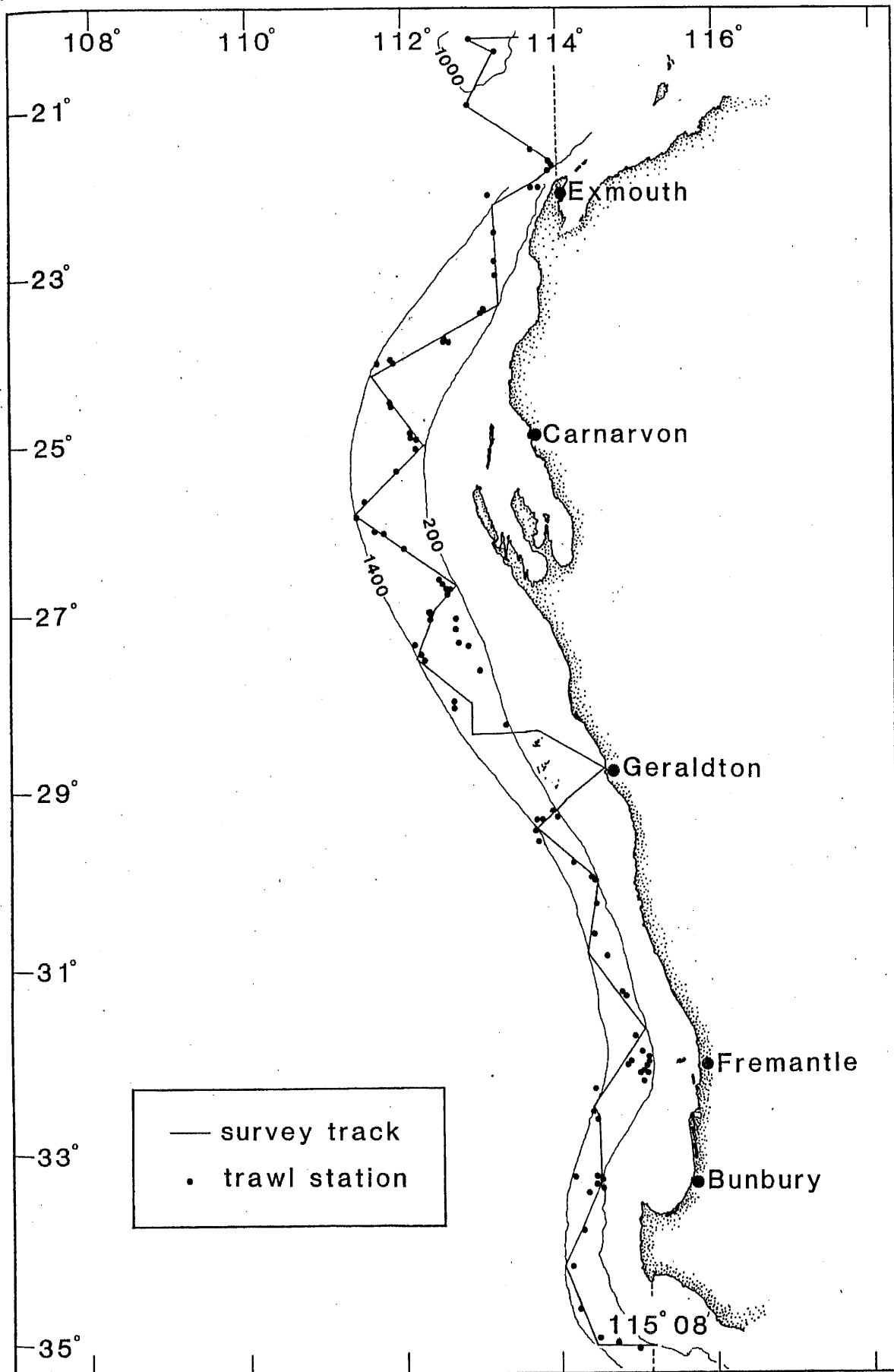
#### Distribution

Members of W and NWSDWTF Industry /Government Advisory Committee

Tiger Fisheries  
Sophisticated Pursuit P/L  
Aries Fishing  
McBoats Seafoods  
WA Seafood Exporters

Austral Fishing P/L  
Newfishing P/L  
Latitude Fisheries  
A. Raptis & Sons

Attachment 1. Map of WDWTF showing survey track and trawl stations.



Attachment 2. Western Deep-water Trawl Fishery Survey: summary of trawl stations

Station No.	Tran-sect	Station Type*	Stratum or depth range	Start Position Lat; Long	Start Dep.(m)	Heading (degrees)	Other Way point#1
1							
2		E	913-914	20.16.5; 113.13.5	913	210	
3		E	854-868	20.07.8; 112.55.1	868	120	
4		E	1120-1180	20.55.4; 112.51.5	1139	40	
5		E	1022-1023	21.28.2; 113.38.6	1022	140	
6		T	328-328	21.37.5; 113.55.8	328	210	Abort
7		T	209-215	21.39.3; 113.58.2	209	30	
8	1	P	200-400	21.44.7; 113.52.3	320	30	Abort
9	1	P	200-400	21.44.4; 113.52.2	274	40	Repeat, Abor
10	1	P	600-800	21.50.6; 113.46.7	685	30	Abort ?
11	1	P	1000-1200	21.54.1; 113.40.7	1158	30	
12	1	P	1460-1700	22.00.5; 113.08.4	1460	15	Abort
13	2	P	1200-1400	22.28.6; 113.12.4	1258	0	
14	2	P	800-1000	22.47.4; 113.13.2	880	15	
15	2	P	400-600	22.59.9; 113.14.3	482	30	
16	3	P	200-400	23.25.4; 113.03.9	297	20	
17	3	P	200-400	23.25.4; 113.03.9	300	30	Replicate
18	3	T	576-587	23.46.4; 112.36.5	576	15	Abort
19	3	P	600-800	23.44.6; 112.35.5	612	350	
20	3	P	600-800	23.44.8; 112.35.3	612	10	Repl., Abort
21	3	P	1000-1200	24.00.4; 111.54.1	1060	15	
22	3	P	1000-1200	23.59.5; 111.54.1	1061	10	Replicate
23	4	P	1200-1400	24.09.6; 111.39.5	1293	20	
24	4	P	800-1000	24.30.2; 111.50.9	892	20	
25	4	P	800-1000	24.30.6; 111.50.4	895	210	Replicate
26	4	P	400-600	24.51.3; 112.07.1	467	10	
27	4	T	444-468	24.52.9; 112.07.8	444	350	
28	4	T	318-344	24.55.7; 112.11.4	318	5	
29	5	P	200-400	25.07.2; 112.09.4	306	20	Abort
30	5	P	200-400	25.07.5; 112.09.3	312	170	Repeat of 29
31	5	P	600-800	25.19.1; 111.56.5	612	350	
32	5	P	1000-1200	25.41.2; 111.30.9	1115	190	
33	6	P	1200-1400	25.52.1; 111.27.2	1254	350	
34	6	T	1000-1005	26.02.1; 111.39.3	1000	300	Abort
35	6	P	800-1000	26.05.3; 111.46.7	882	10	
36	6	P	600-800	26.14.5; 112.03.2	690	350	
37	6	P	400-600	26.35.7; 112.29.0	508	160	Abort
38	7	P	400-600	26.40.4; 112.32.7	478	170	Repeat of 37
39	7	P	200-400	26.42.6; 112.41.1	200	340	
40	7	P	200-400	26.42.3; 112.38.4	285	160	Abort
41	7	P	200-400	26.45.0; 112.36.6	346	210	
42	7	P	600-800	26.57.0; 112.22.3	666	210	
43	7	P	600-800	27.06.8; 112.22.9	714	350	
44	7	P	800-1000	27.22.1; 112.10.8	1009	350	
45	8	P	1000-1200	27.28.5; 112.13.4	1150	130	Abort
46	8	P	1000-1200	27.32.8; 112.15.1	1107	130	Repeat, Abor
47	8	P	1000-1200	27.32.8; 112.15.2	1104	136	Repeat
48	8	P	800-1000	28.00.0; 112.41.0	945	10	

\* P=predetermined; T=target; E=exploratory

Attachment 2. Western Deep-water Trawl Fishery Survey: summary of trawl stations

Station No.	Trans- sect	Station Type*	Stratum or depth range	Start Position Lat; Long	Start Dep (m)	Heading (degrees)	Other
49	8	P	800-1000	28.04.1; 112.42.6	854	347	
50		E	520-520	28.16.8; 113.17.8	520	350	Abort
51		E	510-520	27.17.2; 112.45.2	510	350	
52		T	370-438	27.08.8; 112.44.8	438	350	
53		E	303-333	27.04.7; 112.44.7	303	340	Abort
54		E	279-306	27.23.0; 112.51.9	306	350	
55		E	248-252	27.38.2; 113.00.1	248	340	Abort
56	9	P	200-400	29.15.8; 113.56.8	320	350	
57	9	P	400-600	29.20.5; 113.58.3	490	330	
58	9	P	800-1000	29.21.8; 113.46.6	942	330	
59	9	P	1000-1200	29.22.6; 113.42.8	1160	350	Abort
60	9	P	1000-1200	29.28.9; 113.42.3	1160	350	Abort
61	9	P	1000-1200	29.35.4; 113.44.9	1132	355	Repeat of 60
62	10	P	600-800	29.51.9; 114.11.6	770	350	
63	11	P	200-400	30.01.2; 114.29.2	255	335	
64	11	T	360-380	30.00.1; 114.27.8	380	355	
65	11	P	400-600	30.00.0; 114.27.1	480	340	
66	11	P	600-800	30.16.7; 114.30.2	684	350	
67	11	P	1000-1200	30.39.1; 114.27.7	1058	350	
68	12	P	800-1000	30.51.9; 114.37.3	893	350	
69	12	T	613-614	31.16.2; 114.50.2	613	340	Abort
70	12	T	475-512	31.17.0; 114.52.6	475	350	
71	13	P	200-400	31.44.7; 114.59.7	390	340	
72	13	P	600-800	32.02.3; 114.54.5	670	0	
73		E	350-550	31.53.2; 115.05.7	411	205	
74		E	320-850	31.55.2; 115.10.2	320	210	
75		T	470-484	32.09.8; 115.02.8	484	25	
76		T	295-308	32.07.9; 115.06.7	308	30	
77		T	270-285	32.04.9; 115.09.4	270	30	
78		E	490-510	32.02.3; 115.08.9	510	30	
79		E	700-1200	32.02.5; 114.52.6	700	189	Abort
80		T	286-287	32.14.4; 115.06.4	286	20	
81		T	225-230	32.10.2; 115.08.2	225	25	
82	13	P	1200-1400	32.19.8; 114.28.6	1280	20	
83	14	P	1000-1200	32.34.6; 114.27.2	1030	330	
84	14	P	800-1000	32.40.4; 114.28.2	880	320	
85	14	T	982-982	33.17.9; 114.12.6	982	330	
86	14	T	220-220	33.18.9; 114.31.9	220	310	Abort
87	14	P	400-600	33.17.9; 114.30.8	468	360	
88	15	T	203-204	33.24.1; 114.31.4	203	10	
89	15	P	200-400	33.22.9; 114.29.6	400	5	
90	15	P	600-800	33.25.5; 114.21.0	817	45	
91	15	T	1050-1050	33.49.7; 114.17.5	1050	45	Abort
92	16	P	1200-1400	34.12.8; 114.07.7	1240	45	Abort
93	16	P	800-1000	34.39.4; 114.15.5	890	45	Abort
94	16	P	1000-1200	34.56.9; 114.29.3	900	215	
95	16	P	600-800	34.59.2; 114.43.6	738	200	
96	16	T	870-920	35.04.9; 114.59.7	870	220	

\* P=predetermined; T=target; E=exploratory

Attachment 3. Western Deep-water Trawl Fishery Survey: Catch rates (kg per hour) of fish species by station

Station no.	3	7	11	14	16	17	21	22	23	24	26	27	28	30	31	32	33	35	38	39	41
Depth (m)	868	209	1158	880	297	300	1060	1061	1293	892	467	444	318	312	612	1115	1254	882	478	200	346
Alfonsino		0.6									1.5	1.1	0.1		0.3				0.3		
Blue eye (deep sea trevalla)																					
Boarfish — big-spined														0.6							0.7
Boarfish — black-spotted																					
Cod — rock																					
Conway (knifejaw)																					
Darwin's roughy																					
Dory — John																				1.8	
Dory — king																					
Dory — mirror		0.8			0.8	1.1							22.4	2					1.9		0.1
Fathead — deepwater											0.6	2.3	1								
Gemfish						0.5															
Latchet																					
Morwong																					
Morwong — blue																					
Nannygai — yellow-eyed																					
Oilfish																					
Orange roughy																					
Oreo dory	0.2		0.6	0.5			10.2	8	3.2	0.1						6	2	0.7			
Oreo dory — spiky																					
Perch — deep-sea																					
Perch — ocean																			0.8		
Ribaldo																					
Snapper — deep-sea		24			12	17.6							5.7	19						12	0.2
Snapper — ruby																					
Tusk																					

Attachment 3. Western Deepwater Trawl Fishery Survey: Catch rates (kg per hour) of fish species by station

Station no.	43	44	47	48	49	51	52	54	56	57	58	63	64	65	66	67	68	70	71	72	73
Depth (m)	714	1009	1104	945	854	510	438	306	320	490	942	255	380	480	684	1058	893	475	390	670	411
Alfonsino					0.2									0.6					0.2	0.5	
Blue eye (deep sea trevalla)													6								
Boarfish — big-spined							0.1	0.9	231				57					0.8	17		
Boarfish — black-spotted																					
Cod — rock																					
Conway (knifejaw)																					
Darwin's roughy							0.3			0.1			0.1	0.44				3.3			2.9
Dory — John																					
Dory — king										5										1.5	
Dory — mirror							42.3	4.8	42.2	17.6		1.9	141	21					86		
Flathead — deepwater																					
Gemfish				0.1				20.6	10.3	6.6			101	13.2				1.5	5.8		
Latchet																					
Morwong																					
Morwong — blue																					
Nannygai — yellow-eyed								0.2	0.26				0.1								
Oilfish																		15.8			
Orange roughy																					
Oreo dory	11	1.8	3.4	0.1						16.6					4.6	18.5					
Oreo dory — spiky																					
Perch — deep-sea																					
Perch — ocean	3.2				0.4	0.7				24			0.7	21.2	3.8			2.8	12	7.4	0.6
Ribaldo																					
Snapper — deep-sea								2	2.3												
Snapper — ruby																					
Tusk																					

Attachment 3. Western Deep-sea Trawl Fishery Survey: Catch rates (kg per hour) of fish species by station

Station no.	74	75	76	77	78	80	81	83	84	85	87	88	89	90	95	96
Depth (m)	320	484	308	270	510	286	225	1030	880	982	468	203	400	817	738	870
Alfonsino																
Blue eye (deep sea trevalla)																
Boarfish — big-spined		519	2.9				0.5					3.5				
Boarfish — black-spotted												3.5				
Cod — rock				559												
Conway (knifejaw)	1.6			9.6			9.3					5.6				
Darwin's roughy	1.5															
Dory — John																
Dory — king																
Dory — mirror	5	3.3	42.9	536	3.4								82			
Flathead — deepwater				0.3			1.7					5.2				
Gemfish		4.7	0.7		2.2											
Latchet						0.4	1.6					6				
Morwong	0.4						1					6.5				
Morwong — blue												6.5				
Nannygai — yellow-eyed							0.3					8				
Oilfish																
Orange roughy																3.6
Oreo dory								2.5	62.7	10.8						4.2
Oreo dory — spiky															5	3.9
Perch — deep-sea															1.8	1.2
Perch — ocean	3	5.6			3.5						0.3					
Ribaldo														4.8		3.7
Snapper — deep-sea							0.1									
Snapper — ruby																
Tusk				2.6								2.4				