FI: GCP/RLA/140/JPN

TECHNICAL DOCUMENT No. 6

FAO/GOVERNMENT COOPERATIVE PROGRAMME

SCIENTIFIC BASIS FOR ECOSYSTEM-BASED MANAGEMENT IN THE LESSER ANTILLES INCLUDING INTERACTIONS WITH MARINE MAMMALS AND OTHER TOP PREDATORS

ACOUSTIC BIOMASS ESTIMATES OF PELAGIC FORAGE SPECIES IN THE OFFSHORE WATERS OF THE LESSER ANTILLES

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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Report prepared for the

Lesser Antilles Pelagic Ecosystem Project

(GCP/RLA/140/JPN)

by

Gary Melvin, Paul Fanning, Ciaran O'Donnell, Martin Dahl, Lucine Edwards, Ross Gardner, Hilroy Simon and Derrick Theophille

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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ABSTRACT

Scientific Basis for Ecosystem-Based Management in the Lesser Antilles Including Interactions with Marine Mammals and Other Top Predators: Acoustic biomass estimates of pelagic forage species in the offshore waters of the Lesser Antilles, by Melvin, G[1], P Fanning[2], C O'Donnell[3,] M Dahl[4], L Edwards[5], R Gardner[6], H Simon[7] and D Theophille[8], FAO, Barbados, 2008. viii + 46 pp., 6 Tables and 7 Figures, FI:GCP/RLA/140/JPN. Technical Document No. 6

A recently completed survey of the Lesser Antilles pelagic ecosystem used a combination of multi-frequency acoustics and pelagic trawling to locate and estimate the biomass of forage species. Stratified zig-zag transects were used to investigate an area of 610 000 km^2 in the waters east and west of the Lesser Antilles from Antigua to Trinidad.

Distinct pelagic layers and aggregations observed acoustically were sampled using a multiple (3) codend pelagic trawl. Pelagic organisms were identified to the lowest taxon possible and categorized by the presence or absence of a swim bladder. The acoustic data were grouped into nine broad categories based on the multi-frequency returns considering backscattering strength, aggregation appearance, depth and time of day. The resulting acoustic density was converted to indicative biomass density (kg/m^2) by application of target strength estimates from published sources. Relative abundance and composition of the nine acoustic categories for the 18 and 38 kHz frequencies are presented.

The spatial distribution of these broad categories displayed several distinct patterns. There was an inshore-offshore segregation of some groups throughout the survey area, but there was little sign of latitudinal gradients in distribution of these broad groupings. In the open pelagic waters, diel vertical migrations were observed by several identifiable acoustic categories, particularly mesopelagic fish (largely Myctophormes and Stomiiformes), and squids. Dusk and dawn vertical excursions were observed daily between depths from 500 m to less than 100 m.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY

Backscatter	generic term used to refer to the relative energy returned to the sound source from a target.
Biomass density	the estimated density or concentration of fish in the acoustic beam either per unit area or unit volume (i.e. kg m^{-3} or kg m^{-2})
Calibration	Measuring the performance of an acoustic system (i.e., electrical and acoustical)to a specified standard such that the acoustic energy received after correction for beam spreading and absorption losses is proportional to fish density. Convention method is to use a copper or tungston carbide sphere of known acoustic properties to standardize the system.
Classification	the assignment or grouping of acoustic samples into functional or associated categories. For multiple frequencies the grouping is usually relative to observations of a specific frequency (eg. 38kHz)
Target strength	The range-dependent ratio of the echo intensity at 1 m from a target to the incident intensity.

BACKGROUND

The implementation of the Ecosystem Approach to Fisheries (EAF) entails important changes in the way fisheries management is conceived and practiced. The FAO technical guidelines for the ecosystem approach to fisheries (2003) define EAF as follows: "*An ecosystem approach to fisheries strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries*". Although the main principles that characterize EAF are not new, but already embedded in a number of international agreements and conference documents, there is limited practical experience in implementing them.

The project GCP/RLA/140/JPN (Scientific Basis for Ecosystem-based Management in the Lesser Antilles Including Interactions with Marine Mammals and Other Top Predators) addresses one of the challenges related to the implementation of the ecosystem approach to fisheries, i.e. the development of management strategies that take into account biological interactions among species, including cetaceans and other top predators and any species that may be of no direct importance to fisheries but yet, may play an important role in maintaining ecosystem structure and functioning.

The **medium-term objective** of the project is to enable fishery institutions in the region, by 2007, to carry out improved assessments and monitoring of the status of the pelagic resources and fisheries and the ecosystem of which they form a part, for continuous adaptation and improvement of optimum management strategies. **Immediate objectives** include:

1. obtaining improved estimates of the abundance of key components of the Lesser Antilles pelagic ecosystem, including cetaceans and other top predators;
2. the formulation of a food web model of the ecosystem as a means of investigating ecosystem interactions and impacts;
3. the development of an ecosystem management plan for the pelagic waters of the EEZs of the participating countries, which will include management strategies for key species of fishery interest in the sub-region, as well as for other affected and dependent species, and
4. the development of research and management capacity for ecosystem-based management of their pelagic waters at a national and sub-regional level.

Project activities in support of Objective 1 have included cetacean sighting surveys, both regional and offshore as well as national, nearshore surveys. There was a pelagic acoustic/trawling survey to obtain estimates of abundance of forage species and environmental information. Work towards Objective 2 included collection, compilation and analysis of data to estimate model parameters regarding diets, physiology, fisheries and primary production. These were incorporated into a mass-balance model of the pelagic food web using the Ecopath with Ecosim software. To address Objective 3 the LAPE project first completed a series of stakeholder consultations in each of the participating countries to identify fisheries management issues with a particular view towards ecological issues and prioritizing the identified issues. In most countries this process continued by developing performance reports, including specific indicators, for at least one of the high-priority issues. There remains work to be done in each case to complete this process for the pelagic fisheries, and other sectors have not been started. The development of national and sub-regional capacity in this regard (Objective 4) primarily included training sessions associated with specific activities i.e. 'on-the-job' training. There was also training for smaller groups involved in specific tasks e.g. GIS modellers or diet analysts.

LESSER ANTILLES PELAGIC ECOSYSTEM SURVEY

The FAO Lesser Antilles Pelagic Ecosystem project undertook a multi-disciplinary ecosystem survey in the eastern Caribbean in April and May 2006. This multi-national survey involved a team of 18 scientific staff operating four largely-independent programmes simultaneously; acoustic biomass estimation, biomass sampling, environmental sampling, and a sighting survey. The 26 sea-day survey was conducted in the Lesser Antilles from Trinidad to Antigua between 25 April and 22 May 2006.

The survey ship was the R/V *Celtic Explorer* from the Marine Institute in Galway Ireland. The vessel is a state-of-the-art acoustic fisheries research platform, and one of the first in the world to meet the ICES CRR Report 209 standards for radiated noise for acoustic surveys. An important feature of the vessel is her pelagic trawling capability with a choice of a herring trawl (relatively small for a pelagic trawl) and a larger mackerel trawl, the latter equipped with a three-codend multi-sampler provided by the Institute of Marine Research in Norway. The vessel is also equipped with a suite of oceanographic sampling equipment (CTD, water sampling bottles, fluorometer) and laboratory space. For this survey, sighting platforms on the wheelhouse roof and the crow's nest were used for a visual sighting survey of cetaceans and flyingfish.

SURVEY DESIGN AND CRUISE TRACK

Survey Design

The survey design was based on a number of considerations to balance the time requirements of the four survey activities (acoustic transects, sighting transects, fishing stations and oceanographic sampling stations), while providing broad scale representative coverage of the area. Acoustic and sighting transects were the same lines with the acoustics data collections operating 24-hours a day and the sighting observations limited to daylight hours. All transect surveying was suspended at predetermined and observation-dependent locations to conduct station sampling, either trawling or oceanographic.

The LAPE study area included the inshore and offshore water of the Lesser Antilles from Trinidad to Antigua (Figure 1). The spatial strata and design are fully documented in the LAPE Project Ecosystem Survey Cruise Report (FAO, 2007). Over the 26 days at sea the survey acoustically sampled 3 889 nautical miles (7 202 km), collected 96 biological samples from 40 locations and occupied 38 oceanographic stations. Biological samples were collected at regular intervals and opportunistically to identify acoustic layers and targets. Up to three layers were sampled at each location using the multi sampler cod-end.

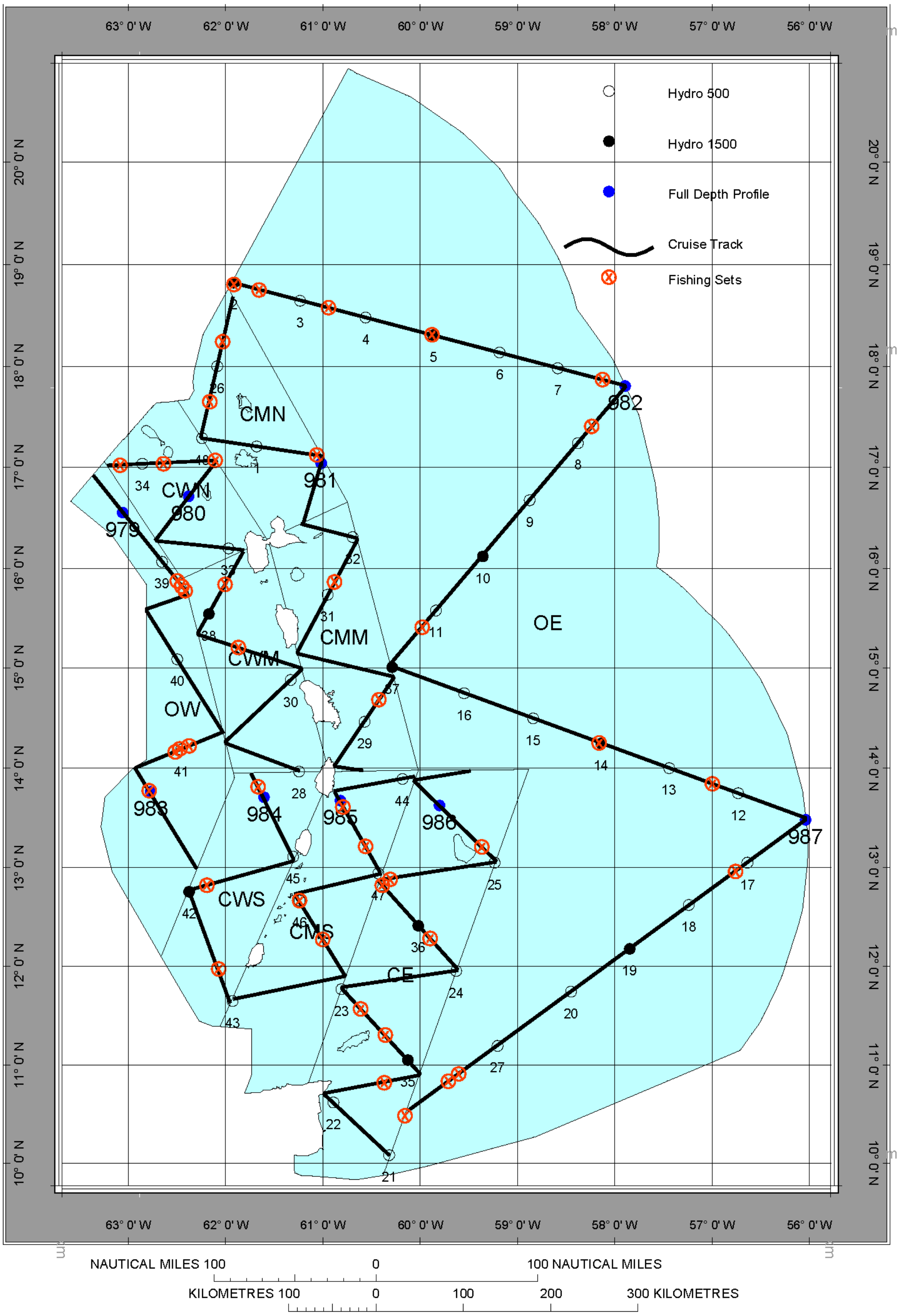


Figure 1 Cruise track, sampling stations and stratum boundaries on ecosystem survey.

ACOUSTIC SURVEY METHODS

Multi-species aggregations of fish, invertebrates and/or plankton distributed throughout the water column can be detected acoustically and the cumulative backscatter quantified to provide estimates of biomass (Simmonds and MacLennan, 2005). The transducers are mounted on the vessels drop keel and lowered to a working depth of 3 m below the vessel's hull, about 8.8 m below the surface (Figure 2). The acoustic array onboard the *Celtic Explorer* consists of 4 split beam transducers with operating frequencies of 18, 38, 120 and 200kHz.

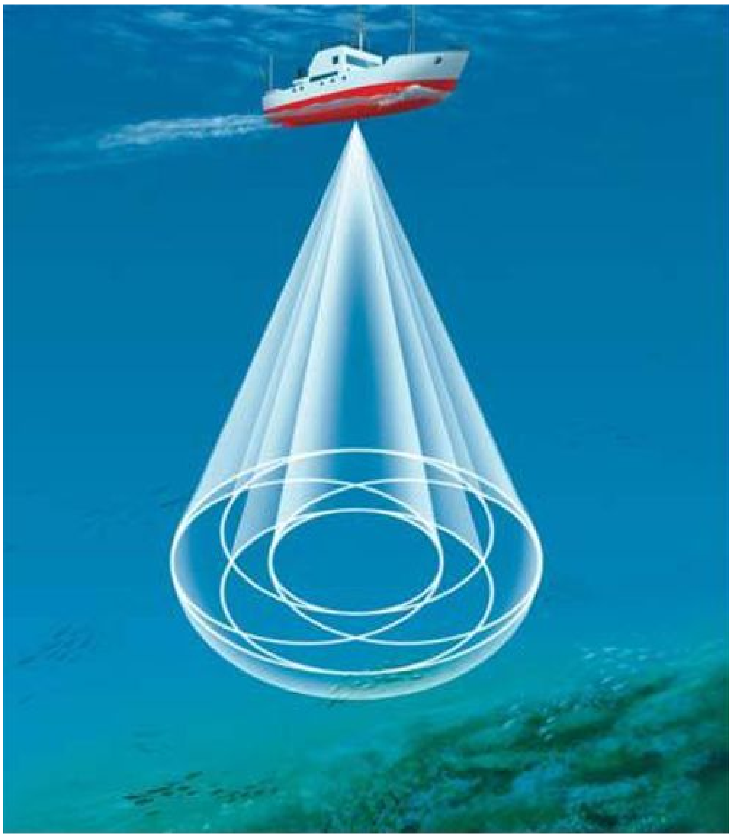


Figure 2 Drop-keel mounted multi-frequency echosounder (Simrad ER 60 multi-frequency echo-sounder with of 4 split beam transducers at 18, 38, 120, and 200kHz)

Acoustic data on fish, micronekton and plankton abundance and distribution was collected using the Simrad ER60 multi-frequency scientific echo-sounder. The quantitative acoustic information (volume backscattering strength, S_v), was characterized into several broad categories and the signal return apportioned by species and size composition of samples obtained by pelagic trawling to estimated biomass. The trawl sampling locations and depths were usually selected to obtain samples from specific acoustic target biomasses. To optimize time on-transect acoustic collection continued during fishing operations and these data were included in the mean area backscatter estimates.

Acoustic Data Acquisition:

To minimize the noise during surveying, vessel propulsion was provided by twin DC electric motors, with generating power supplied from a single diesel engine, thus providing "silent" running. In this mode the underwater radiated noise levels of the vessel has been documented to be well below those described by the ICES standard recommended for the limitation of fish avoidance responses (Mitson, 1995). However, during fishing operations two diesel engines were employed to provide sufficient power to tow the net. This slightly increased the noise levels of transect segments recorded during fishing sets.

Acoustic data from all four frequencies of the ER60 were observed simultaneously and recorded onto independent hard-drives from the processing unit in two formats. The RAW format files were logged to the ER60's hard drive and stored to a laptop computer via a continuous Ethernet connection as "EK5" files using Sonar Data's Echoview® Echolog (Version 3.2) as a backup to ensure data integrity and to prevent data loss. In addition, all acoustic data files from the previous day were downloaded to the vessel's server nightly and as a further precaution backed up on DVD for transporting from the vessel. Sonar Data's Echoview® Echolog (Version 3.2) live viewer was used to display the echogram during data collection and to allow the scientists to scroll back through echograms noting the locations and depths of fish shoals and scattering layers. A member of the scientific staff monitored the equipment continually throughout the survey. A paper log was kept to record each transect's start and stop position and time, as well as all off-track events, noting time, GPS position and vessel mile. The log was used to document the time spent off track during fishing operations and hydrographic stations plus any general observations. Off-track and hydrographic station data were not used in estimating mean backscatter.

Few technical problems were encountered throughout the survey. However, during the pre-survey calibration, off Antigua, a large decrease (2dB) in the sensitivity of the 38kHz transducer was identified. The problem was isolated to the cabling in the drop keel and corrected at the end of transect 2. Consequently, although 38kHz transducer results for transects 1 and 2 are included in the summary tables, they will be excluded from the final biomass analysis. Transect 1 was repeated at the end of the survey but no valid data at 38 KHz were available for Transect 2.

Acoustic Calibration

Calibration of the ER60 acoustic array is routinely carried out onboard the *Celtic Explorer* following the principles described by Foote *et al.* (1987). Regular calibrations are required to align the scale reading of each operating frequency within the system to that of a known standard target. This provides a method to determine transducer gain and S_A correction differences for quantitative data analyses. Results of the previous and subsequent calibrations are also compared to investigate the system's stability during, and after, the survey is completed.

The calibration factor is then applied to the output data to ensure accuracy of the scrutinised S_A data for calculation of species abundance estimates. Prior to the LAPE survey the ER60 was last calibrated in late March 2006 in the North-East Atlantic.

The acoustic equipment was calibrated using the same settings to be employed during the survey for each frequency (Table 1). Ambient environmental conditions were measured at each calibration site using a CTD cast to determine sound velocity profile. Calibrations were carried out using standard spheres with known acoustic properties (i.e., target strength). For the 18 and 38kHz frequencies copper, spheres of 63 mm and 60 mm, respectively, were used as targets. A 38.1 mm tungsten carbide sphere was used for the higher frequencies of 120 and 200kHz.

Table 1 *Celtic Explorer* Simrad ER60 echosounder settings by frequency used during data collection and analysis (C- collection settings, A - analysis settings).

	18kHz		38kHz		120kHz		200kHz	
Parameter	C	A	C	A	C	A	C	A
Sound Speed (m/s)	1545.39	1545.7	1545.40	1545.40	1545.39	1545.70	1545.39	1545.70
Transducer draft (m)	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Transmit power	2000	2000	2000	2000	300	300	120	120
Pulse length (ms)	1.024	1.024	1.024	1.024	1.024	1.024	1.024	1.024
Gain (dB) 26.5 26.5	22.56	22.03	25.55	25.55	26.36	25.99	25.7	25.7
Absorption (dB/m)	0.00156	0.0016	0.00611	0.0061	0.0454	0.0461	0.0871	0.0882
Sa Correction (dB) 0 -3.23	-0.81	-0.86	-0.59	-0.59	-0.39	-0.34	-0.34	-0.34
2-way beam angle (dB re 1Steradian)	-17.00	-17.00	-20.60	-20.60	-20.80	-20.80	-20.70	-20.70
Minor axis beam width (degrees)	10.81	11.09	6.85	6.85	7.45	7.16	6.59	6.59
Major axis beam width (degrees)	10.81	11.47	6.99	6.99	7.21	7.27	6.49	6.49

As this was the first time the vessel has worked in a warm water region two calibrations of each frequency were undertaken to ensure data accuracy. The first calibration was carried out on 26 April in the open sea 6.2 n.mi. west of Antigua in 30 m of water over a sand-flat. Weather conditions on site were considered good, with moderate easterly trade winds (11Kts) and a calm sea state (1 m±0.5 m). Only the 18, 120 and 200kHz transducers were calibrated as a fault in the 38kHz unit was discovered.

A second full calibration of the acoustic array was attempted on 9 May in Oistins Bay, Barbados but was abandoned due to incoming vessel traffic in the vicinity. The calibration was completed on 10 May in Carlisle Bay, Barbados, at the start of the second leg of the survey. The 200kHz transducer could not be calibrated at this time because of the strong current and interference caused by abundant plankton. Weather conditions on site were considered good, with a moderate (18Kts) wind from the southeast and a wind swell of approximately 1 m also from the southeast. Sea conditions on site were not ideal due to a strong (0.8Kts) current running from the east.

A final calibration at the end of the survey was carried out on 21 May, west of Barbuda on the 38kHz frequency only. This was necessary as the repairs carried out on the cabling system earlier in the survey had meant only one valid calibration was available for this frequency. The 200kHz transducer again could not be calibrated due to current and interference from plankton in the water. As no significant changes were observed between calibrations, the calibration factors from the initial calibration of 26 April were used for the 200kHz sounder.

Acoustic Data Scrutinising

The acoustic data were scrutinised daily using Sonar Data's Echoview® (V 3.2) and/or Bergen Echo Integrator (BEI) post processing software. The edited (scrutinised) files were backed up on the vessel's server and DVD daily for the previous days work. Although both software packages were available, and used in the editing process, the final output of nautical area scattering coefficient (NASC) summary values was from the BEI. Although the system is capable of recording data to several thousand meters (18kHz), the bottom detection limit was set at 750 m to improve resolution. No biological echotraces of significance were observed below this depth. In fact, few discernable targets were observed below 500 m (Figure 3). For analysis, the echogram upper limit was set at 10 m, to take into account the vessels drop keel depth (8.8 m subsurface) and also the effects of bubble attenuation at the surface.

The initial step in the scrutinizing or editing process was to identify unwanted targets or bad data segments. Echograms were examined to locate and remove all bad data that originate from sources such as interference or false bottom (Figure 4).

The echograms were classified into several acoustic categories. Partitioning of data into the defined categories was a subjective process and relied on the expertise of the onboard scientists scrutinising the echograms. Echo-integration then computes backscatter or scattering area (NASC) of each classified target for each frequency (primarily 18 and 38kHz for fish) in the acoustic categories. In this survey the acoustic data were initially binned into 10 m vertical intervals and 1 n. mi. segments of transect for output and subsequent analysis.

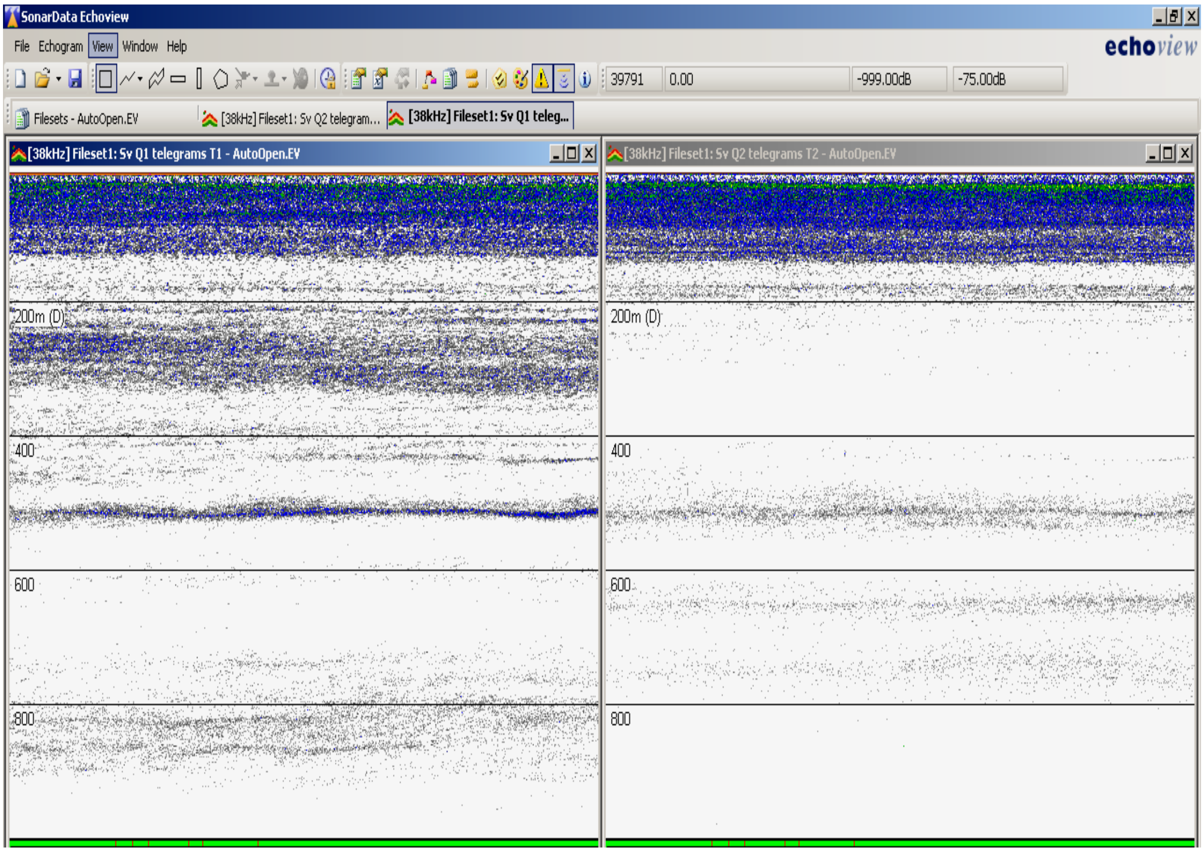


Figure 3 Synchronized echograms from the 18kHz (left) and 38kHz (right) transducers.

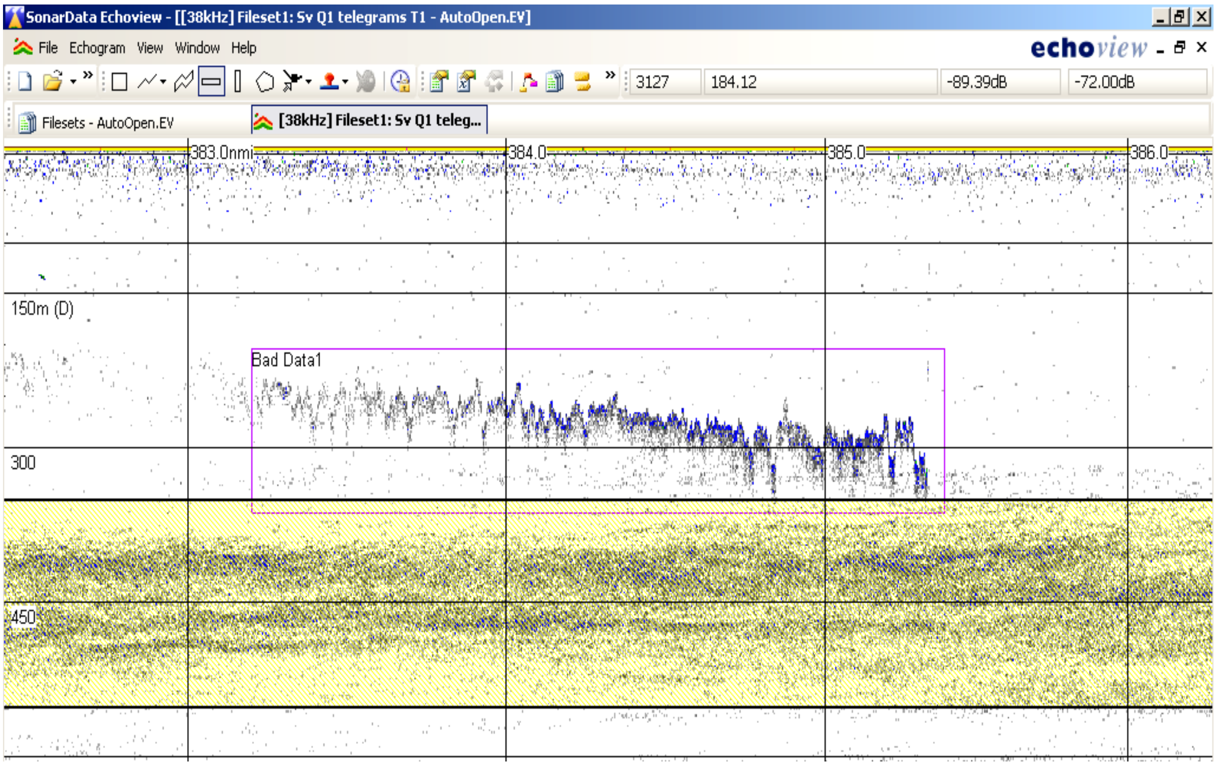


Figure 4. The 38kHz echogram showing interference from 18kHz signal (indicated by box labelled 'Bad Data 1'. Highlighted area is scattering layer classified as mesopelagic/plankton mix.

After inspection, the echograms were partitioned into nine acoustic categories based on time, depth and acoustic characteristics (summarized in Table 2). The Nautical Area Scattering Coefficients (NASC or S_A) were computed for each 10 m vertical interval in units of m^2 /n.mi.$^{-2}$ for each vessel log interval of 1 n.mi. The total S_A at both 18 and 38kHz for each transect are compiled in 50 m depth intervals for each of the nine acoustic categories in Appendix 1. Unless stated otherwise, classifications of echogram intensity were based on the observations from the 38kHz output, the primary frequency employed during most acoustic surveys. Note that due to a problem cable the 38kHz transducer was not performing properly during transect 1 and 2 and these data were excluded from the final analysis. Transect 1 was repeated at the end of the survey as transect 41. Acoustic categories were identified on the basis of trace recognition as follows:

Category 1: Plankton (PLANK)

This classification is applied as a generic term covering phytoplankton, zooplankton, and other non-fish biota within the micronekton. Larval and post-larval fishes are also considered a contributor to this category. For echo integration purposes categorisation criteria included; form dense scattering layers in surface waters (0-100 m); form light scattering layers at depth (200-500 m); show diurnal vertical migration patterns; non-avoidance responses and correlation with the thermocline and halocline layers in shallow waters. The strong halocline observed at 180 m offshore was regarded as the lower limit for surface plankton layers in this case. Deep plankton layers of low density were recorded down to a maximum depth of 500 m in the open ocean. Echogram intensity on lower frequencies appeared highly variable from low density (blue) mixed scattering layers at depth to very high intensity (red) layers in surface waters both at night and during day light hours. High density plankton layers were most frequently observed in surface waters (0-80 m) and at night appearing as mixed layers (see Category 3). High density plankton layers were also associated with shelf edge or frontal areas.

Category 2: Plankton and pelagic mix (PL/PE)

This classification was defined to include well-mixed layers of both plankton and pelagic fish species occurring in surface waters (0-50 m). Selection criteria include; lack of distinct or recognisable schools or single targets in the echogram; presence of pelagic fish species within layer from trawl catches. This layer was applied across all echograms both in the neritic (water over the continental shelf which is less than 200 meters deep) and pelagic realms due to the presence of fish in trawl catches both during the day and at night. Normal practices of threshold adjustment (-65dB) to remove unwanted plankton echotraces also had the effect of removing fish biomass from the echogram, thus necessitating this category.

Category 3: Plankton and mesopelagic mix (PL/ME)

This category takes into account the nightly vertical migration of mesopelagic layers into surface waters (25-100 m). Selection criteria included; the presence of near surface layer during hours of darkness and absence during daylight; well mixed with surface plankton; and non-schooling behaviour. Echogram intensity on lower frequencies (18 & 38kHz) generally appeared as low density (blue) layers.

The above categories (2 and 3) were composed of a mixed fish and plankton layer. The layers were well mixed and proved very difficult to isolate fish and plankton echotraces, thereby necessitating a mixed layer category. The characteristics of plankton layers encountered showed strong resistance to threshold levels commonly used to filter out plankton and reveal underlying fish biomass. Under normal circumstances, a –65dB threshold is applied on 38kHz to remove unwanted plankton. However, thresholds below this level may also remove fish traces from the echogram leading to a removal of fish biomass.

Category 4: Unidentified pelagic species (PMIX)

This category was applied to pelagic schools, and single fish targets forming species occurring in surface waters down to 200 m. Selection criteria include; recognisable school formation during daylight hours and school dispersion at night; indistinguishable from Categories 8 & 9; no trawl samples available to confirm identification.

Category 5: Krill (KRILL)

The krill classification was applied to single distinct schools commonly encountered around a depth range of 150-250 m during daylight hours. Categorisation criteria include; singular schools often of distinct shape and structure; occurrences at or around the 200 m depth; and school dispersion during hours of darkness. Echogram intensity appeared on all frequencies (18, 38, 120 and 200kHz), but was most intense on 18kHz.

Category 6: Mesopleagic (MESO)

This classification was formulated to include, but is not exclusive to, the Myctophidae. Categorisation criteria include; deep scattering layer between 400-600 m during daylight and migration to surface waters (25-100 m) at night; shallow scattering layer at or around 200 m during daylight hours and migration to surface waters (25-100 m) at night; visible migration pattern at dawn and dusk. Echogram intensity dominated by low density (blue) diffuse layers.

Category 7: Mixed bottom species (OTDEM)

This category was defined to include bottom or near bottom schools or layers of fish encountered in coastal waters (<500 m) that were not identified by directed trawling due to gear constraints. Selection criteria; demersal orientation on or near to seabed or bathymetric feature; variable school structure and density during daylight hours; forming diffuse feeding layers above the seabed at night. In coastal areas, (<500 m) this category was commonly applied as a layer extending from the seabed up to cover nightly migration of bottom species. Echogram intensity ranged from high (red) to low (blue), with schools and small marks of variable size and structure.

Category 8: Pelagic 1 (PEL1)

The Pelagic 1 classification included small schooling pelagics, characteristic of fishes with swim bladders such as members of the families Engraulidae and Clupeidae. Classification criteria include; school-forming in surface waters; schools most frequently encountered within plankton or in close association with surface (0-100 m) plankton layers. Echogram intensity of pelagic 1 schools ranged from high intensity (red) to medium intensity (yellow/green), mainly due to high acoustic reflectivity of the gas inclusion in the swim-bladder.

Category 9: Pelagic 2 (PEL2)

The PEL2 category was defined to include small schooling pelagic fishes without swim bladders encountered in surface waters such as species of Scrombrids and Carangids, amongst others. Classification criteria include; the formation of small schools in surface waters; schools most frequently encountered within plankton or in close association with surface (0-150 m) plankton layers. Echogram intensity of this category of schooling fishes was mostly confined to the low (blue) and medium (yellow/green) intensity echotraces.

Table 2 Summary of acoustic classifications used in the 2006 LAPE ecosystem survey

Number	Category	Abbrev	Description	Time	Depth
1	Plankton	PLANK	Generic Plankton - Surface Deep Layer Phytoplankton, Zooplankton, non-fish	Day/Night	 0-150 m ~400 m
2	Plankton/ Pelagic	PL/PE	Plankton and pelagic fish Contains schools	Day/Night	~0-150 m
3	Plankton/ Mesopelagic	PL/ME	Plankton with nightly vertical migration of mesopelagic	Night	25-100 m
4	Unidentified Pelagics	PL/ME	Schools near surface Dispersed at night	Day	0-200 m
5	Krill	KRILL	single schools schools dispersed	Day Night	150-250 ~200 m

Number	Category	Abbrev	Description	Time	Depth
6	Mesopelagic	MESO	Mainly Myctophidae (Deep) Myctophidae mixed with Plankton (Shallow)	Day Night	400-600 m ~200 m
7	Mixed Bottom Species	OTDEM	Unidentified bottom targets	Day/night	1-10 m above bottom
8	Pelagic 1	PEL 1	medium to high Intensity returns likely due to swim-bladder	Day/Night	0-150 m
9	Pelagic 2	PEL 2	low to medium Intensity returns likely swim-bladder absent or not air filled	Day/Night	0-150 m

Biomass Estimation

The challenge in acoustic surveys is to relate the computed area backscatter coefficient (S_A) to the corresponding biomass of fish and other organisms. The species and size composition of the trawl catches are the primary source of information for apportioning the S_A. For biomass estimation the trawl species composition from 96 samples were used to apportion the S_A from each of the nine acoustic categories for the acoustic transect mile and depth intervals closest to the sample (Appendix 2).

The taxa caught in the trawl were pooled to family level and the mean length and weight of each family group was computed (Appendix 2). Families were also classified by body form and the acoustic categories to which they corresponded. Within each acoustic category, the body form and the mean length were used to estimate an average acoustic target strength (TS) for each of the taxonomic families using published relations between size, shape and swim-bladder presence (Table 3 including example families for each target type).

These were used to compute the weighted mean target strength for a taxon (*sp*) observed in a given sample (WT_TS_{sp}) from the catch data as:

$$WT\_TS_{sp} = 10^{\left[\frac{(20\log(len_{sp}) - \mathrm{int}_{sp})}{10}\right]} \times \frac{Num_{sp}}{\sum Num_{sp}}$$

where Num_{sp} is the number of taxon *sp* in the catch sample and len_{sp} is the mean length (mm) of the taxon. The int_{sp} is based on the shape and swim-bladder of the taxon.

Table 3 Examples of estimated acoustic target strengths for families based on shape, length and swim-bladder characteristics. Target strength is given in decibels.

Example Family	Target Shape	Swim Bladder	Mean Length (mm)	Intercept	Target Strength (TS)
Caproidae,	Disk	Y	43.49	-69.30	-56.53
Congridae	Eel	Y	207.81	-68.00	-41.65
Evermannellidae	Eel	N	97.36	-80.00	-60.23
Chauliodontidae	Elongated	N	172.04	-73.50	-48.79
Gempylidae	Elongated	Y	196.25	-68.00	-42.14
Achiridae	Flounder	N	25.50	-85.00	-76.87
Atlantidae	Gastro	N	58.00	-80.00	-64.73
Mugilidae	Herring	Y	72.55	-71.90	-54.69
Nomeidae	Herring	N	81.48	-85.00	-66.78
Euphausiacea	Krill	N	12.77	-75.70	-73.58
Lophiiformes	Perch	Y	52.24	-67.70	-53.34
Opisthoproctidae	Perch	N	37.95	-80.00	-68.42
Spirulidae	Squid	N	38.35	-79.90	-68.22
Scombrolabracidae	Tuna	Y	109.79	-70.90	-50.09
Scombridae	Tuna	N	50.00	-86.90	-72.92
Ulmaridae	Jelly	N	30.00	-85.50	-75.96
Tunicates	tunicates	N	10.00	-85.00	-85.00

TS= 20log(Length in cm) + Intercept

The mean number of average targets, based on the aggregate mean TS is calculated from the corresponding S_A for the acoustic category as:

$$\#/m^2 = 10^{\left[S_A - \frac{10\log(\sum WT\_TS_{sp})}{10}\right]}$$

and the numbers are converted into biomass by applying the numbers-weighted mean weights of the various taxa in the aggregation:

$$Kg/m^2 = \#/m^2 \times \frac{\sum(\overline{WT}_{sp} \times Num_{sp})}{\sum Num_{sp}}$$

Upon completion of the scrutinizing process for all transects, the acoustic categorization was reviewed. It was concluded that only two acoustic categories were clearly distinctive, demersals (OTDEM) and schooling pelagics with swim-bladders (PEL1). These categories were analysed individually. The remaining categories were very difficult to distinguish acoustically and overlapped substantially in species composition. As a result, they were pooled into a single forage group for analysis.

Although the calculations were the same in each case the analysis of the forage group was broken down into finer groupings based on results at each step. These included segregation of samples by day and night and deep (>180 m) and shallow (<=180 m) tows.

An adjustment was applied to account for biomass in the water column above the effective depth of the transducer. This was assumed to be an additional 10 m bin in the shallow stratum. Two adjustments, for day and night, were estimated by assuming that the upper 10 m bin was equal to the average of the three shallowest 10 m bins observed.

Finally, for inclusion in planned ecosystem models, all the taxa observed in the trawl catches were assigned to functional groups previously defined for purposes of ecological modelling. Species within functional groups were considered to play ecologically similar roles, i.e. they had similar diets and were preyed on by similar predators. Thus, the pooled acoustic biomass of the pelagic forage group was partitioned into various functional groups based on the taxa present in the catches from each depth/time stratum using the same process outlined above. The functional groups were then aggregated within the depth/time strata and the final figures re-scaled to equal the average total biomass estimate for day and night.

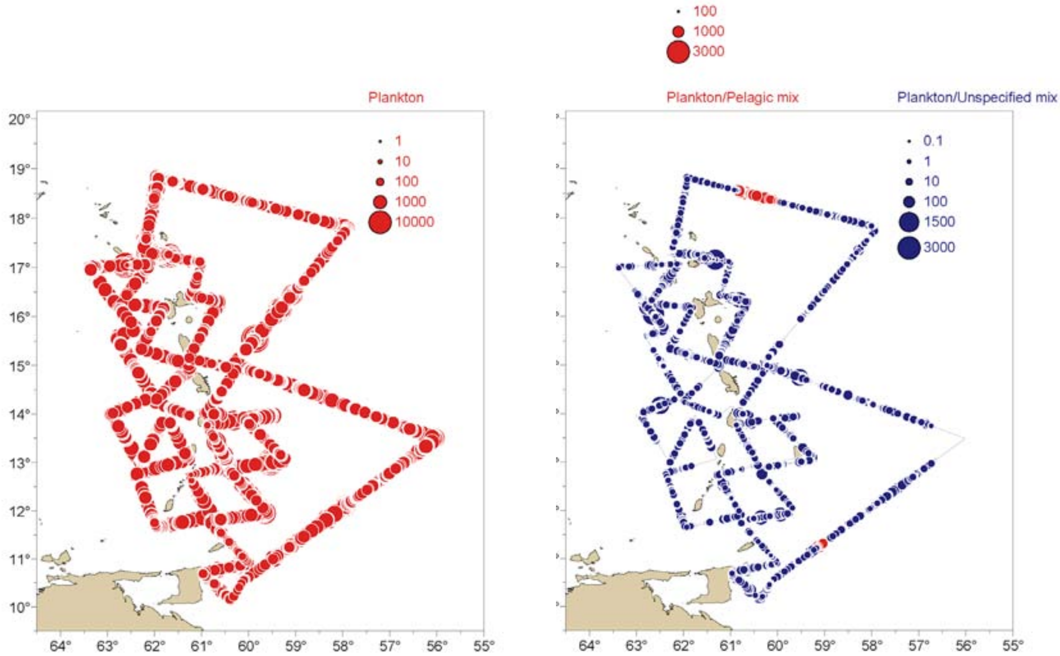
RESULTS

SPATIAL DISTRIBUTION

The total acoustic backscatter (S_A) from each category is plotted mile by mile in (Figure 5), for the 18kHz transducer. Similar data exist for 38 (except Transect 2), 120 and 200kHz. Species composition was generally mixed, with considerable overlap between most of the acoustic categories. Identifiable plankton layers were present in every mile of the survey, and plankton mixtures with other groups were very common throughout the survey area.

Two groups, Demersals (red circles on panel C, OTDEM category) and schooling pelagics with swim-bladders (green circles on panel D, PEL1 category), are distributed only in shelf areas, they were not observed in waters greater than 500 m depth. These were the only two groups to be both acoustically and spatially distinct. As both of these groups only occurred in shallow shelf water, it is assumed that these acoustic groups represent species that are in fact limited to shelf areas i.e. ~2% of the LAPE study area. The biomass density of demersals is estimated at 3.68 $t \cdot km^{-2}$ within the shelf areas and the schooling pelagics at 12.20 $t \cdot km^{-2}$. These estimates correspond to 0.074 and 0.244 $t \cdot km^{-2}$ respectively throughout the entire LAPE area.

The remaining acoustic groups could not be clearly associated with particular species or groups and were pooled into a single pelagic forage group occurring throughout the survey area. The echograms also indicated distinct and relatively consistent layers of organisms within the water column that varied temporally. Given that the pooled group includes numerous species which undertake diel vertical migrations, the acoustic data were partitioned by depth and time strata.



Panel A

Panel B

Panel C

Panel D

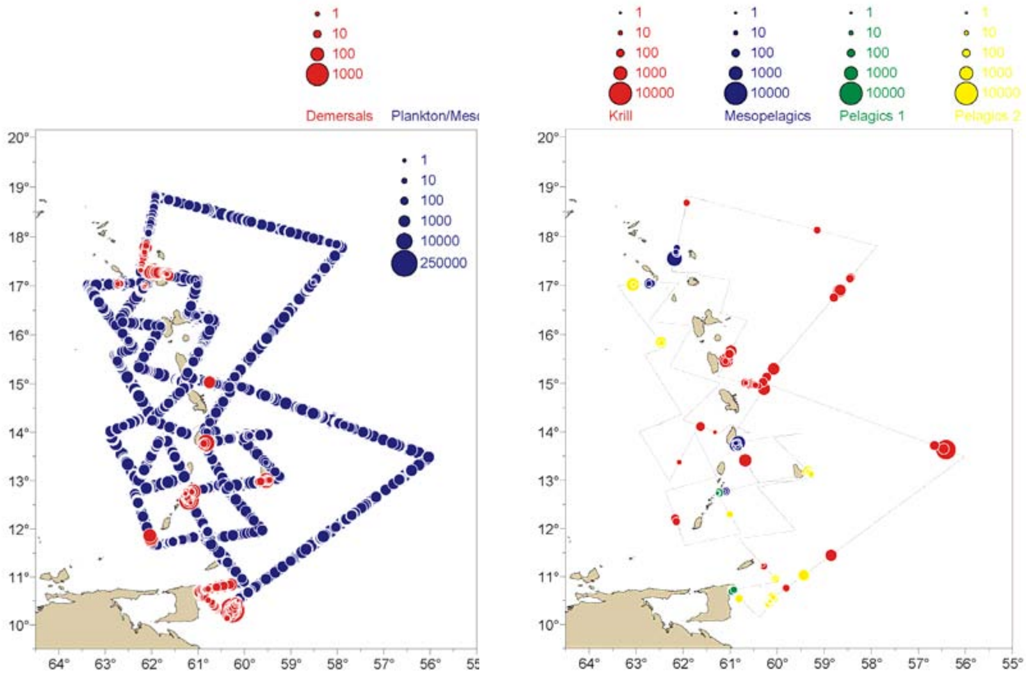


Figure 5 Spatial distribution of backscatter (S_A) by acoustic categories.

DIEL MIGRATION

The diel vertical migration of mesopelagic groups is visible in the echogram (Figure 6) which shows an up-migration of several acoustic layers. This pattern of movement was observed every day during the survey.

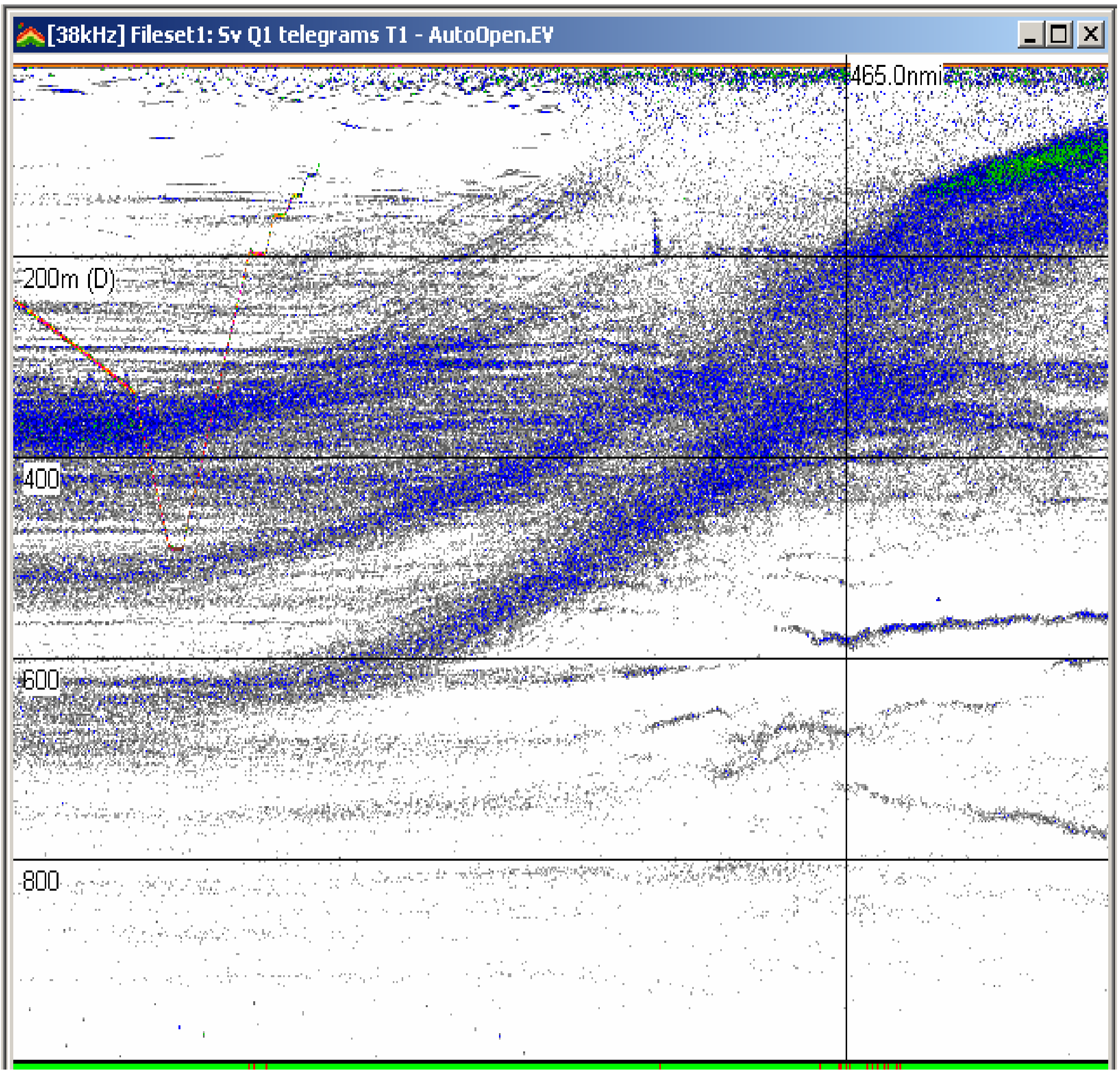


Figure 6 Echogram (38kHz) showing upward vertical migration of a mixed mesopelagic scattering layer. The red traces at the left margin are the echoes of the oceanographic sampler being deployed.

The vertical migration was clearly related to sunrise and sunset. Given that the day length is very close to 12 hours, the day was defined as 06:00 to 18:00 (local time). The transition period one hour before and after dusk and dawn was not included in the analysis. Because trawling was targeting well defined layers and targets, there were no trawl samples collected during the periods of vertical migrations.

Examination of echograms and the depth distribution of taxa in the trawl catches (next section) showed a discontinuity in distributions of various groups at approximately 180 m which approximately corresponded with the observed thermocline and halocline at many oceanographic stations. The water column was thus divided into deep (>180 m) and shallow (<180 m) zones. All the subsequent analyses were based on the four strata defined by day-night and deep-shallow partitions.

Taxonomic Aggregation

Although trawl-caught specimens were identified to the finest taxonomic resolution possible, the subsequent analysis has focused on taxa aggregated to the family level. This ensures reasonably consistent groupings in terms of both body form and ecological role and includes the vast majority of specimens recorded (very few were identified only to taxa higher than family).

The taxonomic composition at the family level of the diel migratory group was inferred from examination of the vertical distribution of catches. For catches in the day (yellow) and the night (blue), trawl tows were plotted against sampling depth (Figure 7, showing fish families only). The most obvious vertical migrating group in this figure is the Myctophidae. Other fish families exhibiting vertical migrations, based on catch data, are Congridae, Neoscopelidae and Trichiuridae. Invertebrates exhibiting diel migration include the squid families Enoploteuthidae and Onycoteuthidae and the crustaceans Oplophoridae and Euphausiacea.

Equally important are non-migrating groups. These include deep-dwellers such as the Stomiiformes (e.g. block of families from Astronesthidae to Stomiidae in Figure 7), and upper water families (e.g. block from Xiphiidae to Scorpaenidae).

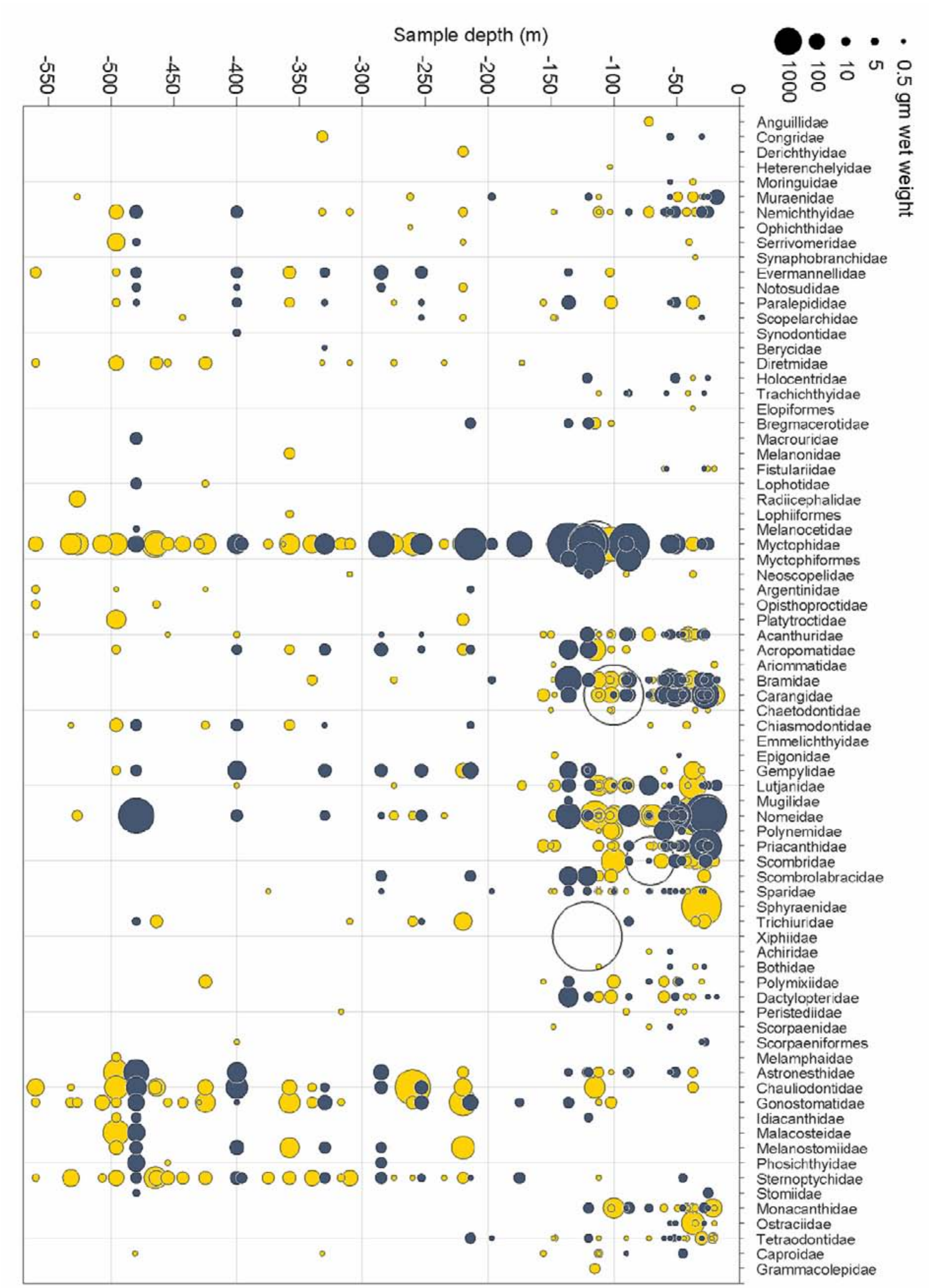


Figure 7 Depth distribution of catches of fish families by day (yellow) and night (blue).

There were adjustments included to account for the transducer depth (~8.8m) and the near-field dead zone i.e. ~10 m below the surface. The mean S_A (per 10 m of depth) over the first three 10 m bins below the dead zone (Table 4) showed fairly consistent patterns throughout the day. The S_A from the 0-10 m bin may still have been reduced as a result of near-field effects from the transducer. The average S_A from the 0-30 m bins for day and night was added to the observed results for the remainder of the shallow stratum to account for the surface layer above the transducer.

Table 4 Calculation of surface layer adjustments to acoustic backscatter for 38kHz. Depths are given as depth below transducer. Values are S_A per 10 m depth. Highlighted figures were used for day and night surface layer adjustments.

38kHz	Overall	Day	Night	Dusk/Dawn
0-10m	127.0	58.6	185.1	126.9
0-20m	174.0	75.8	259.9	166.1
0-30m	171.3	**77.5**	**253.9**	161.8

The overall biomass was estimated based on the family and size composition in the four strata (day-night by deep-shallow) including the surface layer correction discussed above. The S_A for the deep and shallow strata were summed for the total water column and converted to biomass for each part of the day using a weighted mean target strength for the families based on the family and size information in Appendix 3. The day and night totals were averaged to get the biomass estimate for the combined forage species groups (Table 5).

Table 5 Total biomass (tkm^{-2}) estimates for day-night and deep-shallow strata. Overall biomass estimate is the average of the day-night totals.

	Day	Night
Shallow	19.04443	35.09998
Deep	20.16175	4.55215
Total	39.20618	39.65212
day/night average		39.42915

The total backscatter was disaggregated into functional groups and converted into biomass using the same calculations but partitioning the species composition into the defined functional groups. The contribution of each functional group was estimated with and without the surface layer correction. The effect of applying the surface layer correction ranged from 2 to 11 percent depending on the functional group (Table 6) and averaged 7 percent. The surface layer adjusted results in Table 5 are the estimated contributions to the forage biomass for the individual functional groups.

Table 6 Biomass estimates (tkm^{-2}) for functional groups with and without the surface layer adjustment.

Functional Group	No near-surface adjustment	Surface layer adjusted
coastal predator	0.0138	0.0148
demersal	1.2526	1.3783
large mesopelagic	10.5885	10.8328
large zooplankton	0.0039	0.0042
other billfish	0.0000	0.0000
small mesopelagic	17.7449	19.3590
small squid	0.0138	0.0151
small zooplankton	0.0039	0.0039
reef	0.2286	0.2501
large squid	0.1596	0.1771
pelagic	6.8332	7.3938
TOTAL	36.8428	39.4292

One functional group, the demersals, included both a distinct acoustic category, OTDEM, and a component of the mixed forage biomass (Table 6). As noted above, the biomass density of the acoustic category OTDEM was estimated at $0.074tkm^{-2}$. In addition to this, there was a component of the offshore forage group made up of demersal species for which the biomass density was estimated to be 1.378 $t\ km^{-2}$, and the two groups together have a total biomass density of 1.452 tkm^{-2}.

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APPENDIX 1 ACOUSTIC TRANSECT RESULTS

The results of the integrated acoustic backscatter, S_A, from the 41 transects completed during the LAPE ecosystem survey are presented in the following tables and figures. Each table includes results from 18 and 38kHz transducers classified into nine acoustic categories.

Table A1.1 provides the basic information about the individual transects and tables.

Tables A1.2 through A1.10 report the integrated backscattering at 18kHz (left side) and 38kHz (right side) from each transect for 50m depth intervals.

Table A1.1. Acoustic transects completed on LAPE ecosystem survey.

Transect	Stratum	Transect Miles		Start		End		Length	
		Start	End	Lat	Long	Lat	Long	N. Mi.	Km.
1	CMN	5	102	17.318	-62.237	18.785	-61.922	90.8	168.2
2	OE	104	361	18.817	-61.924	17.867	-58.123	223.7	414.3
3	OE	375	589	17.792	-57.897	15.041	-60.303	215.5	399.1
4	OE	590	845	15.018	-60.290	13.549	-56.168	263.3	487.6
5	OE	853	1154	13.491	-56.037	10.471	-60.163	272.4	504.5
6	CE	1187	1235	10.146	-60.387	10.677	-60.959	47.3	87.6
7	CE	1236	1301	10.708	-60.965	10.893	-60.025	56.4	104.5
8	CE	1302	1392	10.917	-60.008	11.762	-60.795	68.8	127.4
9	CE	1393	1462	11.789	-60.797	11.956	-59.637	69.5	128.7
10	CE	1463	1563	11.975	-59.620	12.836	-60.402	46.7	86.5
11	CE	1565	1635	12.875	-60.406	13.029	-59.379	65.8	121.9
12	CE	1645	1739	13.081	-59.232	13.909	-59.877	66.9	123.9
13	CE	1726	1762	13.856	-60.050	13.969	-59.482	33.8	62.6
14	CMS	1795	1844	13.914	-60.059	13.769	-60.877	48.5	89.8
15	CMS	1844	1910	13.752	-60.875	12.961	-60.415	37.2	68.9
16	CMS	2040	2093	12.946	-60.404	12.735	-61.273	52.3	96.9
17	CMS	2094	2189	12.713	-61.268	11.932	-60.786	56.5	104.6
18	CMS	2191	2259	11.895	-60.790	11.658	-61.915	67.6	125.2
19	CWS	2261	2348	11.657	-61.962	12.736	-62.367	93.2	172.6
20	CWS	2349	2414	12.763	-62.371	13.060	-61.316	65.1	120.6
21	CWS	2415	2475	13.086	-61.300	13.975	-61.755	38.4	71.1
22	OW	2542	2615	12.985	-62.293	13.993	-62.923	70.8	131.1
23	OW	2615	2703	14.007	-62.913	14.361	-62.035	55.4	102.6
24	OW	2703	2787	14.377	-62.038	15.569	-62.806	84.2	155.9
25	OW	2787	2814	15.585	-62.809	15.741	-62.391	25.9	48.0
26	OW	2814	2927	15.757	-62.396	17.004	-63.372	93.6	173.3
27	CWM	2927	3036	17.006	-63.354	17.071	-62.132	70.3	130.2
28	CWM	3038	3095	17.055	-62.098	16.307	-62.697	56.6	104.8
29	CWM	3096	3149	16.279	-62.710	16.181	-61.808	52.3	96.9
30	CWM	3149	3205	16.165	-61.815	15.369	-62.279	54.8	101.5
31	CWM	3207	3269	15.332	-62.260	15.015	-61.254	62.3	115.4
32	CWM	3272	3332	14.975	-61.233	14.287	-61.977	60.8	112.6
33	CWM	3333	3377	14.262	-61.996	13.992	-61.308	44.2	81.9
34	CMM	3424	3440	13.976	-60.586	14.012	-60.844	16.2	30.0
35	CMM	3441	3504	14.028	-60.871	14.889	-60.283	64.0	118.5
36	CMM	3505	3562	14.920	-60.278	15.140	-61.230	56.7	105.0
37	CMM	3563	3639	15.155	-61.259	16.258	-60.659	75.7	140.2
38	CMM	3641	3674	16.299	-60.661	16.432	-61.200	33.8	62.6
39	CMM	3676	3716	16.451	-61.206	17.073	-61.010	39.9	73.9
40	CMN	3717	3790	17.105	-61.007	17.287	-62.212	71.0	131.5
1a	CMN	3791	3874	17.292	-62.245	18.662	-61.932	85.1	157.6

Table A1.2 Mean acoustic density for 'PLANKTON' category by transect and 50m depth interval

	18 KHZ SA (m^2nmi^{-2})			Depth Interval (m)								38 KHZ SA (m^2nmi^{-2})			Depth Interval (m)							
Transect	Total	50	100	150	200	250	300	350	400	450	500	Total	50	100	150	200	250	300	350	400	450	500
1	1,906.01	513.67	497.23	220.25	52.93	34.16	53.40	69.09	140.48	121.32	76.32											
2	617.56	83.79	30.82	44.93	18.68	27.48	50.33	71.62	73.92	48.42	32.12											
3	1,103.46	282.16	59.56	17.40	13.81	25.82	41.25	50.45	30.30	23.00	15.51	665.69	325.65	115.12	34.50	29.67	27.94	8.99	4.80	3.44	4.43	10.27
4	925.19	463.68	61.16	44.47	31.77	42.61	52.60	60.31	30.82	13.49	8.58	1,752.56	536.21	850.46	191.73	35.83	23.30	8.45	9.13	4.90	7.85	20.02
5	1,182.12	691.67	26.26	20.23	20.65	40.71	92.03	67.69	35.43	26.50	18.23	941.33	628.10	102.29	33.71	22.79	15.41	10.90	8.92	7.10	11.64	21.45
6	546.44	404.28	131.01	0	0	0	0	0	0	0	0	746.63	492.93	238.46	0	0	0	0	0	0	0	0
7	633.24	391.66	81.25	3.42	24.94	20.61	33.24	26.13	17.50	0.79	0.86	1,041.36	650.34	321.08	15.07	8.73	12.12	6.25	2.47	0.91	0.32	1.42
8	441.06	257.95	51.79	9.58	6.51	14.80	8.25	12.88	16.29	6.33	4.80	922.90	491.56	276.10	69.43	31.52	12.39	5.85	7.05	4.67	1.46	3.51
9	1,064.86	494.91	5.79	0.15	13.23	43.12	48.58	71.46	63.35	34.81	24.36	1,698.33	1,527.72	24.24	0.19	5.24	17.41	6.44	7.37	10.15	11.92	18.80
10	667.28	146.26	28.29	32.42	43.90	82.14	63.34	62.91	17.87	0.82	0	1,940.46	792.31	822.59	140.96	41.41	32.09	11.51	12.00	1.90	0.11	0
11	2,545.91	932.35	255.11	366.04	153.22	176.34	194.27	115.17	94.65	65.05	52.48	1,676.70	1,166.97	155.41	135.56	30.65	34.15	41.00	11.83	11.03	12.52	17.48
12	545.00	212.68	8.53	9.40	25.02	63.38	48.37	25.56	0.11	0	0.09	1,717.29	943.86	463.78	66.76	47.00	36.74	12.56	9.48	2.00	0.15	0.07
13	1,134.04	678.13	9.75	16.25	21.43	25.27	58.40	99.45	47.96	33.66	17.99	800.30	484.97	122.70	21.75	7.99	12.41	11.42	9.04	5.72	6.63	8.17
14	1,080.81	513.43	28.02	18.04	21.10	39.88	50.71	106.89	71.57	47.70	19.52	1,260.02	736.13	340.42	17.17	6.67	14.58	9.74	13.46	8.88	8.59	29.25
15	698.16	185.99	140.78	36.52	22.82	30.23	32.38	61.82	49.22	7.76	3.24	1,074.66	475.63	397.31	75.01	17.24	19.18	6.93	10.89	10.50	1.11	0.69
16	995.58	466.24	187.92	37.28	17.80	24.21	22.89	50.57	36.00	24.46	16.83	2,719.06	2,126.28	404.38	37.22	7.25	7.04	5.12	8.08	9.00	11.62	15.77
17	966.00	450.24	254.09	81.59	6.93	5.74	11.57	23.99	27.31	9.26	5.32	940.22	560.93	256.95	21.82	10.98	5.87	3.30	5.11	5.10	10.34	7.55
18	1,683.91	876.86	585.60	28.60	0.30	0.44	0.05	13.19	29.14	22.51	17.51	1,234.53	720.58	348.49	7.94	0.19	0.06	0.00	4.94	19.41	38.28	28.37
19	775.26	285.31	189.81	72.51	57.25	40.81	30.32	8.14	0	0	0	1,616.23	413.23	874.98	140.69	48.79	25.68	8.81	4.03	0	0	0
20	1,217.70	731.65	16.04	8.42	3.89	9.21	76.73	102.41	66.73	51.20	47.33	863.52	635.27	12.82	4.17	1.79	3.72	14.81	18.07	12.86	20.99	62.74
21	864.77	380.01	86.78	20.45	14.71	14.10	46.11	64.11	48.77	32.58	42.75	605.28	246.33	156.57	25.74	12.78	8.07	17.39	16.55	11.39	19.57	33.44
22	1,219.44	606.81	108.66	44.38	13.44	9.55	82.42	119.16	84.19	51.78	34.11	852.64	504.10	123.01	27.49	8.21	8.31	29.52	22.46	16.25	14.66	23.60
23	732.01	307.23	134.09	64.79	38.42	41.05	39.09	12.46	8.63	8.91	10.21	899.58	266.35	439.93	71.67	29.18	18.58	7.51	2.62	2.20	8.65	16.98
24	953.37	529.05	1.71	0	0	32.19	96.03	70.28	61.73	37.81	26.72	669.05	465.21	3.69	0	0	8.90	18.30	11.55	9.02	14.22	38.71
25	1,068.72	401.12	341.68	91.43	40.12	24.08	15.22	0	0	0.11	0.38	1,278.49	371.65	573.16	133.32	34.00	32.03	8.88	0	0	0.09	0.72
26	1,013.44	433.94	182.28	36.57	22.55	18.49	17.81	42.70	52.62	46.17	34.37	1,019.93	527.38	217.28	70.29	23.83	14.47	10.70	9.89	6.85	8.89	22.10
27	1,132.33	374.86	229.14	117.05	46.24	38.34	67.77	59.41	50.64	55.38	37.26	863.12	220.94	269.00	147.48	50.44	25.50	15.57	25.11	16.12	14.07	22.45
28	867.41	454.03	26.04	8.24	2.01	5.12	31.91	54.59	85.84	83.74	46.83	840.00	498.20	75.52	17.82	6.77	4.24	8.06	13.15	12.57	12.90	34.81
29	1,060.28	502.99	72.62	20.36	7.05	10.50	53.85	89.96	96.00	70.57	41.88	702.04	391.67	60.22	24.09	8.07	5.42	25.11	20.50	15.05	15.83	36.91
30	574.68	172.59	153.42	113.63	36.23	34.35	30.05	17.85	5.52	0	0	1,321.71	193.73	614.31	361.61	77.76	27.51	11.49	8.32	3.80	0	0
31	933.56	473.79	124.20	32.67	15.97	6.36	8.54	36.70	58.18	51.77	35.32	1,116.97	635.39	96.63	94.98	18.16	6.69	4.50	5.53	9.57	14.32	45.95
32	1,225.91	539.71	238.18	87.96	26.65	20.82	12.32	55.14	85.39	35.32	22.90	1,827.38	591.72	967.15	86.19	21.68	11.01	4.64	11.60	13.14	10.64	15.78
33	533.21	91.42	111.60	103.13	26.50	37.39	33.26	28.06	0	0	0	1,407.90	205.15	874.57	184.56	28.22	24.73	5.08	4.18	0	0	0
34	1,079.46	664.78	287.89	18.23	0	0	0.14	7.22	13.47	10.66	6.42	1,314.61	1,023.17	135.14	0	0	0	0	2.53	5.60	8.79	20.04
35	750.21	353.16	10.61	10.49	26.10	23.90	48.36	68.38	49.33	45.29	34.93	576.64	338.39	27.43	3.86	8.70	8.73	10.96	11.39	8.57	12.75	36.45
36	466.82	88.62	105.64	30.57	31.18	23.36	34.67	40.29	21.27	3.69	2.04	1,439.80	300.45	894.14	61.92	45.28	32.90	13.90	8.22	4.11	0.67	0.55
37	758.60	268.37	135.44	14.25	11.37	23.74	61.97	67.42	50.70	36.59	17.84	773.16	378.49	137.29	48.84	27.84	15.32	10.61	7.88	6.83	10.12	27.35
38	790.66	530.97	54.93	0.38	5.63	5.37	37.71	37.61	28.24	28.70	20.29	751.10	575.95	82.60	0.26	1.65	1.78	7.05	6.44	3.81	5.68	9.78
39	492.54	167.90	121.69	46.55	22.46	27.57	18.69	31.04	0.74	2.00	3.68	1,060.27	340.91	463.60	84.04	38.88	27.72	3.71	2.05	0.63	2.32	9.76
40	1,131.00	907.97	66.61	21.97	8.66	6.90	15.18	31.44	20.33	4.33	1.36	1,300.87	456.81	385.24	367.02	20.71	22.95	5.75	5.83	5.08	1.20	0.57
1a	825.55	413.42	50.50	39.85	21.78	23.07	54.77	65.13	40.79	36.23	32.45	1,048.87	670.72	77.63	41.59	18.67	33.16	15.26	12.77	9.24	7.37	14.16

Table A1.3 Mean acoustic density for 'KRILL' category by transect and 50m depth interval

	18 KHZ SA (m^2nmi^{-2})				Depth Interval (m)							38 KHZ SA (m^2nmi^{-2})				Depth Interval (m)						
Transect	Total	50	100	150	200	250	300	350	400	450	500	Total	50	100	150	200	250	300	350	400	450	500
1	0	0	0	0	0	0	0	0	0	0	0											
2	0.17	0	0	0	0	0	0.00	0.09	0.08	0	0											
3	9.66	0	0	0.06	0.72	5.64	2.02	1.17	0.00	0	0	2.99	0	0	0.09	0.70	1.55	0.52	0.11	0.00	0	0
4	18.98	0	0.44	17.68	0.72	0.06	0.00	0	0	0	0	4.91	0	0.34	4.14	0.37	0.05	0.00	0	0	0	0
5	1.45	0	0	0.27	1.04	0.00	0.11	0.02	0	0	0	0.51	0	0	0.19	0.27	0.00	0.04	0.00	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	1.16	0	0.30	0.82	0.03	0.00	0	0	0	0	0	0.91	0	0.50	0.34	0.05	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	8.89	0	0	0	0	0.36	6.31	2.09	0	0	0	0.86	0	0	0	0	0.11	0.46	0.28	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	2.00	0	0	0	0	0.07	1.78	0.13	0	0	0	4.24	0	0	0.10	0.60	1.07	1.28	0.60	0.52	0.02	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0.29	0.03	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	2.94	0	0	0	0	0	0.11	2.71	0.06	0	0	0.54	0	0	0	0	0	0.01	0.49	0.02	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	8.45	0	0	0.00	8.16	0.16	0	0	0	0	0	0.70	0	0	0.00	0.64	0.05	0	0	0	0	0
36	13.37	0	0	3.38	0.93	7.84	0.63	0.34	0.02	0	0	3.00	0	0	0.46	0.49	1.69	0.21	0.08	0.01	0	0
37	30.25	0	0	15.75	11.30	2.69	0.11	0	0	0	0	4.59	0	0	1.80	2.19	0.51	0.02	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A1.4 Mean acoustic density for 'MESOPELAGICS' category by transect and 50m depth interval

	18 KHZ SA (m^2nmi^{-2})				Depth Interval (m)							38 KHZ SA (m^2nmi^{-2})				Depth Interval (m)						
Transect	Total	50	100	150	200	250	300	350	400	450	500	Total	50	100	150	200	250	300	350	400	450	500
1	17.48	3.18	2.56	8.03	3.13	0.39	0	0	0	0	0											
2	0	0	0	0	0	0	0	0	0	0	0											
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	18.15	0.31	0.80	0.28	0.21	0.03	7.99	5.75	2.25	0.17	0	4.57	0.11	0.39	0.71	0.16	0.05	1.13	1.08	0.78	0.06	0
15	19.11	0.40	0.60	0.66	1.88	5.00	1.64	2.97	3.39	1.44	0.48	10.18	0.16	0.32	0.65	0.64	2.01	1.05	1.30	1.58	1.73	0.42
16	2.87	0.40	0.18	0	0.00	0	0.00	0.24	1.75	0.23	0.02	1.03	0.35	0.12	0	0.01	0.03	0.00	0.09	0.30	0.08	0.03
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	9.46	0	0	0	0	0	0	0.59	1.62	3.80	2.51	5.61	0	0	0	0	0	0	0.26	1.37	2.05	1.29
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A1.5 Mean acoustic density for 'OTHER DEMERSALS' category by transect and 50m depth interval

	18 KHZ SA (m^2nmi^{-2})	Depth Interval (m)										38 KHZ SA (m^2nmi^{-2})	Depth Interval (m)									
Transect	Total	50	100	150	200	250	300	350	400	450	500	Total	50	100	150	200	250	300	350	400	450	500
1	3.27	0.86	0.09	0.01	0	0.00	0.14	0.26	1.13	0.60	0.04											
2	0	0	0	0	0	0	0	0	0	0	0											
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	12.42	10.26	1.90	0	0	0	0	0	0	0	0	10.93	6.32	4.39	0	0	0	0	0	0	0	0
7	16.01	6.50	8.07	0.43	0.53	0.20	0	0	0	0	0	16.60	7.65	8.27	0.23	0.13	0.02	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	4.56	0	0	0	0.04	1.00	2.51	0	0	0.18	0.19	3.90	0	0	0	0.06	1.22	1.84	0	0	0.09	0.18
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	5.40	0.21	0.53	0	0.00	0.00	2.01	2.13	0.34	0.07	0	2.22	0.25	0.82	0	0.01	0.04	0.38	0.43	0.18	0.07	0
15	0.51	0.27	0.23	0	0.01	0	0	0	0	0	0	0.62	0.36	0.22	0	0.03	0	0	0	0	0	0
16	4.14	1.64	0.18	0	0.00	0	0.00	0.24	1.75	0.23	0.02	2.03	1.33	0.12	0	0.01	0.03	0.00	0.09	0.30	0.08	0.03
17	14.43	9.84	2.91	0.76	0.01	0.01	0.04	0.37	0.15	0.02	0.02	10.28	6.66	2.71	0.53	0.04	0.00	0.01	0.08	0.04	0.02	0.01
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	8.39	8.22	0.00	0	0.00	0.04	0	0	0	0	0	7.42	7.27	0.01	0.00	0.00	0.04	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0.57	0	0	0	0	0	0	0.04	0.10	0.23	0.15	0.81	0	0	0	0	0	0	0.02	0.08	0.12	0.16
28	0.09	0	0	0	0	0	0	0	0	0	0	0.27	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0.82	0	0.81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	22.72	20.62	1.76	0	0	0	0	0	0	0	0	14.83	13.17	1.44	0	0	0	0	0	0	0	0
1a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A1.6 Mean acoustic density for 'PELAGICS 1' category by transect and 50m depth interval

	18 KHZ SA (m^2nmi^{-2})				Depth Interval (m)							38 KHZ SA (m^2nmi^{-2})				Depth Interval (m)						
Transect	Total	50	100	150	200	250	300	350	400	450	500	Total	50	100	150	200	250	300	350	400	450	500
1	0	0	0	0	0	0	0	0	0	0	0											
2	0	0	0	0	0	0	0	0	0	0	0											
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	3.94	3.87	0	0	0	0	0	0	0	0	0	4.43	4.35	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1.85	1.81	0	0	0	0	0	0	0	0	0	3.51	3.44	0	0	0	0	0	0	0	0	0
17	0.06	0.06	0	0	0	0	0	0	0	0	0	0.08	0.08	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A1.7 Mean acoustic density for 'PELAGICS 2' category by transect and 50m depth interval

	18 KHZ SA (m^2nmi^{-2})			Depth Interval (m)								38 KHZ SA (m^2nmi^{-2})			Depth Interval (m)							
Transect	Total	50	100	150	200	250	300	350	400	450	500	Total	50	100	150	200	250	300	350	400	450	500
1	0	0	0	0	0	0	0	0	0	0	0											
2	0	0	0	0	0	0	0	0	0	0	0											
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	4.74	0.80	1.45	2.32	0.16	0.00	0	0	0	0	0	3.85	1.17	1.41	0.85	0.41	0	0	0	0	0	0
6	1.34	1.31	0	0	0	0	0	0	0	0	0	0.72	0.70	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	1.21	0.96	0.23	0.00	0	0	0	0	0	0	0	0.82	0.62	0.15	0.04	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	5.91	3.58	2.09	0.18	0	0	0	0	0	0	0	2.38	1.53	0.75	0.07	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0.55	0.05	0.50	0	0	0	0	0	0	0	0	0.66	0.06	0.58	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	2.80	0	0	0.37	2.41	0	0	0	0	0	0	1.86	0	0	0.65	1.19	0	0	0	0	0	0
27	8.76	0	0.00	8.55	0.09	0	0	0	0	0	0	0.65	0	0	0.59	0.06	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A1.8 Mean acoustic density for 'PLANKTON/MESOPELAGICS MIX' category by transect and 50m depth interval

	18 KHZ SA (m^2nmi^{-2})				Depth Interval (m)							38 KHZ SA (m^2nmi^{-2})				Depth Interval (m)						
Transect	Total	50	100	150	200	250	300	350	400	450	500	Total	50	100	150	200	250	300	350	400	450	500
1	52.49	0	0	0	17.18	22.98	11.77	0	0	0	0											
2	662.54	0	156.59	64.91	16.19	16.11	15.20	6.39	11.59	54.85	126.60											
3	829.84	0	113.74	117.74	40.47	35.97	51.70	65.26	52.96	95.97	120.58	405.64	0	81.56	69.63	27.31	20.99	9.24	8.17	6.88	19.34	42.41
4	1,052.38	0	303.42	107.22	72.78	81.13	50.20	36.14	60.06	93.89	92.00	794.68	60.06	360.03	107.54	25.66	16.96	9.92	8.46	16.86	31.81	71.15
5	866.34	0	229.84	122.42	53.69	29.81	16.16	18.04	41.85	95.45	96.04	700.64	124.21	228.26	140.40	31.93	8.12	4.94	5.64	13.27	33.83	56.29
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	87.31	0	0	0	0	0	0.91	9.13	23.14	18.85	14.46	33.99	0	0	0	0	0	0.07	1.52	2.71	5.81	11.57
8	2,561.49	0	142.01	78.43	52.88	298.62	626.49	482.85	381.35	222.92	114.24	333.97	30.73	27.63	21.71	16.45	33.27	53.76	29.93	30.48	27.12	28.52
9	1,192.26	0	560.85	285.90	93.16	43.47	44.34	24.35	2.67	1.70	1.13	1,436.57	294.39	793.90	261.22	46.07	10.72	4.81	2.39	0.42	0.55	1.00
10	726.87	0	0	0	0	0	0	2.84	66.39	208.86	187.82	293.60	0	0.32	3.33	0.88	1.98	0	0	18.29	46.12	72.96
11	989.15	0	454.31	300.09	54.68	37.94	0	0	10.86	6.19	5.69	1,091.27	119.92	437.78	366.80	66.51	61.13	8.50	0.43	2.20	1.62	2.00
12	741.72	0	0	0	0	0	0.18	21.66	95.54	206.07	158.76	341.11	0	0	0	0	0	0.02	2.51	19.52	61.12	79.89
13	912.40	0	77.67	52.82	63.17	31.59	17.92	89.60	156.87	112.15	95.25	570.56	19.36	109.09	83.54	35.59	18.66	8.91	16.72	34.04	56.22	66.25
14	610.17	0	198.30	195.37	61.81	22.18	0.93	4.15	14.34	17.46	13.63	925.74	236.55	411.37	194.33	35.19	6.18	0.36	0.76	2.56	6.50	4.33
15	611.11	0	0	0	0	0.05	0.62	1.53	41.49	129.61	216.96	233.70	0	0	0	0	0.03	0.18	0.33	8.29	34.77	59.69
16	416.24	0	0.45	80.49	53.95	33.59	15.53	39.95	78.50	46.61	34.42	213.82	0	2.01	61.23	28.09	15.41	5.98	7.67	14.10	20.50	30.47
17	447.75	0	1.50	55.67	23.97	42.56	45.41	59.19	107.02	57.80	24.45	156.27	0	0	42.78	20.86	11.13	8.29	11.04	15.14	17.43	15.57
18	379.22	0	0	114.53	55.25	68.78	84.72	49.38	0.58	0.05	0	136.44	0	0	45.39	38.72	20.71	17.16	12.03	0.40	0.07	0
19	621.07	0	0.01	1.93	5.25	5.43	9.19	57.33	133.27	223.59	108.72	280.40	0.17	0.03	0.39	0.87	1.63	2.72	15.88	43.35	69.66	81.87
20	1,444.98	0	478.87	464.31	159.01	105.39	50.74	11.68	6.70	4.78	4.12	1,413.98	189.65	819.14	237.69	65.99	46.27	17.65	7.33	3.81	2.13	1.97
21	790.29	0	234.73	224.44	40.83	31.60	6.47	39.04	41.33	43.20	34.67	588.45	90.72	237.00	83.86	26.57	18.08	2.74	8.67	14.60	28.81	42.58
22	1,558.91	0	360.38	503.29	177.17	104.01	11.34	19.09	30.52	24.63	19.43	1,388.86	276.71	506.45	345.77	94.63	69.76	6.11	8.99	13.43	15.33	12.37
23	988.60	0	304.52	46.72	43.35	39.68	36.36	28.96	67.84	145.69	73.66	491.70	40.48	104.16	25.59	18.61	11.04	15.43	19.46	32.55	47.47	58.20
24	1,372.17	0	528.61	494.62	181.25	58.42	1.02	1.45	0.83	0.05	0	1,377.26	178.20	654.08	393.42	109.53	23.86	1.10	0.59	0.24	0.02	0
25	663.06	0	0.09	2.33	5.20	10.22	15.64	110.43	190.91	145.88	63.99	395.35	0	0.25	3.49	3.18	7.10	9.00	39.62	40.61	65.31	98.86
26	765.81	0	126.58	181.26	104.87	43.94	47.63	40.78	64.56	69.56	38.44	568.02	0	133.74	151.97	52.09	33.92	18.93	20.83	28.80	33.83	49.82
27	719.89	0	83.02	91.07	90.17	62.40	41.51	42.03	42.61	59.62	112.13	441.15	0.46	89.09	84.91	40.87	30.84	14.58	10.28	10.80	20.43	41.35
28	1,020.34	0	380.65	350.11	109.07	45.83	27.92	14.11	7.08	38.96	17.94	830.07	0	382.39	236.58	68.92	45.52	16.23	8.68	2.84	6.26	6.77
29	1,089.91	0	193.11	344.87	233.27	84.67	11.08	12.20	69.60	34.13	26.48	875.87	2.93	308.67	283.73	114.29	57.67	7.31	3.44	12.62	10.66	14.09
30	750.03	0	0	0	0	0	0	3.37	87.64	267.77	160.18	424.11	0	0	0	0	0	0	1.97	31.63	75.52	89.46
31	1,357.86	0	497.42	341.02	102.53	71.48	99.04	77.06	51.74	25.40	24.11	951.39	0	512.24	163.88	65.76	44.83	27.67	21.94	18.45	19.73	23.36
32	660.18	0	21.94	109.50	51.00	37.95	40.54	32.90	95.03	102.80	47.19	378.26	0.25	25.32	54.67	36.62	34.89	21.71	10.90	17.76	31.67	52.40
33	710.66	0	0	0	0	0	0	4.57	33.40	244.96	284.46	286.15	0	0	0	0	0	0	1.07	11.83	64.83	106.04
34	912.55	0	522.45	164.63	56.29	49.66	52.47	13.38	0	0	0	448.62	0	230.40	139.71	33.33	9.46	6.85	2.48	0	0	0
35	1,361.74	0	659.63	269.57	53.43	33.30	6.43	10.61	25.32	23.77	15.80	1,031.64	333.53	394.02	151.13	52.23	22.45	3.80	4.65	7.46	8.61	18.11
36	619.11	0	0.02	0.10	0.62	1.22	1.81	15.52	46.47	138.26	148.05	327.11	0.02	0.20	0.14	1.50	1.83	5.92	4.50	12.18	36.28	68.39
37	891.34	0	251.19	183.55	43.97	38.61	23.10	15.99	52.99	62.40	98.79	521.53	46.64	128.49	87.52	38.13	41.11	18.55	10.32	10.54	18.31	47.04
38	2,390.60	0	691.48	1,044.92	330.80	102.49	46.47	17.35	13.96	15.27	5.47	1,734.07	19.30	985.89	295.43	178.34	70.96	21.23	8.00	10.84	8.83	14.85
39	604.67	0	7.71	11.94	12.31	11.21	21.23	54.36	111.83	118.55	115.24	401.26	0	6.88	4.48	6.60	7.83	10.71	20.22	27.89	34.69	82.07
40	445.69	0	40.17	39.71	5.72	0	0.12	6.36	26.47	28.09	42.72	277.98	7.43	51.29	26.62	3.10	0.00	0	0.18	1.85	7.83	15.85
1a	685.62	0	294.98	211.92	36.22	1.88	2.07	2.48	17.35	33.18	30.50	686.95	16.58	334.22	179.64	33.76	1.82	1.53	1.12	2.98	7.38	10.68

Table A1.9 Mean acoustic density for 'PLANKTON/PELAGICS MIX' category by transect and 50m depth interval

	18 KHZ SA (m^2nmi^{-2})					Depth Interval (m)						38 KHZ SA (m^2nmi^{-2})					Depth Interval (m)					
Transect	Total	50	100	150	200	250	300	350	400	450	500	Total	50	100	150	200	250	300	350	400	450	500
1	0	0	0	0	0	0	0	0	0	0	0											
2	225.38	224.40	0	0	0	0	0	0	0	0	0											
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	24.71	24.62	0	0	0	0	0	0	0	0	0	95.84	95.51	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	69.32	67.93	0	0	0	0	0	0	0	0	0	158.91	155.73	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A1.10 Mean acoustic density for 'UNIDENTIFIED PELAGICS' category by transect and 50m depth interval

	18 KHZ SA (m^2nmi^{-2})				Depth Interval (m)							38 KHZ SA (m^2nmi^{-2})				Depth Interval (m)						
Transect	Total	50	100	150	200	250	300	350	400	450	500	Total	50	100	150	200	250	300	350	400	450	500
1	7.98	0	0.94	0.10	0.02	0.02	0.09	0.05	0.03	0	0											
2	5.86	0	0.46	0.31	0.09	0.01	0.01	0.01	0.01	0.00	0											
3	7.01	0	0.67	0.21	0.02	0.02	0.00	0.00	0	0	0	4.31	3.36	0.79	0.12	0.02	0	0	0	0	0	0
4	14.25	0	4.18	0.97	0	0	0	0	0	0	0	8.65	7.70	0.71	0.11	0	0.06	0.04	0	0	0	0
5	12.89	0	1.99	0.08	0.05	0.01	0	0	0	0	0	6.68	5.95	0.62	0.07	0.02	0.00	0	0	0	0	0
6	31.33	0	0.29	0	0	0	0	0	0	0	0	20.35	19.89	0.05	0	0	0	0	0	0	0	0
7	22.97	0	0.90	0	0	0	0	0	0	0	0	8.32	7.78	0.39	0	0	0	0	0	0	0	0
8	8.46	0	1.04	0	0	0	0	0	0	0	0	4.77	4.54	0.18	0	0	0	0	0	0	0	0
9	12.02	0	0.55	0	0	0	0	0	0	0	0	8.17	6.60	1.45	0	0	0	0	0	0	0	0
10	6.69	0	0.70	0.19	0	0	0	0	0	0	0	8.70	7.10	1.31	0.18	0	0	0	0	0	0	0
11	6.62	0	0	0.29	0.04	0	0	0	0	0	0	8.38	8.04	0	0.17	0.02	0	0	0	0	0	0
12	12.46	0	1.21	1.23	0.12	0	0	0	0	0	0	5.74	4.31	0.64	0.49	0.22	0	0	0	0	0	0
13	5.06	0	0.62	1.10	0.39	0	0	0	0	0	0	2.63	2.07	0	0.45	0.03	0	0	0	0	0	0
14	16.30	0	2.48	0	0	0	0	0	0	0	0	5.76	3.11	2.53	0	0	0	0	0	0	0	0
15	9.66	0	1.23	0.17	0	0	0	0	0	0	0	5.91	5.52	0.14	0.16	0	0	0	0	0	0	0
16	9.35	0	0.02	0.04	0.01	0	0	0	0	0	0	5.87	5.68	0.05	0.02	0.01	0	0	0	0	0	0
17	15.58	0	0.09	1.57	0.01	0	0	0	0	0	0	9.57	7.55	0.09	1.77	0.01	0	0	0	0	0	0
18	6.40	0	0.02	0	0	0	0	0	0	0	0	5.55	5.45	0.01	0	0	0	0	0	0	0	0
19	10.92	0	0.20	0	0	0	0	0	0	0	0	5.46	5.17	0.21	0	0	0	0	0	0	0	0
20	3.34	0	0	0	0	0	0	0	0	0	0	2.36	2.33	0	0	0	0	0	0	0	0	0
21	5.45	0	0	0	0	0	0	0	0	0	0	2.15	2.11	0	0	0	0	0	0	0	0	0
22	7.35	0	0.02	0	0	0	0	0	0	0	0	3.88	3.83	0	0	0	0	0	0	0	0	0
23	24.70	0	3.08	1.67	0	0.52	5.70	6.71	0	0	0	7.21	4.40	0.93	0.60	0	0.22	0.39	0.53	0	0	0
24	7.29	0	0	0	0	0.14	0.43	0.30	0.21	0.09	0.00	4.23	3.55	0	0	0	0.07	0.16	0.13	0.15	0.11	0.00
25	38.31	0	17.35	0	0	0	0	0	0	0	0	4.21	3.22	0.84	0	0	0	0	0	0	0	0
26	41.01	0	13.56	17.40	0	0	0	0	0	0	0	6.12	3.08	1.42	1.56	0	0	0	0	0	0	0
27	7.80	0	0.44	0	0	0	0.05	0.53	0.44	0.34	0	4.83	4.05	0.44	0	0	0	0.01	0.09	0.12	0.08	0
28	34.23	0	0.17	0	0	0	0	3.02	7.53	5.52	2.15	23.87	14.87	0.41	0	0	0	0	0.15	0.22	0.38	1.30
29	10.38	0	0.06	0	0	0	0	0	0	0	0	6.30	6.05	0.12	0	0	0	0	0	0	0	0
30	9.10	0	0.51	0	0	0	0	0	0	0	0	3.31	3.23	0.02	0	0	0	0	0	0	0	0
31	16.89	0	3.80	0.09	0	0	0	0	0	0	0	9.58	8.27	1.16	0	0	0	0	0	0	0	0
32	4.44	0	0.62	0	0	0	0	0	0	0	0	3.83	2.35	1.42	0	0	0	0	0	0	0	0
33	5.00	0	0.81	0	0	0	0	0	0	0	0	2.86	2.65	0.15	0	0	0	0	0	0	0	0
34	12.06	0	0.81	2.60	3.46	2.45	0.58	0.07	0	0	0	0.42	0.35	0.05	0	0	0	0	0	0	0	0
35	7.40	0	0	0	0	0	0	0	0	0	0	6.77	6.66	0	0	0	0	0	0	0	0	0
36	14.75	0	1.96	0.11	0	0	0	0	0	0	0	5.60	5.31	0.19	0.00	0	0	0	0	0	0	0
37	38.30	0	14.46	0.01	0	0	0	0	0	0	0.17	9.96	6.99	2.22	0.00	0	0	0	0	0	0	0
38	29.07	0	3.66	0.21	1.41	1.34	5.90	3.08	2.81	1.83	1.39	13.00	3.09	0.09	0.07	0.41	0.44	0.97	0.62	0.87	0.90	0.76
39	5.01	0	0.36	0	0	0	0	0	0	0	0	3.28	3.17	0	0	0	0	0	0	0	0	0
40	40.72	0	1.06	0.03	0	0	0	0	0	0	0	20.67	10.74	0.43	0.25	0	0	0	0	0	0	0
1a	8.89	0	1.37	0.37	0.24	0.08	0.10	0.15	0.19	0.46	0.17	6.74	4.57	0.38	0.27	0.19	0.25	0.10	0.10	0.11	0.40	0.12

APPENDIX 2 TRAWL SAMPLE ACOUSTIC BACKSCATTER

The acoustic backscatter S_A associated with each trawl sample was obtained from the depth bins (10m intervals) corresponding to the trawl sample depth and the acoustic track miles immediately adjacent to the trawl station. Transect refers to the acoustic transect number and sample is a sequential the trawl sample with the last digit indicating the number of layers sampled. The minimum and maximum depth are the depth range encountered by the open cod-end (multisampler trawl - ms) or the primary towing depths (herring trawl - h). The total acoustic backscatter is partitioned into the acoustic categories as described in the main body of the report.

Stratum	Trawl Type	Transect	Sample	Min Depth	Max Depth	Total S_A	PLANK	KRILL	MESO	OTDEM	PEL1	PEL2	PL/ME	PL/PE	PMIX
cmn	ms	1	11	25	60	592.0	584.9	.	3.4	.	.	.	.	.	3.7
oe	ms	2	21	507	541	115.0	.	.	.	.	.	.	115.0	.	.
oe	ms	2	22	112	137	101.1	101.1	.	.	.	.	.	.	.	.
oe	ms	2	23	44	71	174.7	171.7	.	.	.	.	.	.	.	3.0
oe	ms	2	31	527	556	.	.	.	.	.	.	.	.	.	.
oe	ms	2	32	112	135	65.4	65.4	.	.	.	.	.	.	.	.
oe	ms	2	33	28	54	116.1	114.8	.	.	.	.	.	.	.	1.2
oe	ms	2	41	214	239	63.3	.	.	.	.	.	.	63.3	.	.
oe	ms	2	42	90	114	235.4	.	.	.	.	.	.	235.4	.	.
oe	ms	2	43	41	67	1,024.3	.	.	.	.	.	.	864.6	159.8	.
oe	ms	2	51	560	592	.	.	.	.	.	.	.	.	.	.
oe	ms	3	61	532	560	.	.	.	.	.	.	.	.	.	.
oe	ms	3	62	455	486	29.2	.	.	.	.	.	.	29.2	.	.
oe	ms	3	63	40	66.9	42.2	41.4	.	.	.	.	.	.	.	0.9
oe	ms	3	71	186	212	60.7	59.6	1.1	.	.	.	.	.	.	.
oe	ms	3	72	58	86.2	345.9	345.6	.	.	.	.	.	.	.	0.3

Stratum	Trawl Type	Transect	Sample	Min Depth	Max Depth	Total S_A	PLANK	KRILL	MESO	OTDEM	PEL1	PEL2	PL/ME	PL/PE	PMIX
oe	ms	3	73	27	50	190.6	184.1	.	.	.	.	.	.	.	6.5
oe	ms	4	81	120	151	193.0	.	.	.	.	.	.	193.0	.	.
oe	ms	4	82	88	117	426.2	.	.	.	.	.	.	426.2	.	.
oe	ms	4	83	25	47	996.1	332.3	.	.	.	.	.	660.4	.	3.4
oe	ms	4	91	90	116	3,471.2	3,471.2	.	.	.	.	.	.	.	.
oe	ms	5	101	119	147	47.9	47.9	.	.	.	.	.	.	.	.
oe	ms	5	102	72	97.2	28.7	28.7	.	.	.	.	.	.	.	.
oe	ms	5	103	18	42	98.3	93.7	.	.	.	.	.	.	.	4.6
oe	ms	5	111	197	226	12.1	12.1	.	.	.	.	.	.	.	.
oe	ms	5	112	48	76.2	694.8	694.8	.	.	.	.	.	.	.	.
oe	h	5	121	49	70	273.3	236.2	.	.	.	.	28.4	.	.	8.7
oe	h	6	131	100	113	.	.	.	.	.	.	.	.	.	.
ce	h	7	141	52	61.4	294.7	286.8	.	.	5.6	.	.	.	.	2.3
ce	ms	8	151	30	52.9	306.9	306.6	.	.	.	.	.	.	.	0.4
ce	ms	8	152	54	76.5	431.1	431.1	.	.	.	.	.	.	.	.
ce	ms	8	153	21	37	643.2	640.4	.	.	.	.	.	.	.	2.8
ce	ms	8	161	260	289	268.8	.	.	.	.	.	.	268.8	.	.
ce	ms	10	171	45	71.2	372.9	372.9	.	.	.	.	.	.	.	.
ce	ms	10	172	262	286	24.2	24.2	.	.	.	.	.	.	.	.
ce	ms	10	173	443	474	38.2	.	.	.	.	.	.	38.2	.	.
ce	ms	10	181	25	47	199.4	199.2	.	.	.	.	.	.	.	0.2
ce	ms	10	182	69	91	1,090.8	1,081.5	.	.	.	.	.	.	.	9.3
ce	ms	10	183	317	345	10.4	10.4	.	.	.	.	.	.	.	.
ce	ms	11	191	28	52.3	370.3	370.3	.	.	.	.	.	.	.	.
ce	ms	11	192	112	140	225.8	225.8	.	.	.	.	.	.	.	.
ce	ms	12	201	46	67.6	71.2	66.4	.	.	.	.	4.8	.	.	.
ce	ms	12	202	60	74.3	41.9	37.7	.	.	.	.	4.1	.	.	.

Stratum	Trawl Type	Transect	Sample	Min Depth	Max Depth	Total S_A	PLANK	KRILL	MESO	OTDEM	PEL1	PEL2	PL/ME	PL/PE	PMIX
ce	ms	12	203	20	40.9	160.4	142.8	.	.	.	.	3.4	.	.	14.1
cms	ms	15	211	100	124	30.8	30.8	.	.	.	.	.	.	.	.
cms	ms	15	212	56	81.1	71.3	71.3	.	.	.	.	.	.	.	.
cms	ms	15	213	22	44.3	301.6	298.2	.	.	.	.	.	.	.	3.4
cms	ms	15	221	375	410	7.7	3.1	.	.	.	.	.	4.6	.	.
cms	ms	15	222	148	175	7.3	7.3	.	.	.	.	.	.	.	.
cms	h	17	231	37	42.5	74.4	37.7	.	.	23.0	1.3	.	.	.	12.3
cms	ms	17	241	62	92	147.2	141.2	.	.	.	.	6.1	.	.	.
cms	ms	17	242	340	368	37.6	.	.	.	.	.	.	37.6	.	.
cws	ms	20	251	310	335	10.6	1.3	.	.	.	.	.	9.3	.	.
cws	ms	20	252	235	258	6.0	5.4	0.6	.	.	.	.	.	.	.
cws	ms	20	261	102	127	118.7	0.9	.	.	.	.	.	117.8	.	.
cws	ms	20	262	37	61.7	462.5	381.9	.	.	.	.	.	78.2	.	2.4
cws	ms	20	271	465	490	95.8	.	.	.	.	.	.	95.8	.	.
cws	ms	20	272	60	85.1	608.9	608.9	.	.	.	.	.	.	.	.
ow	ms	22	281	136	163	286.1	8.3	.	.	.	.	.	277.9	.	.
ow	ms	22	282	51	73	410.0	25.3	.	.	.	.	.	384.7	.	.
ow	ms	23	291	266	299	7.5	7.5	.	.	.	.	.	.	.	.
ow	ms	23	301	307	338	13.1	4.4	.	.	.	.	.	8.7	.	.
ow	ms	26	311	105	129	199.2	199.2	.	.	.	.	.	.	.	.
ow	ms	26	321	396	426	17.3	.	.	.	.	.	.	17.3	.	.
ow	ms	26	322	71	93.5	110.7	110.1	.	.	.	.	.	.	.	0.6
ow	ms	26	323	30	52.3	85.1	83.8	.	.	.	.	.	.	.	1.4
ow	ms	27	331	275	275	56.8	56.8	.	.	.	.	.	.	.	.
ow	ms	27	333	156	181	43.2	43.2	.	.	.	.	.	.	.	.
ow	ms	27	341	147	173	69.5	49.9	.	.	.	.	.	19.6	.	.
ow	ms	27	351	121	145	107.5	107.5	.	.	.	.	.	.	.	.

Stratum	Trawl Type	Transect	Sample	Min Depth	Max Depth	Total S_A	PLANK	KRILL	MESO	OTDEM	PEL1	PEL2	PL/ME	PL/PE	PMIX
ow	ms	27	352	55	77.2	156.6	153.5	.	.	.	.	.	.	.	3.1
ow	ms	27	353	30	51.2	92.7	82.4	.	.	.	.	.	.	.	10.3
cwn	h	27	361	400	428	31.9	.	.	.	.	.	.	31.9	.	.
cwn	ms	30	371	363	387	15.6	2.2	.	.	.	.	.	13.4	.	.
cwn	ms	30	372	72	94.4	361.8	361.8	.	.	.	.	.	.	.	0.0
cwn	ms	30	373	35	55	137.1	136.1	.	.	.	.	.	.	.	1.0
cwm	ms	31	381	464	507	37.1	37.1	.	.	.	.	.	.	.	.
cwm	ms	31	382	332	351	7.7	6.0	.	.	.	.	.	1.7	.	.
cwm	ms	31	383	150	175	63.1	.	.	.	.	.	.	63.1	.	.
cwm	ms	35	391	496	526	35.5	18.1	.	.	.	.	.	17.4	.	.
cwm	ms	35	392	115	134	76.9	4.7	.	.	.	.	.	72.2	.	.
cmm	ms	37	401	480	503	47.8	47.8	.	.	.	.	.	.	.	.
cmm	ms	37	402	285	305	10.5	6.3	.	.	.	.	.	4.2	.	.
cmm	ms	37	403	175	192	52.1	.	.	.	.	.	.	52.1	.	.
cmm	ms	40	411	425	451	2.5	.	.	.	.	.	.	2.5	.	.
cmm	ms	40	412	358	383	1.6	.	.	.	.	.	.	1.6	.	.
cmm	ms	40	413	220	237	25.1	25.1	.	.	.	.	.	.	.	.
cmm	ms	40	421	481	510	16.6	.	.	.	.	.	.	16.6	.	.
cmm	ms	40	422	430	450	5.1	.	.	.	.	.	.	5.1	.	.
cmm	ms	40	423	173	189	11.2	11.2	.	.	.	.	.	.	.	.
cmn	ms	1	431	253	273	18.5	9.5	.	.	.	.	.	9.0	.	.
cmn	ms	1	432	330	349	12.4	7.7	.	.	.	.	.	4.7	.	.
cmn	ms	1	433	400	421	18.6	14.9	.	.	.	.	.	3.7	.	.
cmn	ms	1	441	103	121	69.9	.	.	.	.	.	.	69.9	.	.
cmn	ms	1	442	42	58.3	102.2	.	.	.	.	.	.	100.1	.	2.0

APPENDIX 3 TRAWL CATCH INFORMATION BY TAXONOMIC FAMILIES FOR TARGET STRENGTH ESTIMATION.

Trawl catches were aggregated to the taxonomic family to compute mean length, mean weight and total numbers in each of the acoustic strata (day-night and deep-shallow). Exceptional specimens (i.e., single large fish) were excluded in several cases, noted in the comment field, and subjective estimates of mean length were made in several cases (in red) where data were unavailable or appeared erroneous.

class	order	family	night	shallow	freq_occ	tot_num	tot_wt	mean_wt	mean_len	Comment
Actinopterygii			0	0	1	1	2	2	50	
Actinopterygii			0	1	1	1	1	1	42	
Actinopterygii	Anguilliformes	Anguillidae	0	1	1	2	9	4.5	213.5	
Actinopterygii	Anguilliformes	Congridae	0	0	1	3	24	8	222.9777	
Actinopterygii	Anguilliformes	Congridae	1	1	2	3	4	1.3333	131.6535	
Actinopterygii	Anguilliformes	Derichthyidae	0	0	1	1	20	20	315	
Actinopterygii	Anguilliformes	Heterenchelyidae	0	1	1	1	1	1	50	
Actinopterygii	Anguilliformes	Moringuidae	0	1	1	3	3	1	79.992	
Actinopterygii	Anguilliformes	Moringuidae	1	1	1	1	1	1	44	
Actinopterygii	Anguilliformes	Muraenidae	0	0	2	2	6	3	175	
Actinopterygii	Anguilliformes	Muraenidae	0	1	5	24	35	1.4583	144.7633	
Actinopterygii	Anguilliformes	Muraenidae	1	1	4	14.2571	83.2571	5.8397	216.6147	
Actinopterygii	Anguilliformes	Nemichthyidae	0	0	4	9	85	9.4444	408.4036	
Actinopterygii	Anguilliformes	Nemichthyidae	0	1	8	32	63	1.9688	141.4014	
Actinopterygii	Anguilliformes	Nemichthyidae	1	0	2	8	70	8.75	642.125	
Actinopterygii	Anguilliformes	Nemichthyidae	1	1	6	38.2808	79.2808	2.071	125.4869	
Actinopterygii	Anguilliformes	Ophichthidae	0	0	1	1	1	1	105	
Actinopterygii	Anguilliformes	Serrivomeridae	0	0	2	18	160	8.8889	415.6857	

class	order	family	night	shallow	freq_occ	tot_num	tot_wt	mean_wt	mean_len	Comment
Actinopterygii	Anguilliformes	Serrivomeridae	0	1	1	1	3	3	295	
Actinopterygii	Anguilliformes	Serrivomeridae	1	0	1	1	5	5	282	
Actinopterygii	Anguilliformes	Synaphobranchidae	0	1	1	1	1	1	50	
Actinopterygii	Aulopiformes	Evermannellidae	0	0	3	4	64	16	134.5	
Actinopterygii	Aulopiformes	Evermannellidae	0	1	1	1	8	8	114.8452	
Actinopterygii	Aulopiformes	Evermannellidae	1	0	5	14	154	11	83.5	
Actinopterygii	Aulopiformes	Evermannellidae	1	1	1	2	5	2.5	80	
Actinopterygii	Aulopiformes	Notosudidae	0	0	1	1	8	8	168	
Actinopterygii	Aulopiformes	Notosudidae	1	0	3	5	17	3.4	113	
Actinopterygii	Aulopiformes	Paralepididae	0	0	3	3	19	6.3333	116.9883	
Actinopterygii	Aulopiformes	Paralepididae	0	1	3	18	88	4.8889	139.8749	
Actinopterygii	Aulopiformes	Paralepididae	1	0	4	5	16	3.2	62.6604	
Actinopterygii	Aulopiformes	Paralepididae	1	1	3	16	75	4.6875	135.9864	
Actinopterygii	Aulopiformes	Scopelarchidae	0	0	2	2	5	2.5	73.5	
Actinopterygii	Aulopiformes	Scopelarchidae	0	1	2	4	5	1.25	58	
Actinopterygii	Aulopiformes	Scopelarchidae	1	0	1	1	2	2	80	
Actinopterygii	Aulopiformes	Scopelarchidae	1	1	1	1	1	1	35	
Actinopterygii	Aulopiformes	Synodontidae	1	0	1	3	5	1.6667	80	
Actinopterygii	Beryciformes	Berycidae	1	0	1	1	1	1	40	
Actinopterygii	Beryciformes	Diretmidae	0	0	11	21	174	8.2857	60.6514	
Actinopterygii	Beryciformes	Holocentridae	0	1	1	1	1	1	45	
Actinopterygii	Beryciformes	Holocentridae	1	1	2	19	26	1.3684	50.2	
Actinopterygii	Beryciformes	Trachichthyidae	0	1	5	10	5	0.5	22	
Actinopterygii	Beryciformes	Trachichthyidae	1	1	3	5.2808	5.2808	1	16.3317	
Actinopterygii	Elopiformes		0	1	1	3	1	0.3333	70.6596	
Actinopterygii	Gadiformes	Bregmacerotidae	0	1	2	18.3885	30.777	1.6737	52.2	
Actinopterygii	Gadiformes	Bregmacerotidae	1	0	1	5	21	4.2	84.4	

class	order	family	night	shallow	freq_occ	tot_num	tot_wt	mean_wt	mean_len	Comment
Actinopterygii	Gadiformes	Bregmacerotidae	1	1	2	17.7714	34.5428	1.9437	68.625	
Actinopterygii	Gadiformes	Macrouridae	1	0	1	1	33	33	354	
Actinopterygii	Gadiformes	Melanonidae	0	0	1	2	19	9.5	117.5	
Actinopterygii	Gasterosteiformes	Fistulariidae	0	1	4	5	4	0.8	276.3057	
Actinopterygii	Gasterosteiformes	Fistulariidae	1	1	1	1	1	1	153	
Actinopterygii	Lampridiformes	Lophotidae	0	0	1	1	4	4	209	
Actinopterygii	Lampridiformes	Lophotidae	1	0	1	4	23	5.75	200	
Actinopterygii	Lampridiformes	Radiicephalidae	0	0	1	1	113	113	510	
Actinopterygii	Lophiiformes		0	0	1	1	5	5	65	
Actinopterygii	Lophiiformes	Melanocetidae	1	0	1	1	2	2	41	
Actinopterygii	Myctophiformes		1	1	3	1533.18	3025.86	1.9736	52.5141	
Actinopterygii	Myctophiformes	Myctophidae	0	0	24	1133.293	3749.965	3.3089	69.5435	
Actinopterygii	Myctophiformes	Myctophidae	0	1	9	5072.748	15399.16	3.0357	67.8383	
Actinopterygii	Myctophiformes	Myctophidae	1	0	7	531	3093	5.8249	73.1846	
Actinopterygii	Myctophiformes	Myctophidae	1	1	12	4885.081	15212.73	3.1141	65.7281	
Actinopterygii	Myctophiformes	Neoscopelidae	0	0	1	29	0	0	42.212	
Actinopterygii	Myctophiformes	Neoscopelidae	0	1	2	5	6	1.2	62	
Actinopterygii	Myctophiformes	Neoscopelidae	1	1	1	8.5143	8.5143	1	65	
Actinopterygii	Osmeriformes	Argentinidae	0	0	3	3	9	3	82.6584	
Actinopterygii	Osmeriformes	Argentinidae	1	0	1	6	4	0.6667	101.1869	
Actinopterygii	Osmeriformes	Opisthoproctidae	0	0	2	2	13	6.5	67.5	
Actinopterygii	Osmeriformes	Platytroctidae	0	0	3	9	262	29.1111	150.5	
Actinopterygii	Perciformes	Acanthuridae	0	0	4	14	5	0.3571	24.8577	
Actinopterygii	Perciformes	Acanthuridae	0	1	22	358.3885	254.3885	0.7098	28.6896	
Actinopterygii	Perciformes	Acanthuridae	1	0	2	2	2	1	26	
Actinopterygii	Perciformes	Acanthuridae	1	1	8	518.7218	201.6691	0.3888	19.1572	
Actinopterygii	Perciformes	Acropomatidae	0	0	3	9	49	5.4444	98.75	

class	order	family	night	shallow	freq_occ	tot_num	tot_wt	mean_wt	mean_len	Comment
Actinopterygii	Perciformes	Acropomatidae	0	1	3	102.7194	456.0432	4.4397	71.5	
Actinopterygii	Perciformes	Acropomatidae	1	0	5	22	107	4.8636	73.9514	
Actinopterygii	Perciformes	Acropomatidae	1	1	2	78.7999	368.4853	4.6762	73.0484	
Actinopterygii	Perciformes	Ariommatidae	0	1	2	4	4	1	39.5	
Actinopterygii	Perciformes	Bramidae	0	0	2	3	19	6.3333	72.9927	
Actinopterygii	Perciformes	Bramidae	0	1	17	148	606	4.0946	50.6824	
Actinopterygii	Perciformes	Bramidae	1	0	1	1	5	5	278	
Actinopterygii	Perciformes	Bramidae	1	1	12	179.9176	1810.387	10.0623	65.31	
Actinopterygii	Perciformes	Carangidae	0	1	57	6748.561	30538.71	4.5252	76.2845	
Actinopterygii	Perciformes	Carangidae	1	1	33	1577.889	2322.881	1.4721	59.6997	
Actinopterygii	Perciformes	Chaetodontidae	0	1	5	9	8	0.8889	26.4418	
Actinopterygii	Perciformes	Chiasmodontidae	0	0	4	6	76	12.6667	117.5126	
Actinopterygii	Perciformes	Chiasmodontidae	0	1	2	2	5	2.5	96	
Actinopterygii	Perciformes	Chiasmodontidae	1	0	4	11	58	5.2727	92.2	
Actinopterygii	Perciformes	Epigonidae	0	1	1	1	3	3	76	
Actinopterygii	Perciformes	Epigonidae	1	1	1	1	1	1	60	
Actinopterygii	Perciformes	Gempylidae	0	0	2	4	85	21.25	432.5	
Actinopterygii	Perciformes	Gempylidae	0	1	3	4	176	44	334.2999	
Actinopterygii	Perciformes	Gempylidae	1	0	11	27	465	17.2222	223.147	
Actinopterygii	Perciformes	Gempylidae	1	1	3	24.2857	240.3712	9.8976	154	
Actinopterygii	Perciformes	Lutjanidae	0	0	3	11	11	1	40.4505	
Actinopterygii	Perciformes	Lutjanidae	0	1	16	2377.385	1713.17	0.7206	34.9161	
Actinopterygii	Perciformes	Lutjanidae	1	1	12	331.9527	357.2893	1.0763	43.9732	
Actinopterygii	Perciformes	Mugilidae	0	1	1	3	3	1	70	
Actinopterygii	Perciformes	Mugilidae	1	1	2	5	14	2.8	68.8	
Actinopterygii	Perciformes	Nomeidae	0	0	4	22	40	1.8182	116.5	
Actinopterygii	Perciformes	Nomeidae	0	1	24	1498.326	8295.23	5.5363	73.9264	

class	order	family	night	shallow	freq_occ	tot_num	tot_wt	mean_wt	mean_len	Comment
Actinopterygii	Perciformes	Nomeidae	1	0	6	19	3239	4.1	76.2651	adjusted to exclude 3166g Psenes sp
Actinopterygii	Perciformes	Nomeidae	1	1	17	3137.322	14617.42	4.6592	111.1187	
Actinopterygii	Perciformes	Polynemidae	0	1	4	165.8152	297.0747	1.7916	58.6883	
Actinopterygii	Perciformes	Polynemidae	1	1	2	217.766	245.99	1.1296	52.4016	
Actinopterygii	Perciformes	Priacanthidae	0	1	24	668.306	1412.38	2.1134	39.8943	
Actinopterygii	Perciformes	Priacanthidae	1	1	14	3269.129	2349.565	0.7187	37.2822	
Actinopterygii	Perciformes	Scombridae	0	1	12	98.1113	12844.34	12.91	99.5641	adjusted to exclude 11950g wahoo
Actinopterygii	Perciformes	Scombridae	1	1	5	35.8229	98.9512	2.7622	68.5	
Actinopterygii	Perciformes	Scombrolabracidae	0	1	3	5	105	21	128.2	
Actinopterygii	Perciformes	Scombrolabracidae	1	0	2	11	43	3.9091	76.1742	
Actinopterygii	Perciformes	Scombrolabracidae	1	1	2	13.1463	447.705	34.0556	144.5	
Actinopterygii	Perciformes	Sparidae	0	0	1	1	1	1	20	
Actinopterygii	Perciformes	Sparidae	0	1	16	56.0741	23.1482	0.4128	19.526	
Actinopterygii	Perciformes	Sparidae	1	0	2	3	2	0.6667	24.3309	
Actinopterygii	Perciformes	Sparidae	1	1	10	68.2926	29.1463	0.4268	17.8354	
Actinopterygii	Perciformes	Sphyraenidae	0	1	2	2	5161	1	40	adjusted to exclude 5160g barracuda
Actinopterygii	Perciformes	Trichiuridae	0	0	4	9	222	24.6667	330.3003	
Actinopterygii	Perciformes	Trichiuridae	0	1	2	4	74	18.5	342.25	
Actinopterygii	Perciformes	Trichiuridae	1	0	2	3	9	3	255.3078	
Actinopterygii	Perciformes	Trichiuridae	1	1	1	9.8425	13.1234	1.3333	137.6688	
Actinopterygii	Perciformes	Xiphiidae	1	1	1	1	54000	54000	2660	do not use
Actinopterygii	Pleuronectiformes	Achiridae	0	1	1	1	1	1	30	
Actinopterygii	Pleuronectiformes	Achiridae	1	1	1	1	1	1	35	
Actinopterygii	Pleuronectiformes	Bothidae	0	1	3	8	3	0.375	16	
Actinopterygii	Pleuronectiformes	Bothidae	1	1	1	2	1	0.5	23.5	

class	order	family	night	shallow	freq_occ	tot_num	tot_wt	mean_wt	mean_len	Comment
Actinopterygii	Polymixiiformes	Polymixiidae	0	0	1	1	44	44	153	
Actinopterygii	Polymixiiformes	Polymixiidae	0	1	5	15.1482	84.1854	5.5575	67.1751	
Actinopterygii	Polymixiiformes	Polymixiidae	1	1	3	7	30	4.2857	71.4442	
Actinopterygii	Scorpaeniformes		1	1	2	5.9237	5.9237	1	31.5	
Actinopterygii	Scorpaeniformes	Dactylopteridae	0	1	5	71	98	1.3803	32.928	
Actinopterygii	Scorpaeniformes	Dactylopteridae	1	1	6	32.076	297.0522	9.2609	57.4756	
Actinopterygii	Scorpaeniformes	Peristediidae	0	0	1	1	1	1	55	
Actinopterygii	Scorpaeniformes	Peristediidae	0	1	3	8	6	0.75	50.75	
Actinopterygii	Scorpaeniformes	Scorpaenidae	0	1	2	6	2	0.3333	11.1681	
Actinopterygii	Scorpaeniformes	Scorpaenidae	1	1	1	1	1	1	20	
Actinopterygii	Stephanoberyciformes	Melamphaidae	0	0	1	1	12	12	92	
Actinopterygii	Stomiiformes	Astronesthidae	0	0	5	17	743	43.7059	188.1607	
Actinopterygii	Stomiiformes	Astronesthidae	0	1	3	10	36	3.6	92.6	
Actinopterygii	Stomiiformes	Astronesthidae	1	0	4	78	1119	14.3462	201.8342	
Actinopterygii	Stomiiformes	Astronesthidae	1	1	7	18.5379	75.1756	4.0552	81.5909	
Actinopterygii	Stomiiformes	Chauliodontidae	0	0	9	546.538	4350.319	7.9598	176.3262	
Actinopterygii	Stomiiformes	Chauliodontidae	0	1	2	35.777	367.3237	10.267	132.5	
Actinopterygii	Stomiiformes	Chauliodontidae	1	0	5	37	862	23.2973	219.064	
Actinopterygii	Stomiiformes	Gonostomatidae	0	0	15	415.5268	1816.989	4.3727	54.3726	
Actinopterygii	Stomiiformes	Gonostomatidae	0	1	2	42	28	0.6667	130	
Actinopterygii	Stomiiformes	Gonostomatidae	1	0	8	72	359	4.9861	107.0724	
Actinopterygii	Stomiiformes	Gonostomatidae	1	1	1	1	20	20	175	
Actinopterygii	Stomiiformes	Idiacanthidae	0	0	1	3	12	4	229.977	
Actinopterygii	Stomiiformes	Idiacanthidae	1	0	1	6	13	2.1667	233.6904	
Actinopterygii	Stomiiformes	Idiacanthidae	1	1	1	4.2571	8.5143	2	112	
Actinopterygii	Stomiiformes	Malacosteidae	0	0	2	7	823	117.5714	302.6622	
Actinopterygii	Stomiiformes	Malacosteidae	1	0	2	9	182	20.2222	194.9805	

class	order	family	night	shallow	freq_occ	tot_num	tot_wt	mean_wt	mean_len	Comment
Actinopterygii	Stomiiformes	Melanostomiidae	0	0	6	24	805	33.5417	206.1	
Actinopterygii	Stomiiformes	Melanostomiidae	1	0	6	17	162	9.5294	132.75	
Actinopterygii	Stomiiformes	Phosichthyidae	0	0	2	2	2	1	36	
Actinopterygii	Stomiiformes	Phosichthyidae	1	0	2	15	188	12.5333	102.5	
Actinopterygii	Stomiiformes	Sternoptychidae	0	0	39	179	831	4.6425	57.0907	
Actinopterygii	Stomiiformes	Sternoptychidae	0	1	2	4	9	2.25	42.3291	
Actinopterygii	Stomiiformes	Sternoptychidae	1	0	13	46	167	3.6304	62.72	
Actinopterygii	Stomiiformes	Stomiidae	1	0	1	1	3	3	135	
Actinopterygii	Stomiiformes	Stomiidae	1	1	1	1	15	15	181	
Actinopterygii	Tetraodontiformes	Monacanthidae	0	1	24	139.889	408.7043	2.9216	56.4647	
Actinopterygii	Tetraodontiformes	Monacanthidae	1	1	5	29.2229	50.2752	1.7204	36.6	
Actinopterygii	Tetraodontiformes	Ostraciidae	0	1	5	7	475	67.8571	79.75	
Actinopterygii	Tetraodontiformes	Ostraciidae	1	1	2	2	2	1	9	
Actinopterygii	Tetraodontiformes	Tetraodontidae	0	1	14	49	81	1.6531	35.3531	
Actinopterygii	Tetraodontiformes	Tetraodontidae	1	0	2	2	20	10	44.5	
Actinopterygii	Tetraodontiformes	Tetraodontidae	1	1	5	8.2571	12.5143	1.5156	24.25	
Actinopterygii	Zeiformes	Caproidae	0	0	2	2	2	1	24	
Actinopterygii	Zeiformes	Caproidae	0	1	3	8	15	1.875	35.6705	
Actinopterygii	Zeiformes	Caproidae	1	1	1	1	1	1	19	
Actinopterygii	Zeiformes	Grammacolepidae	0	1	1	14.3885	14.3885	1	30	
Cephalopoda	Decapodiformes		0	1	1	1	1	1	20	
Cephalopoda	Decapodiformes	Bathyteuthidae	0	0	2	5	15	3	46	
Cephalopoda	Decapodiformes	Chiroteuthidae	0	0	1	1	51	51	40	
Cephalopoda	Decapodiformes	Chtenopterygidae	1	0	1	2	5	2.5	27.5	
Cephalopoda	Decapodiformes	Cranchiidae	0	0	3	3	2	0.6667	32	
Cephalopoda	Decapodiformes	Cranchiidae	0	1	2	2	3	1.5	26.8862	
Cephalopoda	Decapodiformes	Cranchiidae	1	1	3	10	5	0.5	20	

class	order	family	night	shallow	freq_occ	tot_num	tot_wt	mean_wt	mean_len	Comment
Cephalopoda	Decapodiformes	Enoploteuthidae	0	0	12	100.8482	277.9971	2.7566	25.9042	
Cephalopoda	Decapodiformes	Enoploteuthidae	0	1	6	226.9424	554.8849	2.445	33.125	
Cephalopoda	Decapodiformes	Enoploteuthidae	1	0	5	24	43	1.7917	34.7779	
Cephalopoda	Decapodiformes	Enoploteuthidae	1	1	8	341.7897	1062.55	3.1088	23.947	
Cephalopoda	Decapodiformes	Histioteuthidae	0	0	1	2	239	119.5	41.998	
Cephalopoda	Decapodiformes	Histioteuthidae	1	0	3	3	267	89	40	
Cephalopoda	Decapodiformes	Loliginidae	0	0	1	2	1	0.5	21	
Cephalopoda	Decapodiformes	Loliginidae	0	1	2	642	1534	2.3894	33.4262	
Cephalopoda	Decapodiformes	Loliginidae	1	1	1	6	67	11.1667	71.8477	
Cephalopoda	Decapodiformes	Lycoteuthidae	0	0	6	11	50	4.5455	31.75	
Cephalopoda	Decapodiformes	Lycoteuthidae	0	1	6	212.3309	380.8849	1.7938	30.4619	
Cephalopoda	Decapodiformes	Lycoteuthidae	1	0	2	8	56	7	40.4	
Cephalopoda	Decapodiformes	Lycoteuthidae	1	1	8	181.8107	401.645	2.2091	29.5714	
Cephalopoda	Decapodiformes	Octopoteuthidae	0	0	1	5	11	2.2	27	
Cephalopoda	Decapodiformes	Ommastrephidae	0	0	5	14	327	23.3571	79.6824	
Cephalopoda	Decapodiformes	Ommastrephidae	0	1	25	1475.781	7462.071	5.0564	46.2227	
Cephalopoda	Decapodiformes	Ommastrephidae	1	0	7	155	484	3.1226	38.7868	
Cephalopoda	Decapodiformes	Ommastrephidae	1	1	23	993.3241	5423.317	5.4598	47.3409	
Cephalopoda	Decapodiformes	Onycoteuthidae	1	1	1	47	53	1.1277	30	
Cephalopoda	Decapodiformes	Ornychoteuthidae	0	0	5	29	54	1.8621	33.312	
Cephalopoda	Decapodiformes	Ornychoteuthidae	0	1	1	60	38	0.6333	20	
Cephalopoda	Decapodiformes	Ornychoteuthidae	1	0	3	5	43	8.6	60.2	
Cephalopoda	Decapodiformes	Ornychoteuthidae	1	1	2	43.5428	67.5428	1.5512	28.3778	
Cephalopoda	Decapodiformes	Sepiolidae	0	0	6	26	88	3.3846	16.7486	
Cephalopoda	Decapodiformes	Sepiolidae	1	0	1	1	1	1	12	
Cephalopoda	Decapodiformes	Spirulidae	0	0	2	2	13	6.5	34.5	
Cephalopoda	Decapodiformes	Spirulidae	1	0	2	7	15	2.1429	35.8577	

class	order	family	night	shallow	freq_occ	tot_num	tot_wt	mean_wt	mean_len	Comment
Cephalopoda	Decapodiformes	Thysanoteuthidae	0	0	1	1	1	1	45	
Cephalopoda	Decapodiformes	Thysanoteuthidae	0	1	1	9	8	0.8889	45	
Chondrichthys	Rajiformes	Dasyatidae	0	1	1	1	2540	2540	960	
Crustacea	Amphipoda		0	0	1	1	1	1	10	
Crustacea	Amphipoda		0	1	1	1	1	1	10	
Crustacea	Amphipoda		1	1	1	1	1	1	10	
Crustacea	Amphipoda	Hyperiidae	0	0	1	3	1	0.3333	10	
Crustacea	Amphipoda	Hyperiidae	1	0	1	1	1	1	10	
Crustacea	Amphipoda	Phronimidae	0	0	1	1	1	1	10	
Crustacea	Amphipoda	Phronimidae	0	1	2	3	5	1.6667	10	
Crustacea	Amphipoda	Phrosinidae	0	1	1	1	1	1	10	
Crustacea	Amphipoda	Platyscelidae	0	0	3	10	4	0.4	8.5	
Crustacea	Amphipoda	Platyscelidae	0	1	1	3	1	0.3333	10	
Crustacea	Amphipoda	Platyscelidae	1	0	1	6	2	0.3333	10	
Crustacea	Brachyura		0	0	1	3	1	0.3333	10	
Crustacea	Brachyura		0	1	3	8	50	6.25	10	
Crustacea	Brachyura		1	1	5	466.4373	43.0054	0.0922	10	
Crustacea	Caridea	Oplophoridae	0	0	14	445.8066	857.0254	1.9224	16.9939	
Crustacea	Caridea	Oplophoridae	0	1	6	107.7194	476.3885	4.4225	12.6	
Crustacea	Caridea	Oplophoridae	1	0	7	73	86	1.1781	15.2869	
Crustacea	Caridea	Oplophoridae	1	1	5	170.3837	218.8802	1.2846	8.4	
Crustacea	Decapoda	Caridea	0	0	1	1	15	15	50	
Crustacea	Decapoda	Caridea	1	0	2	2	8	4	29.5	
Crustacea	Decapoda	Sergestidae	0	0	3	6	18	3	21.75	
Crustacea	Decapoda	Sergestidae	0	1	1	2	5	2.5	16.5	
Crustacea	Decapoda	Sergestidae	1	0	5	68	188	2.7647	17.25	
Crustacea	Decapoda	Sergestidae	1	1	1	2	4	2	15.5	

class	order	family	night	shallow	freq_occ	tot_num	tot_wt	mean_wt	mean_len	Comment
Crustacea	Euphausiacea		0	0	17	1321	794	0.6011	11.5063	
Crustacea	Euphausiacea		0	1	1	4	1	0.25	6	
Crustacea	Euphausiacea		1	0	5	29	28	0.9655	33.75	
Crustacea	Euphausiacea		1	1	4	49.5617	12.2808	0.2478	5.5	
Crustacea	Mysidacea	Lophogastridae	0	0	4	13	33	2.5385	26.9	
Crustacea	Mysidacea	Lophogastridae	1	0	1	2	2	1	20	
Crustacea	Palinura		0	1	4	27	4	0.1481	7	
Crustacea	Palinura		1	1	1	2	1	0.5	7	
Crustacea	Palinura	Palinuridae	0	1	1	1	1	1	7	
Crustacea	Peneidea	Penaeidae	0	0	5	74	183	2.473	15.9442	
Crustacea	Peneidea	Penaeidae	0	1	1	71.9424	57.554	0.8	10	
Crustacea	Peneidea	Penaeidae	1	0	2	35	80	2.2857	17.0017	
Crustacea	Peneidea	Penaeidae	1	1	1	12.2926	12.2926	1	16.5	
Crustacea	Stenopodidea	Stenopodidae	0	0	1	1	1	1	10	
Crustacea	Stenopodidea	Stenopodidae	1	1	1	1	1	1	10	
Crustacea	Stomatopoda		0	0	1	3	1	0.3333	10	
Crustacea	Stomatopoda		0	1	2	5	2	0.4	10	
Crustacea	Stomatopoda		1	1	3	29	3	0.1034	10	
Gastropoda	Heteropoda	Atlantidae	0	0	2	3	6	2	104	
Gastropoda	Heteropoda	Atlantidae	0	1	2	2	2	1	104	
Gastropoda	Heteropoda	Atlantidae	1	1	1	1	1	1	104	
Gastropoda	Pteropoda	Cavoliniidae	0	1	1	1	1	1	7	
Gastropoda	Pteropoda	Cavoliniidae	1	0	1	4	2	0.5	7	
Gastropoda	Pteropoda	Cavoliniidae	1	1	2	3	2	0.6667	7	
Hydromedusa			0	0	1	2	40	20	30	
Hydromedusa	Capitata	Corymorphidae	0	1	1	1	24	24	30	
Hydromedusa	Capitata	Corymorphidae	1	0	1	1	50	50	104	

class	order	family	night	shallow	freq_occ	tot_num	tot_wt	mean_wt	mean_len	Comment
Hydromedusa	Hydromedusae		0	0	1	27	40	1.4815	10	
Hydromedusa	Hydromedusae		0	1	1	1	18	18	30	
Hydromedusa	Hydromedusae		1	0	1	4	17	4.25	20	
Hydromedusa	Hydromedusae		1	1	2	8	57	7.125	20	
Hydromedusa	Semaeostomae	Ulmaridae	0	1	1	2	12	6	20	
Hydromedusa	Semaeostomae	Ulmaridae	1	1	1	1	382	382	300	
Thaliacdea	Salpida	Tunicates	0	0	2	84	45	0.5357	30	
Thaliacdea	Salpida	Tunicates	1	0	3	5	31	6.2	30	
Thaliacdea	Salpida	Tunicates	1	1	1	6.1463	6.1463	1	30	