Mesopelagic and Larval Fish Survey

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Abstract

A survey of mesopelagic and larval fish was carried out during Leg II of the oceanographic survey using a three-panel net (Tucker Trawl). Finfish were also collected during IKMT deployments as part of a gear comparison experiment. Data collection included species identification, size composition, spatial and diel vertical distribution, diet composition, and otolith sampling of mesopelagic and larval finfish species around Elephant Island, near Joinville Island, and in the Bransfield Strait. Additional stations were sampled within the Gerlache Strait. The results from this field season include:

- 70 stations completed:
  - 26 in Elephant Island Area,
  - 14 in Joinville Island Area,
  - 22 in South Area (Bransfield Strait), and
  - 8 in Gerlache Strait;
- 148 individuals (1.479 kg) mesopelagic finfish of 10 species captured from all nets;
- 1,226 individual finfish larvae of 18 species captured from all nets;
- Spatial distribution of standardized finfish densities demonstrated substantial contrast across the shelf area;
- Length-frequency data presented for *Electrona antarctica* and *Gymnoscopelus braueri*; and
- Diet data presented for 82 specimens of 7 mesopelagic finfish species.

Introduction

It has been recognized that mesopelagic finfish species are among the most important predators of Antarctic krill and other important pelagic invertebrates in the South Shetland Islands and northern Antarctic Peninsula region. Further, pelagic finfish species serve as prey items, second only to Antarctic krill, for land-based predators such as fur seals and penguins. Although the importance of these finfish species in the Antarctic ecosystem is acknowledged, there are considerable uncertainties with respect to their population dynamics and their spatial distribution around the South Shetland Islands and northern Antarctic Peninsula, as well as the physical and biological factors that influence these.

The objective of the trawl survey conducted during Leg II was to elucidate the roles of mesopelagic and pelagic finfish in the pelagic trophic web; specific goals included data collection to be used for estimates of biomass, distribution, species and size composition, demographic structure, and diet composition of mesopelagic finfish species within the U.S. AMLR survey grid, as well as regions farther south. This survey represents the first comprehensive scientific characterization of these finfish in this area that the U.S. AMLR Program has undertaken, and the first survey of its kind in this region of the Southern Ocean.

Several other sampling efforts and biological experiments were conducted during the course of this survey, including otolith sampling for age and growth studies, voucher samples for land-based predator diet studies, and other specimen and tissue collections for biological, physiological, and phylogenetic studies. These data will be used to better understand the relationships of mesopelagic finfish to other components of the Antarctic ecosystem, including the physical oceanography in the region, and the density and distribution of Antarctic krill.

Methods

Pelagic Tucker Trawl Sampling

The primary fishing gear type employed was a four square meter effective mouth multiple opening/closing (three panel) Tucker Trawl net system (Open Seas Instrumentation Inc., Musquodoboit Harbour, NS). Additional finfish specimens were sampled with the IKMT net during gear comparison trials. The first and third panels of the Tucker Trawl were fitted with 505 μm nitex mesh net, and the second net (specifically targeting mesopelagic finfish) was fitted with a five millimeter knotless nylon mesh net. The cod-ends for all three nets consisted of six inch nominal OD, PVC, with four liter capacity and 250 μm window mesh. The trawl was instrumented with pitch and roll sensors, two GO (Model 2031H) electronic flow me-

Table 5.1. Deployment, station and nominal finfish catch information for the 2010/11 AMLR mesopelagic trawl survey. EI = Elephant Island; JI = Joinville Island; SA = Bransfield Strait (South Area); GS = Gerlache Strait.

AMLR Station	Deployment Type	Date	Region	Latitude Midpoint	Longitude Mid-point	Time First De-ployment	Number Finfish	Number Species
D0203A	Net Comp.	2/17/2011	EI	-60.489	-54.070	1:50 AM	8	3
D0206A	Net Comp.	2/17/2011	EI	-61.25	-53.904	11:52 AM	0	0
D0207A	Net Comp.	2/17/2011	EI	-61.498	-53.975	03:16 PM	0	0
D0307A	Net Comp.	2/17/2011	EI	-61.497	-54.525	06:31 PM	0	0
D0306A	Net Comp.	2/17/2011	EI	-61.225	-54.490	09:45 PM	0	0
D0307B	Net Comp.	2/18/2011	EI	-61.492	-54.484	1:17 AM	7	3
D0207B	Net Comp.	2/18/2011	EI	-61.501	-54.576	4:32 AM	1	1
D0206B	Net Comp.	2/18/2011	EI	-61.250	-53.877	8:25 AM	0	0
D02051	Net Comp.	2/18/2011	EI	-61.006	-53.983	11:45 AM	0	0
D0305A	Net Comp.	2/18/2011	EI	-60.988	-54.335	02:25 PM	0	0
D0405A	Net Comp.	2/18/2011	EI	-60.981	-54.787	06:06 PM	0	0
D0306B	Net Comp.	2/19/2011	EI	-61.217	-54.767	1:20 AM	4	2
D0307C	All Tucker	2/19/2011	EI	-61.529	-54.571	5:30 AM	9	5
D0305B	Net Comp.	2/21/2011	EI	-60.988	-54.556	12:48 AM	0	0
D0405B	Net Comp.	2/21/2011	EI	-60.991	-54.826	3:42 AM	0	0
D0404A	All Tucker	2/21/2011	EI	-60.735	-55.047	7:19 AM	2	1
D0403A	All Tucker	2/21/2011	EI	-60.479	-55.050	10:54 AM	6	1
D0303A	All Tucker	2/21/2011	EI	-60.478	-54.695	02:45 PM	0	0
D0304A	Net Comp.	2/21/2011	EI	-60.742	-54.521	06:56 PM	0	0
D0203B	Net Comp.	2/21/2011	EI	-60.495	-54.236	010:46 PM	0	0
D0202	All Tucker	2/22/2011	EI	-60.247	-54.060	1:33 AM	13	3
D0201A	All Tucker	2/22/2011	EI	-60.038	-54.072	5:41 AM	5	2
D0201	All Tucker	2/22/2011	EI	-60.000	-53.972	7:08 AM	13	3
D0402	Tucker 1 & 3	2/22/2011	EI	-40.131	-43.595	07:23 PM	0	0
D0401	Tucker 1 & 3	2/23/2011	EI	-59.990	-33.014	04:12 PM	0	0
D05501	Tucker 1 & 3	2/23/2011	EI	-59.998	-55.479	08:11 PM	0	0
D0209	All Tucker	2/26/2011	JI	-61.983	-54.599	3:35 AM	2	2
D0210	Tucker 1 & 3	2/26/2011	JI	-62.041	-54.017	8:08 AM	0	0
D0211	Tucker 1 & 3	2/26/2011	JI	-62.493	-54.009	11:52 AM	0	0
D0212	Tucker 1 & 3	2/26/2011	JI	-62.755	-54.054	03:20 PM	0	0
D0213	Net Comp.	2/26/2011	JI	-62.980	-54.079	06:38 PM	0	0
D0413	All Tucker	2/26/2011	JI	-62.987	-54.721	011:49 PM	2	1
D0412	Net Comp.	2/27/2011	JI	-62.735	-55.044	3:23 AM	0	0
D0411	All Tucker	2/27/2011	JI	-62.483	-55.046	6:51 AM	0	0
D0410	Net Comp.	2/27/2011	JI	-62.240	-55.044	10:24 AM	0	0
D0409	Net Comp.	2/27/2011	JI	-62.015	-54.996	02:36 PM	0	0

Table 5.1 continued. Deployment, station and nominal finfish catch information for the 2010/11 AMLR mesopelagic trawl survey. EI = Elephant Island; JI = Joinville Island; SA = Bransfield Strait (South Area); GS = Gerlache Strait.

AMLR Station	Deployment Type	Date	Region	Latitude Midpoint	Longitude Mid-point	Time First De-ployment	Number Finfish	Number Species
D0609	Net Comp.	2/27/2011	JI	-61.987	-55.600	07:30 PM	1	1
D0610	Net Comp.	2/27/2011	JI	-62.241	-56.029	011:05 PM	1	1
D0611	All Tucker	2/28/2011	JI	-62.486	-56.037	2:23 AM	0	0
D0612	All Tucker	2/28/2011	JI	-62.736	-56.021	7:07 AM	0	0
D0711	Net Comp.	2/28/2011	SA	-62.491	-56.320	12:07 PM	0	0
D0810	Net Comp.	2/28/2011	SA	-62.243	-56.791	03:17 PM	0	0
D0909	Net Comp.	2/28/2011	SA	-62.041	-57.215	06:47 PM	0	0
D1010	Net Comp.	2/28/2011	SA	-62.245	-57.584	010:27 PM	0	0
D0911	All Tucker	3/1/2011	SA	-62.369	-57.526	1:58 AM	12	5
D0812A	All Tucker	3/1/2011	SA	-62.757	-57.268	6:20 AM	0	0
D0913	Net Comp.	3/1/2011	SA	-62.980	-57.510	12:28 PM	0	0
D1012	Net Comp.	3/1/2011	SA	-62.757	-57.800	03:50 PM	0	0
D1111	Net Comp.	3/2/2011	SA	-62.481	-58.310	2:56 AM	5	1
D1212	All Tucker	3/2/2011	SA	-62.744	-58.855	7:00 AM	8	3
D1113	Net Comp.	3/2/2011	SA	-62.999	-58.728	12:15 PM	0	0
D1313	Net Comp.	3/2/2011	SA	-62.996	-59.129	07:31 PM	0	0
D1412	Net Comp.	3/2/2011	SA	-62.741	-59.824	010:52 PM	0	0
D1513	All Tucker	3/3/2011	SA	-63.029	-60.296	2:16 AM	6	2
D1414	All Tucker	3/3/2011	SA	-63.216	-60.152	6:37 AM	12	1
D1515	Net Comp.	3/3/2011	SA	-63.489	-60.298	11:02 AM	0	0
D1614	Net Comp.	3/3/2011	SA	-63.238	-60.651	02:27 PM	0	0
D1713	Tucker 1 & 3	3/3/2011	SA	-62.993	-61.506	05:58 PM	0	0
GS01A	All Tucker	3/3/2011	GS	-63.747	-61.457	011:55 PM	5	3
GS02A	All Tucker	3/4/2011	GS	-64.328	-61.697	5:46 AM	4	4
GS03A	All Tucker	3/4/2011	GS	-64.577	-62.344	10:41 AM	1	1
GS03B	All Tucker	3/5/2011	GS	-64.562	-62.590	1:18 AM	7	2
GS03C	Targeted	3/3/2011	GS	-64.562	-62.550	2:44 AM	0	0
GS02B	All Tucker	3/5/2011	GS	-64.305	-61.769	7:10 AM	0	0
GS01B	All Tucker	3/5/2011	GS	-63.764	-61.570	12:43 PM	3	2
GS13	IKMT Only	3/5/2011	GS	-64.109	-61.468	011:22 PM	1	1
D1110A	All Tucker	3/7/2011	SA	-62.315	-58.045	09:55 PM	3	2
D1110B	All Tucker	3/8/2011	SA	-62.301	-58.032	12:27 AM	2	2
D1110C	Tucker 1 & 3	3/8/2011	SA	-62.333	-58.011	3:09 AM	4	2
D1110D	All Tucker	3/8/2011	SA	-62.293	-57.995	6:41 AM	1	1

ters, a net drop sensor, and a Sea-Bird Seacat plus profiler.

Mesopelagic finfish sampling operations were conducted aboard the R/V *Moana Wave* 17 February through 8 March 2011 (Table 5.1). A total of 70 stations were completed (Figure 5.1). The survey targeted areas near Elephant Island, Joinville Island, the Bransfield Strait, and the Gerlache Strait. Of the 70 stations, 34 were sampled as part of the gear comparison between the IKMT and Tucker Trawl nets one and three (the 505 µm nitex nets for krill); 26 of the comparison tows used all three nets of the Tucker Trawl and eight comparison tows used Tucker Trawl nets one and three. In addition, there was one tow taken to ground truth a strong scattering layer of krill, and one tow only using the IKMT. The positions of these stations by deployment type are illustrated in Figure 5.1.

Sampling depths depended on the gear deployment type. In the case of the Tucker Trawl deployments, net one was fished from the surface to 170 m (descending), net two fished from 170 m to the maximum deployment depth, which ranged from 240 to 652 m, and net three fished from 170 m to the surface (ascending). The IKMT was deployed the standard 170 m. Sampling was conducted around the clock, with most Tucker Trawl net two deployments undertaken at night.

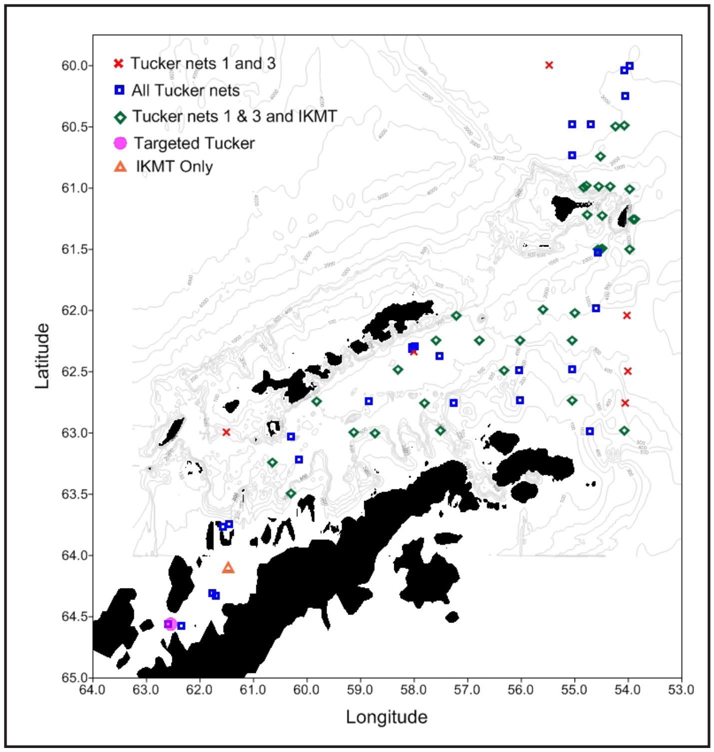


Figure 5.1. Station locations by gear deployment from the 2010/11 AMLR mesopelagic finfish survey of the Elephant Island, Joinville Island and South Areas.

Haul Processing

After a successful haul, the contents of the trawl were emptied and transferred to a sorting table, where fish were identified, separated into species, and placed into individual species trays. Pelagic fish were processed separately from krill and invertebrates. Trays were weighed to obtain total catch weights by species. Data collected in included length (mm), mass (g), sex, gonad maturity stage where possible, and diet composition. Length types were collected as standard length (length from tip of snout to end of caudal peduncle). All masses were measured as total fresh mass to nearest gram. For mesopelagic species, maturity was classified on a scale of I to V (immature, maturing virgin or resting, developing, gravid, spent) according to the method set out for *Electrona antarctica* in the CCAMLR manual for scientific observers (CCAMLR 1999). In addition, otoliths and tissue samples were taken from most specimens. Early life stages of fish species were classified on a scale of I to IV according to Koubbi et al. (1990) and measured in standard length to the nearest mm. Identification was done mainly using North and Kellerman (1990).

An examination of the diet composition of mesopelagic finfish was conducted across all regions of the survey for most species. Stomach content information included content weight (to the nearest g); a measure of the filling degree on a scale of 0 - 5 (empty, 25% full, 50% full, 75% full, 100% full, regurgitated); and a measure of the degree of digestion on a scale of 1-3 (fresh, moderately digested, fully digested). Dietary items were identified to general common taxonomic groupings, and to species whenever possible. The relative volume of each species present within a stomach was recorded by assigning each dietary component a proportion from 0-10, with the total score for each stomach adding to 10.

Results

Patterns of Distribution of Mesopelagic Finfish

A total of 148 individuals (1.48 kg) of 10 finfish species were processed from all hauls (Table 5.2). The family Myctophidae was the dominant element of the pelagic finfish fauna both in terms of biomass and numbers. The highest catches of all mesopelagic fish occurred at offshore stations (Figure 5.2). In general, there was an absence of fish at stations located on shallower shelf areas, though this is likely influenced by the specific gear deployment and time of day (Table 5.1, Figure 5.2). In the case of the latter, myctophids likely migrated deeper than the depth of gear deployment during daylight hauls. With regard to catch by gear type (Figure 5.3), the Tucker Trawl net two,

Table 5.2. Summary of catch data for mesopelagic finfish by species.

Family	Species	Total Numbers	Total Weight (g)	No. Stations Occurred	Stomachs Analyzed	Otoliths Collected
Myctophidae	*Electrona antarctica*	76	693	38	58	25
	Electrona carlsbergi	13	90	6	12	8
	Gymnoscopelus braueri	32	229	15	26	11
	Gymnoscopelus nicholsi	11	368	9	11	8
	Gymnoscopelus opisthopterus	1	16	1	1	
	Protomyctophum bolini	4	2	4	3	1
Bathylagidae	*Bathylagus antarcticus*	7	36	6	3	1
Nototheniidae	*Pleuragramma antarcticum*	2	16	1	-	-
	Chionodraco rastrospinosus	1	30	1	-	-
Gonostomatidae	*Cyclothone* spp.	1	-	1	-	
Total		148	1480		114	54

specifically designed and deployed to catch mesopelagic fish, caught the most fish (n = 62), followed by the Tucker Trawl net three (n = 42), Tucker Trawl net one (n = 24) and the IKMT (n = 21). For most species, the Tucker Trawl net one (505 μm mesh descending net) caught fewer fish than Tucker Trawl net three (505 μm mesh ascending net).

The two most prominent mesopelagic finfish species encountered during the course of the survey were *Electrona antarctica* and *Gymnoscopelus braueri* (Table 5.2), which were captured in all net types, followed by *Electrona carlsbergi* and *Gymnoscopelus nicholsi*. The remaining species only represented a few individuals. Average standard lengths of all specimens measured are listed in Table 5.3, and length-frequency distributions for *E. antarctica* and *G. braueri* are plotted in Figure 5.4. The spatial distribution of catches was driven primarily by the occurrence of *E. antarctica* (Figure 5.5), which was encountered at 38 stations, followed by *G. braueri* (Figure 5.6), which was encountered at 15 stations.

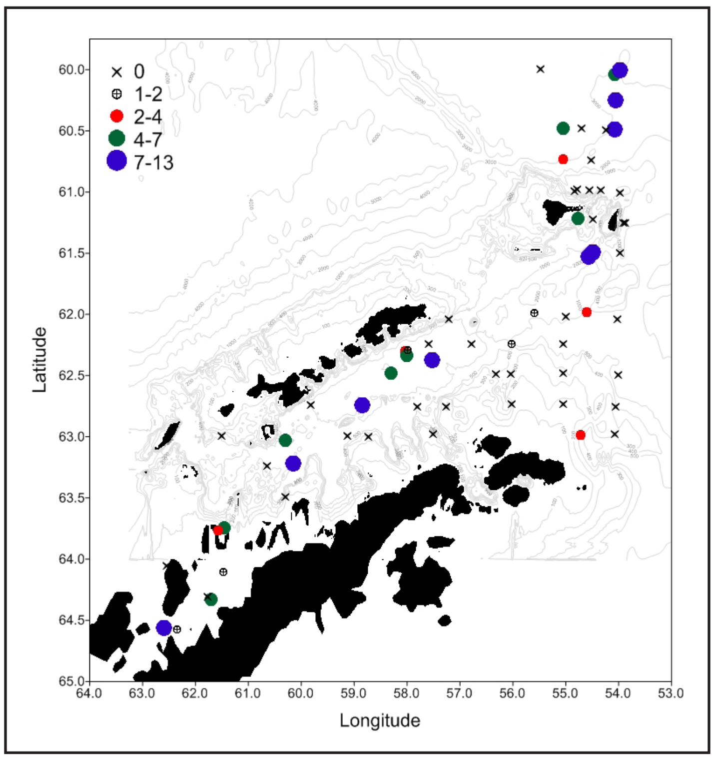


Figure 5.2. Nominal catch in numbers of mesopelagic finfish from all gear deployments.

Diet

Diet was characterized for 114 fish (Table 5.4). Of these, 82 (72%) had stomach contents. The frequency of occurrence of prey items (number of stomachs where the specific prey was found over the total number of stomachs with prey) for the four main myctophid species are illustrated in Figure 5.7. The x axis of each figure lists the major planktonic groups, while the y axis indicates the frequency of occurrence for some prey items identified to species. Caution should be noted with respect to interpreting the species-specific data with respect to euphausiids, as most of them were digested and could not be identified to species. Thus, the frequencies of occurrence of *Thysanoessa macrura* and *Euphausia superba* (identified to species) is underestimated, whereas the frequency of occurrence of total euphausiids

Table 5.3. Standard length (cm) of mesopelagic finfish by species.

Species	Total numbers	Mean SL (cm)	STD SL	SL Min	SL Max
Bathylagus antarcticus	4	10.5	1.2	9.1	11.9
Bathylagus spp. (juveniles)	3	3.6	1.1	2.9	4.9
Cyclothone spp.	1	3.4			
Electrona antarctica	76	8.4	1.6	3.2	10.6
Electrona carlsbergi	13	8	0.3	7.4	8.6
Gymnoscopelus braueri	32	9.2	1.8	6.4	13.1
Gymnoscopelus nicholsi	11	14.6	0.7	13.4	15.6
Gymnoscopelus opithopterus	1	12.5			
Protomyctophum bolini	4	4.825	0.4	4.4	5.3
Pleuragramma antarcticum	2	9.7		9.6	9.8
Chionodraco rastrospinosus	1	15.8			

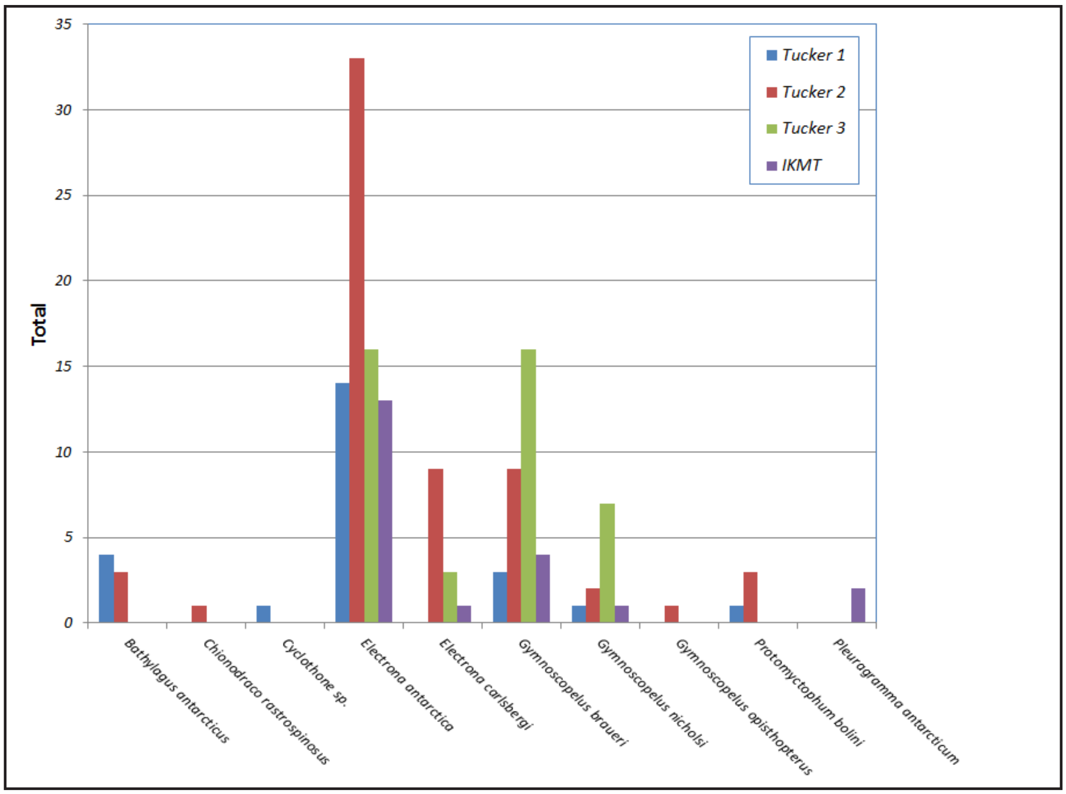


Figure 5.3. Nominal catch in numbers of mesopelagic finfish by gear type.

is more accurate. The issue of identification to species was less important for other prey species. In addition, it should be noted that sample sizes for species other than *E. antarctica* are very low, and thus the dietary composition should be treated as indicative.

The top prey items for all four myctophid species were euphausiids and copepods. The primary species within these major planktonic groups for *E. antarctica*, *G. braueri*, and *G. nicholsi* were the euphausiids *E. superba* and *T. macrura*, and the calanoid copepod *Metridia* spp. At the species level, the diet of *E. carlsbergi* was also dominated by *Metridia* spp., though the importance of the copepods *Oncea* spp. and *Rhincalanus gigas* were also apparent.

The spatial distribution of diet for *E. antarctica* and *G. braueri* across the surveyed area is illustrated in Figures 5.8 and 5.9, respectively. With respect to *E. antarctica*, there were no clear patterns, although interestingly, krill were particularly prominent in the stomachs of fish sampled just outside Admiralty Bay, where anecdotal evidence suggest the commercial krill fishery operated for a significant portion of the survey period. Also, the substantial proportion of *T. macrura* in the most southerly samples was noteworthy. Dietary composition of *G. braueri* demonstrated a somewhat stronger pattern particularly in the Bransfield Strait; *T. macrura* were particularly important in the stomachs of *G. braueri* collected south of King George Island, whereas the diets of the most southerly samples showed very similar compositions with respect to the proportions of *E. superba* and *T. macrura*.

Diel Vertical Distribution

During night tows, catches were taken primarily in the epipelagic zone. Bathypelagic species were rarely collected.

Estimates of the vertical distribution of *E. antarctica* were completed us-

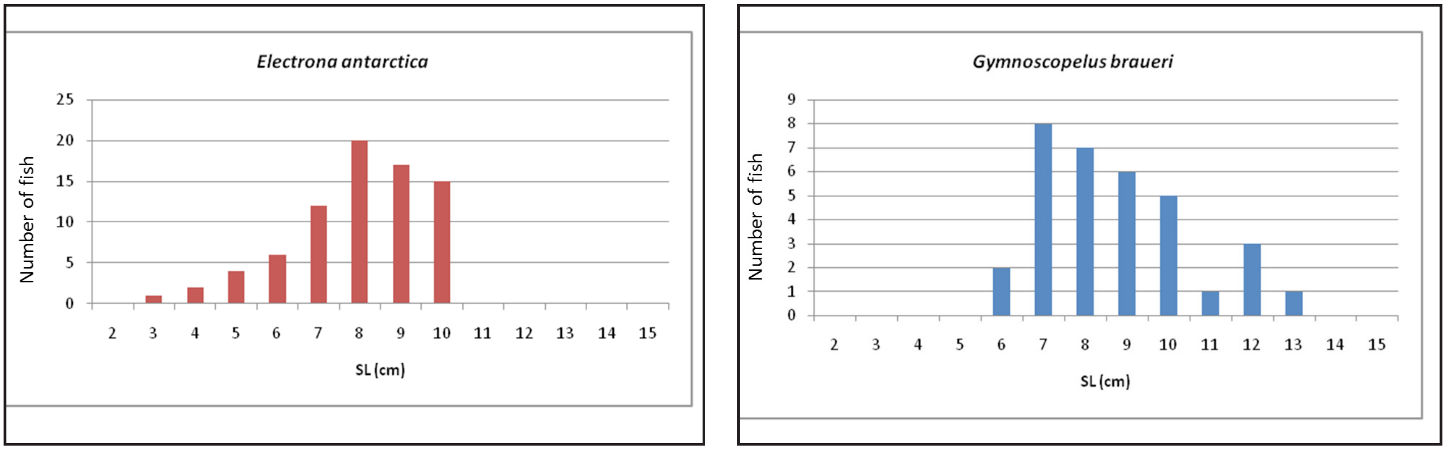


Figure 5.4. Length-frequency distributions for *E. antarctica* and *G. braueri* (SL = standard length).

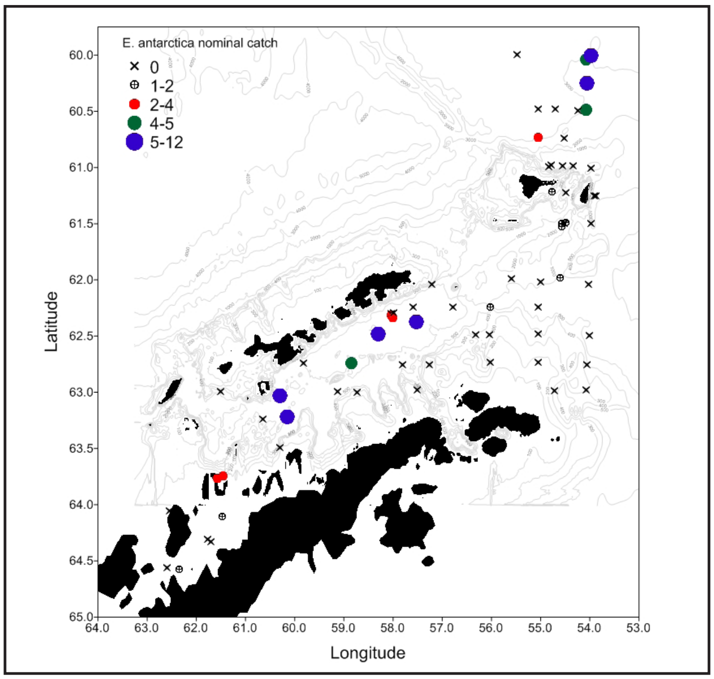


Figure 5.5. Nominal catch in numbers of *Electrona antarctica* from all gear deployments.

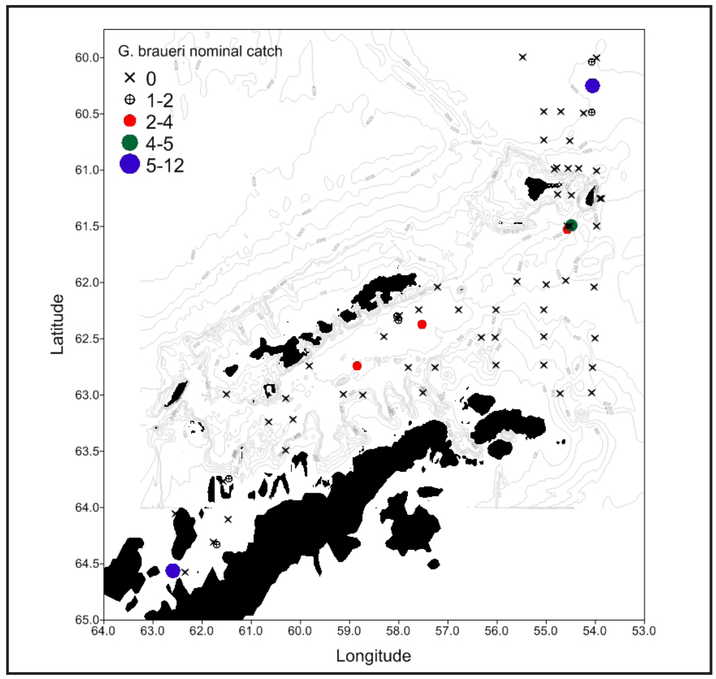


Figure 5.6. Nominal catch in numbers of *Gymnoscopelus braueri* from all gear deployments.

ing the maximum depth of each IKMT and Tucker Trawl sample and the local time at sampling. Figure 5.10 demonstrates the vertical migration at night of *E. antarctica*, which migrates to deep layers during the day. Bubble size corresponds to the number of fish collected (and is indicative of abundance), and the blue points correspond to each IKMT and Tucker Trawl. When information on flow rates of all trawls become available, it will worthwhile using this information to calculate the actual abundance.

As expected, the few specimens of Bathylagidae (many of them juveniles) were collected in the deeper layers, and *G. braueri* was only found at night in all layers.

Fish Larvae

A total of 1,226 fish larvae of 18 different species were collected from all nets. For samples with high numbers of salps, subsamples were sorted for fish larvae and the rest of the plankton sample was rapidly screened. Otherwise, all larvae were sorted. The majority of fish larvae collected were identified to species level, according to North and Kellerman (1990). On a few occasions, identifications were made at a higher taxonomical level, due mainly to damaged specimens. Due to the uncertainties of volume readings from the Tucker Trawl (at the time of this report), it was not possible to calculate accurate abundances for

Table 5.4. Numbers of species analyzed for diet composition with stomach filling degree. Filling degree categories are as follows: 0 = empty, 1 = 25% full, 2 = 50% full, 3 = 75% full, 4 = 100% full, and 5 = regurgitated.

Species	Filling Degree						Total Fish Analyzed	Fish with Stomach Contents
	0	1	2	3	4	5		
Bathylagus antarcticus		3					3	3
Electrona antarctica	20	15	12	9	2		58	37
Electrona carlsbergi	1	4	7				12	11
Gymnoscopelus braueri	11	6	3	6			26	15
Gymnoscopelus nicholsi	1	7	3				11	10
Gymnoscopelus opithopterus		1					1	1
Protomyctophum bolini		2	1				3	3
Total							114	82

fish larvae, so the term "abundance" as used here represents the number of collected specimens. The most abundant species found was *Lepidonotothen larseni* (n = 558), which was collected at 28.95% of sampled stations. The species encountered most frequently was *Lepidonotothen kempi*, which was collected at more than 40% of the stations, although in low numbers (n = 98) (Table 5.5). Other frequently collected species were *Trematomus scotti* (FO 23.68%; n = 78); *Chionodraco rastrospinosus* (FO 21.05%, n = 29), *Pleuragramma antarcticum* (FO 17.11%, n = 111) and *Champ-*

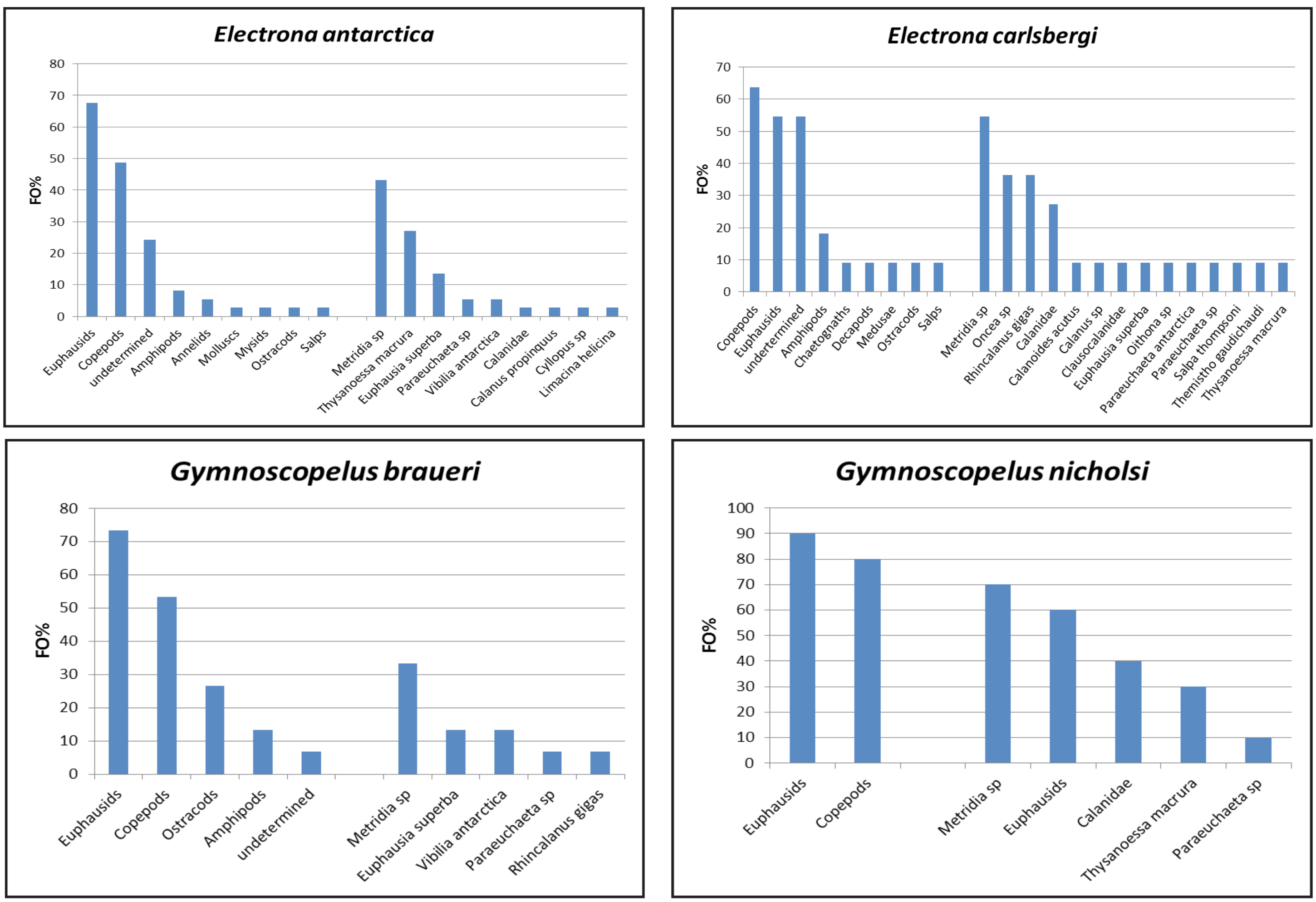


Figure 5.7. Frequency of occurrence for prey items found in the four prominent species of myctophids.

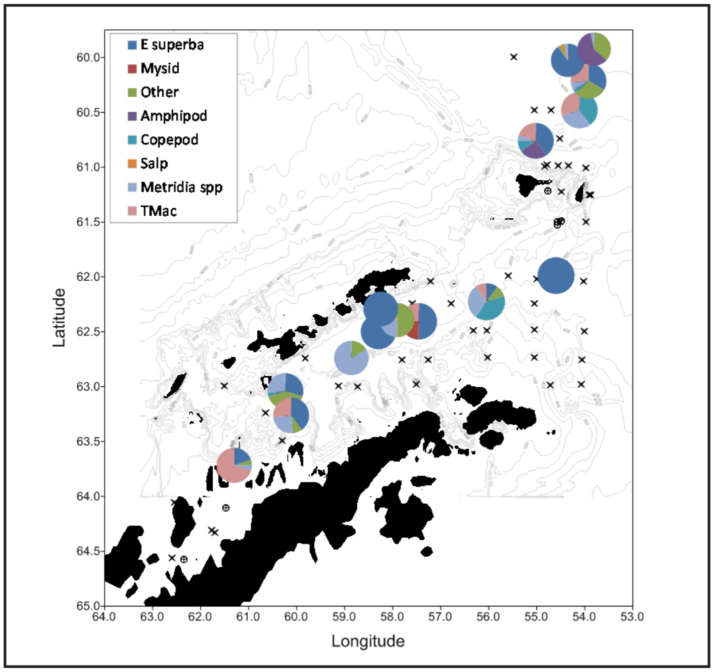


Figure 5.8. Spatial distribution of average dietary composition for the myctophid *E. antarctica*. TMac is the euphausiid *Thysanoessa macrura*.

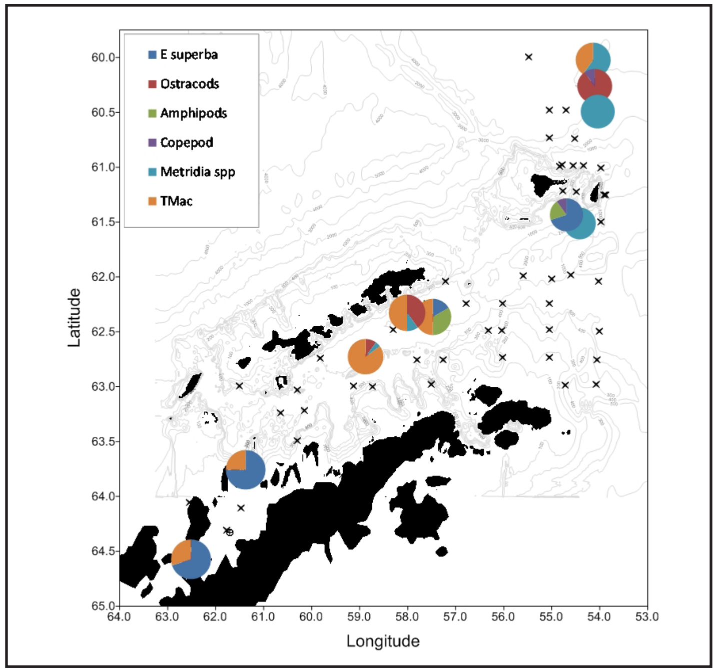


Figure 5.9. Spatial distribution of average dietary composition for the myctophid *G. braueri*. TMac is the euphausiid *Thysanoessa macrura*.

socephalus gunnari (FO 15.79%, n = 130).

The majority of fish larvae collected (97.4%) were of early life stages (stages 1 - 4, according to Koubbi et al. (1990)); the rest were juveniles or transforming larvae stages. For instance, all *Chaenodraco wilsoni*, *C. rastrospinosus*, *Cryodraco antarcticus*, *Parachaenichthys charcoti*, and *Pogonophryne marmorata* specimens collected were juveniles or transforming stages (Table 5.6). A few *P. antarcticum* juveniles were also collected.

Table 5.7 shows the minimum and maximum standard lengths found per species. Figure 5.11 illustrates length-frequency distributions for the most abundant fish larvae collected.

The capture comparison between the different nets was also evaluated according to stage of development. Fish larvae in stages 1 - 4 were mainly captured in the upper 170 m of the water column. Although the IKMT net caught the most larval fish, the Tucker Trawl, with a similar towing dynamic, collected a greater number of specimens when Tucker Trawl net one (towed from 0 – 170 m) and net three (towed from 170 – 0 m) data were combined (Figure 5.12). This is consistent with the greater dimension of the Tucker Trawl. Captures of juveniles and transforming larvae were greater in deeper layers, as emphasized by the greater number of specimens collected in Tucker Trawl net two, towed between 170 and 300 m (for most hauls,

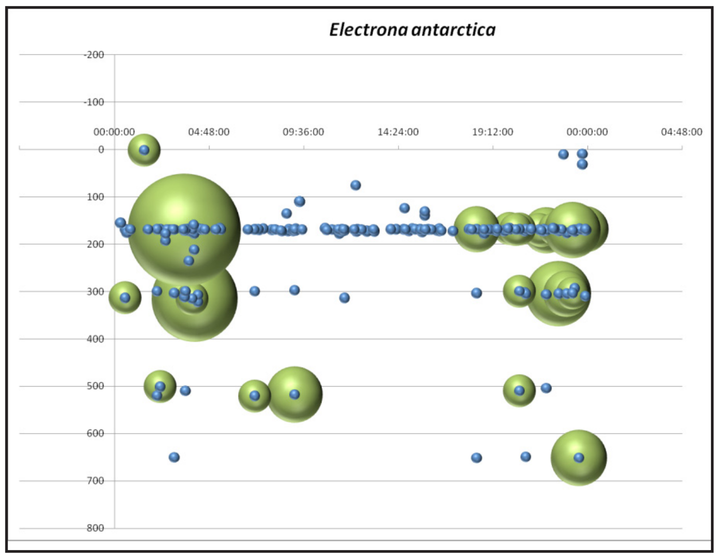


Figure 5.10. Catch of *E. antarctica* by time of deployment. Time of day is on the horizontal axis, and depth is on the vertical axis. Bubble size corresponds to the number of fish collected, and the blue points correspond to each IKMT and Tucker net deployment.

Figure 5.13). When the flow meter readings are resolved, catch/m^3 will clarify any differences in net efficiencies.

Discussion

Future mesopelagic finfish sampling efforts should endeavor to undertake deep net deployments during day-

Table 5.5. Number of fish larvae collected and % occurrence.

Species	Number Collected	% Occurrence
Bathylagus antarcticus	1	1.32
Bathylagus spp.	4	5.26
Chaenodraco wilsoni	2	1.32
Champsocephalus gunnari	130	15.79
Channichthydae spp.	2	2.63
Chionodraco rastrospinosus	29	21.05
Cryodraco antarcticus	4	5.26
Electrona antartica	9	10.53
Electrona sp.	115	7.89
Gobionothen gibberifrons	1	1.32
Lepidonotothen kempi	98	40.79
Lepidonotothen larseni	558	28.95
Myctophidae larvae	1	1.32
Notolepis coatsi	10	9.21
Notolepis spp.	3	2.63
Nototheniidae spp.	4	5.26
Nototheniops nudifrons	31	5.26
Pagetopsis maculatus	2	2.63
Pagetopsis spp.	2	2.63
Parachaenichthys charcoti	4	1.32
Pleuragramma antarcticum	111	17.11
Pogonophryne marmorata	1	1.32
Racovitzia glacialis	3	2.63
Trematomus newnesi	7	1.32
Trematomus scotti	74	23.68
Unident. fish larvae	20	2.63
Total	1,226	

light hours to better understand the vertical migratory patterns in the AMLR study region. During this field season, the Tucker Trawl was deployed to depths considerably more shallow than what was intended (approximately 600 m), primarily due to technical difficulties with the cable. Fishing at greater depths for all hauls will improve sampling of mesopelagic fish, and will enable collection of a broader range of mesopelagic species and better elucidation of their relationships to mesozooplankton.

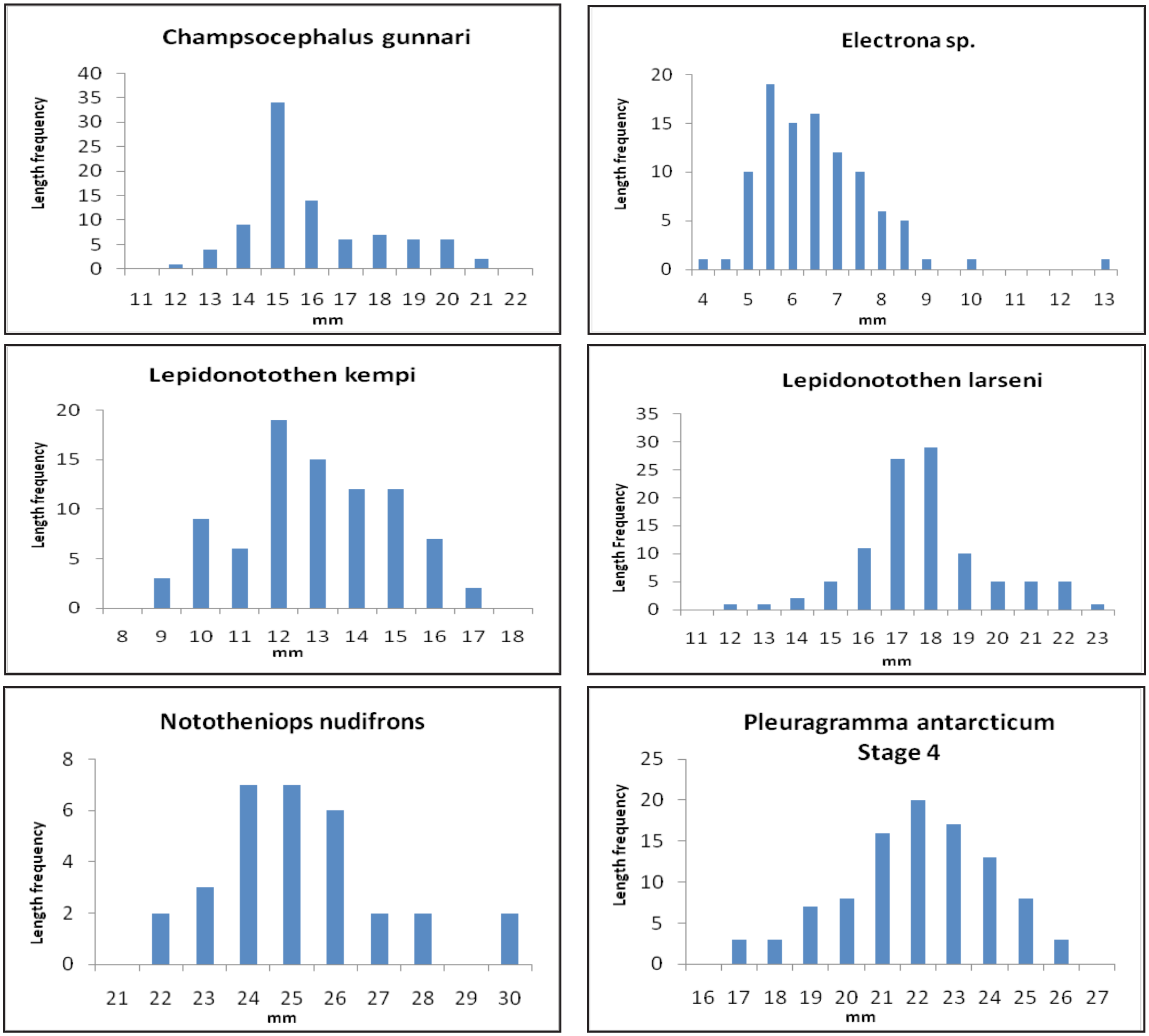
With respect to larval fish, some small changes to the

Table 5.6. Number of juveniles/transforming stages collected.

Species	Number collected
Bathylagus spp.	3
Chaenodraco wilsoni	2
Chionodraco rastrospinosus	7
Cryodraco antarcticus	4
Notolepis spp.	2
Nototheniidae spp.	1
Parachaenichthys charcoti	4
Pleuragramma antarcticum	8
Pogonophryne marmorata	1

Table 5.7. Minimum, maximum, and average standard lengths (with standard deviation) of fish larvae (SL = standard length).

Species	Min SL (mm)	Max SL (mm)	Average SL (mm)	St. dev SL (mm)
Bathylagus spp.	17	49	31.25	13.22
Bathylagus antarcticus	11.3	11.3		
Chaenodraco wilsoni	56	69	62.5	9.19
Champsocephalus gunnari	12	21.2	16.23	2.04
Chionodraco rastrospinosus	40	72	54.3	9.62
Cryodraco antarcticus	87	107	100.75	9.46
Electrona antarctica	8.6	15.3	11.35	2.89
Electrona spp.	4.44	13	6.82	1.21
Gobionothen gibberifrons	26.5	26.5		
Lepidonotothen kempi	9.4	17.2	13.16	1.89
Lepidonotothen larseni	12.4	23	17.86	1.92
Nothteniidae juv.	71	71		
Notolepis coatsi	12.3	42	26.89	10.17
Notolepis spp.	65	65		
Nototheniidae unid.	13.1	13.1		
Nototheniops nudifrons	22	30.2	25.23	1.99
Pagetopsis maculatus	17	17		
Pagetopsis spp.	19	22	20.5	2.12
Parachaenichthys charcoti	52.8	58.7	54.475	2.83
Pleuragramma antarcticum	17.7	72	25.07	10.87
Pogonophryne marmorata	31.2	31.2		
Racovitzia glacialis	20.6	24	22.27	1.7
Trematomus newnesi	34.5	39.7	37.27	2.14
Trematomus scotti	11.7	20	15.7	2.03



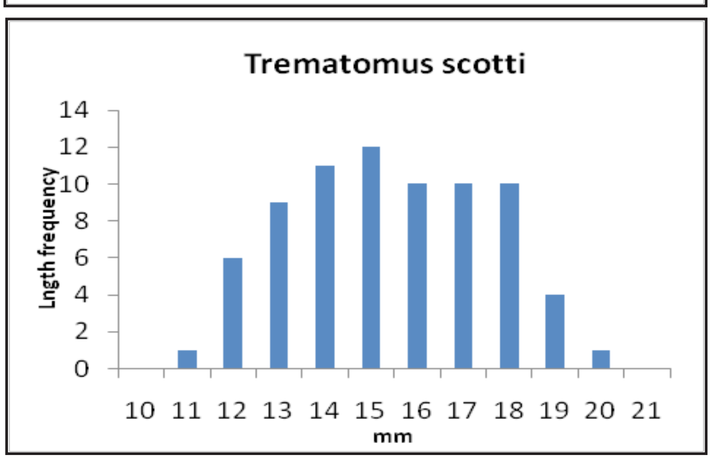


Figure 5.11. Length-frequency distributions for the most abundant fish larvae.

protocol of zooplankton sampling would reduce underestimation of fish larvae. As for krill, samples should be processed whole for fish larvae presence or an increased subsample volume should be considered. When there is a great abundance of *Salpa thompsoni* it could be tedious, but in some occasions species not found in the subsample were instead found in the rest of the sample, within the same net.

Protocol Deviations

This was the first year that a pelagic fish survey was

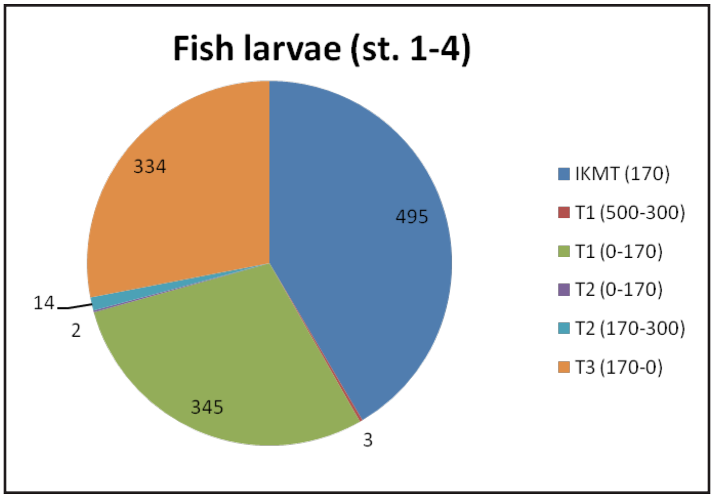


Figure 5.12. Catch comparison per net type of fish larvae stage of development 1-4. Numbers in parentheses indicate the depths in meters at which the nets were towed, and the numbers in the figure are the numbers of larvae caught.

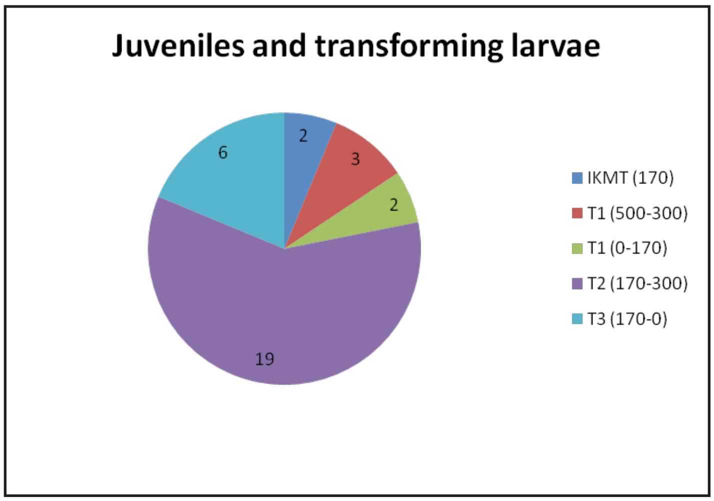


Figure 5.13. Catch comparison per net type of juvenile fish and transforming larvae. Numbers in parentheses indicate the depths in meters at which the nets were towed, and the numbers in the figure are the numbers of larvae caught.

completed by the U.S. AMLR Program. As such, the sampling protocol is still in development. However, this year the protocol was designed for sampling to approximately 600 m using the Tucker Trawl; poor weather conditions and a faulty cable prevented sampling to this depth. Most samples were collected in tows done at 300 m depth, with a few samples collected as deep as 500 m.

Disposition of Data

Data are available from Christopher Jones, NOAA Fisheries, Antarctic Ecosystem Research Division, 8901 La Jolla Shores Dr., La Jolla, CA 92037. Ph: 858-546-5605, Fax: 858-546-7003.

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