

**Pilot Egg Survey of Orange Roughy  
in the South East Fishery's Western Zone**

*I. A. Knuckey and D. C. Smith*

**PROJECT 96/110**



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**Fisheries Research and Development Corporation**

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in the South East Fishery's Western Zone**

**I.A. Knuckey and D.C. Smith**

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**96/110 Pilot Egg Survey of Orange Roughy (*Hoplostethus atlanticus*)  
in the South East Fishery's Western Zone**

**Principal Investigator:**

**Dr D. C. Smith**

**Address:**

**Marine and Freshwater Resources Institute**

**PO Box 114 Queenscliff VIC 3225**

**Telephone: 03 5258 0111 Fax: 03 5258 0270**

**Objectives**

1. To undertake a search for orange roughy eggs in the far west of the SEF's western zone.
2. To provide an indication of the extent of spawning by comparing results with previous surveys in the eastern and southern zones.
3. To evaluate the potential for further research into orange roughy in the western zone.

**Summary**

Spawning orange roughy (*Hoplostethus atlanticus* Collett 1889) have been found throughout south-eastern Australia but the only known major spawning aggregation is on the east coast of Tasmania. As orange roughy quotas in the Eastern and Southern Management Zones of the South East Fishery are reduced to sustainable levels, there has been increased interest in finding other significant spawning aggregations. Previous studies indicated that there is spawning in the Western Management Zone (western Victoria and south-eastern South Australia) and this project was undertaken to determine the likely extent of this spawning and whether a major spawning aggregation occurred in this area. Two surveys, each comprising twelve north/south transects with three vertical plankton tows per transect, were undertaken between 27/07/96 and 10/08/96 in the western reaches of the Zone. The tows were taken from bottom depths of around 800, 1000 and 1200 m. The plankton samples were sorted and any orange roughy eggs or larvae were removed and counted. Most of the plankton samples contained no orange roughy eggs. Small numbers were found in some of the samples, which indicates that a low level of spawning is taking place. Although the samples were taken during the peak spawning period of orange roughy, the absence of high concentrations of eggs indicates that a large spawning aggregation was unlikely within the survey area.

**Keywords:** Orange roughy, egg survey, spawning aggregation

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## Background

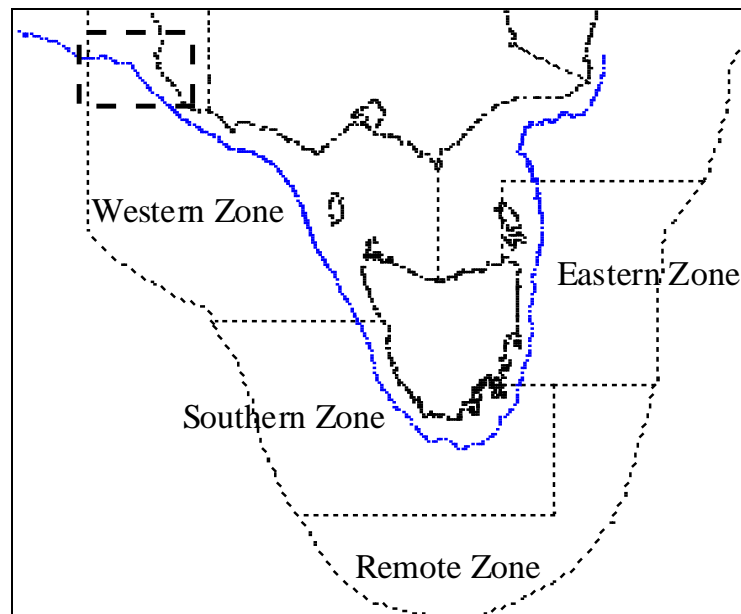
Orange roughy (*Hoplostethus atlanticus*) are widely distributed on the mid-slope regions of temperate waters. (Gomon *et al.* 1994). In Australian waters they are found at depths from 700 to 1400 m but the bulk of the catch is taken between 800 and 1200 m. The species forms an integral part of the trawl catch in Australia's South East Fishery (SEF, Fig. 1).

Orange roughy were first recorded in Australian waters off NSW in 1972 (Lyle *et al.* 1989). Although widely distributed at low densities, orange roughy form dense spawning and non-spawning aggregations from which large catches can be taken. They were first taken commercially off Tasmania in 1982 and in late 1986 a non-spawning aggregation off Sandy Cape, western Tasmania was discovered. Over the next two years other non-spawning aggregations were found off Port Davey and Beachport and, together with catches from dispersed fish, annual landings ranged from 4000 to 8500 t (Chesson 1996). These aggregations did not recur annually.

Landings increased dramatically in 1989 when a major spawning aggregation was discovered off the east coast of Tasmania along with non-spawning aggregations off southern Tasmania. Landings peaked at about 41,000 t in 1990.

Orange roughy are long-lived, slow growing fish which are highly vulnerable to exploitation (Smith *et al.* 1995). In the Eastern and Southern Management Zones, where fishing levels have been highest, quota limits have been reduced to reach sustainable levels. Total landings have subsequently declined, to about 7,000 t in 1995 (Chesson 1996).

Spawning orange roughy have been found throughout south-eastern Australia (Bell *et al.* 1992) but the only known significant aggregation is that on the east coast of Tasmania. As a consequence of the reduction in total catch, the search for other significant spawning aggregations has assumed greater importance.



**Figure 1.** Orange roughy management zones of the South East Fishery. The study was undertaken on the continental shelf in the far west of the western zone (dashed box).

There is evidence of spawning in the Western Zone and some fishers believe there is a spawning aggregation in the zone. An exploratory survey, using commercial vessels was conducted during winter 1993 in an attempt to locate a spawning aggregation west of Portland (Smith and Smith 1993). The survey started late and due to its limited extent and duration, only two vessels caught orange roughy. It was difficult to draw firm conclusions but there appeared that there was some spawning activity.

A more extensive survey was conducted between 11 July and 21 August, 1994 (Smith *et al.* 1994). Eight commercial vessels carried out an acoustic survey between depths of 700 and 1400m in an area from approximately 15 nautical miles (nm) east of Portland ( $141^{\circ} 58'$ ) to 30 nm west of the western boundary of the SEF ( $139^{\circ} 30'$ ). Four vessels reported orange roughy catches during the survey period with approximately 200 tonnes taken. The greatest catches were taken west of Beachport to the boundary of the SEF. Catch rates of up to 16 tonnes per shot were recorded but most were under 10 tonnes per shot. Approximately 250 tonnes were also caught after the survey in the same general area west of Beachport. No catches were reported from the area west of the SEF boundary. Fish caught during the early part of the survey were in spawning condition, whilst catches later in the survey and during the post-survey period were of almost exclusively spent fish.

The results of the survey confirmed those of 1993, that there is some spawning in the Western Zone west off Portland, but despite the intensive survey, no large aggregation was located. However, a number of vessels reported extensive mid-water marks. A considerable tonnage of pre- and post-spawning orange roughy were again caught in the same general area during winter 1995.

During this study we conducted a pilot egg survey in the area west of Beachport to provide information on the nature of the spawning activity taking place and determine if there was any evidence of a large spawning aggregation. It was not intended to quantify the biomass of spawning orange roughy in this area, although it was envisaged that the results could be generally compared with those of previous egg surveys of orange roughy off St Helens (Koslow *et al.* 1995) and in the Southern Management Zone (Lyle 1991).

### **Need**

Spawning orange roughy have been found throughout south-eastern Australia (Bell *et al.* 1992) but the only known significant aggregation is that on the east coast of Tasmania. As a consequence of the reduction in total catch, the search for other significant spawning aggregations has assumed greater importance.

An egg survey in the area west of Beachport would provide the best means of determining the extent of spawning. A comparison of the number of orange roughy eggs taken at each station with similar data for St Helens and the Southern Zone would provide some indication of the potential biomass of spawning fish. Results would also indicate whether a more intensive survey aimed at quantifying the mass of orange roughy is warranted.

This proposal was developed at the request of industry. A project to undertake the work in 1995 was endorsed by SETMAC and it proposed that quota for charter be used. Unfortunately, quota for charter was unattractive in this sector of the fishery and the study did not proceed. This proposal included charter costs and quota for charter was not required.

## Objectives

1. To undertake a search for orange roughy eggs in the far west of the western Zone of the SEF.
2. To provide an indication of the extent of spawning by comparing results with previous surveys in the eastern and southern zones.
3. To evaluate the potential for further research into orange roughy in the western zone.

## Materials and Methods

The peak spawning period for orange roughy off south eastern Australia is around July / August. Two surveys were conducted during this time, one beginning on 27/07/96 and the other on 10/08/96. On each survey, twelve north/south transects comprising three plankton tows per transect were undertaken. Ten of the transects were conducted at about 4.5 nm intervals between 138° 08.00' and 138° 48.50'. Two further transects were conducted at 7 nm from either end, one at 138° 01.00' and the other at 138° 55.50'.

At three sites along each transect, vertical plankton tows were taken from bottom depths of around 800, 1000 and 1200 m, using 720, 920 and 1120 m cable lengths respectively. Details of the transect (1-12), site (A,B,C), date, time, position and depth were recorded for each sample. To avoid the plankton net from becoming entangled during the descent, it was hung in a 5.0 m x 1.0 m aluminium frame which had a 100 kg weight attached to the bottom. A 14 mm polypropylene rope was attached to the frame and upon reaching the desired depth, it was hauled in at a rate of about 100 m / minute. A flowmeter was positioned in the mouth of the net to estimate tow distance. As a comparison, the tow distance ( $d$ ) was also estimated based on the depth of the tow ( $Z$  estimated by the length of cable deployed) and the position of the vessel at the beginning and end of the tow  $\Delta(p_1, p_2)$  where  $d = [Z^2 + \Delta(p_1, p_2)^2]^{0.5}$  (Koslow *et al.* 1995). Once the net was clear of the water, it was rinsed with seawater, and captured organisms were removed via a PVC codend and the sample was placed in a container in 5% formaldehyde solution in sea water.

The samples were transported to the laboratory, and after being fixed for at least a week in formaldehyde, they were transferred into 70% alcohol. Each of these samples was sorted, and any orange roughy eggs or larvae were removed and counted.



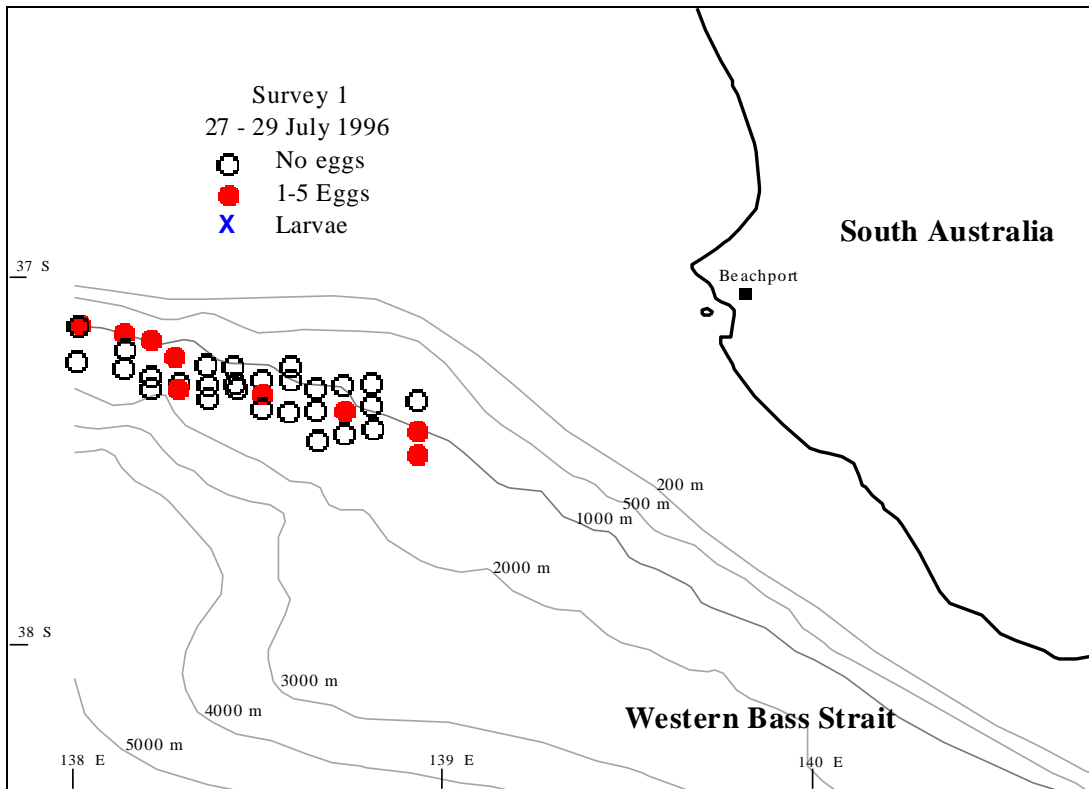
The gonad condition of female orange roughy caught in the Western Zone and landed in Beachport prior to, during and after the survey period was monitored as an indication of the population's spawning phase. The length of the fish were measured and their gonads were staged macroscopically on a scale of 1 to 6 as shown below.

**TABLE 1.** Developmental stages and macroscopic description of the gonads of female orange roughy.

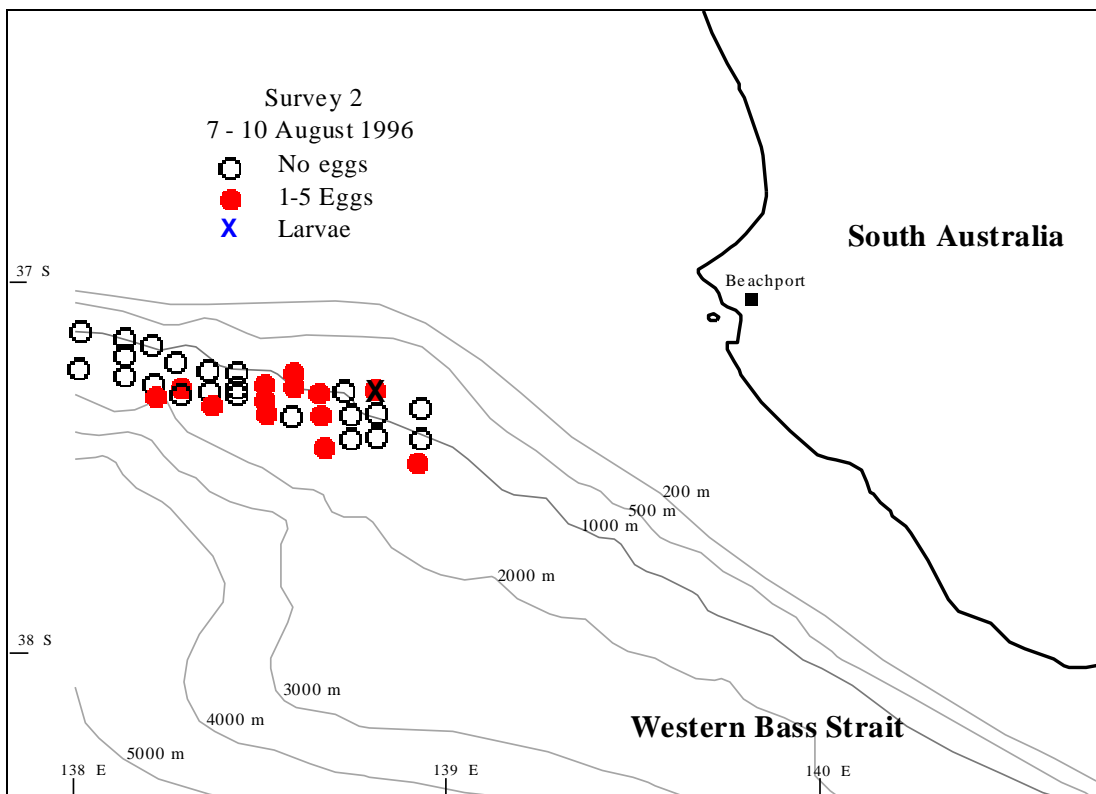
Stage	Macroscopic description
1 Immature	Small thread-like pink and translucent ovaries
2 Early developing	Ovaries pink and translucent, oocytes not visible
3 Developing	Small oocytes visible, still translucent
4 Late Developing	Small opaque oocytes clearly visible
5 Ripe	Large transparent oocytes visible and easily expressed from ovaries
6 Spent	Ovaries flaccid with thickened and wrinkled wall. Some residual oocytes visible within translucent material

## Results

There were no large concentrations of orange roughy eggs found in the samples from either survey. The maximum number of orange roughy eggs collected at any station was less than five. Eggs were collected from tows at the three different depths and across most of the survey transects. The distribution and abundance of the orange roughy eggs and larvae found in the two surveys are shown in Figures 2 and 3. There was no apparent trend in either the depth or the longitude of tows in which orange roughy eggs were found either within or between the replicate surveys. Two larvae were found in the shallow tow of transect 10 in the second survey which were probably orange roughy. They had the correct number of myomeres, the remains of a bright orange oil droplet (Bruce CSIRO, pers. comm.) and were similar to larvae shown as orange roughy by Grimes and Zeildis (1993).



**Figure 2.** Distribution and abundance of orange roughy eggs and larvae from the first survey of the far west of the Western Zone.



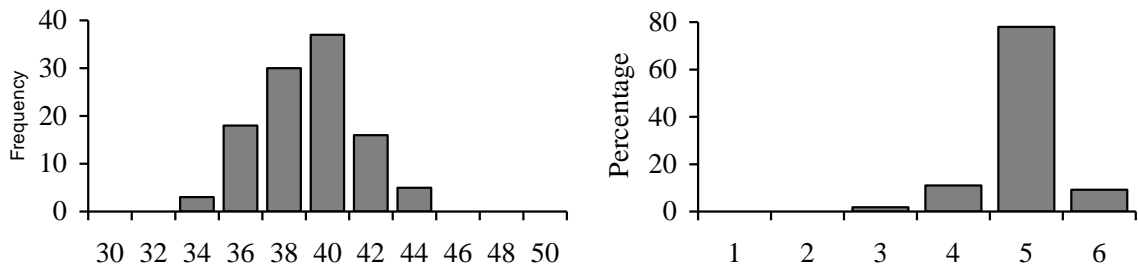
**Figure 3.** Distribution and abundance of orange roughy eggs and larvae from the first survey of the far west of the Western Zone.

Other large eggs were found during the surveys, many of which were probably anguilliform (Bruce CSIRO, pers. comm.) and some appeared to be macrourids, possibly blue grenadier (*Macruronus novaezealandiae*) (Lewis CSIRO, pers. comm.).

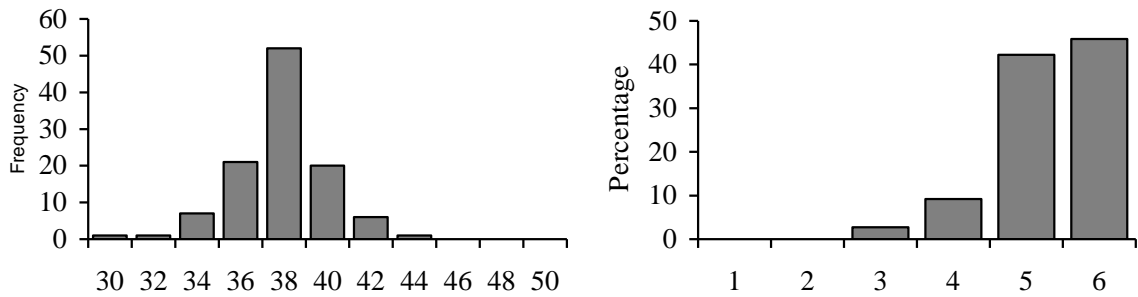
The details of the date, time, position, depth and tow distance of each plankton tow undertaken during the two replicate surveys and the number of orange roughy eggs and the number of other large eggs (> 1.5 mm diam.) caught in each tow are shown in Appendix 1. To allow semi-quantitative estimation of egg densities, tow distances based on the position and depth of each tow and calculation from flow meter readings are provided. However, egg numbers caught during the surveys were too low to warrant such estimations.

Figure 4 shows the length frequency and gonad stage of female orange roughy landed from the Western Zone at four different times (8<sup>th</sup> 11<sup>th</sup> 12<sup>th</sup> and 17<sup>th</sup> of August) during the survey period. Fish generally ranged between 34 and 44 cm standard length with the mode at 38 - 40 cm. Most of the females had gonads that were staged as either 5 (running ripe) or 6 (spent) which indicates the survey coincided with spawning season. Prior to the second survey, 80% of the fish were running ripe and a week after the survey most of the fish (about 70%) were spent.

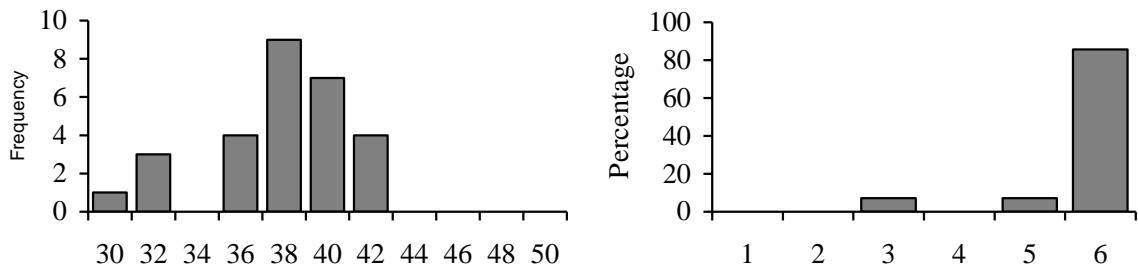
8 Aug 96 (n = 109)



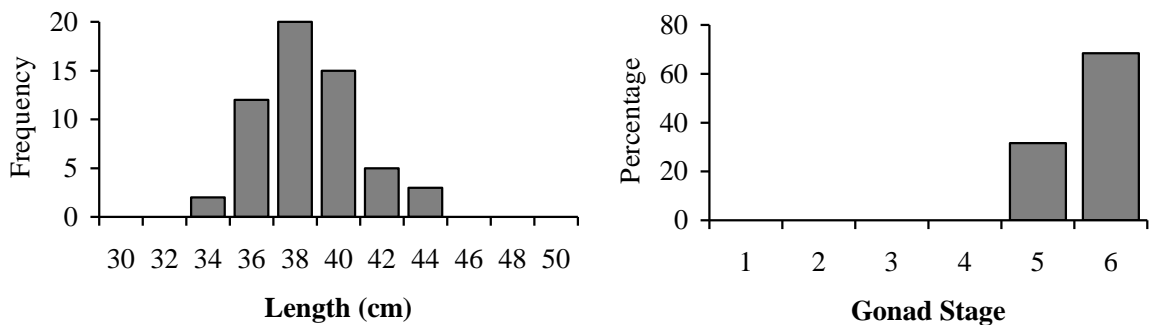
11 Aug 96 (n = 109)



12 Aug 96 (n = 28)



17 Aug 96 (n = 57)



**Figure 4.** a) Length frequency distribution of female orange roughy caught in the Western Zone and landed in Beachport during the survey period. b) Percentage of these fish with gonad stages 1 - 6 (4 - developing, 5 - running ripe, 6 - spent).

## Discussion

Orange roughy undergo group-synchronous spawning over a period of three to six weeks, primarily during the mid-winter period (Bell *et al.* 1992, Pankhurst *et al.* 1987). Large aggregations of spawning orange roughy often form around mid-slope seamounts and are targets for intensive fishing. In Australia, such a spawning aggregation was discovered around “St Helens Hill” off north-eastern Tasmania in 1989 (Lyle *et al.* 1989) and quickly became one of Australia’s largest and most valuable fisheries.

Egg surveys of orange roughy during these spawning aggregations around St Helens Hill have been undertaken in an effort to determine the biomass of orange roughy for stock assessment purposes (Koslow *et al.* 1995). These revealed a highly patchy egg distribution but some plankton tows caught many hundreds of orange roughy eggs. In surveys that coincided with periods of peak spawning, the mean density of orange roughy eggs in a 5 × 5 nm stratum centred on St Helens Hill was 146 per sample and 99 per sample in 1991 and 1992 respectively. This contrasts to the results of the present study, where mean densities were < 0.5 eggs per sample, a maximum of five orange roughy eggs were found in any sample and most samples did not contain any orange roughy eggs. These results support the presence of spawning orange roughy in the western regions of the Western Management Zone but the low numbers of eggs found lead us to believe that a large spawning aggregation was not present within the survey area. Similar egg abundances (6-10 / tow) were found at a few stations in a previous survey of the Southern Management Zone by Lyle (1991) and although his results were inconclusive in terms of establishing the presence (or absence) of a major spawning aggregation off southern Tasmania, he also concluded that some spawning was occurring in this zone.

Spawning orange roughy are not necessarily restricted to large aggregations, and can be found throughout south eastern Australia (Bell *et al.* 1992). Spawning orange roughy have been continually caught during July and August in the Western Management Zone of the SEF, and some fishers believed there may have been a spawning aggregation. Acoustic surveys in the Western Zone (Smith *et al.* 1994) and egg surveys in the Southern Zone (Lyle 1991) have found spawning orange roughy, but failed to detect large spawning aggregations. The results of the present study are consistent with those of previous studies and suggest that in addition

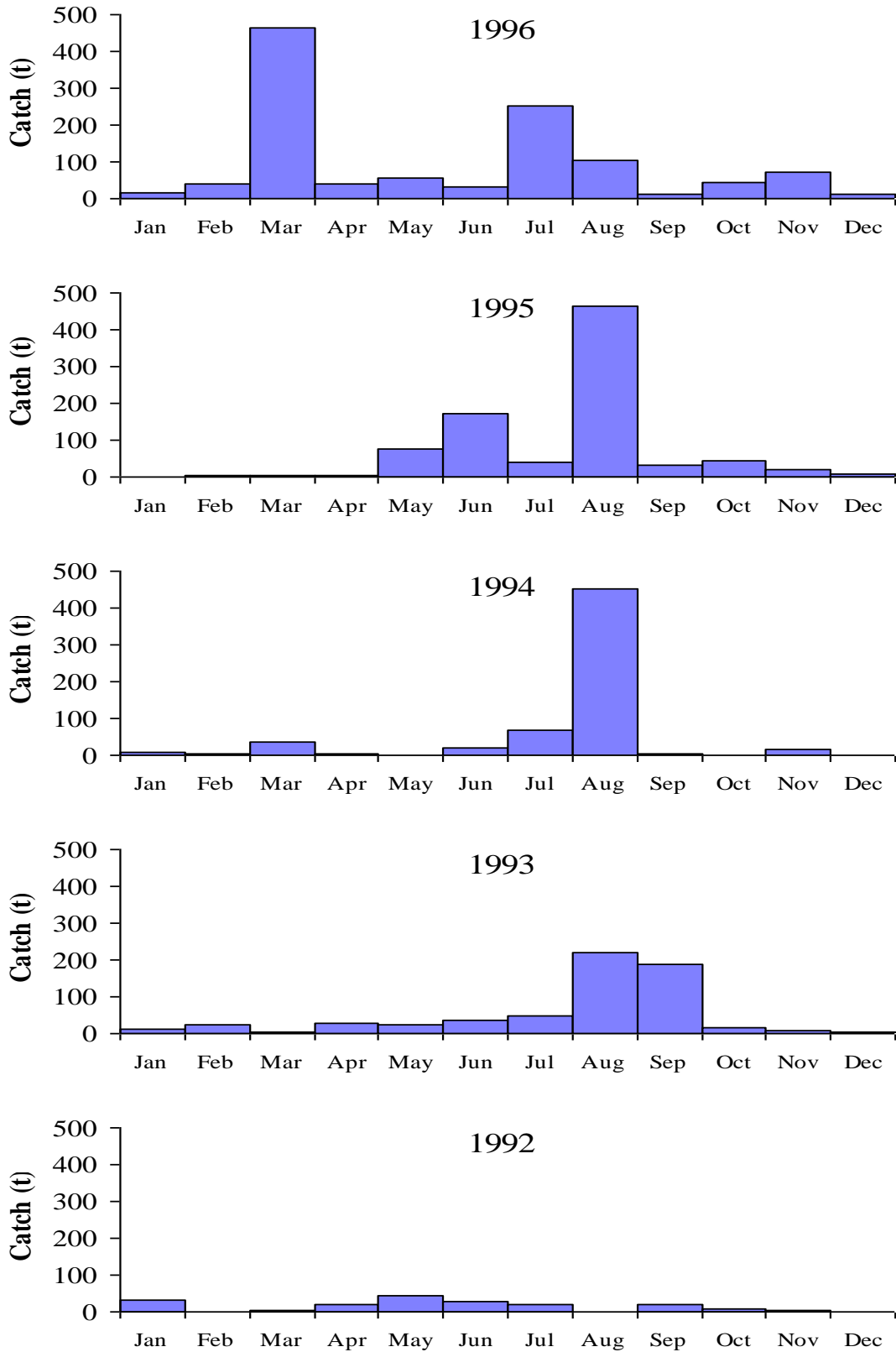
to the aggregations off north-eastern Tasmania, spawning orange roughy could be widespread throughout their distribution without occurring in large aggregations.

Another possibility consistent with our results is that a major spawning aggregation did occur in the survey area, but eggs were not found due to some spatial or temporal inadequacies in the survey design. We do not believe this is likely, as explained below.

The gonad condition of female orange roughy caught in the west of the Western Zone in early August revealed that they were in spawning condition and by mid August, most were spent. Studies in New Zealand (Pankhurst *et al.* 1987) and south eastern Australia (Bell *et al.* 1992; Koslow *et al.* 1995) have shown that spawning usually occurs over about a three week period. The two surveys therefore appear to be well within the main spawning period.

Densities of 1-day-old egg off St Helens Hill, remained high at 5 nm from the spawning site, but reduced to negligible densities at distances greater than about 10 nm (Koslow *et al.* 1995). The transects in the main area of the present survey were 4.5 nm apart, and the average distance between stations was about 3 nm, so if a major spawning aggregation was within the study area, one would expect more than 5 eggs per tow would have been found. Egg densities in the studies off St Helens were two orders of magnitude greater than those in the present survey.

Whilst other studies have been able to lower the plankton net to within a few metres of the bottom (Koslow *et al.* 1995), in the present survey there was no acoustic transducer on the plankton net to monitor its height above the bottom, so to avoid snagging, the net was usually set about 80 m above the expected depth (the actual difference was  $89 \pm 30$  m) in a range of bottom depths from 770 to 1240 m. This could have resulted in lower egg numbers than if the net was lowered to the bottom, but it is considered to be of negligible effect. In a depth-stratified egg survey on St Helens Hill, Bulman and Koslow (1995) found the earliest stage eggs were between 600-900 m and as the eggs developed, their mean depth of occurrence decreased, rising at an estimated rate of  $23.8 \text{ m h}^{-1}$ . Presumably then, even if the eggs were released at the maximum depth possible at each station, they would have been vulnerable to the sampling gear used in the present study within a few hours.



**Figure 5.** Monthly summaries of the landed weight (t) of orange roughy caught in the Western Management Zone between 1992 and 1996. Data obtained from SEF1 logbooks.

Overall, it is considered that the design of the present survey was adequate to detect a large spawning aggregation of orange roughy in the survey area. The presence of some orange roughy eggs supports the hypothesis of low-level spawning in the area. This is consistent with logbook data which shows that a significant component of the annual catch has been taken during the winter months (Fig. 5). However, the low number of eggs collected during this survey indicates that a large spawning aggregation in the area is unlikely.

Much of the stock assessment of orange roughy in south eastern Australia is presently derived from biomass estimates based on acoustic surveys and egg surveys of the major spawning aggregations (Koslow *et al.* 1995). The growing body of evidence supporting a degree of low level spawning in many areas off southeastern Australia could influence these estimates, and warrants consideration in future stock assessments.

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### **Benefits**

Industry was hopeful that a spawning aggregation of orange roughy may be present in the western regions of the Western Zone, but the results of the current survey do not support this. Although no spawning aggregation was found, the tangible benefit to industry and managers is that the results help to resolve some of the uncertainty regarding the extent of the Western Zone resource. This should help managers when setting the TAC for orange roughy in the Western Zone and will enable industry to better plan its future commitment to the orange roughy fishery.

### **Intellectual Property**

No intellectual property has been gained as part of this study.

### **Further Development**

No indications of a large spawning aggregation have been found during this study and other broader surveys of the Western Zone. As a consequence, it is not envisaged that there will be any follow up to this project. Unless evidence of a large spawning aggregation is discovered, the current low-level fishing pressure will probably continue in the Western Zone, based on non-spawning aggregations of orange roughy.

**Staff**

Dr David Smith	Principal Investigator (MAFRI)
Mr Ian Knuckey	Senior Scientist (MAFRI)
Dr Tony Koslow	Co-investigator (CSIRO)
Dr Jeremy Prince	Co-investigator (Biospherics)
Mr Ken Smith	Field Technician (MAFRI)
Mrs Paula Baker	Laboratory Technician (MAFRI)

**Acknowledgments**

We wish to thank Mr John Cull and the crew of the Trinity for their help with the field sampling and Mr Ken Smith for the collection of samples. Appreciation to Mrs Paula Baker for the many hours of sorting through plankton samples. Mr Mark Lewis and Dr Barry Bruce provided valuable assistance in the identification of orange roughy eggs and larvae. Dr Tony Koslow helped in the sampling design and provided valuable comments on the manuscript. The project staff wish to thank the FRDC for funding the project and the SEF fishers for their support of this research.

**Final Cost (FRDC)**

Item	Expenditure
Salaries	\$15,089
Travel	\$928
Operating	\$32,373
Capital	\$0
<b>TOTAL</b>	<b>\$48,390</b>

## Distribution

A copy of the Final Report has been sent to the following:

Executive Officer  
South East Trawl Management Advisory  
Committee  
C/- AFMA  
PO Box 7051  
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ACT 2610

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Chairman  
South East Fishery Assessment Group  
C/- Bureau of Resource Sciences  
PO Box E 11  
Kingston  
ACT 2604

Director  
Bureau of Resource Sciences  
PO Box E 11  
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Director  
Marine & Freshwater Resources Institute  
PO Box 114  
Queenscliff  
VIC 3225

Chief  
CSIRO Division Marine Research  
GPO Box 1538  
Hobart  
TAS 7001

Director  
NSW Fisheries Research Institute  
PO Box 21  
Cronulla  
NSW 2230

Director  
South Australian Research and Development  
Institute  
2 Hamra Avenue  
West Beach  
SA 5022

Director, Marine Resources Division  
Dept. of Primary Industry & Fisheries  
Marine Research Labs  
GPO Box 619F  
Hobart  
TAS 7001

Chief Scientist, Aquatic Sciences  
South Australian Research and Development  
Institute  
2 Hamra Avenue  
West Beach  
SA 5022

Director, Research  
Dept. of Primary Industry & Fisheries  
Tasmanian Marine Research Labs  
GPO Box 619F  
Hobart  
TAS 7001

Director, Research  
NSW Fisheries Research Institute  
PO Box 21  
Cronulla  
NSW 2230

## **Appendix 1**

Operational data on the date, time, position, depth and tow distance of each plankton tow undertaken during the two replicate surveys. The number of orange roughy eggs and the number of other large eggs (> 1.5 mm diam.) caught in each tow are shown.

## Survey 1

Date	Transect	Station	Start time	End time	Start latitude	End latitude	Start longitude	End longitude	Start flowmeter	End flowmeter	Bottom depth (m)	Cable depth (m)	Tow dist. (m)	F'meter dist. (m)	Orange roughy eggs	Other large eggs
27/07/96	0	A	18:11	18:19	37 07.853	37 07.878	138 00.943	138 01.025	666093	708147	900	820	835	1130	4	1
27/07/96	0	B	17:45	17:55	37 07.925	37 08.033	138 00.650	138 00.661	618767	666093	1050	920	942	1272	0	3
27/07/96	0	C	16:26	16:38	37 13.890	37 13.889	138 00.227	138 00.253	560467	618765	1234	1120	1121	1567	0	0
27/07/96	1	A	19:11	19:18	37 09.022	37 09.053	138 08.060	138 08.186	708147	744140	816	720	759	967	2	3
27/07/96	1	B	19:54	20:03	37 11.819	37 11.812	138 08.178	138 08.325	744127	790369	1011	920	960	1243	0	1
27/07/96	1	C	20:45	20:56	37 14.334	37 14.914	138 08.005	138 08.120	790369	850188	1200	1120	1141	1608	0	2
27/07/96	2	A	23:48	23:55	37 10.153	37 10.159	138 12.410	138 12.409	955169	992549	827	720	720	1005	2	5
27/07/96	2	B	22:39	22:47	37 16.312	37 16.328	138 12.303	138 12.375	907658	955169	988	920	930	1277	0	3
27/07/96	2	C	21:57	22:09	37 18.223	37 18.274	138 12.433	138 12.485	850202	907657	1160	1120	1128	1544	0	23
28/07/96	3	A	0:34	0:40	37 12.884	37 12.929	138 16.304	138 16.371	992574	1028130	801	720	735	955	1	5
28/07/96	3	B	1:23	1:33	37 17.262	37 17.314	138 16.948	138 16.975	28348	75011	1000	920	926	1254	0	12
28/07/96	3	C	1:53	2:05	37 18.054	37 18.099	138 16.930	138 16.962	75011	131850	1100	1100	1105	1527	1	11
28/07/96	4	A	7:40	7:48	37 14.326	37 14.384	138 21.497	138 21.493	232991	273547	802	720	728	1090	0	1
28/07/96	4	B	18:47	18:55	37 17.723	37 17.838	138 21.820	138 21.837	190117	232991	1027	920	945	1152	0	3
28/07/96	4	C	14:50	15:02	37 19.805	37 19.851	138 21.722	138 21.713	131850	190120	1237	1120	1123	1566	0	13
28/07/96	5	A	8:26	8:33	37 14.655	37 14.679	138 25.949	138 25.976	273541	309151	801	720	723	957	0	0
28/07/96	5	B	9:02	9:10	37 17.212	37 17.287	138 26.115	138 26.127	309150	351268	1150	920	931	1132	0	2
28/07/96	5	C	9:31	9:43	37 18.193	37 18.295	138 26.298	138 26.322	351268	408058	1200	1120	1137	1526	0	1
28/07/96	6	A	10:28	10:35	37 16.668	37 16.639	138 30.458	138 30.464	408078	444471	798	720	722	978	0	2
28/07/96	6	B	11:03	11:11	37 18.939	37 18.998	138 30.439	138 30.398	444471	487608	990	920	930	1159	1	9
28/07/96	6	C	11:44	11:55	37 21.433	37 21.446	138 30.655	138 30.617	487611	544322	1182	1120	1122	1524	0	5
28/07/96	7	A	12:35	12:45	37 21.955	37 21.946	138 35.024	138 34.954	544331	601248	1218	1120	1128	1530	0	23
28/07/96	7	B	13:37	13:46	37 16.720	37 16.706	138 35.175	138 35.174	601248	648864	1030	920	920	1280	0	23
28/07/96	7	C	14:13	14:20	37 14.673	37 14.656	138 35.159	138 35.208	648877	684494	810	720	726	957	0	8
27/07/96	8	A	11:58	12:06	37 18.080	37 18.183	138 39.262	138 39.210	524860	560469	810	720	751	957	0	9
27/07/96	8	B	11:04	11:13	37 21.759	37 21.826	138 39.365	138 39.335	482486	524860	1000	920	930	1139	0	4
27/07/96	8	C	9:51	10:05	37 26.784	37 26.853	138 39.556	138 39.641	425950	482476	1198	1120	1138	1519	0	14
27/07/96	9	A	6:54	7:01	37 17.699	37 17.769	138 43.766	138 43.702	285447	321538	815	720	741	970	0	2
27/07/96	9	B	7:44	7:56	37 21.742	37 21.711	138 44.002	138 43.968	321527	369069	1011	920	924	1278	1	5
27/07/96	9	C	8:41	8:56	37 25.535	37 25.529	138 44.093	138 44.184	369069	425950	1206	1120	1133	1529	0	38
27/07/96	10	A	6:03	6:10	37 17.396	37 17.415	138 48.285	138 48.213	247773	285417	800	720	733	1012	0	4
27/07/96	10	B	5:15	5:25	37 21.019	37 21.002	138 48.393	138 48.390	201281	247776	1010	920	921	1249	0	36
27/07/96	10	C	4:18	4:30	37 24.793	37 24.813	138 48.668	138 48.775	141396	201287	1215	1120	1138	1609	0	3
28/07/96	11	A	0:16	0:26	37 20.126	37 20.066	138 55.698	138 55.701	846	37258	780	720	729	979	0	18
28/07/96	11	B	1:23	1:39	37 25.002	37 24.991	138 55.671	138 55.764	37300	84119	1060	920	936	1258	1	12
28/07/96	11	C	2:31	2:44	37 28.775	37 28.775	138 55.906	138 56.066	84155	141395	1210	1120	1159	1538	1	6

## Survey 2

Date	Transect	Station	Start time	End time	Start latitude	End latitude	Start longitude	End longitude	Start flowmeter	End flowmeter	Bottom depth (m)	Cable depth (m)	Tow dist. (m)	F'meter dist. (m)	Orange roughy eggs	Other large eggs
8/08/96	0	A	22:39	22:47	37 07.860	37 07.871	138 00.946	138 01.049	692988	731761	800	720	745	1042	0	7
8/08/96	0	B	23:09	23:20	37 08.013	37 08.127	138 00.765	138 00.879	731972	781747	1060	1020	1063	1338	0	6
8/08/96	0	C	0:16	0:28	37 14.018	37 14.118	138 00.749	138 00.830	781738	837181	1200	1120	1145	1490	0	6
9/08/96	1	A	3:03	3:11	37 08.966	37 08.997	138 07.984	138 08.097	936967	971674	770	720	752	933	0	0
9/08/96	1	B	2:17	2:27	37 11.887	37 11.898	138 08.133	138 08.251	893667	936966	1020	920	946	1164	0	2
9/08/96	1	C	1:20	1:33	37 15.182	37 15.322	138 08.056	138 08.293	837173	893914	1200	1120	1231	1525	0	3
9/08/96	2	A	3:48	3:56	37 10.060	37 10.085	138 12.519	138 12.555	971673	1010939	821	720	725	1055	0	0
9/08/96	2	B	5:00	5:09	37 16.398	37 16.439	138 12.672	138 12.798	10930	60652	975	920	952	1336	0	4
9/08/96	2	C	5:42	5:54	37 18.325	37 18.552	138 12.833	138 12.913	60652	124539	1200	1120	1205	1717	1	1
9/08/96	3	A	8:17	8:24	37 12.810	37 12.829	138 16.364	138 16.404	233910	269100	800	720	725	946	0	1
9/08/96	3	B	7:15	7:25	37 17.149	37 17.262	138 17.001	138 17.032	185250	234429	990	920	945	1322	2	3
9/08/96	3	C	6:34	6:46	37 18.040	37 18.131	138 17.194	138 17.261	124506	183299	1200	1120	1139	1580	0	6
9/08/96	4	A	9:07	9:14	37 14.324	37 14.410	138 21.404	138 21.409	269089	303740	806	720	737	931	0	8
9/08/96	4	B	9:56	10:06	37 17.710	37 17.776	138 21.853	138 21.952	303763	350870	1030	920	946	1266	0	6
9/08/96	4	C	10:38	10:50	37 19.714	37 19.825	138 21.893	138 21.991	350911	405567	1215	1120	1153	1469	2	6
9/08/96	5	A	12:51	12:59	37 14.553	37 14.587	138 26.095	138 26.085	516611	554311	808	720	723	1013	0	0
9/08/96	5	B	12:08	12:18	37 17.082	37 17.106	138 26.103	138 26.251	462990	514837	1000	920	961	1393	0	2
9/08/96	5	C	11:32	11:43	37 18.180	37 18.219	138 26.241	138 26.399	405590	462522	1200	1120	1160	1530	0	2
9/08/96	6	A	13:41	13:49	37 16.527	37 16.496	138 30.482	138 30.519	554326	593762	796	740	745	1060	1	6
9/08/96	6	B	14:23	14:33	37 18.838	37 18.782	138 30.537	138 30.643	593719	639108	992	920	946	1220	1	2
9/08/96	6	C	15:11	15:23	37 21.076	37 21.073	138 30.792	138 30.924	639079	695270	1190	1120	1146	1510	2	6
9/08/96	7	A	17:35	17:43	37 14.543	37 14.455	138 35.281	138 35.192	789880	824408	800	720	756	928	3	3
9/08/96	7	B	17:00	17:10	37 16.648	37 16.607	138 35.121	138 35.022	745321	789655	1028	920	941	1191	2	3
9/08/96	7	C	16:00	16:12	37 21.601	37 21.513	138 35.033	138 34.980	695250	744309	1210	1120	1136	1318	0	1
9/08/96	8	A	18:33	18:42	37 17.771	37 17.631	138 39.425	138 39.439	824371	863759	800	720	766	1058	2	6
9/08/96	8	B	19:32	19:42	37 21.457	37 21.422	138 39.589	138 39.537	863760	907008	997	920	927	1162	1	9
9/08/96	8	C	21:00	21:12	37 26.599	37 26.599	138 40.082	138 40.133	906999	956391	1190	1120	1124	1327	2	21
9/08/96	9	A	23:41	23:49	37 17.594	37 17.596	138 43.476	138 43.082	62885	102423	812	720	1025	1063	0	22
9/08/96	9	B	22:51	23:00	37 21.552	37 21.551	138 44.410	138 44.440	17752	63442	1000	920	922	1228	0	3
9/08/96	9	C	21:56	22:08	37 25.226	37 25.228	138 44.419	138 44.407	956418	1010568	1200	1120	1120	1455	0	4
10/08/96	10	A	0:24	0:31	37 17.382	37 17.461	138 48.380	138 48.444	102420	140981	800	720	744	1036	2	7
10/08/96	10	B	1:10	1:20	37 21.119	37 21.166	138 48.606	138 48.759	140963	187608	1010	920	967	1253	0	5
10/08/96	10	C	2:02	2:13	37 24.991	37 24.994	138 48.738	138 48.811	187608	241378	1210	1120	1128	1445	0	6
10/08/96	11	A	5:31	5:39	37 20.226	37 20.245	138 55.847	138 55.927	390190	427222	800	720	736	995	0	2
10/08/96	11	B	4:25	4:36	37 25.156	37 25.224	138 55.791	138 55.888	306577	356195	1050	1020	1043	1333	0	6
10/08/96	11	C	3:23	3:35	37 29.161	37 29.231	138 55.092	138 55.168	241377	300177	1210	1120	1136	1580	1	1