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Continuation of a Fishery Independent Survey for the Southern and Eastern Scalefish and Shark Fishery (SESSF) — 2014



Ian Knuckey, Matt Koopman, Simon Boag,
Jemery Day and David Peel

June 2015



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Introduction

The Southern and Eastern Scalefish and Shark Fishery (SESSF) is one of Australia's largest fisheries and supplies much of the fresh fish to our domestic markets. 2012–13 landings from the Commonwealth Trawl Sector (CTS), Scalefish Hook Sector (ScHS) and the Shark Gillnet and Shark Hook Sectors (SGSHS) were 10,724 t, 768 t and 1,867 t respectively and their 2011–12 gross values of production were \$45.9m, \$7.0m and \$14.9m (Woodhams *et al.* 2013).

The SESSF has a harvest strategy, under which stock assessments are conducted for all quota species in order to set a recommended biological catch (RBC) and an annual Total Allowable Catch (TAC). Depending on the amount and quality of information available, these assessments range from fully quantitative integrated model-based assessments, to simple assessments based on trends in standardised catch rates. Nearly all of the SESSF assessments use some form of catch per unit effort (CPUE) time series as the main index of stock abundance, however CPUE data have some inherent problems, particularly in a multispecies fishery.

The main problem with using commercial CPUE as the primary index of abundance largely stems from the critical assumption that there is a functional relationship between commercial catch rate and stock abundance (Shelton 2005). The veracity of this relationship has been questioned for numerous fish stocks around the world (e.g. Clark and Mangel 1979; Hutchings and Myers 1994; Hutchings 1996; Walters and Maguire 1996; Rose and Kulka 1999), and there has been significant doubt regarding that relationship for many SESSF species for some time. Apart from the well documented effects of hyperstability (Hilborn and Walters 1992) and technology creep (Marchal *et al.* 2007), the SESSF has a number of other aspects that could readily affect the relationship between catch rates and abundance. With the large number of possible target species, fishers modify their fishing practices to suit quota availability and market demands. This means that it's often unclear what the target species of fishing effort is, and that effort may be expended on fishing grounds that are unsuitable for the species of interest. Compounding this problem is that patterns of fishing effort in the SESSF change from year to year and within seasons (Tilzey 1994). Also, discarding of quota species occurs for a number of reasons including quota availability, size limits and market demands, and this also may change markedly from year to year (Liggins and Knuckey 1999). This discarding has only recently begun to be reported in commercial logbooks, and the frequency and accuracy of reported discards is not at a standard that can be included in analysis of catch rates. Further, several species such as Eastern Gemfish and Blue Warehou have low or 'bycatch' TACs, which prevents targeting of those species and undermines the use of commercial CPUE as a good index of abundance.

Many of the above problems can be largely addressed by the implementation of fishery independent surveys to provide a time series of abundance indices that can be used in addition to, or instead of, commercial CPUE data (e.g. Gunderson 1993; Pennington and Strømme 1998). Although fishery independent surveys have been implemented for single species fisheries in the SESSF — such as for Orange Roughy (see summary in Kloser *et al.* 2011) and Blue Grenadier (Ryan and Kloser 2009) — there has always been a level of industry concern about the practicalities and cost-effectiveness of undertaking a FIS for multiple species in the SESSF, which has prevented their implementation (Knuckey and Gason 2006). Despite these concerns, the growing need for an alternative and independent index of abundance saw the agreement to implement a multi-species fishery independent trawl survey during 2008.

As part of FRDC/AFMA Project 2006/028 “Implementation of fishery independent surveys for the Southern and Eastern Scalefish and Shark Fishery”, a model-based survey design was developed for the SESSF instead of a typical random stratified survey. This better enabled abundance estimates to be achieved for multiple species with low bias and reasonable (<30%) CVs (Peel *et al.* 2012). During this project, pilot surveys took place during summer and winter of 2008, and after review and subsequent small modifications to the design, the summer and winter surveys were repeated during 2010 (Knuckey *et al.* 2013a). The survey was continued during the summer and winter of 2012 (Knuckey *et al.* 2013b), with the principal investigator transitioning from Fishwell Consulting to the South East Trawl Fishing Industry Association (SETFIA) as originally intended.

Under AFMA’s current cost recovery model, 100% of costs for the SESSF fishery independent survey have been recovered from industry levies. AFMA and ComFRAB had previously advised that although not guaranteed, around \$500,000 would be available in future years to conduct the survey. During early 2012, SESSFRAG considered the CVs achieved during just the winter 2008 and 2010 surveys and agreed that it would be appropriate, given current cost restrictions, to conduct only winter surveys, thereby achieving a good time-series of abundance estimates that could be used in stock assessments in a much shortened time period. At the moment there is only a commitment to run the surveys biennially pending an evaluation of the costs/benefits of alternative intervals.

This report provides the results of the SESSF 2014 winter fishery independent survey. To date, no funds have been committed to conduct a 2016 winter survey.

Objectives

1. Continue the time-series of fishery independent trawl surveys in the SESSF for during 2014.
2. Provide fishery-independent indices of abundance for SESSF quota and byproduct species such as Silver Warehou, Blue Grenadier, Tiger Flathead, Jackass Morwong, Mirror Dory, Pink Ling, Common Sawshark, Southern Sawshark, Offshore Ocean Perch, Gummy Shark, John Dory and the Deepwater Shark basket; Western Gemfish, Redfish, Ocean Jacket, Latchet, King Dory, Stargazer, Frostfish and Red Gurnard.
3. Collect length frequencies and otoliths from all major quota species and selected high risk and non-quota species.
4. Prepare all survey information for use in fishery stock assessments and data summaries.

Material and Methods

SESSF Survey Design

The model-based approach used for the design of a fishery independent survey (FIS) for the Southern and Eastern Scalefish and Shark Fishery (SESSF) is described in Peel *et al.* (2012). Design components specific to the SESSF, and the rationale behind the sampling design using commercial trawls that was implemented in 2008, 2010, 2012 and 2014, are outlined in Knuckey *et al.* (2013a) and Knuckey *et al.* (2013b). We include a brief description of the methods, with emphasis on elements relevant for 2014, below.

In designing the SESSF FIS, the trawl CPUE data from shot by shot logbook records were analysed for eleven main species for two distinct seasons: summer (January to March) and

winter (July to September). The SESSF CPUE dataset was used to inform the model-based survey design. The data include shot specific covariates such as location, depth, date, time of day, and shot duration. To minimize any confounding from operational changes, only summer and winter CPUE data between 2000 and 2005 were analysed, comprising about 50,000 shots (Upston *et al.* 2013). In 2014, only the winter (July to September) season was surveyed.

The survey area encompasses the entire extent of the Commonwealth Trawl Sector (CTS) (Figure 1), ranging eastward from Cape Jervis (longitude 138° 08' 05" E) in South Australia, around the Victorian, Tasmanian and NSW coastlines to Barranjoey Point (latitude 33° 34' 54"). This survey design uses depth, and distance along a coastline curve, which starts in South Australia, instead of using latitude and longitude to describe a location. Depth at a location is interpolated from bathymetric maps. Distance along the curve ("coastal position") is computed by projecting a location to the nearest point on the curve. Using this coordinate system, we model the two dimensions independently and parsimoniously, without the need for complicated interaction terms.

In the initial survey design, two strategies were adopted for depth sampling in the range 50–700 m, depending on season. The winter 2014 survey used the deeper of the two sampling strategies — as with previous winter surveys — to improve precision of Gemfish, Blue-eye Trevalla, and Mirror Dory.

The survey's spatial distribution was chosen to be an equal mixture of fisheries effort (focused near ports) and a uniform distribution across the spatial extent of the fishery. A further practical consideration was whether the ground was "trawlable" at a proposed sample site.

Figure 2 shows how the implemented design sits within the covariate space (i.e. coastal position versus depth) for each of the two survey seasons.

Field Methods

Detailed descriptions of field methods and vessel and gear specifications are reported in Knuckey *et al.* (2013a)

Standardised "generalist" survey nets and doors were used for the survey, with one net designs for the NSW and east survey region and net design more suited to rougher ground in the west region (Table 2). Skipper were given locations of survey sites, and were required to tow at a speed of 3 knots for a two hour duration. The position of these shots has been retained each year, with some modifications to avoid heavily fouled ground. Given the large geographical extent of the fishery, three survey vessels are chartered to complete the survey. Vessels are chartered through an open tender process, and the proceeds from the catch are retained by the project to offset costs.

Each survey vessel carried a scientific observer who was responsible for sampling the catch. Once on board, fish were identified to the lowest taxonomic level possible, and their total weights either measured or estimated. Catches of commercial species were verified by comparing estimates to landed weights. Length frequency measurements and otoliths were taken for important commercial species. Data were entered and archived on Olrac Dynamic Data Logger (V5.0.1). Where possible, LOTEK LAT1400 temperature-depth recorders were deployed on the nets during survey tows to record date, time, depth and temperature at the net at specified time intervals.

SESSF Model

A full technical description of the SESSF model is included in Peel *et al.* (2012) with a brief summary in Upston *et al.* (2013).

The parameters to be estimated from each survey comprise only the change in spatial distribution of each species relative to its long term average, plus the overall mean for the year (Peel *et al.* 2012, Upston *et al.* 2013). To maintain the same structure and basis as the original fit, the survey model was re-parameterised using the model matrix and smooth matrix from the historical CPUE data fit. A new dispersion parameter was fitted to the survey data, and this reflects the sampling variance.

Relative abundance indices and CVs for 11 main species and select additional species were reported for summer and winter in each of three years, 2008 and 2010 and 2012 (Upston *et al.* 2013). As there was no summer survey in 2014, we only calculate abundance indices and CVs for the winter survey here and compare these results with the winter surveys in 2008, 2010 and 2012.

There are some caveats in interpreting the relative abundance indices, and these are included in the footnotes of tables. The different trawl nets used in the east and west regions since 2010 are implicitly assumed to be comparable in their ability to catch species and can be treated as a single gear type. Gemfish is an exception to this as Eastern and Western Gemfish indices are calculated separately, so if there are any differences in gear type between the east and the west, these are considered separately for this species.

Quality Assurance

All data are recorded in an observer version of ORLAC Dynamic Data Logger (DDL), which includes quality insurance protocols including automatic data capture (time, date and position), field restrictions, range checks, mandatory fields and lookup tables. All data are manually error checked against data sheets before loading into the shore version of ORLAC DDL. This database is regularly backed up, and used to extract data for analyses. A subset of data summary outputs were reproduced and compared using an alternative software package. Model outputs were reviewed and discussed amongst the CSIRO SESSF stock assessment group.

Results and Discussion

Survey Coverage

Vessels selected to conduct surveys in eastern, NSW and western regions were the Western Alliance, Francesca and Moira Elizabeth respectively. With support from AFMA, survey shots that were located in fisheries closures would be sampled during 2014, requiring each vessel to operate under scientific permits. Permits were issued for Western Alliance (#1002656), Francesca (#1002657) and Moira Elizabeth (#1002655). A total of 195 valid shots were conducted during July–September 2014 (Table 3 and Table 10), over 16 trips comprising 76 sea days. Mean tow speeds in the eastern, NSW and western zones were 3.0 kts, 3.0 kts and 3.1 kts (Table 3).

Catch Composition

Total catch during the winter 2014 FIS was 143.7 t, and comprised 251 different species or species groups (Table 9). Overall, 43 different quota species were caught (this includes the different species that comprise the deepwater shark and oreo baskets and flathead species other than Tiger Flathead), with Blue Grenadier (14.1 t), Tiger Flathead (8.3 t), Silver

Warehou (5.2 t), Mirror Dory (3.7 t) and Pink Ling (3.7 t) the quota species caught in the largest quantities (Figure 3 and Table 9). Tiger Flathead (108 shots), Silver Warehou (105 shots), and Pink Ling (94 shots) were observed in the greatest number of shots (Figure 4).

Totals catches (including discards) of 42.1 t, 63.0 t and 38.6 t were caught in the eastern, NSW and western zones respectively (Table 9). In the NSW zone, Spikey Dogfish (10.5 t, 17%), Frostfish (9.3 t, 15%), Blacktip Cucumberfish (7.8 t, 12%), and Tiger Flathead (3.0 t, 5%) made up the majority of the catch (Figure 5, Figure 8 and Table 9). Other quota species caught in large quantities in the NSW zone were Mirror Dory (1.7 t, 3%) and Bigeye Ocean Perch (1.2 t, 2%). Tiger Flathead (5.1 t, 12%), Roundsnout Gurnard (3.4 t, 8%), Blue Grenadier (2.7 t, 7%) and Ocean Jacket (2.0 t, 5%) were the top four species caught in the eastern zone (Figure 6, Figure 8 and Table 9), followed by Mirror Dory (1.7 t, 4%), Cocky Gurnard (1.6 t, 4%) and Pink Ling (1.4 t, 3%). Species caught in the greatest quantities in the western zone (Figure 7, Figure 8 and Table 9) were Blue Grenadier (10.8 t, 28%), Silver Warehou (4.1 t, 11%), Latchet (2.0 t, 5%) and Australian Burrfish (1.8 t, 5%). Pink Ling (1.6 t, 4%), Common Sawshark (1.0 t, 3%) and Spikey Oreodory (0.8 t, 2%) were also in the top 10 species caught in that zone.

Length Frequencies

A total of 18,092 length measurements were taken from 22 different species during the 2014 FIS (Table 4). Large numbers of measurements were taken from Tiger Flathead (4,082), Bigeye Ocean Perch (2,082), Mirror Dory (1,999), Blue Grenadier (1,494) and Silver Warehou (1,456). Otolith samples were taken from 1,875 fish comprising 18 different species including Tiger Flathead (411), Gemfish (239), Bigeye Ocean Perch (210), Pink Ling (207) and Blue Grenadier (203).

Lengths frequency distributions for major species from 2008, 2010, 2012 and 2014 surveys are shown in Figure 9 – Figure 22.

Length frequency distributions for many species have remained stable over the duration of the FIS. For example, distributions for Mirror Dory from the east have had modes of around 30 cm with a scattering of larger fish, while those from NSW have a bimodal distribution in each year with peaks at about 20 cm and 40–45 cm (Figure 16). Within each region, length frequency of Pink Ling was similar for each survey, and they were generally larger from the Western region compared to the East and NSW regions (Figure 17). Clear cohorts can be seen in the length frequency distributions for some species. Eastern Gemfish recruits appear in samples from NSW most years (except 2010), ranging 25–35 cm fork length (Figure 14). No small Eastern Gemfish were measured in the Eastern region during the first three years of surveys, but during 2014, 25–30 cm fish were measured, and there were also peaks at about 40 cm and 47 cm. Different cohorts can also be seen for Blue Grenadier (Figure 10), Mirror Dory (Figure 16) and Silver Warehou (Figure 21).

CVs for relative abundance estimates

In general there is a broad correspondence between yearly survey catch weights and yearly abundance indices (Table 6, Table 7, Figure 23, Figure 24, Figure 25). The number of survey shots included in the analyses for each year and season are reported in Table 5 and shown in Figure 25 and Figure 27. There is good correspondence between years in the distribution of the number of survey shots spatially and in the two depth zones. There is also a good correspondence between the predicted and achieved CVs for the eleven main species considered in the FIS design for the 2014 winter survey (Table 6).

The total catch weight of quota and main species for each winter survey is listed in Table 7. Four species show both an increase in total catch weight compared to all previous winter surveys and an increase in catch of more than 50% compared to the 2012 survey: Western Gemfish, Alfonsino, Blue Grenadier and Ocean Jacket (Table 7). In contrast, nine species show both a decrease in total catch weight compared to all previous winter surveys and a decrease in catch of more than 50% compared to the 2012 survey: Blue Warehou, Jackass Morwong, John Dory, Blue-eye Trevalla, Ocean Perch, Dogfishes, Barracouta, Silver Dory and Toothed Whiptail (Table 7). For the winter survey, reasonable CVs (<0.30 and without a flag for diagnostics) were obtained for eleven quota species and one additional species (Table 8). Compared to the previous winter surveys in 2008, 2010 and 2012, both the catch weights and the number of shots were considerably reduced for four species in 2014: Blue Warehou and Blue-eye Trevalla from the 11 target species (Figure 24, Figure 25) and Ocean Perch and Dogfishes (Figure 26, Figure 27) from the list of additional species. In each case, the abundance estimates for these species have CVs greater than 0.3 in 2014 (Table 8).

Silver Warehou stands out as the species with the largest range in the survey catch weight per shot and in the maximum shot size between years. The four largest shots for Silver Warehou in 2008 were all over 3000 kg, with no shots larger than 2000 kg in 2010 or 2012 and no shots over 1000kg in 2014 (Figure 28). The abundance estimates for Silver Warehou vary dramatically from one survey to the next. These two results suggest that the variance is underestimated for this species, and that the impact of a few large “jackpot” shots on the survey results could be producing confounding results in this case. Results like this from a schooling species could distort the abundance estimates, so the abundance estimates for this species should be treated with some caution. These unusually large catches per shot were removed prior to analysis of the historical CPUE data for the full model to allow for more stable estimation of spatial variability (Knuckey *et al.* 2013). The large catches were thought to be a consequence of specific and unusual targeting practises aimed at large aggregations, which were assumed to be unlikely to occur in the FIS itself (Knuckey *et al.* 2013). However, the assumption will not be met for Silver Warehou in some years, and the CV for the abundance index will be under-estimated by the model.

Conclusions

The results of this survey provide the fourth year of a fishery independent survey for SESSF species over an eight year period in the area of the CTS. The primary objective of this project was to increase the time series of fishery independent estimates of abundance indices with reasonable CVs (≤ 0.3) for the quota species Jackass Morwong, John Dory, Gemfish, Tiger Flathead, Pink Ling, Redfish, Silver Warehou (with a diagnostics flag), Gummy Shark, School Shark, Blue Grenadier, Common Sawshark, and for the bycatch species King Dory (Table 8). The 2014 winter FIS successfully recorded the catch composition from 195 shots respectively throughout the area of the CTS, and these data have been provided to CSIRO.

The fourth objective was to prepare all survey information for use in stock assessments and data summaries. This has been achieved with the data sent to CSIRO and processed in their data management system. Collaboration with CSIRO during the design, implementation and continuation of the FIS ensures that data collected can be easily incorporated into stock assessments. In addition, large numbers of length measurements and otolith samples were taken from a variety of species for use in the stock assessments.

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References

- Clark, C. W. and Mangel, M. (1979), Aggregation and fishery dynamics: A theoretical study of schooling and the purse seine tuna fisheries. *Fishery Bulletin*, 77, 317–337.
- Gunderson, D. R. (1993), *Surveys of Fisheries Resources*. John Wiley and Sons, Inc New York, 248pp.
- Hilborn, R. and Walters, C. J. (1992), *Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty*. Chapman and Hall, London.
- Hutchings, J. A. (1996), Spatial and temporal variation in the density of northern cod and a review of hypotheses for the stock's collapse. *Canadian Journal of Fisheries and Aquatic Sciences*, 53, 943–962.
- Hutchings, J. A. and Myers, R. A. (1994), What can be learned from the collapse of a renewable resource? Atlantic cod, *Gadus morhua*, of Newfoundland and Labrador. *Canadian Journal of Fisheries and Aquatic Sciences*, 51, 2126–2146.
- Kloser, R. J., Knuckey, I. A., Ryan, T. E., Pitman, L. and Sutton, C. (2011), Orange roughy conservation program: Eastern Zone surveys and trials of a cost effective acoustic headline system. Final report to the South East Trawl Fishing Industry Association, June 2011.
- Knuckey, I., Bravington, M., Peel, D., Koopman, M., Fuller, M., Klaer, N., Day, J., Upston, J. and Hudson, R. (2013a), Implementation of a fishery independent survey for the Southern and Eastern Scalefish and Shark Fishery. FRDC Project 2006/028. Fishwell Consulting, 168pp.
- Knuckey, I. A. and Gason, A. S. H. (2006), Assessing the feasibility of an industry-based fishery independent survey of the South East Fishery. Fisheries Research and Development Project 2002/072, Final Report. Fishwell Consulting, 55pp.
- Knuckey, I., Koopman, M., Boag, S., Upston, J., Klaer, N., Day, J., Peel, D. and Hudson, R. (2013b), Continuation of a fishery independent survey for the Southern and Eastern Scalefish and Shark Fishery – 2012. AFMA Project 2012/802. Fishwell Consulting 79 pp.
- Liggins, G. W. and Knuckey, I. A. (1999), Factors affecting discarding in the South East Fishery. In: Buxton, C.D. and S.E. Eayrs (eds), *Establishing meaningful targets for bycatch reduction in Australian fisheries*. Australian Society for Fish Biology Workshop Proceedings, Hobart, September 1998, pp 56–71.
- Marchal, P., Andersen, B., Caillart, B., Eigaard, O., Guyader, O., Hovgaard, H., Iriondo, A., Le Fur, F., Sacchi, J. and Santurtun, M. (2007), Impact of technological creep on fishing effort and fishing mortality, for a selection of European fleets. *ICES Journal of Marine Science*, 64 (1), 192.

Peel, D., Bravington, M.V., Kelly, N., Wood, S.N. and I. Knuckey (2012) A Model-Based Approach to Designing a Fishery-Independent Survey. *Journal of Agricultural, Biological and Environmental Statistics*, Vol. 18 (1), 1-21.

Pennington, M. and Strømme, T. (1998), Surveys as a research tool for managing dynamic stocks. *Fisheries Research*, 37, 97–106.

Rose, G. A., and Kulka, D. W. (1999), Hyperaggregation of fish and fisheries: how catch-per-unit-effort increased as the northern cod (*Gadus morhua*) declined. *Canadian Journal of Fisheries and Aquatic Sciences*, 56, 118–127.

Ryan, T. E. and Kloser R. J. (2009), Industry based acoustic surveys of Tasmanian west coast blue grenadier during the 2008 spawning season. Final report to AFMA (Project 2008/808) August 2009. CSIRO, Hobart.

Shelton, P. A. (2005), Did over-reliance on commercial catch rate data precipitate the collapse of northern cod? *ICES Journal of Marine Science*, 62, 1139–1149.

Tilzey, R. (Ed) (1994), The South East Fishery – A scientific review with reference to quota management. Bureau of Resource Sciences, Parkes ACT, Australia.

Upston, J, Day, J, Klaer, N, and Peel, D, (2013) Fishery Independent Survey for the Southern and Eastern Scalefish and Shark Fishery – 2012 Survey. Report to Fishwell Consulting. CSIRO. 50pp.

Walters, C., and Maguire, J-J. (1996), Lessons for stock assessment from the northern cod collapse. *Reviews in Fish Biology and Fisheries*, 6, 125–137.

Woodhams, J., Vieira, S. and Stobutzki, I., (eds) 2013, Fishery status reports 2012, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

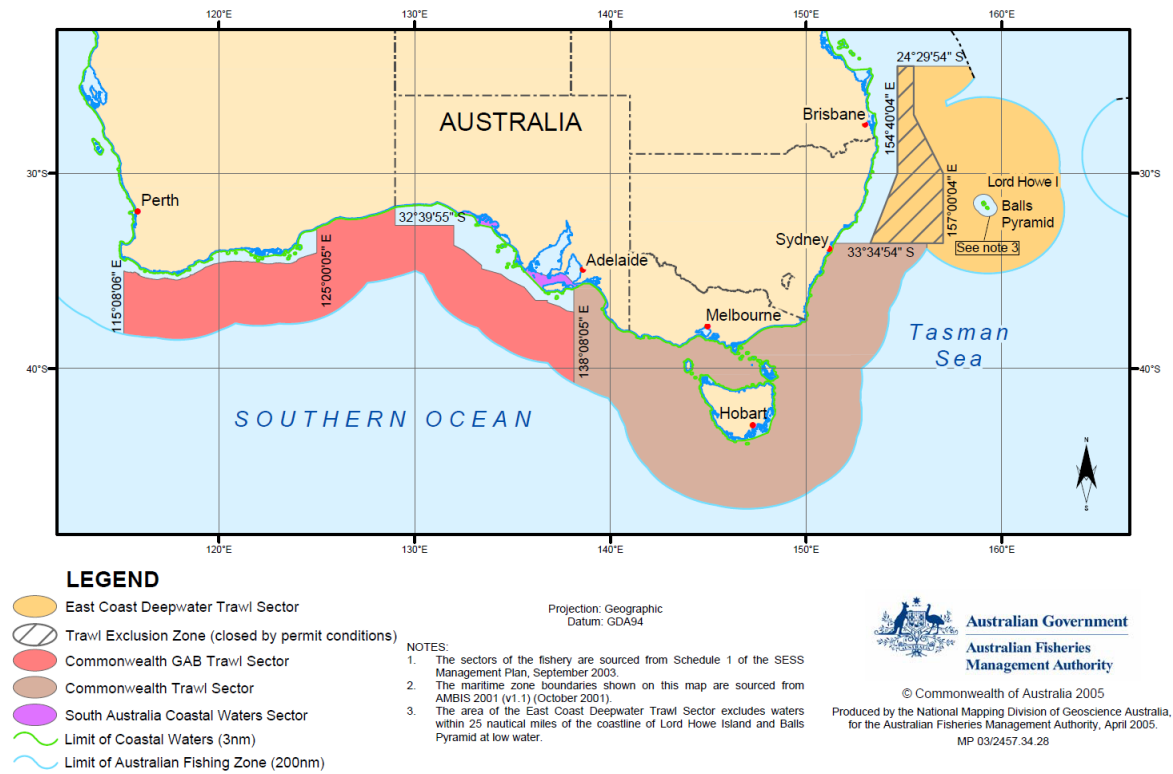


Figure 1. The Commonwealth Trawl Sector of the Southern and Eastern Scalefish and Shark Fishery.

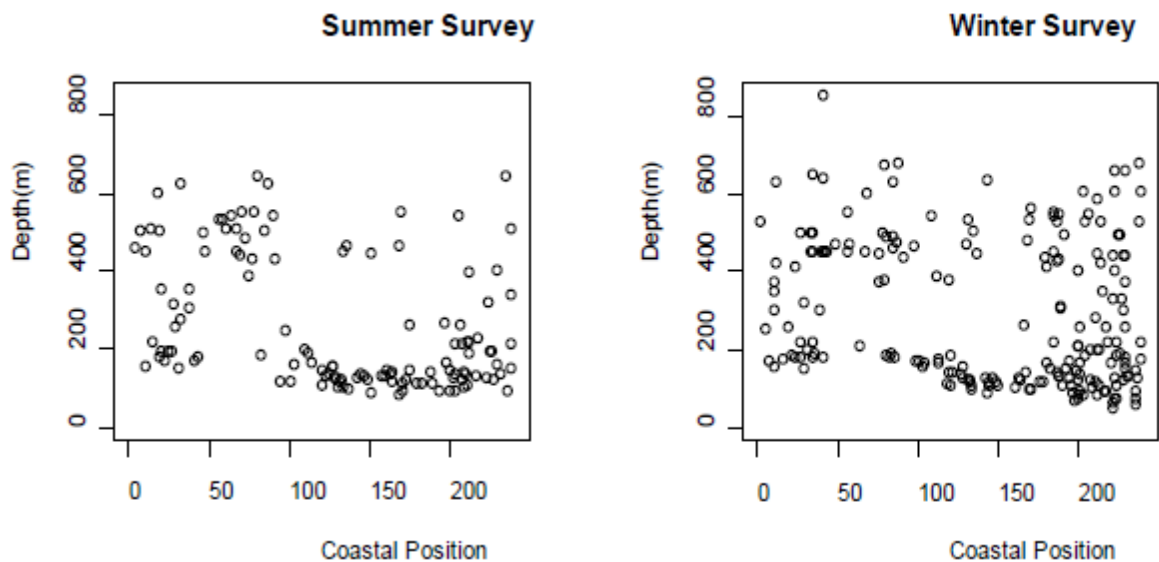


Figure 2. Covariate coverage (i.e. depth versus coastal locations) for the survey in summer and winter.

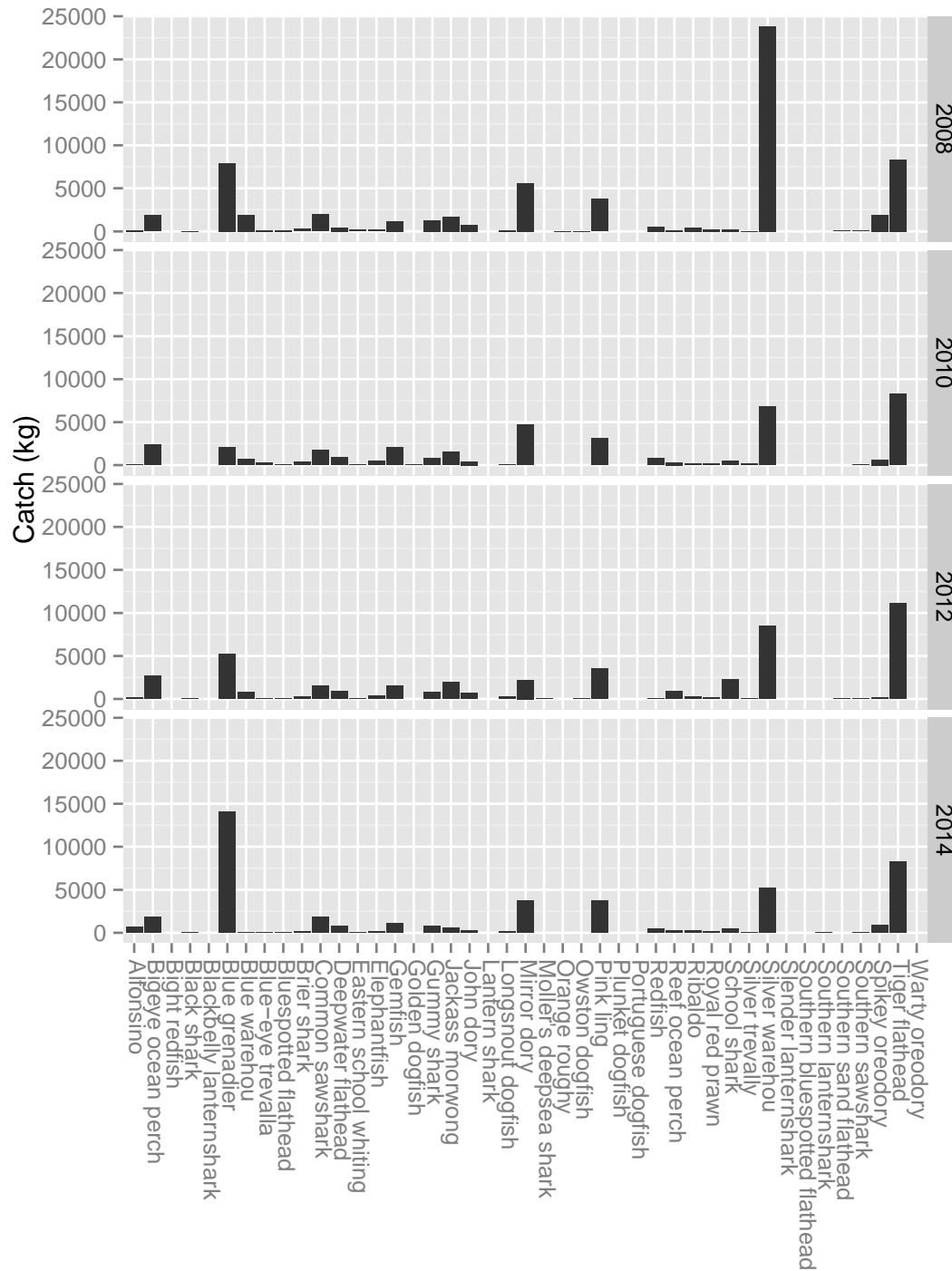


Figure 3. Total catch (kg) of each quota species during winter 2008, 2010, 2012 and 2014 surveys.

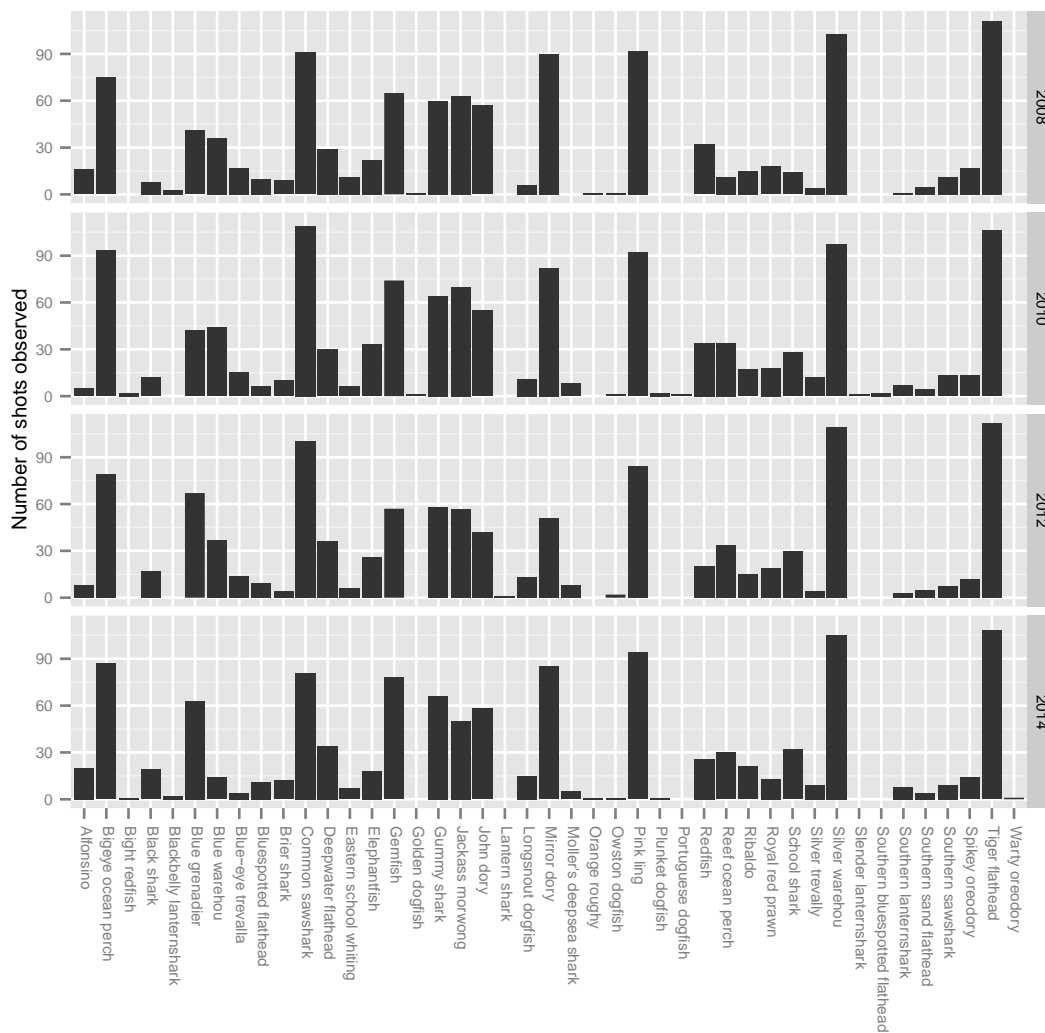


Figure 4. Number of shots containing each quota species during winter 2008, 2010, 2012 and 2014 surveys.

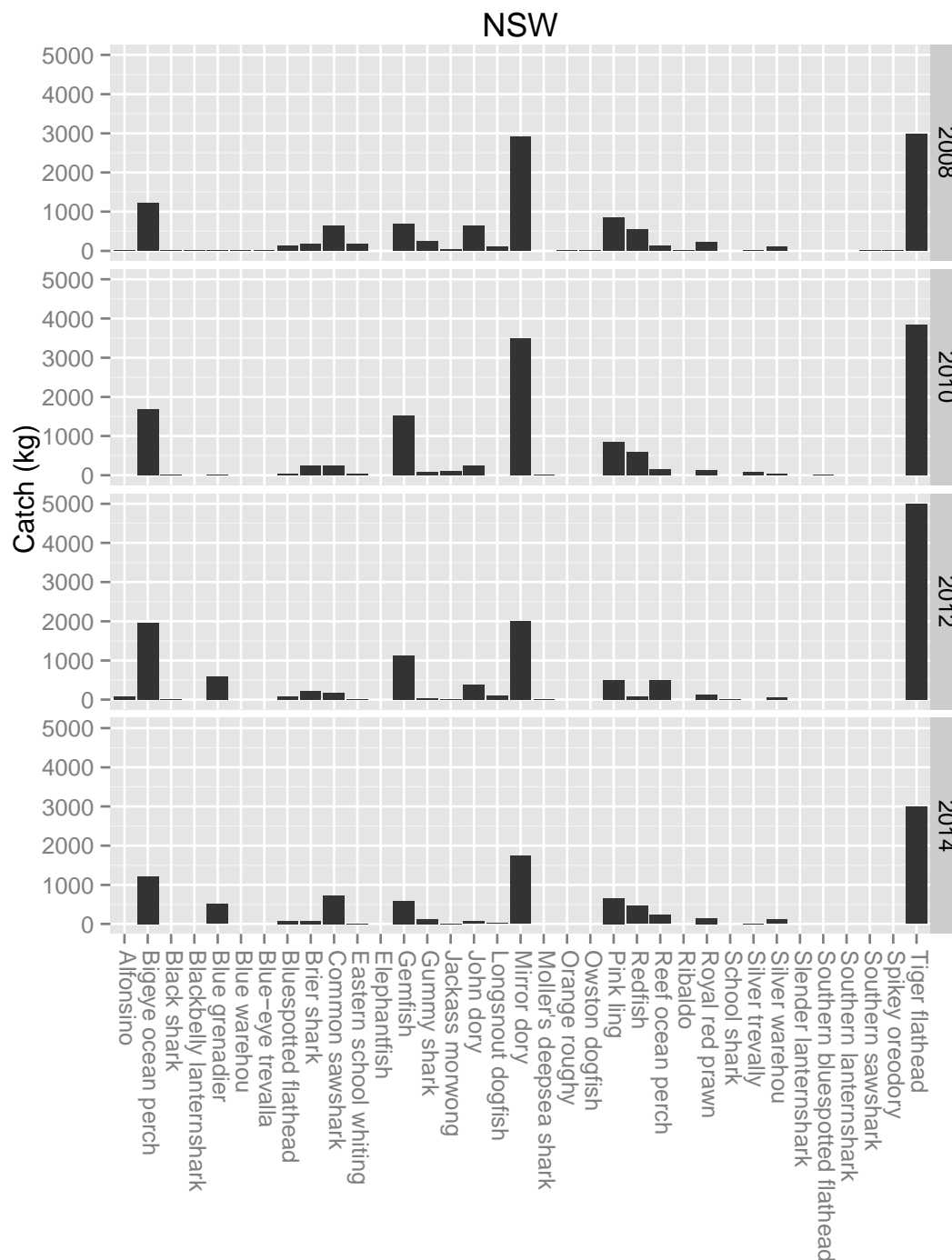


Figure 5. Total catch (kg) of each quota species in NSW during winter 2008, 2010, 2012 and 2014 surveys.

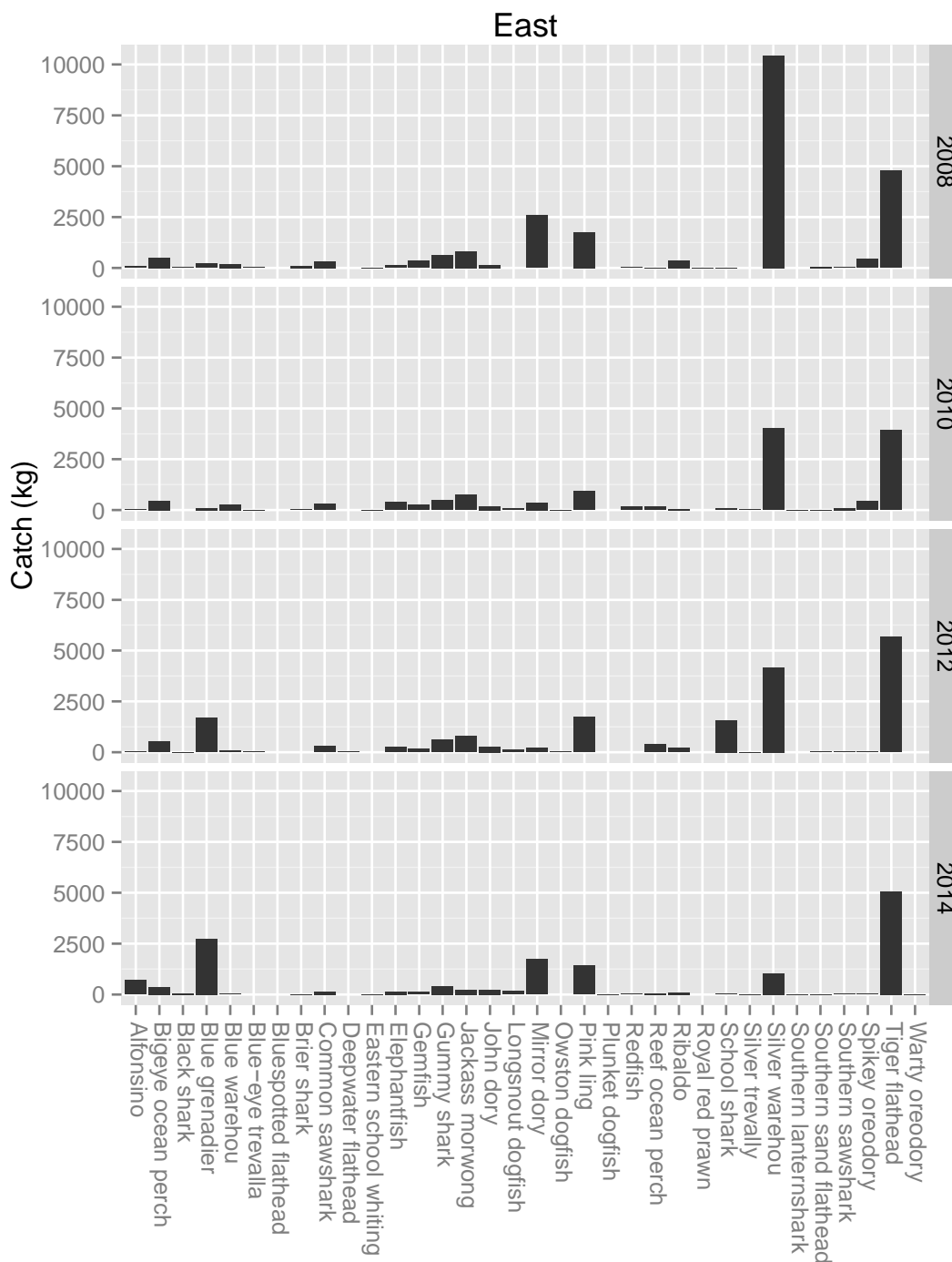


Figure 6. Total catch (kg) of each quota species in the Eastern region during winter 2008, 2010, 2012 and 2014 surveys.

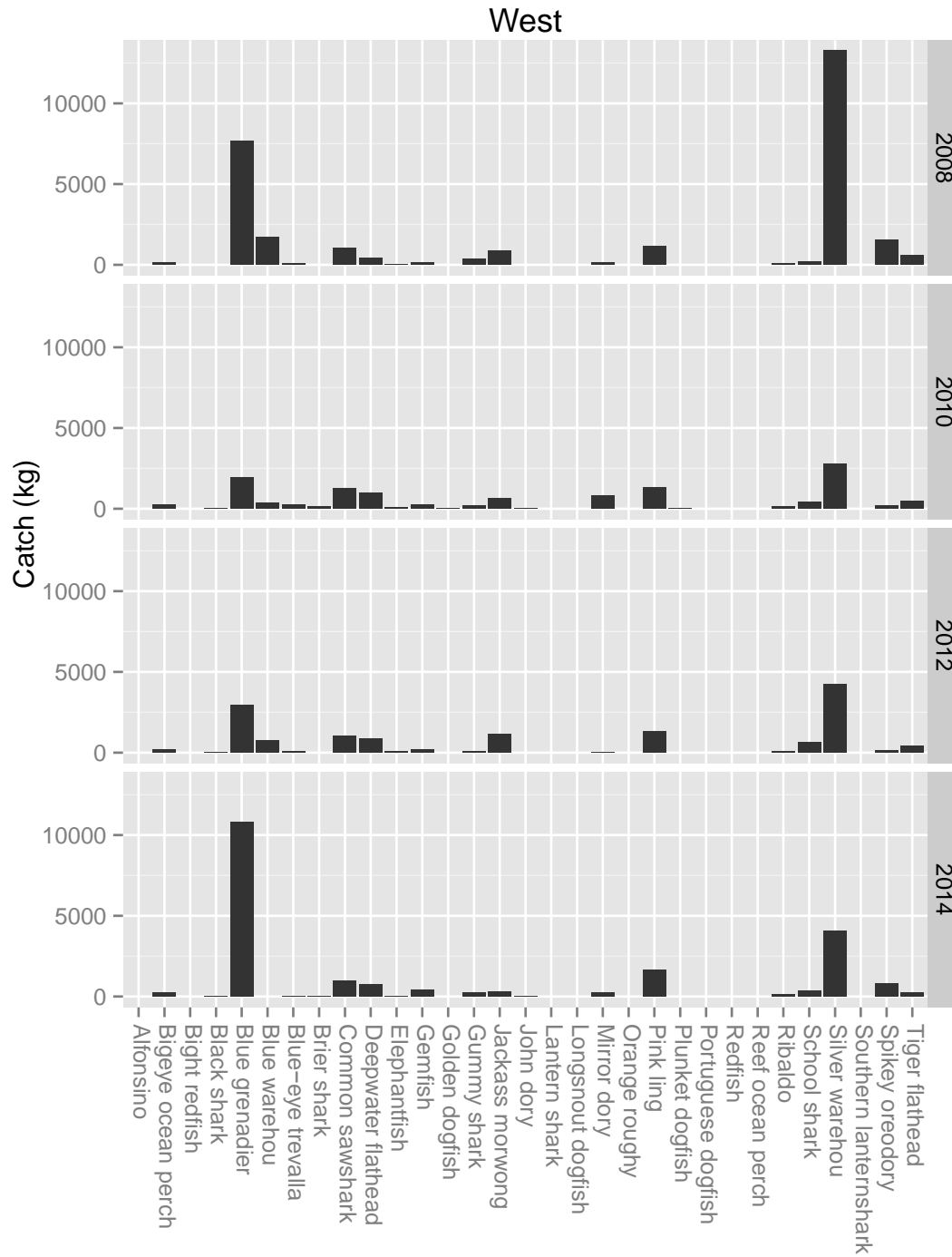


Figure 7. Total catch (kg) of each quota species in the Western region during winter 2008, 2010, 2012 and 2014 surveys.

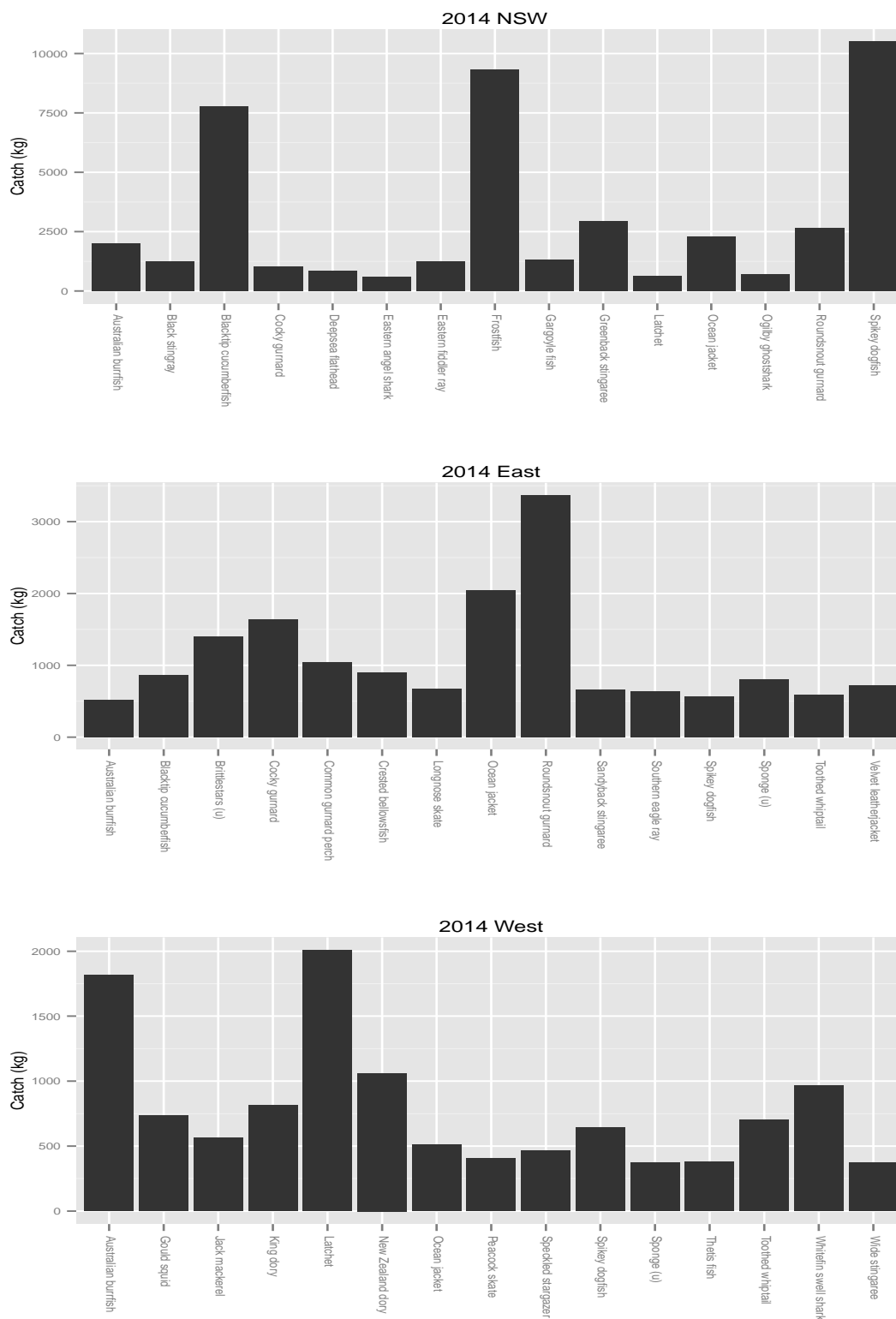


Figure 8. Catches of the top 15 non-quota species in each region during winter 2014.

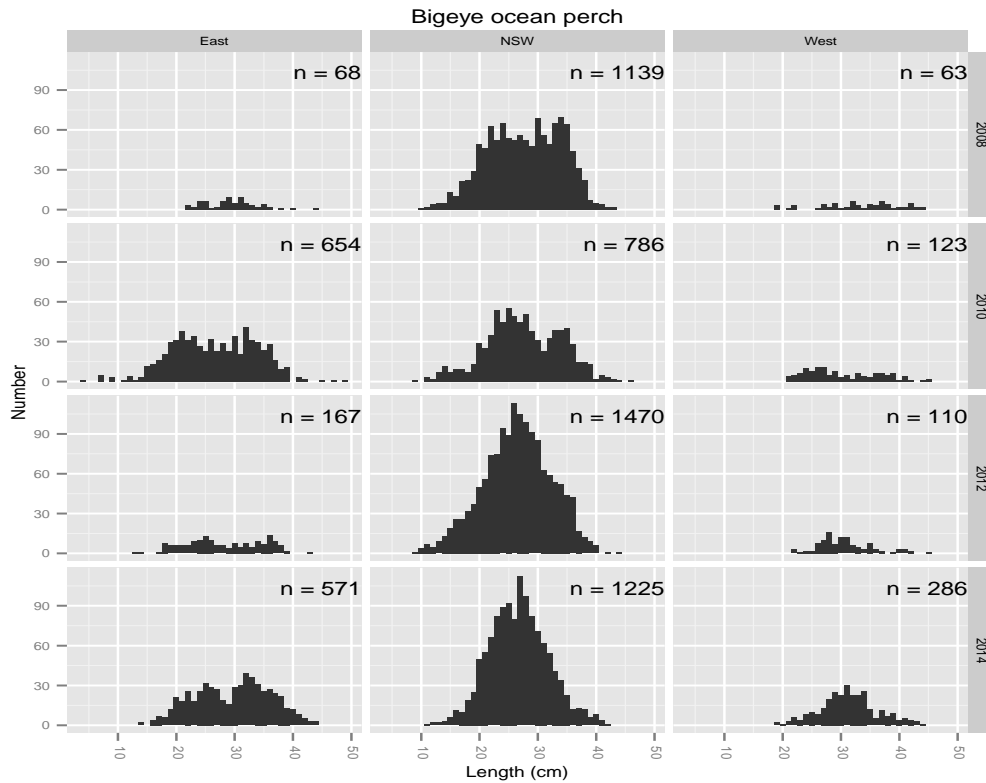


Figure 9. Length frequency of Bigeye Ocean Perch in each region during 2008, 2010, 2012 and 2014 surveys.

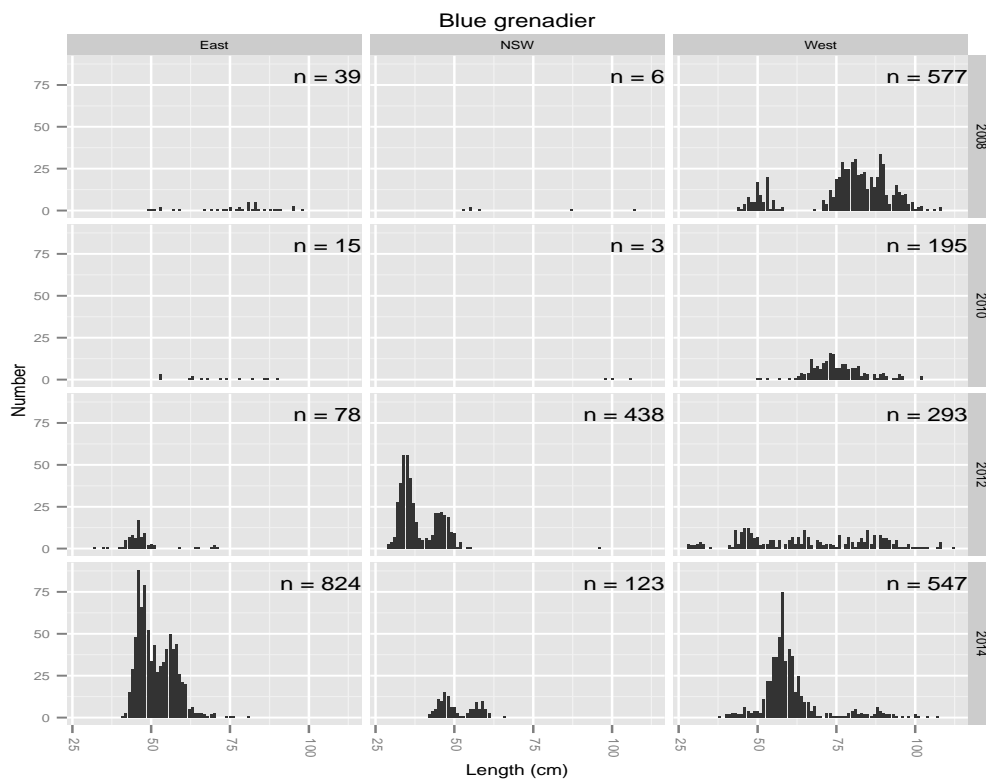


Figure 10. Length frequency of Blue Grenadier in each region during 2008, 2010, 2012 and 2014 surveys.

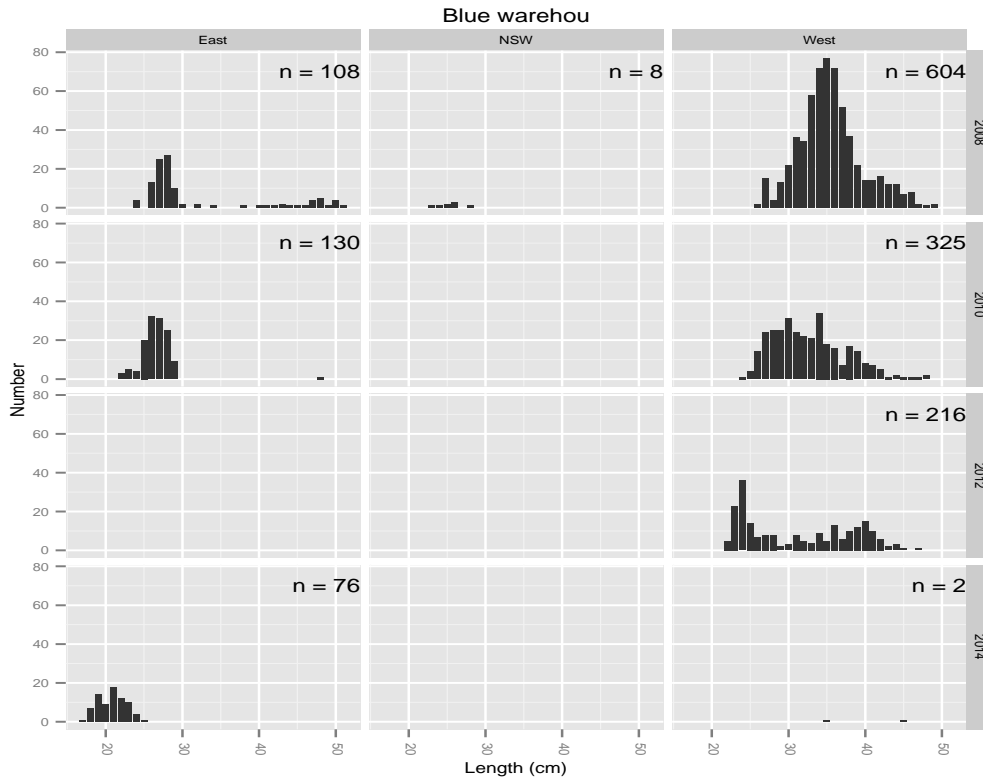


Figure 11. Length frequency of Blue Warehouse in each region during 2008, 2010, 2012 and 2014 surveys.

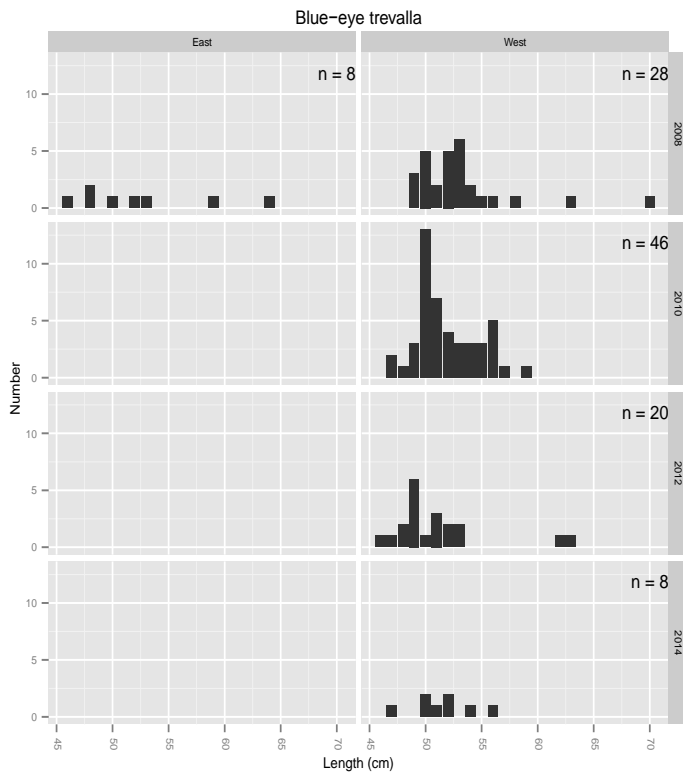


Figure 12. Length frequency of Blue-eye Trevalla in each region during 2008, 2010, 2012 and 2014 surveys.

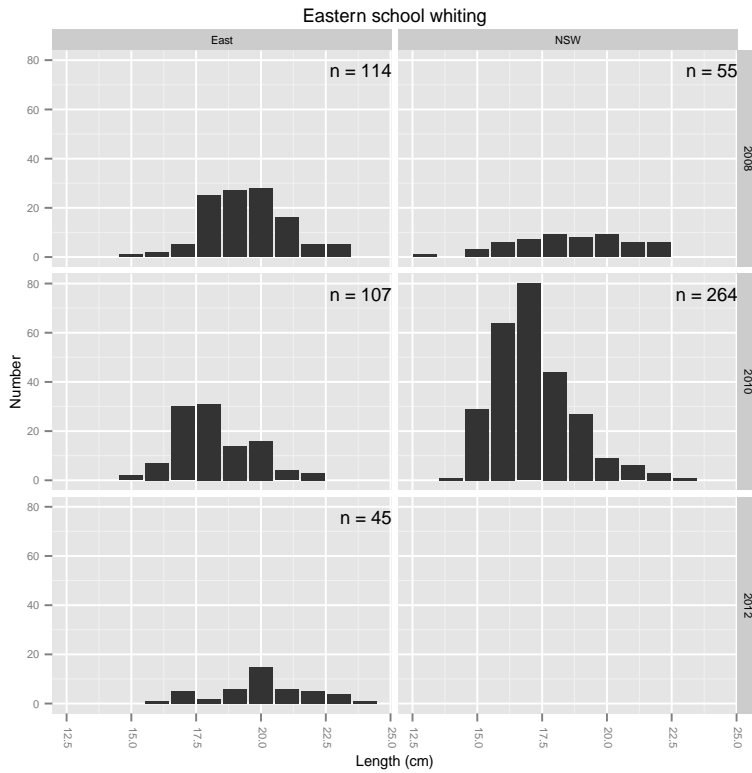


Figure 13. Length frequency of Eastern School Whiting in each region during 2008, 2010, 2012 and 2014 surveys .

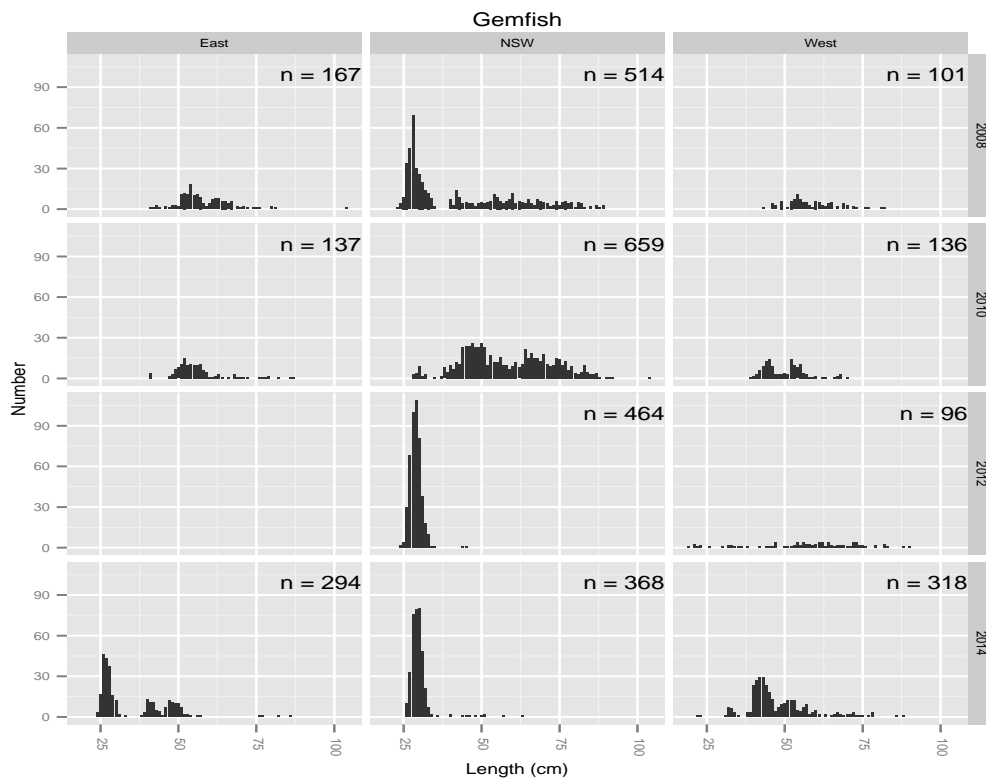


Figure 14. Length frequency of Gemfish in each region during 2008, 2010, 2012 and 2014 surveys.

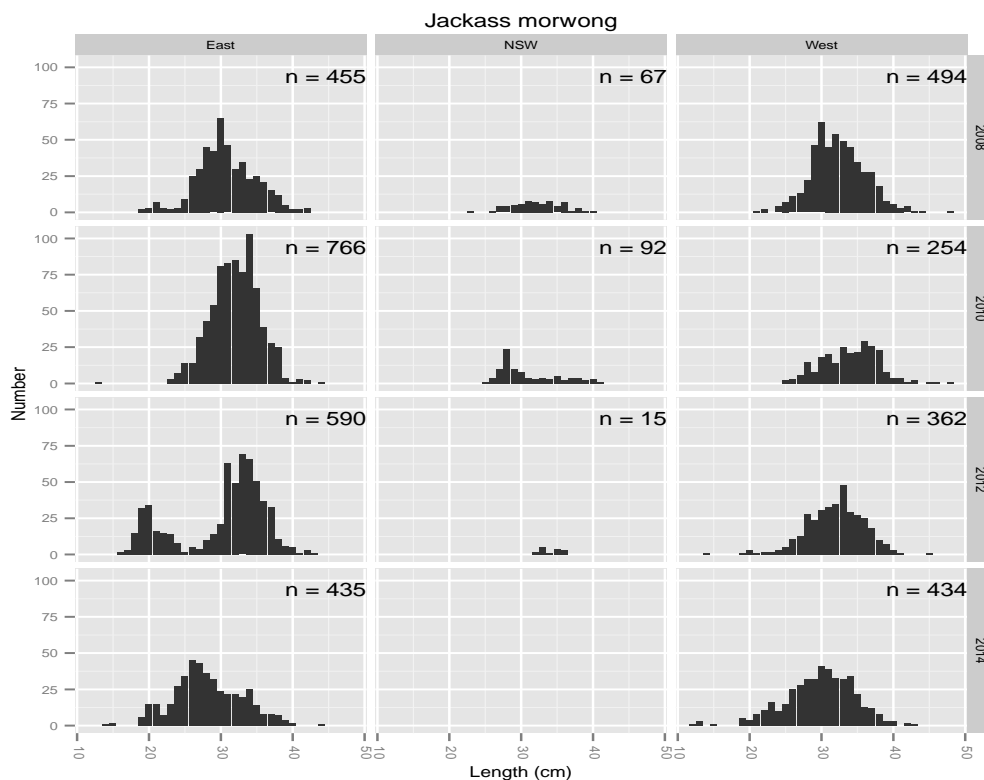


Figure 15. Length frequency of Jackass Morwong in each region during 2008, 2010, 2012 and 2014 surveys.

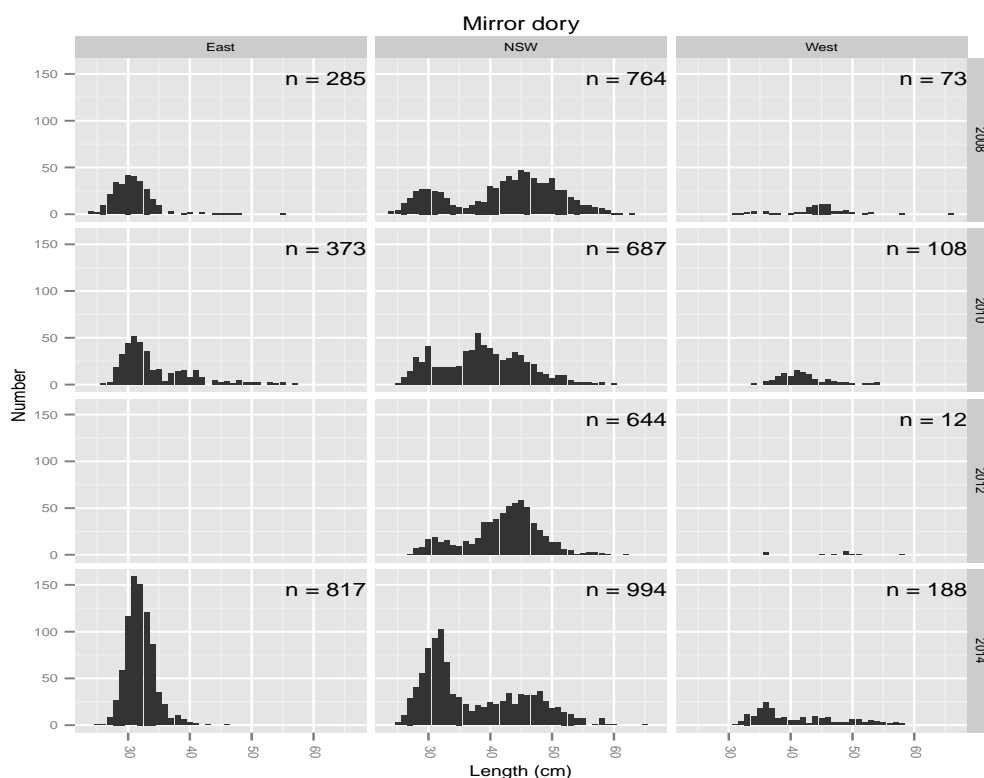


Figure 16. Length frequency of Mirror Dory in each region during 2008, 2010, 2012 and 2014 surveys.

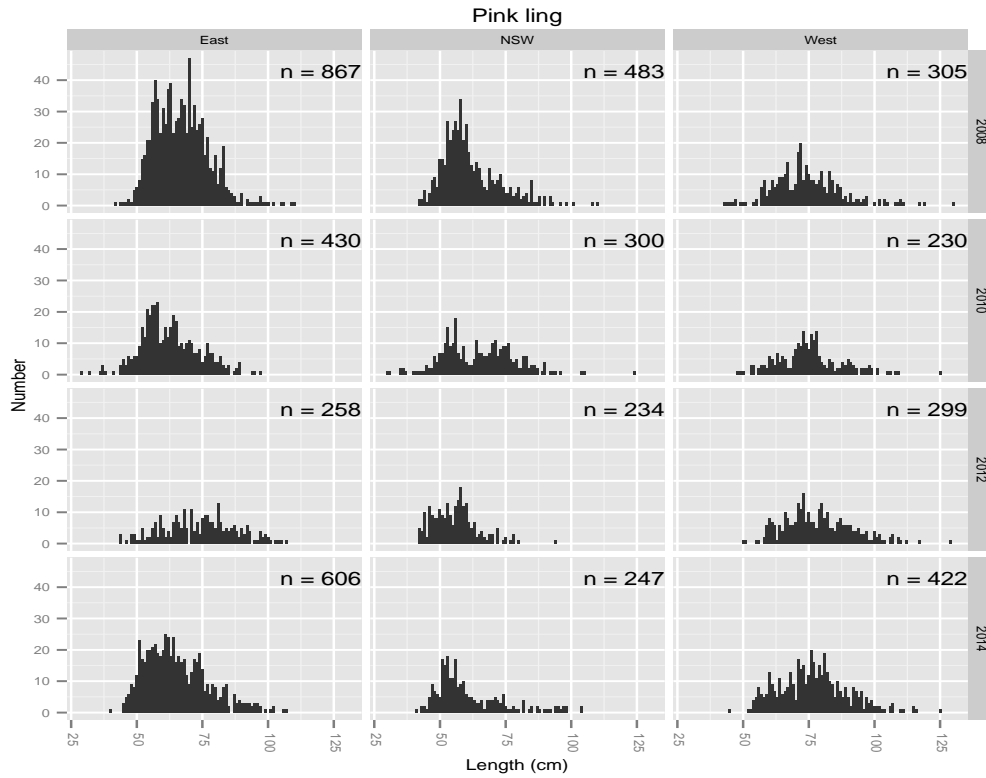


Figure 17. Length frequency of Pink Ling in each region during 2008, 2010, 2012 and 2014 surveys.

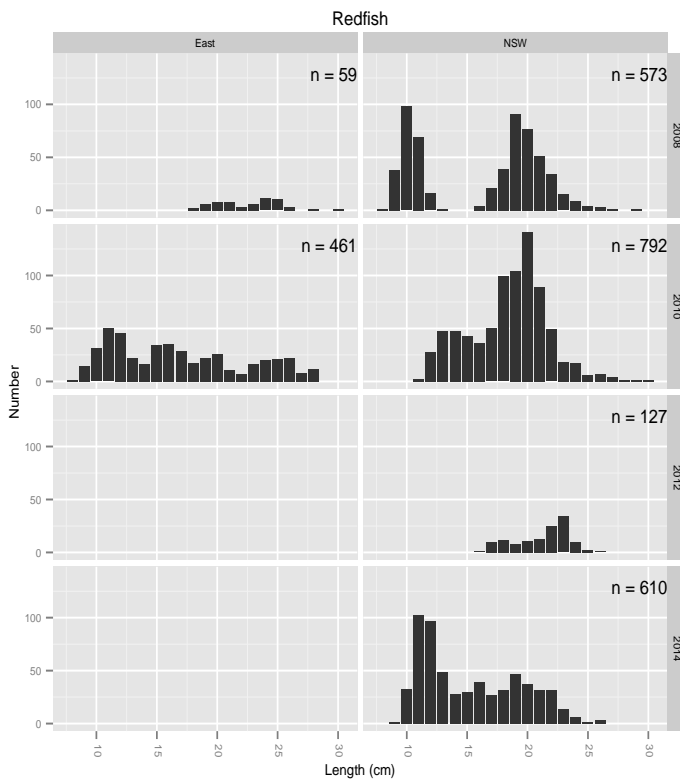


Figure 18. Length frequency of Redfish in each region during 2008, 2010, 2012 and 2014 surveys.

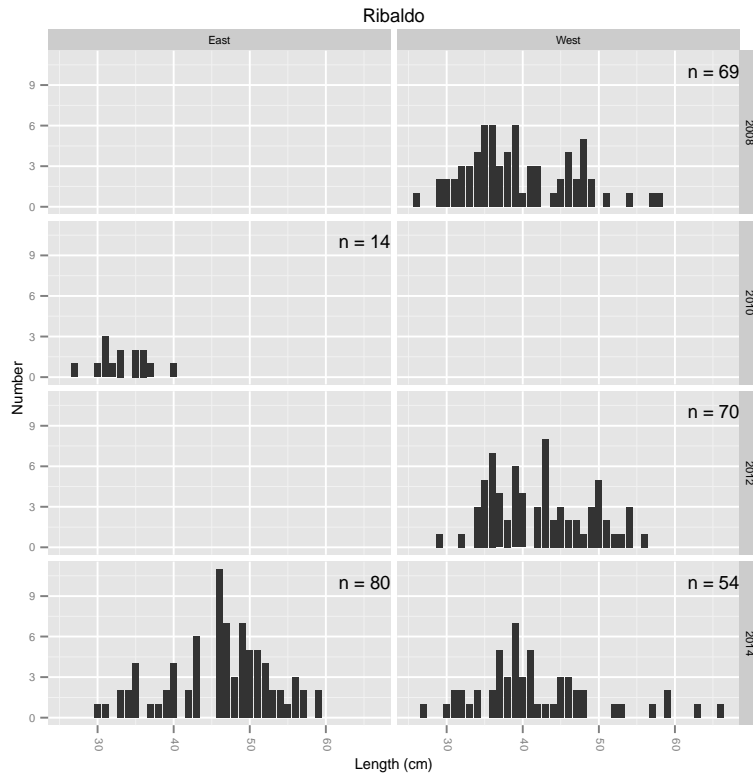


Figure 19. Length frequency of Ribaldo in each region during 2008, 2010, 2012 and 2014 surveys.

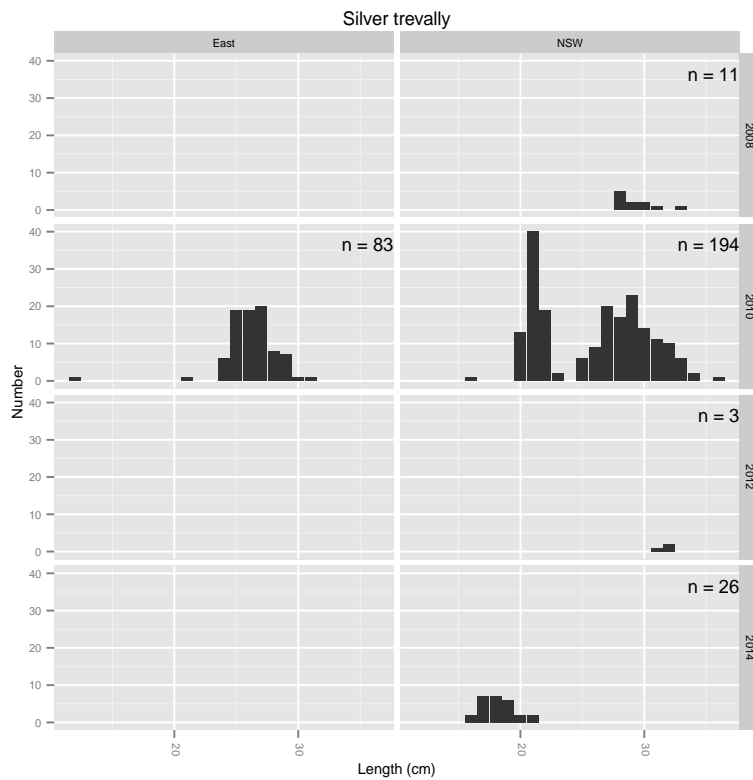


Figure 20. Length frequency of Silver Trevally in each region during 2008, 2010, 2012 and 2014 surveys.

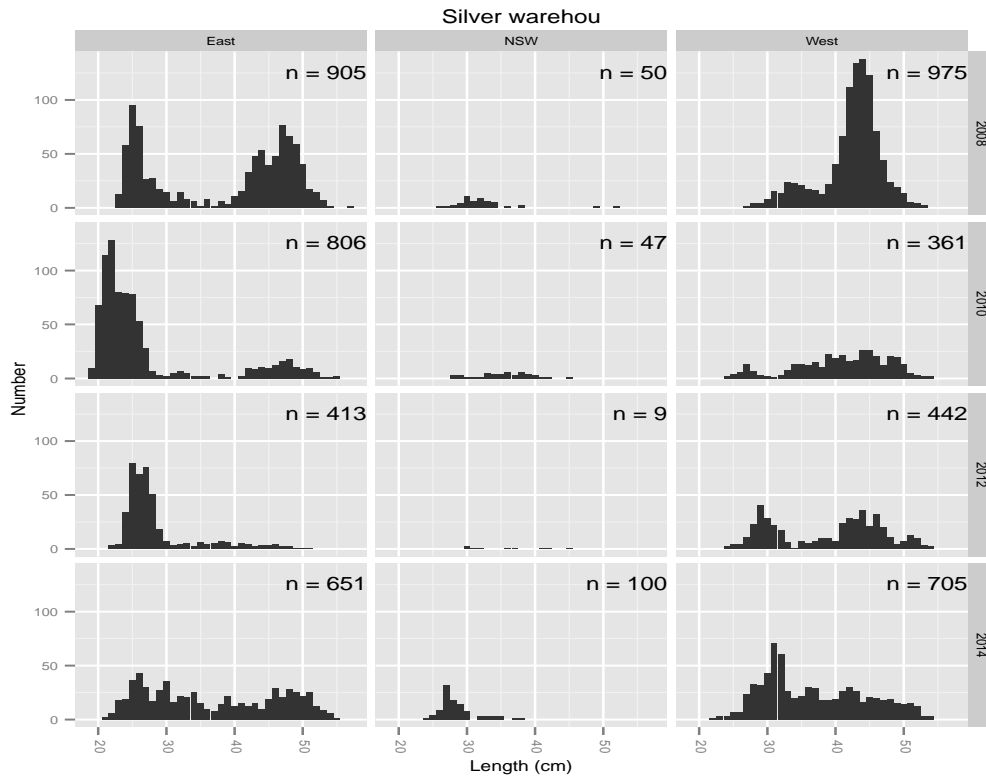


Figure 21. Length frequency of Silver Warehouse in each region during 2008, 2010, 2012 and 2014 surveys.

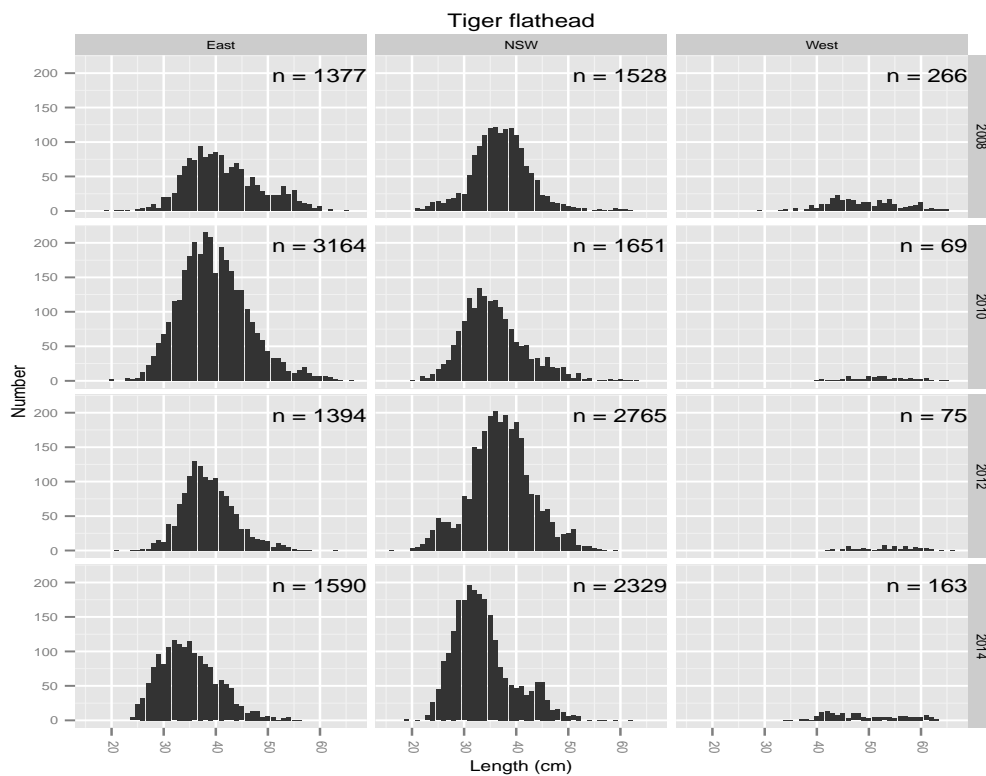


Figure 22. Length frequency of Tiger Flathead in each region during 2008, 2010, 2012 and 2014 surveys.

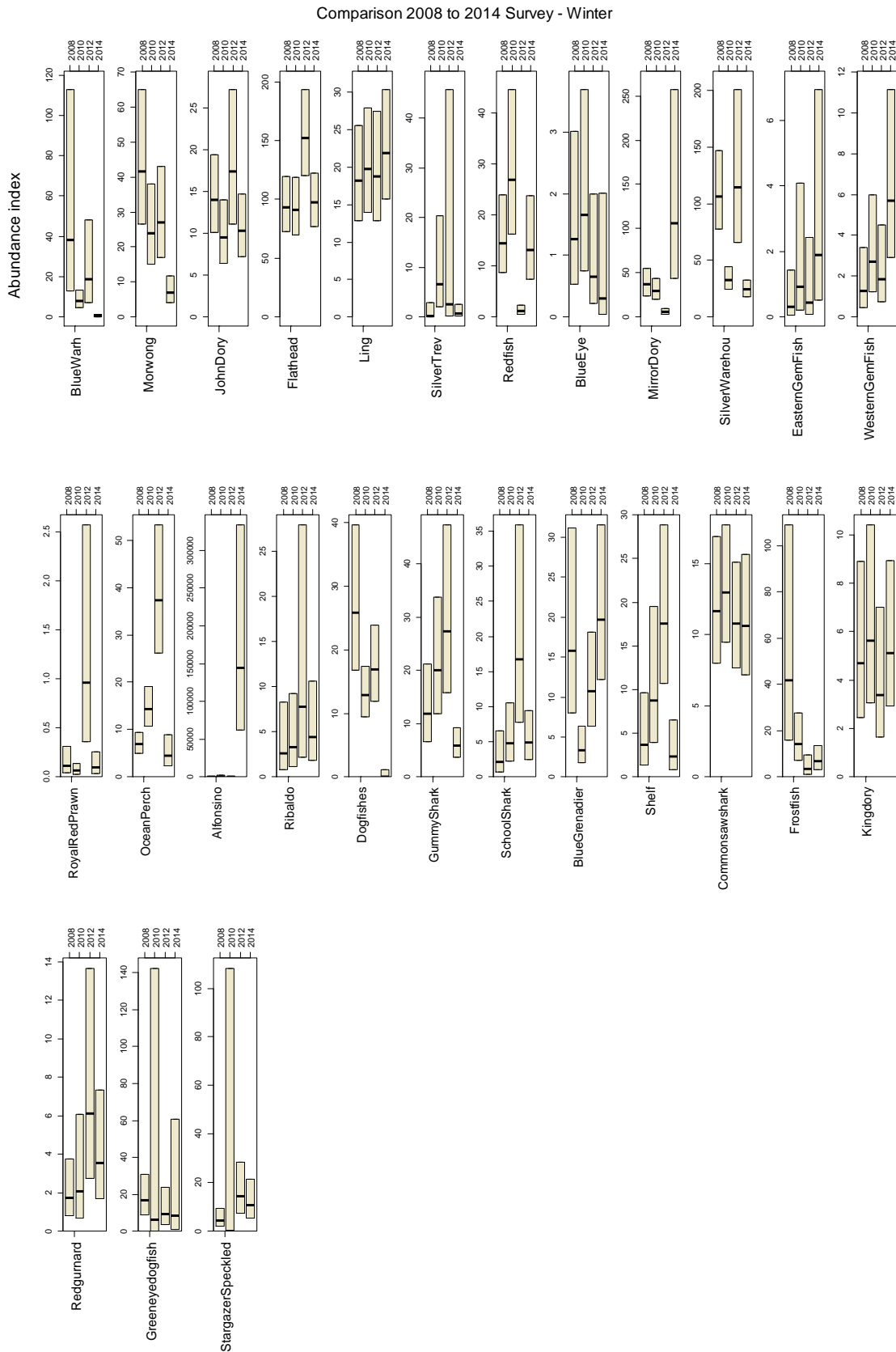


Figure 23. Relative abundance indices for 11 main species and additional species for the winter 2008, 2010, 2012 and 2014 surveys. Note that Ocean Perch includes Inshore, Offshore and Deepsea Ocean Perch.

Comparison catch weight 2008, 2010, 2012, 2014 Winter

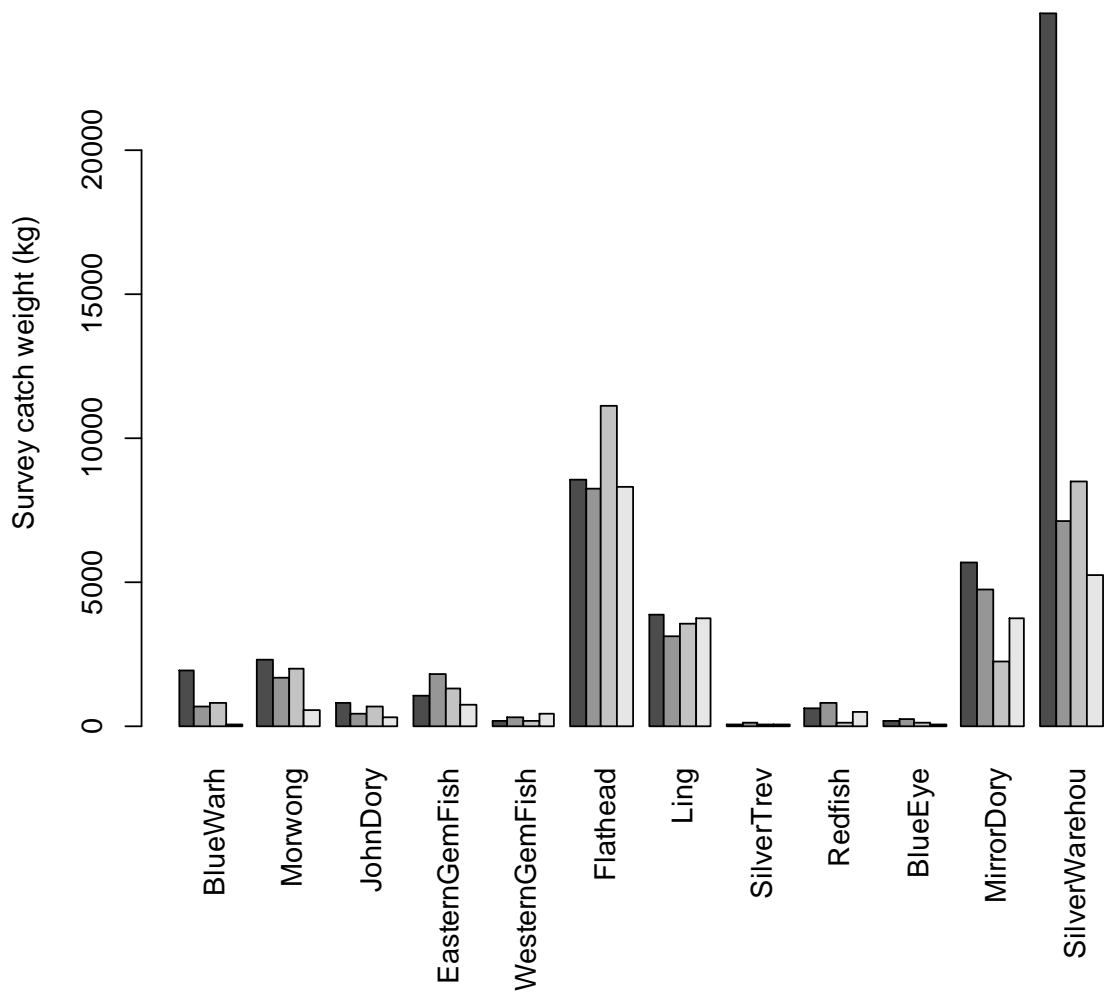


Figure 24. Catch weight for 11 main species and additional species for the 2008, 2010, 2012 and 2014 surveys, by season.

Comparison of shot numbers 2008, 2010, 2012, 2014 - Winter

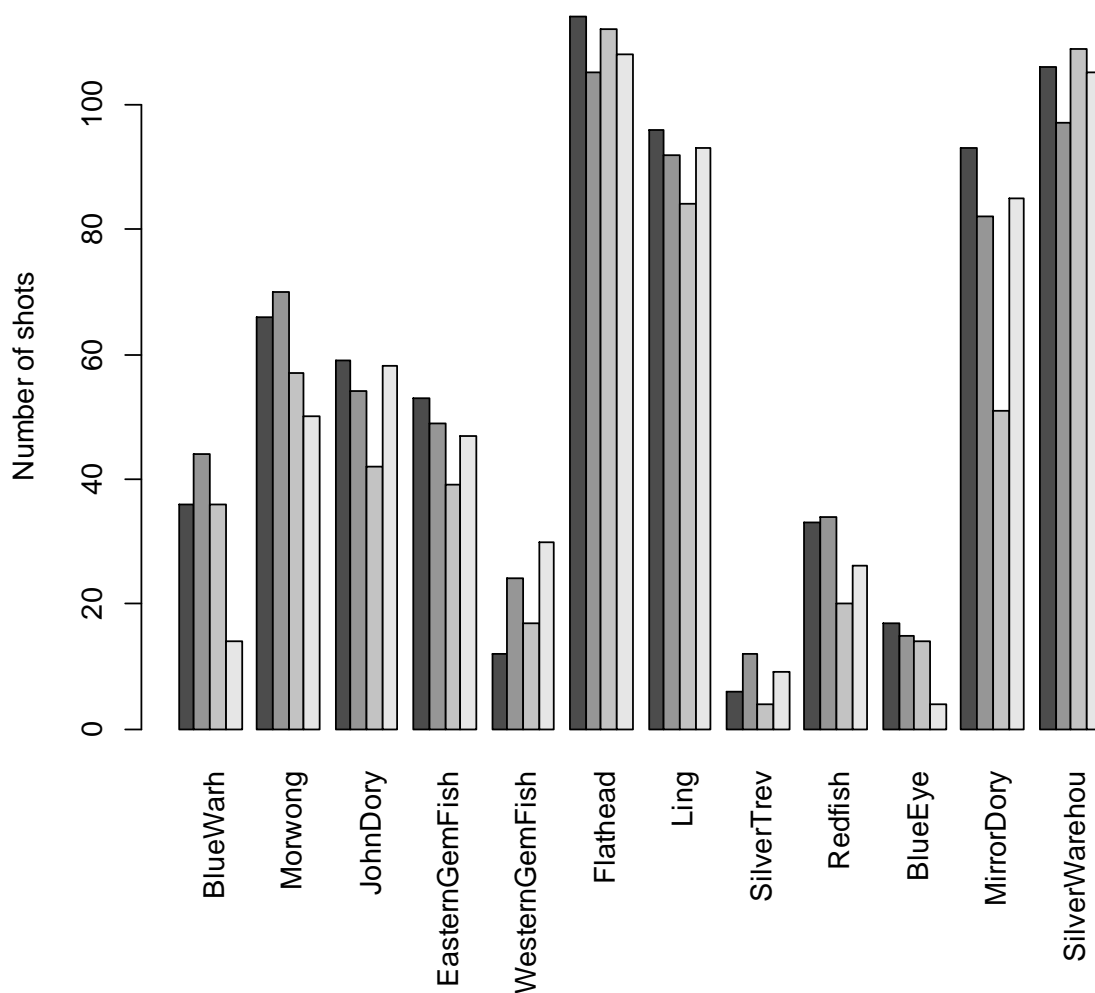


Figure 25. Number of shots with catches for 11 main species for the 2008, 2010, 2012 and 2014 winter surveys.

Comparison catch weight 2008, 2010, 2012, 2014 Winter

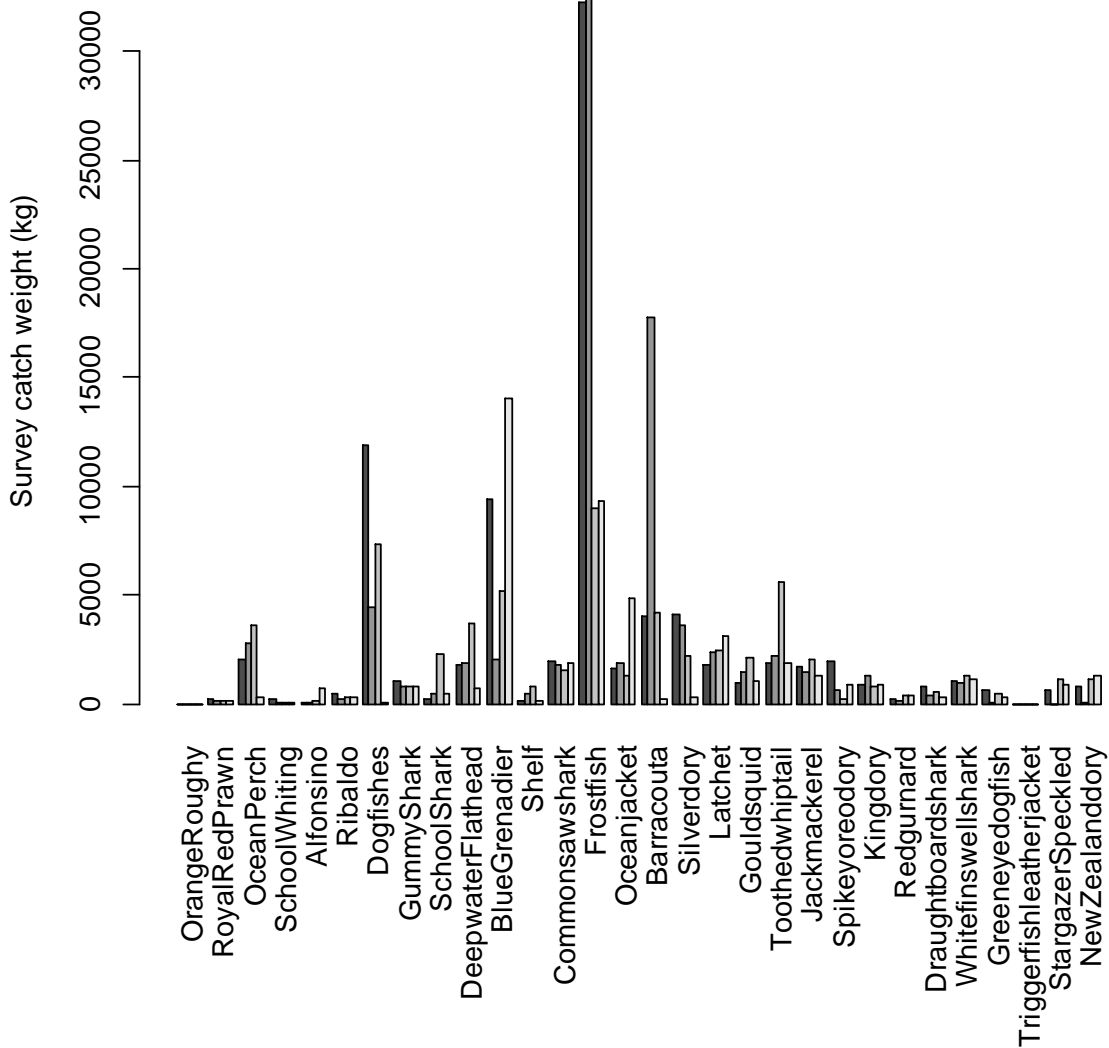


Figure 26. Catch weight for additional species for the 2008, 2010, 2012 and 2014 surveys, by season. Note that Ocean Perch includes Inshore, Offshore and Deepsea Ocean Perch.

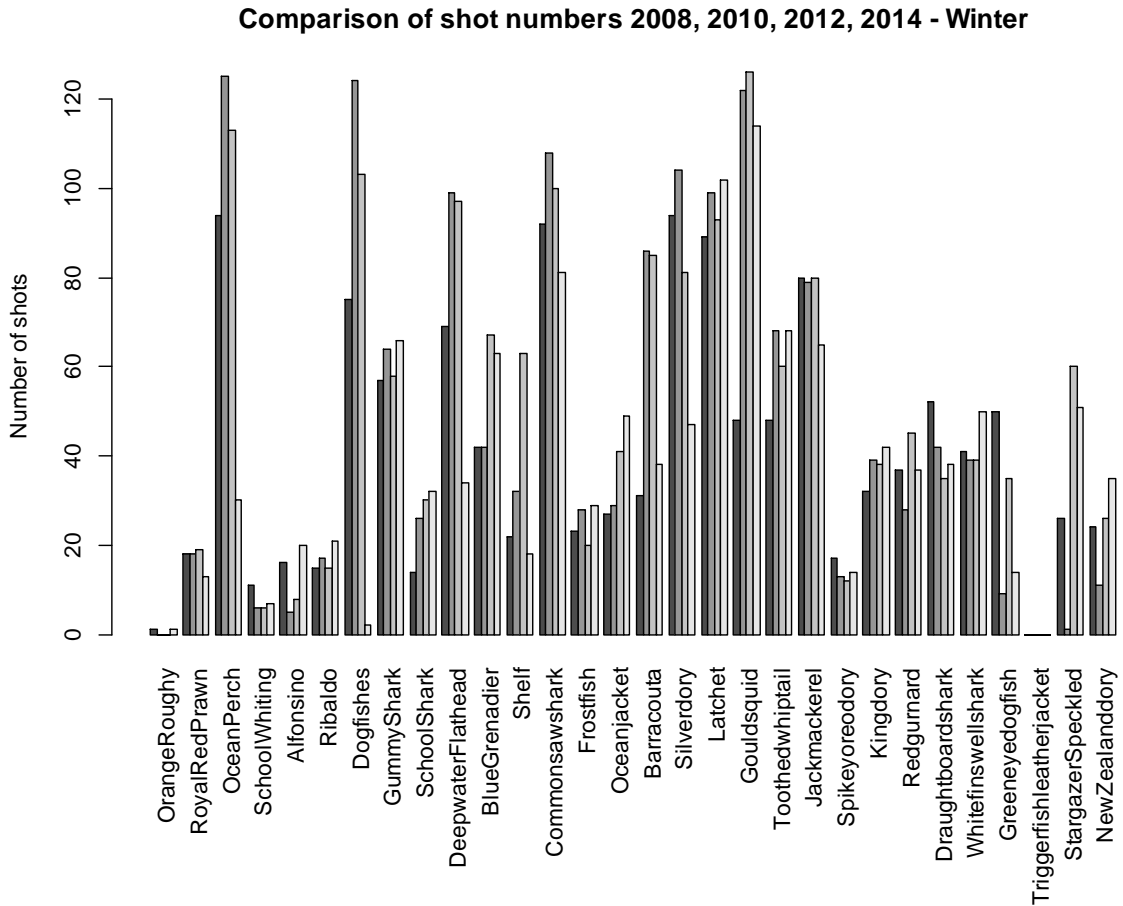


Figure 27. Number of shots with catches for additional species for the 2008, 2010, 2012 and 2014 winter surveys. Note that Ocean Perch includes Inshore, Offshore and Deepsea Ocean Perch.

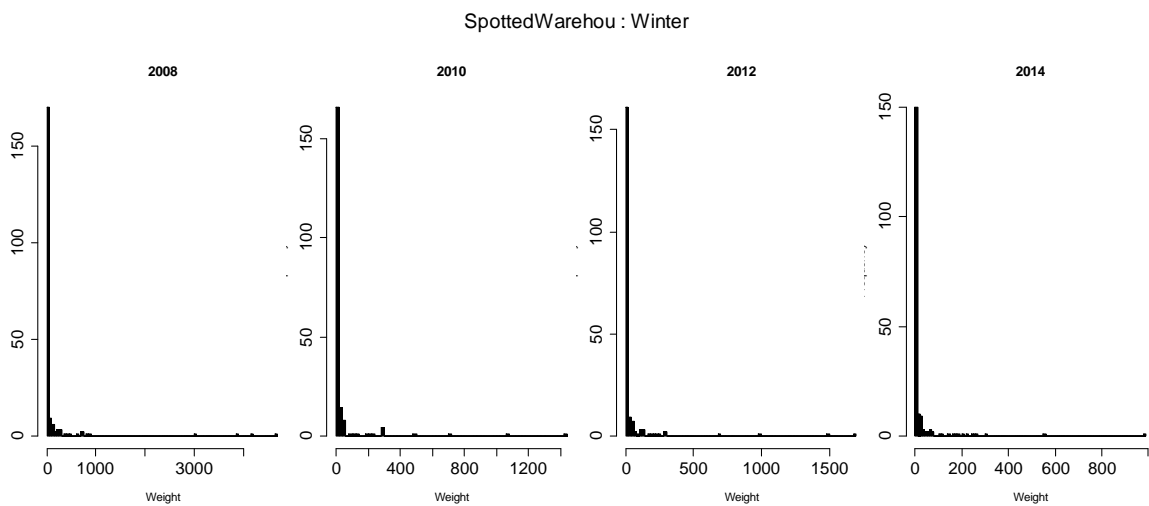


Figure 28. Catch per shot frequency for Silver Warehou for the 2008, 2010, 2012 and 2014 winter surveys. Note the four shots over 3000kg in 2008, and no shots over 1000kg in 2014.

Table 1. Key species design considered in design process.

Blue Warehou (<i>Seriolella brama</i>)
Jackass Morwong (<i>Nemadactylus macropterus</i>)
John Dory (<i>Zues faber</i>)
Western and Eastern Gemfish (<i>Rexea solandri</i>)
Tiger Flathead (<i>Neoplatycephalus richardsoni</i>)
Pink Ling (<i>Genypterus blacodes</i>)
Silver Trevally (<i>Pseudocaranx dentex</i>)
Redfish (<i>Centroberyx affinis</i>)
Blue-Eye Trevalla (<i>Hyperoglyphe antarctica</i>)
Mirror Dory (<i>Zenopsis nebulosis</i>)
Silver Warehou (<i>Seriolella punctata</i>)

Table 2. Key features of nets designed for NSW, eastern and western zones for the FIS.

SESSF Survey net	
NSW and Eastern Survey Regions	Western Survey Region
<ul style="list-style-type: none"> Operating 50-600m depth A basic, generalist wing or diamond trawl net <ul style="list-style-type: none"> 1800 – 2000 inch round net opening To suit a vessel of minimum 350Hp towing at 3.0 knots average Lengthener 100 mesh long 90mm single <ul style="list-style-type: none"> Codend 33 mesh long 100 mesh round 90mm single / double Approximate headline height 3-4 m Rubber line with 6 inch discs and leads (70 kg) 	<ul style="list-style-type: none"> Operating 100-600m depth A basic, generalist wing or diamond trawl net <ul style="list-style-type: none"> 2000-2400 inch round net opening To suit a vessel of minimum 450Hp towing at 3.0 knots average Lengthener 100 mesh long 100 mm single <ul style="list-style-type: none"> Codend 50 mesh long 100 mesh round 102mm double Approximate headline height 4-5 m Rubber line with 9 inch discs and leads (100 kg)

Table 3. Number of trips, sea days, number of valid shots, shot duration and tow speed during the 2014 survey.

Region	Number of trips	Number of seadays	Number of shots	Average shot duration (hrs)	Average tow speed (kts)
East	4	23	67	1:58	3.0
NSW	7	18	63	2:05	3.0
West	5	35	65	1:56	3.1
Total	16	76	195	1:59	3.0

Table 4. Species and numbers of fish for which length frequency and otolith samples were collected during the 2014 survey.

Species	East		NSW		West		Total	
	LF	Otol	LF	Otol	LF	Otol	LF	Otol
Gummy Shark	248				22		270	
School Shark	34				25		59	
Common Sawshark					45		45	
Ribaldo	80	4			54	30	134	34
Blue Grenadier	824	100	123	15	547	88	1,494	203
Pink Ling	606	50	247	18	422	139	1,275	207
Redfish		0	610	87			610	87
King Dory	68	9			431	1	499	10
Mirror Dory	817	54	994		188	11	1,999	65
John Dory	137	20	119		11	18	267	38
Spikey Oreodory		0			217	3	217	3
Reef Ocean Perch	131	30	279			2	410	32
Bigeye Ocean Perch	571	50	1,225	130	286	30	2,082	210
Tiger Flathead	1,590	109	2,329	292	163	10	4,082	411
Deepwater Flathead		0			497	58	497	58
Silver Trevally		0	26				26	
Jackass Morwong	435	5			434	84	869	89
Gemfish	294	21	368	78	318	140	980	239
Blue-Eye Trevalla		0			8	5	8	5
Blue Warehou	76	0			2	6	78	6
Silver Warehou	651	49	100	13	705	104	1,456	166
Ocean Jacket	706	10			29	2	735	12
Total	7,268	511	6,420	633	4,404	731	18,092	1,875

Table 5. Number of survey shots included in analyses for each year and season. “East” refers to shots at sites ≥ 146 degrees longitude (including NSW).

Year	Season	Number of shots				Total
		East	West	<200 m	≥ 200 m	
2008	Summer	79	47	71	55	126
	Winter	140	65	97	108	205
2010	Summer	71	50	67	54	121
	Winter	135	67	104	98	202
2012	Summer	70	51	70	51	121
	Winter	132	65	103	94	197
2014	Winter	130	65	101	94	195

Table 6. Predicted vs achieved CV values for 2014 winter surveys for the main species.

Species	Winter	
	Predicted	Real
Blue Warehou	0.39	0.47
Jackass Morwong	0.25	0.24
John Dory	0.24	0.16
Gemfish	0.36	0.19
Tiger Flathead	0.15	0.10
Pink Ling	0.18	0.15
Silver Trevally	0.81	0.62
Redfish	0.22	0.26
Blue-eye Trevalla	0.50	0.85
Mirror Dory	0.22	0.40
Silver Warehou ²	0.16	0.13

² = CV is likely to be under-estimated due to occasional very large catches.

Table 7. Total catch weight (kg) for 2008, 2010, 2012 and 2014 surveys. SESSF quota species are in bold type.

Species	Winter Catch (kg)				
	2008	2010	2012	2014	
Blue Warehou	1916.5	673.4	815.2	30.8	-
Jackass Morwong	2285.4	1672.7	1996.5	560.6	-
John Dory	802.1	438.8	653.3	296.8	-
Gemfish	1156.3	2078.2	1477.1	1138.2	
Eastern Gemfish	1016	1803.5	1281.4	742.6	
Western Gemfish	140.3	274.7	195.7	395.6	+
Tiger Flathead	8536.5	8228.3	11135	8286.8	
Pink Ling	3856.8	3122.2	3548	3714.3	
Silver Trevally	11.1	125	13	12	
Redfish	573.5	762.3	77.4	491.2	
Blue-eye Trevalla	136.6	253.5	73.05	28.8	-
Mirror Dory	5685.1	4736.5	2221.4	3746.9	
Silver Warehou	24772.1	7146.4	8499.5	5234.1	
Orange Roughy	10	0	0	1.8	
Royal Red Prawn	229	126.3	122.5	149	
Ocean Perch &	2074	2796.6	3595.5	282.4	-
School Whiting	185.8	53.6	20	18.5	
Alfonsino	88.8	23	103.5	700.1	+
Ribaldo	439.9	177.5	301.7	260.7	
Dogfishes	11902.9	4427	7310.5	15	-
Gummy Shark	1037.3	779.2	759.5	781.5	
School Shark	209	455.5	2264.4	439.1	
Deepwater Flathead	1786.75	1848.7	909.2	751.1	
Blue Grenadier	9379.5	2048.5	5205.2	14057	+
Common Sawshark	1966.7	1785	1510.2	1871.3	
Frostfish	32237	32720.5	8953	9350	
Ocean Jacket	1608.2	1853.7	1251.8	4849	+
Barracouta *	3991.2	17747.3	4186	231.7	-
Snook *	11052.5	0	0	0	
Silver Dory *	4082.7	3642.7	2227	274.9	-
Southern Ocean Arrow Squid *	2931.8	0	32	0	
Latchet *	1773.65	2381	2450.8	3113	
Gould's Squid *	942.8	1439.3	2117.3	1039.5	
Toothed Whiptail *	1877.9	2176.2	5622	1844.7	-
Jack Mackerel	1667.7	1449.1	2058	1332.3	
Spikey Oreodory	1952.2	636	202	840.6	
King Dory	877	1330.3	777.6	918.9	
Red Gurnard	195.1	143.4	409.9	396.3	
Draughtboard Shark	820.1	410	544.5	306	
Whitefin Swell Shark	1058	970.2	1326.2	1113.3	
Greeneye Dogfish *	634.3	66.7	463.5	326	
Triggerfish and leatherjacket	0	0	0	0	
Speckled Stargazer *	593.4	1	1087	884.4	
New Zealand dory *	834.2	16.5	1092.2	1314	

*Catches not directly comparable between years due to species being re-defined/ database changes.

& Includes Inshore, Offshore and Deepsea Ocean Perch

Key: + increase in catch in 2014 c.f. 2012 by > 50% AND 2014 catch greater than in 2008 and 2010;

- refers to a > 50% decrease in catch in 2014 c.f. 2012 AND 2014 catch less than in 2008 and 2010

Table 8. Abundance indices and CV estimates for 2008, 2010, 2012 and 2014 winter surveys. The 2008, 2010 and 2012 results are from Upston *et al.* (2013). CVs < 0.30 are highlighted (except for 2014 CVs with a flag for Diagnostics). SESSF quota species are in bold type. Key: ‘nc’ no convergence; ‘na’ no CPUE fit/ model result implausible.

Species	Abundance2008	CV2008	Abundance2010	CV2010	Abundance2012	CV2012	Abundance2014	CV2014	Diagnostics 2014
Blue Warehou	38.10	0.49	7.84	0.23	18.74	0.42	0.39	0.47	
Jackass Morwong	41.51	0.20	23.97	0.21	27.00	0.21	6.87	0.24	
John Dory	13.99	0.14	9.46	0.17	17.38	0.20	10.24	0.16	
Gemfish	3.50	0.29	4.81	0.21	2.90	0.21	3.98	0.19	
Eastern Gemfish	0.30	0.69	0.92	0.66	0.45	0.76	1.89	0.58	
Western Gemfish	1.26	0.44	2.72	0.35	1.85	0.40	5.70	0.30	
Tiger Flathead	93.06	0.11	91.06	0.12	152.36	0.11	97.22	0.10	
Pink Ling	18.16	0.15	19.72	0.15	18.75	0.17	21.89	0.15	
Silver Trevally	0.24	1.09	6.53	0.51	2.50	1.30	0.64	0.62	
Redfish	14.37	0.23	26.89	0.23	1.14	0.31	13.20	0.26	
Blue-eye Trevalla	1.26	0.39	1.66	0.36	0.65	0.50	0.30	0.85	
Mirror Dory	36.56	0.19	29.21	0.18	5.39	0.24	105.77	0.40	
Silver Warehou	106.69	0.14	32.87	0.14	114.80	0.25	24.12	0.13	2
Orange Roughy	0.01	2.18	nc	nc	nc	nc	0.00	2.31	
Royal Red Prawn	0.12	0.44	0.06	0.35	0.96	0.44	0.09	0.44	
Ocean Perch &	6.90	0.14	14.34	0.13	37.38	0.16	4.49	0.30	
Alfonsino	16.93	0.43	521.14	0.72	4.58	0.57	143930.50	0.38	
Ribaldo	2.62	0.52	3.28	0.46	7.77	0.57	4.45	0.39	
Dogfishes	25.81	0.19	12.83	0.14	16.85	0.16	0.05	1.38	
Gummy Shark	11.89	0.26	20.04	0.23	27.41	0.24	5.83	0.20	
School Shark	2.10	0.51	4.81	0.35	16.76	0.34	4.85	0.30	
Deepwater Flathead	11629.86	0.39	4913.68	0.25	na	na	536.79	0.37	
Blue Grenadier	15.83	0.30	3.38	0.28	10.75	0.23	19.65	0.21	
Common Sawshark	11.62	0.17	12.94	0.14	10.75	0.15	10.59	0.17	
Frostfish	41.73	0.43	14.11	0.30	3.46	0.45	6.68	0.32	
King Dory	4.68	0.29	5.64	0.27	3.39	0.32	5.13	0.25	
Red Gurnard	1.76	0.34	2.08	0.48	6.12	0.36	3.54	0.32	1
Greeneye Dogfish*	16.64	0.27	6.41	1.38	9.46	0.41	8.47	0.88	
Triggerfish and leatherjacket	nc	nc	nc	nc	nc	nc	nc	nc	
Speckled Stargazer*	4.58	0.33	nc	nc	14.51	0.30	10.69	0.31	

*Abundance estimates not directly comparable between years, due to species being re-defined/ database changes.

& Includes Inshore, Offshore and Deepsea Ocean Perch

Diagnostics: 1= Long-term curve for coastal distribution from Logbooks and yearly smooth differ markedly;

2 = CV is likely to be under-estimated.

Appendix 1 – Catch and shot details for the 2014 winter surveys.

Table 9. Total catch (kg) of all species in each zone during the winter 2012 survey. Note that (u) denoted animal not identified to species level.

CAABcode	Common Name	Species Name	NSW	Catch (kg)			Total
				East	West		
37258002	Alfonsino	<i>Beryx splendens</i>	1.9	692.0	6.2		700.1
37232067	Aloha Whiptail	<i>Nezumia propinqua</i>	20.5				20.5
28860001	Antlered Crab	<i>Dagnaudus petterdi</i>	61.0		1.0		62.0
35000000	Ascidian (U)	<i>Ascidacea - undifferentiated</i>		241.0			241.0
37086001	Australian Anchovy	<i>Engraulis australis</i>		60.1			60.1
37024001	Australian Angelshark	<i>Squatina australis</i>		179.0	202.0		381.0
37469002	Australian Burrfish	<i>Allomycterus pilatus</i>	1988.0	517.0	1814.1		4319.1
41131003	Australian Fur Seal	<i>Arctocephalus pusillus doriferus</i>		290.0			290.0
37467004	Balloonfish	<i>Sphoeroides pachygaster</i>	47.0				47.0
37279001	Banded Bellowsfish	<i>Centriscoops humerosus</i>	67.0	115.6	66.8		249.4
37038002	Banded Stingaree	<i>Urolophus cruciatus</i>	52.0	313.0	294.2		659.2
37232002	Banded Whiptail	<i>Coelorinchus fasciatus</i>	41.5	220.0			261.5
37013001	Banded Wobbegong	<i>Orectolobus ornatus</i>			45.0		45.0
37439001	Barracouta	<i>Thyrsites atun</i>	15.5	39.0	177.2		231.7
37390001	Barred Grubfish	<i>Paraperca allporti</i>	23.0	30.9			53.9
25171000	Basketstar (U)	<i>Gorgonocephalidae - undifferentiated</i>		2.0			2.0
37378002	Bastard Trumpeter	<i>Latridopsis forsteri</i>		2.0			2.0
37327001	Bigeye Deepsea Cardinalfish	<i>Epigonus lenimen</i>			3.5		3.5
37287093	Bigeye Ocean Perch	<i>Helicolenus barathri</i>	1208.1	358.0	236.2		1802.3
37012002	Bigeye Thresher	<i>Alopias superciliosus</i>	200.0				200.0
37258004	Bight Redfish	<i>Centroberyx gerrardi</i>			1.2		1.2
37031010	Bight Skate	<i>Dipturus gudgeri</i>	570.0	126.0	89.0		785.0
37367004	Bigspine Boarfish	<i>Pentaceros decacanthus</i>	7.5	11.0	0.7		19.2
37042010	Black Ghostshark	<i>Hydrolagus homomycteris</i>		15.0			15.0
37020002	Black Shark	<i>Dalatias licha</i>	4.1	51.0	27.5		82.6
37254001	Black Spinyfin	<i>Diretmichthys parini</i>			1.8		1.8
37035002	Black Stingray	<i>Dasyatis thetidis</i>	1240.0	55.0	15.0		1310.0
37020005	Blackbelly Lanternshark	<i>Etmopterus lucifer</i>	0.5				0.5
37042003	Blackfin Ghostshark	<i>Hydrolagus lemures</i>	9.0	107.0	141.3		257.3
37367005	Blacksport Boarfish	<i>Zanclistius elevatus</i>	62.2	44.3	26.4		132.9
37232005	Blacksport Whiptail	<i>Lucigadus nigromaculatus</i>		1.4			1.4
37287002	Blackspotted Gurnard Perch	<i>Neosebastes nigropunctatus</i>		30.0			30.0
37120001	Blacktip Cucumberfish	<i>Paraulopus nigripinnis</i>	7773.0	869.5	78.9		8721.4
37255001	Blacktip Sawbelly	<i>Hoplostethus intermedius</i>	11.6	7.0			18.6
37446010	Blue Cubehead	<i>Cubiceps caeruleus</i>	3.1				3.1
37227001	Blue Grenadier	<i>Macruronus novaezelandiae</i>	513.0	2744.0	10800.0		14057.0
37441001	Blue Mackerel	<i>Scomber australasicus</i>	4.3	124.5	0.6		129.4
28911005	Blue Swimmer Crab	<i>Portunus armatus</i>	0.2	1.0			1.2
37445005	Blue Warehou	<i>Seriola lalandi</i>		20.5	10.3		30.8
37445001	Blue-Eye Trevalla	<i>Hyperoglyphe antarctica</i>			28.8		28.8
37232017	Blueband Whiptail	<i>Coelorinchus matamua</i>			75.0		75.0
37296007	Bluespotted Flathead	<i>Platycephalus caeruleopunctatus</i>	81.0				81.0
37355001	Bluestriped Goatfish	<i>Upeneichthys lineatus</i>	1.5				1.5
37020003	Brier Shark	<i>Deania calcea</i>	88.0	3.0	26.0		117.0
25160000	Brittlestars (U)	<i>Class Ophiuroidea - undifferentiated</i>		1400.0	60.0		1460.0
37005002	Broadnose Shark	<i>Notorynchus cepedianus</i>		11.0	3.0		14.0
28821904	Bug	<i>Ibacus & Thenus spp</i>	13.2	38.3			51.5
37400001	Bulldog Stargazer	<i>Xenopeltus armatus</i>	56.0	79.0			135.0
37288003	Butterfly Gurnard	<i>Lepidotrigla vanessa</i>		193.0			193.0
37311002	Butterfly Perch	<i>Caesioperca lepidoptera</i>		2.2			2.2
37224004	Chiseltooth Grenadier Cod	<i>Tripterygius gilchristi</i>		1.3			1.3
37288007	Cocky Gurnard	<i>Lepidotrigla modesta</i>	1025.0	1633.0	228.5		2886.5
37211000	Coffinfish (U)	<i>Chaunacidae - undifferentiated</i>		0.5			0.5
37013002	Collar Carpetshark	<i>Parascyllium collare</i>	32.0				32.0
37279002	Common Bellowsfish	<i>Macroramphosus scolopax</i>	12.3	4.5			16.8
37287005	Common Gurnard Perch	<i>Neosebastes scorpaenoides</i>		1038.0			1038.0
37023002	Common Sawshark	<i>Pristiophorus cirratus</i>	720.0	152.0	999.3		1871.3
37400003	Common Stargazer	<i>Kathetostoma laevis</i>	2.0				2.0
37038006	Common Stingaree	<i>Trygonoptera testacea</i>	38.0				38.0
37427001	Common Stinkfish	<i>Faetorepus calauropomus</i>		101.0			101.0
37067000	Conger & Short-Tail Conger Eel (U)	<i>Congridae, Colacocongridae - undifferentiated</i>		3.5			3.5
37067900	Conger Eel	<i>Conger verreauxi & Conger wilsoni</i>			0.8		0.8
37345003	Cosmopolitan Rubyfish	<i>Plagiogeneion rubiginosum</i>			353.9		353.9
24155000	Cowrie (U)	<i>Cypraeidae - undifferentiated</i>		1.4			1.4
28850000	Crab (U)	<i>Brachyura - undifferentiated</i>	4.0		3.0		7.0
37279003	Crested Bellowsfish	<i>Notopogon lillieae</i>		902.0	85.1		987.1
23607000	Cuttlefish (U)	<i>Sepiidae - undifferentiated</i>	309.7	171.0	14.0		494.7
37297001	Deepsea Flathead	<i>Hoplichthys haswelli</i>	846.0	161.0	182.5		1189.5
23632000	Deepsea Squid (U)	<i>Bathyteuthidae - undifferentiated</i>	35.0	42.0	89.5		166.5
28821001	Deepwater Bug	<i>Ibacus alticrenatus</i>			9.3		9.3
37296002	Deepwater Flathead	<i>Platycephalus conatus</i>			751.1		751.1
37031035	Deepwater Skate	<i>Dipturus acrobatus</i>		388.0			388.0
37400004	Deepwater Stargazer	<i>Kathetostoma nigrofasciatum</i>			8.0		8.0
23270006	Doughboy Scallop	<i>Chlamys asperrimus</i>		0.1			0.1
37015001	Draughtboard Shark	<i>Cephaloscyllium laticeps</i>		304.0	2.0		306.0
37446000	Driftfish (U)	<i>Nomeidae - undifferentiated</i>	0.2				0.2

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CAABcode	Common Name	Species Name	NSW	Catch (kg)		
				East	West	Total
37024004	Eastern Angel Shark	<i>Squatina albigunctata</i>	602.0			602.0
37344002	Eastern Australian Salmon	<i>Arripis trutta</i>	1.0			1.0
37027006	Eastern Fiddler Ray	<i>Trygonorrhina fasciata</i>	1243.0			1243.0
37311001	Eastern Orange Perch	<i>Lepidoperca pulchella</i>	1.5			1.5
37330014	Eastern School Whiting	<i>Sillago flindersi</i>	16.5	2.0		18.5
37027009	Eastern Shovelnose Ray	<i>Aptychotrema rostrata</i>	409.0	20.0		429.0
37466002	Eastern Smooth Boxfish	<i>Anoplocapros inermis</i>	10.3			10.3
37043001	Elephantfish	<i>Callorhynchus milii</i>		134.0	33.2	167.2
37020001	Endeavour Dogfish	<i>Centrophorus maluccensis</i>	15.0			15.0
37439901	Escolar	<i>Lepidocybium flavobrunneum & Ruvettus pretiosus</i>			16.0	16.0
37288032	Eye Gurnard	<i>Lepidotrigla argus</i>	8.0			8.0
24207001	False Bailer Shell	<i>Livonia mammilla</i>	20.0	359.0		379.0
37311102	Fangtooth Perch	<i>Lepidoperca brochata</i>	0.2			0.2
37296000	Flathead (U)	<i>Platycephalidae - undifferentiated</i>		2.0		2.0
37485000	Flounder (U)	<i>Flounder - undifferentiated</i>	0.2			0.2
37361002	Footballer Sweep	<i>Neatyus obliquus</i>			1.0	1.0
37210000	Frogfish, Doublefin & Straightback Frogfish (U)	<i>Antennariidae, Tetrabrachiidae, Lophichthyidae - undifferentiated</i>	1.5			1.5
37440002	Frostfish	<i>Lepidopus caudatus</i>	9306.0	14.0	30.0	9350.0
37211003	Furry Coffinfish	<i>Chaunax endeavouri</i>	6.6			6.6
37232003	Gargoyle Fish	<i>Coelorinchus mirus</i>	1328.0			1328.0
37439002	Gemfish	<i>Rexea solandri</i>	587.4	129.2	440.6	1157.2
37367002	Giant Boarfish	<i>Paristiopterus labiosus</i>	4.0	4.0	18.5	26.5
28925001	Giant Crab	<i>Pseudocarcinus gigas</i>		12.0	12.7	24.7
28712008	Giant Scarlet Prawn	<i>Aristaeopsis edwardsiana</i>	4.1			4.1
37469001	Globefish	<i>Diodon nichthemerus</i>		2.0		2.0
37355000	Goatfish (U)	<i>Mullidae - undifferentiated</i>		8.0		8.0
37208000	Goosefish (U)	<i>Lophiidae - undifferentiated</i>		1.0		1.0
23636004	Gould Squid	<i>Nototodarus gouldi</i>	230.5	74.5	734.5	1039.5
37038007	Greenback Stingaree	<i>Urolophus viridis</i>	2930.0	235.0	81.0	3246.0
37020007	Greeneye Dogfish	<i>Squalus mitsukurii</i>	50.0	216.0	60.0	326.0
37020901	Greeneye Dogfish (U)	<i>Squalus spp</i>		88.0		88.0
37377002	Grey Morwong	<i>Nemadactylus douglasii</i>	205.5	25.4		230.9
37031028	Grey Skate	<i>Dipturus canutus</i>	15.0		55.5	70.5
37017001	Gummy Shark	<i>Mustelus antarcticus</i>	130.0	407.7	243.8	781.5
37311006	Hapuku	<i>Polyprion oxygeneios</i>			38.0	38.0
37020010	Harrisson Dogfish	<i>Centrophorus harrissoni</i>	38.5			38.5
20027000	Hermit Crab (U)	<i>Hermit crab - undifferentiated</i>	34.5	140.0	0.2	174.7
25400000	Holothurian (U)	<i>Class Holothuroidea - undifferentiated</i>		6.5	68.0	74.5
37258001	Imperador	<i>Beryx decadactylus</i>	4.8		4.5	9.3
37337002	Jack Mackerel	<i>Trachurus declivis</i>	428.3	342.0	562.0	1332.3
37377003	Jackass Morwong	<i>Nemadactylus macropterus</i>	9.0	221.0	330.6	560.6
11120000	Jellyfish (U)	<i>Scyphozoa spp - undifferentiated</i>			55.0	55.0
37264004	John Dory	<i>Zeus faber</i>	65.6	216.0	15.2	296.8
37264001	King Dory	<i>Cyttus traversi</i>	25.6	82.0	811.3	918.9
37369002	Knifejaw	<i>Oplegnathus woodwardi</i>			139.8	139.8
37122000	Lanternfish (U)	<i>Myctophidae - undifferentiated</i>			0.1	0.1
37118001	Largescale Saury	<i>Saurida undosquamis</i>		1.0		1.0
37288006	Latchet	<i>Pterygotrigla polyommata</i>	616.5	503.0	2005.5	3125.0
37020009	Leafscale Gulper Shark	<i>Centrophorus squamosus</i>	52.0			52.0
37232047	Little Whiptail	<i>Coelorinchus gormani</i>		5.2	10.5	15.7
37439009	Longfin Gemfish	<i>Rexea antefurcata</i>	0.1			0.1
37031005	Longnose Skate	<i>Dipturus confusus</i>		670.0		670.0
37367003	Longsnout Boarfish	<i>Pentaceropsis recurvirostris</i>		69.1		69.1
37020004	Longsnout Dogfish	<i>Deania quadrispinosa</i>	18.0	157.0		175.0
28030000	Mantis Shrimp (U)	<i>Order Stomatopoda - undifferentiated</i>		1.0		1.0
23659003	Maori Octopus	<i>Pinnoctopus cordiformis</i>		62.0		62.0
37296038	Marbled Flathead	<i>Platycephalus marmoratus</i>	1.6			1.6
37400007	Marbled Stargazer	<i>Uranoscopus cf bicinctus</i>			1.2	1.2
37031006	Melbourne Skate	<i>Spiriraja whiteleyi</i>		407.0	33.5	440.5
37264003	Mirror Dory	<i>Zenopsis nebulosus</i>	1740.5	1721.0	285.4	3746.9
37020033	Moller's Deepsea Shark	<i>Etmopterus mollerii</i>	3.4			3.4
23000000	Mollusc (U)	<i>Phylum Mollusca - undifferentiated</i>		27.5		27.5
37465003	Mosaic Leatherjacket	<i>Eubalichthys mosaicus</i>	9.0	91.0		100.0
37296041	Mud Flathead	<i>Ambiserrula jugosa</i>	30.5			30.5
37264005	New Zealand Dory	<i>Cyttus novaezealandiae</i>		253.0	1061.0	1314.0
37445003	New Zealand Ruffe	<i>Schedophilus huttoni</i>		2.0		2.0
37232014	Notable Whiptail	<i>Coelorinchus innotabilis</i>	0.2		9.5	9.7
37465006	Ocean Jacket	<i>Nelusetta ayraud</i>	2288.0	2048.0	513.0	4849.0
23659000	Octopus (U)	<i>Octopodidae - undifferentiated</i>	17.0	3.0	12.5	32.5
37042001	Ogilby Ghostshark	<i>Hydrolagus ogilbyi</i>	701.0		19.0	720.0
37255009	Orange Roughy	<i>Hoplostethus atlanticus</i>			1.8	1.8
37015024	Orange Spotted Catshark	<i>Asymbolus rubiginosus</i>	28.1	102.5		130.6
37024002	Ornate Angelshark	<i>Squatina tergocellata</i>	135.0			135.0
37020019	Owston Dogfish	<i>Centroscyrnus owstonii</i>	1.0			1.0
37288005	Painted Latchet	<i>Pterygotrigla andertonii</i>	84.7	15.0	0.8	100.5
23659004	Pale Octopus	<i>Octopus pallidus</i>		81.5		81.5
37031009	Peacock Skate	<i>Pavoraja nitida</i>	8.0	83.0	405.0	496.0
37337077	Peruvian Jack Mackerel	<i>Trachurus murphyi</i>		42.0		42.0
37298000	Pigfish	<i>Congiopodidae - undifferentiated</i>	2.0			2.0
37228002	Pink Ling	<i>Genypterus blacodes</i>	659.0	1421.5	1638.8	3719.3
37282000	Pipefish (U)	<i>Syngnathidae - undifferentiated</i>		0.1		0.1
37020013	Plunket Dogfish	<i>Proscymnodon plunketi</i>		2.0		2.0

CAABcode	Common Name	Species Name	Catch (kg)			
			NSW	East	West	Total
37007001	Port Jackson Shark	<i>Heterodontus portusjacksoni</i>	483.0	79.0	171.0	733.0
28710000	Prawn (U)	<i>Penaeoidea & Caridea - undifferentiated</i>		9.6		9.6
37021001	Prickly Dogfish	<i>Oxynotus bruniensis</i>	2.3	4.0		6.3
37224006	Red Cod	<i>Pseudophycis bachus</i>		16.5		16.5
37288001	Red Gurnard	<i>Chelidonichthys kumu</i>	292.3	88.0	16.0	396.3
23636007	Red Ocean Squid	<i>Ommastrephes bartramii</i>		16.0		16.0
37345001	Redbait	<i>Emmelichthys nitidus</i>		8.8	91.1	99.9
37258003	Redfish	<i>Centroberyx affinis</i>	467.2	23.0	1.0	491.2
37287001	Reef Ocean Perch	<i>Helicolenus percoides</i>	229.7	52.0	0.7	282.4
37224002	Ribaldo	<i>Mora moro</i>	4.0	98.0	158.7	260.7
37467002	Ringed Toadfish	<i>Omegophora armilla</i>		1.0	49.5	50.5
37288004	Robust Amour Gurnard	<i>Peristedion picturatum</i>	5.0			5.0
37327018	Robust Deepsea Cardinalfish	<i>Epigonus robustus</i>		2.6		2.6
37228008	Rock Ling	<i>Genypterus tigerinus</i>	3.0	30.0		33.0
37210014	Rough Anglerfish	<i>Kuiterichthys furcipilis</i>		0.1		0.1
37288008	Roundsnout Gurnard	<i>Lepidotrigla mulhalli</i>	2654.0	3370.0		6024.0
28714005	Royal Red Prawn	<i>Haliporoides sibogae</i>	149.0			149.0
37445004	Rudderfish	<i>Centrolophus niger</i>	41.0			41.0
37013005	Rusty Carpetshark	<i>Parascyllium ferrugineum</i>		6.0	25.8	31.8
37015031	Saddled Swellshark	<i>Cephaloscyllium variegatum</i>	282.0			282.0
25262000	Sand Dollar (U)	<i>Clypeasteridae - undifferentiated</i>	1.3			1.3
37255003	Sandpaper Fish	<i>Paratrachichthys macleayi</i>			5.5	5.5
37038001	Sandyback Stingaree	<i>Urolophus bucculentus</i>	553.0	657.0		1210.0
37015009	Sawtail Catshark	<i>Figaro boardmani</i>	100.0	47.2	6.8	154.0
37400005	Scaled Stargazer	<i>Pleuroscopus pseudodorsalis</i>		3.0		3.0
37017008	School Shark	<i>Galeorhinus galeus</i>		42.1	397.0	439.1
25200000	Sea Urchin (U)	<i>Class Echinoidea - undifferentiated</i>	180.0	75.0	2.0	257.0
41131000	Seal (U)	<i>Otariidae - undifferentiated</i>	140.0			140.0
25102000	Seastar (U)	<i>Class Asteroidea - undifferentiated</i>	8.5	37.8	4.0	50.3
37117001	Sergeant Baker	<i>Aulopus purpurissatus</i>	0.5	0.2		0.7
37005001	Sharpnose Sevengill Shark	<i>Heptranchias perlo</i>	16.3	5.0	24.0	45.3
37466003	Shaw Cowfish	<i>Aracana aurita</i>		1.0		1.0
37028003	Short-Tail Torpedo Ray	<i>Torpedo macneilli</i>	71.0	25.0	51.0	147.0
37264002	Silver Dory	<i>Cyttus australis</i>	1.8	221.9	51.2	274.9
37337062	Silver Trevally	<i>Pseudocaranx dentex</i>	10.0	2.0		12.0
37445006	Silver Warehou	<i>Seriola punctata</i>	113.5	1040.0	4080.6	5234.1
37465036	Sixspine Leatherjacket	<i>Meuschenia freycineti</i>	3.5			3.5
37031000	Skate (U)	<i>Rajidae - undifferentiated</i>		7.0		7.0
37019004	Smooth Hammerhead	<i>Sphyrna zygaena</i>	35.0			35.0
37035001	Smooth Stingray	<i>Dasyatis brevicaudata</i>	175.0	144.0	52.0	371.0
37232007	Smooth Whiptail	<i>Malacocephalus laevis</i>	18.0	334.0		352.0
37305001	Smooth-Head Blobfish	<i>Psychrolutes microporos</i>		2.0	18.0	20.0
37353001	Snapper	<i>Pagrus auratus</i>	17.1		285.8	302.9
37076000	Snipe Eel (U)	<i>Nemichthyidae - undifferentiated</i>	0.5			0.5
11176000	Soft Coral (U)	<i>Alcyoniidae - undifferentiated</i>		1.1	250.0	251.1
23617005	Southern Calamari	<i>Sepioteuthis australis</i>	23.0	45.0		68.0
37042005	Southern Chimaera	<i>Chimaera fulva</i>		71.0	2.0	73.0
37020011	Southern Dogfish	<i>Centrophorus zeehaani</i>	4.0	6.0	5.0	15.0
37039001	Southern Eagle Ray	<i>Myliobatis australis</i>	331.0	636.0	221.0	1188.0
37027011	Southern Fiddler Ray	<i>Trygonorrhina dumerilii</i>		136.0	27.0	163.0
37020021	Southern Lanternshark	<i>Etmopterus baxteri</i>		9.2	2.0	11.2
28820001	Southern Rocklobster	<i>Jasus edwardsii</i>		1.0		1.0
37296003	Southern Sand Flathead	<i>Platycephalus bassensis</i>		4.5		4.5
37023001	Southern Sawshark	<i>Pristiophorus nudipinnis</i>		20.0		20.0
37083001	Southern Spineback	<i>Notacanthus sexspinis</i>	0.2			0.2
37232001	Southern Whiptail	<i>Coelorinchus australis</i>		97.0	283.6	380.6
37038004	Sparsely-Spotted Stingaree	<i>Urolophus paucimaculatus</i>	2.0	439.0		441.0
37400018	Spinkled Stargazer	<i>Kathetostoma canaster</i>		420.0	464.4	884.4
28880000	Spider Crab (U)	<i>Majidae & related families - undifferentiated</i>	24.0	399.0	8.2	431.2
37020006	Spikey Dogfish	<i>Squalus megalops</i>	10500.0	565.5	644.5	11710.0
37266001	Spikey Oreodory	<i>Neocyttus rhomboidalis</i>	0.3	19.0	821.3	840.6
37288002	Spiny Gurnard	<i>Lepidotrigla papilio</i>		205.0		205.0
37282029	Spiny Pipehorse	<i>Solegnathus spinosissimus</i>	0.5	4.7		5.2
37311055	Splendid Perch	<i>Callanthias australis</i>			0.2	0.2
10216000	Sponge (U)	<i>Grantiidae - undifferentiated</i>		800.0	375.0	1175.0
37044000	Spookfish (U)	<i>Rhinochimaeridae - undifferentiated</i>			2.2	2.2
37013003	Spotted Wobbegong	<i>Orectolobus maculatus</i>	60.0		75.0	135.0
28840000	Squat Lobster (U)	<i>Galatheidae, Munididae & Munidopsidae - undifferentiated</i>		0.1		0.1
37035000	Stingray (U)	<i>Dasyatidae - undifferentiated</i>		45.0		45.0
37378001	Striped Trumpeter	<i>Latris lineata</i>		2.0	6.0	8.0
28911020	Swimmer Crab	<i>Ovalipes mollerii</i>	29.0	187.0		216.0
37031002	Sydney Skate	<i>Dipturus australis</i>	422.0			422.0
37028002	Tasmanian Numbfish	<i>Narcine tasmaniensis</i>	108.5	82.6	31.5	222.6
37445002	Tasmanian Rudderfish	<i>Tubbia tasmanica</i>		1.0		1.0
37287006	Thetis Fish	<i>Neosebastes thetidis</i>	0.5	17.0	376.7	394.2
37031007	Thornback Skate	<i>Dentiraja lemprieri</i>		14.0	84.0	98.0
37311053	Threespine Cardinalfish	<i>Apogonops anomalous</i>	76.0	15.1		91.1
37296001	Tiger Flathead	<i>Platycephalus richardsoni</i>	2991.0	5060.0	235.8	8286.8
37467000	Toadfish (U)	<i>Tetraodontidae - undifferentiated</i>		53.0		53.0
37232004	Toothed Whiptail	<i>Lepidorhynchus denticulatus</i>	552.0	589.0	703.7	1844.7
37228001	Tusk	<i>Dannevigia tusca</i>			99.0	99.0
37465005	Velvet Leatherjacket	<i>Meuschenia scaber</i>	49.0	724.0	273.7	1046.7
37266004	Warty Oreodory	<i>Alloctytus verrucosus</i>		1.0		1.0

CAABcode	Common Name	Species Name	Catch (kg)			
			NSW	East	West	Total
37445011	White Warehou	<i>Seriola caerulea</i>	1.0	161.0	0.6	162.6
37015013	Whitewin Swell Shark	<i>Cephaloscyllium albiginnum</i>	32.0	115.1	966.2	1113.3
37020008	Whitespotted Dogfish	<i>Squalus acanthias</i>		1.0	5.5	6.5
37031003	Whitespotted Skate	<i>Dipturus cerva</i>		249.0		249.0
37038008	Wide Stingaree	<i>Urolophus expansus</i>		82.0	371.5	453.5
37038005	Yellowback Stingaree	<i>Urolophus sufflavus</i>	398.0			398.0
37258006	Yelloweye Redfish	<i>Centroberyx australis</i>			0.9	0.9
37384035	Yellowfin Pigfish	<i>Bodianus flavipinnis</i>	1.0			1.0
37367001	Yellowspotted Boarfish	<i>Paristiopterus gallipavo</i>			14.2	14.2
37337003	Yellowtail Scad	<i>Trachurus novaezelandiae</i>	0.1			0.1
Total			62,993	42,118	38,550	143,661

Table 10. Details of all shots conducted during the 2014 survey.

Shot code	Zone	Shot date	Time of shot	Shot duration (hrs)	Start point		End point		Mean depth (m)
					Latitude	Longitude	Latitude	Longitude	
					105	East	28-Jul-14	7:34	
106	East	28-Jul-14	10:20	2:00	-38.3107	148.4838	-38.2428	148.5842	110
107	East	28-Jul-14	14:02	2:00	-38.3715	148.7557	-38.3322	148.8755	430
108	East	28-Jul-14	17:48	2:00	-38.2100	149.0410	-38.2105	149.1738	150
117	East	29-Jul-14	5:10	2:01	-37.9062	149.9867	-37.8167	150.0460	150
123	East	29-Jul-14	8:06	2:01	-37.8102	150.1367	-37.7188	150.1938	300
122	East	29-Jul-14	10:52	2:01	-37.7382	150.1823	-37.6397	150.2213	300
126	East	29-Jul-14	13:54	2:02	-37.5975	150.1907	-37.4905	150.2313	150
127	East	29-Jul-14	16:55	2:00	-37.4153	150.2138	-37.3165	150.2542	130
124	East	30-Jul-14	5:37	2:00	-37.6488	149.9288	-37.7412	149.8880	100
121	East	30-Jul-14	10:20	2:00	-37.9900	150.0902	-37.8943	150.1387	430
120	East	30-Jul-14	13:15	2:01	-37.8980	150.1590	-38.0023	150.1205	530
118	East	30-Jul-14	16:55	2:00	-37.9648	150.1092	-38.0677	150.0487	450
111	East	31-Jul-14	5:07	2:00	-38.1312	149.9523	-38.1877	149.8402	445
114	East	31-Jul-14	8:12	2:00	-38.1245	149.8225	-38.0678	149.9285	220
115	East	31-Jul-14	11:14	2:00	-38.0081	149.8722	-38.0325	149.7425	140
116	East	31-Jul-14	14:35	2:00	-37.9239	149.6556	-37.8556	149.7711	128
129	East	1-Aug-14	5:10	2:00	-37.1508	150.2358	-37.2492	150.2219	105
128	East	1-Aug-14	8:20	2:00	-37.2808	150.3417	-37.1742	150.3483	250
130	East	1-Aug-14	12:15	2:00	-37.1531	150.1208	-37.0475	150.1592	85
131	East	2-Aug-14	8:10	2:00	-36.9061	150.0483	-36.7908	150.0481	70
135	East	2-Aug-14	11:31	2:00	-36.7292	150.2019	-36.8239	150.1883	125
133	East	2-Aug-14	14:26	2:00	-36.8556	150.2625	-36.9564	150.3064	145
132	East	2-Aug-14	17:00	2:00	-36.9967	150.3125	-37.0964	150.3225	145
119	East	3-Aug-14	5:20	2:00	-38.0786	150.0742	-38.1383	149.9614	500
113	East	3-Aug-14	8:30	2:00	-38.1300	149.9747	-38.2011	149.8761	480
112	East	3-Aug-14	11:25	2:00	-38.2119	149.8394	-38.2372	149.7108	520
110	East	3-Aug-14	16:40	2:00	-38.1372	149.2597	-38.2133	149.1564	150
104	East	5-Aug-14	5:06	2:00	-39.0197	148.4292	-39.1130	148.5113	95
103	East	5-Aug-14	7:32	1:59	-39.1326	148.5219	-39.2239	148.5786	95
99	East	5-Aug-14	11:23	1:59	-39.3941	148.7359	-39.4867	148.7678	250
98	East	5-Aug-14	13:57	2:00	-39.5073	148.7748	-39.6057	148.7977	280
97	East	5-Aug-14	17:30	2:00	-39.7284	148.7127	-39.8256	148.7628	125
96	East	6-Aug-14	5:03	2:00	-39.8384	148.7652	-39.9412	148.7833	120
95	East	6-Aug-14	8:27	2:00	-39.9364	148.6627	-40.0339	148.7052	97
90	East	7-Aug-14	5:00	1:59	-41.4592	148.4166	-41.5643	148.4306	90
91	East	7-Aug-14	7:39	1:52	-41.5893	148.4616	-41.4911	148.4770	100
87	East	7-Aug-14	10:43	2:00	-41.5594	148.5874	-41.6630	148.5578	130
88	East	7-Aug-14	15:32	1:50	-41.5680	148.6411	-41.6948	148.6111	650
84	East	8-Aug-14	5:07	1:59	-42.4059	148.4075	-42.5051	148.3557	100
82	East	8-Aug-14	8:00	1:59	-42.4786	148.4338	-42.5827	148.4090	117
83	East	8-Aug-14	10:52	2:00	-42.5918	148.3174	-42.6918	148.2647	100
80	East	8-Aug-14	13:43	2:00	-42.7449	148.3081	-42.6424	148.3278	115
77	East	8-Aug-14	17:57	2:00	-42.8343	148.3060	-42.9361	148.2584	120
76	East	9-Aug-14	5:02	2:01	-42.9685	148.2643	-43.0719	148.2319	140
75	East	9-Aug-14	9:06	2:00	-43.1258	148.1473	-43.2215	148.0900	125
71	East	9-Aug-14	14:45	2:00	-43.4731	147.6018	-43.5382	147.4976	109
74	East	12-Aug-14	5:12	2:00	-43.7581	147.8345	-43.6767	147.9162	400
73	East	12-Aug-14	8:07	1:39	-43.6424	147.8813	-43.7144	147.8329	170
72	East	12-Aug-14	11:18	2:00	-43.5954	147.7637	-43.6632	147.6545	154
70	East	12-Aug-14	15:22	1:59	-43.6496	147.4436	-43.5678	147.5360	120
68	East	13-Aug-14	5:09	1:31	-43.9689	146.8352	-44.0138	146.9289	160
67	East	13-Aug-14	8:58	1:59	-44.0720	146.9269	-44.0991	147.0683	170
66	East	13-Aug-14	11:24	1:30	-44.0853	147.0615	-44.0177	147.0022	160
69	East	13-Aug-14	16:41	1:59	-43.7661	147.4915	-43.6817	147.5953	146
79	East	14-Aug-14	5:08	0:59	-42.6263	148.3832	-42.6710	148.3472	115
78	East	14-Aug-14	7:30	1:30	-42.7684	148.3925	-42.8596	148.3627	500
81	East	14-Aug-14	11:03	1:59	-42.7026	148.4261	-42.5790	148.4735	450
85	East	14-Aug-14	14:36	2:00	-42.6075	148.4714	-42.4788	148.5157	460
86	East	14-Aug-14	17:59	1:59	-42.4107	148.5367	-42.3113	148.5680	480
92	East	15-Aug-14	5:32	2:00	-41.3784	148.6080	-41.2727	148.6197	125
93	East	15-Aug-14	8:34	1:59	-41.2001	148.5675	-41.0968	148.5711	115
94	East	15-Aug-14	11:13	1:59	-41.0613	148.5419	-40.9564	148.5331	100
100	East	16-Aug-14	5:15	2:00	-39.3594	148.7736	-39.2621	148.7308	480

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Shot code	Zone	Shot date	Time of shot	Shot duration (hrs)	Start point		End point		Mean depth (m)
					Latitude	Longitude	Latitude	Longitude	
101	East	16-Aug-14	8:24	2:22	-39.1781	148.7152	-39.0588	148.6775	580
102	East	16-Aug-14	12:02	2:06	-39.0317	148.6368	-39.1593	148.7014	480
109	East	17-Aug-14	5:14	2:01	-38.2534	149.2782	-38.2784	149.1507	400
192	NSW	4-Aug-14	5:52	2:08	-34.2179	151.4900	-34.3028	151.4332	439
186	NSW	4-Aug-14	9:59	2:02	-34.3803	151.4018	-34.2973	151.4615	567
184	NSW	4-Aug-14	13:14	1:59	-34.3255	151.3798	-34.4064	151.3220	3.2
181	NSW	4-Aug-14	16:20	2:24	-34.4586	151.2524	-34.5669	151.1939	192
167	NSW	5-Aug-14	8:57	2:03	-34.9745	151.1089	-35.0566	151.0799	338
171	NSW	5-Aug-14	12:23	2:05	-35.0521	151.1121	-34.9571	151.1517	585
166	NSW	5-Aug-14	15:56	1:58	-34.9929	151.0661	-35.0809	151.0300	174
176	NSW	6-Aug-14	5:36	1:59	-34.8220	151.1038	-34.7293	151.1245	192
172	NSW	6-Aug-14	8:45	2:01	-34.7781	151.0396	-34.8771	151.0386	128
175	NSW	6-Aug-14	12:10	1:50	-34.9168	150.9133	-34.8308	150.8867	64
174	NSW	6-Aug-14	14:52	1:26	-34.8094	150.8431	-34.8806	150.8638	55
164	NSW	7-Aug-14	6:26	2:02	-35.2299	150.9534	-35.3131	150.8914	229
165	NSW	7-Aug-14	9:22	1:59	-35.2923	150.9073	-35.3733	150.8418	229
161	NSW	7-Aug-14	12:29	2:04	-35.4529	150.7987	-35.5430	150.7441	347
158	NSW	8-Aug-14	5:22	2:00	-35.5390	150.6975	-35.6267	150.6414	150
159	NSW	8-Aug-14	10:42	2:01	-35.5851	150.7406	-35.5017	150.7897	567
160	NSW	8-Aug-14	14:17	1:59	-35.5668	150.7454	-35.4805	150.7933	494
153	NSW	9-Aug-14	8:24	2:15	-35.7385	150.6200	-35.8304	150.5748	494
154	NSW	9-Aug-14	12:30	2:02	-35.9542	150.4782	-35.8598	150.5296	219
151	NSW	9-Aug-14	15:30	2:08	-35.8802	150.5281	-35.7849	150.5819	293
150	NSW	10-Aug-14	5:01	1:59	-35.9005	150.3178	-35.8130	150.3708	110
152	NSW	10-Aug-14	7:53	2:02	-35.7907	150.4306	-35.6977	150.4532	128
156	NSW	10-Aug-14	10:55	1:59	-35.6768	150.3785	-35.5965	150.4575	82
163	NSW	14-Aug-14	5:34	2:00	-35.2852	150.6375	-35.2774	150.6925	91
148	NSW	14-Aug-14	12:36	2:11	-35.9665	150.3709	-36.0749	150.3643	123
149	NSW	14-Aug-14	15:41	2:18	-36.0916	150.4058	-36.1975	150.3828	219
136	NSW	15-Aug-14	5:13	2:01	-36.6431	150.3130	-36.7451	150.3156	247
137	NSW	15-Aug-14	8:08	2:01	-36.7015	150.3439	-36.6111	150.3363	402
140	NSW	15-Aug-14	11:01	2:03	-36.6032	150.3155	-36.5077	150.3019	265
139	NSW	15-Aug-14	13:59	2:02	-36.5677	150.2887	-36.6716	150.2782	183
141	NSW	15-Aug-14	16:44	2:17	-36.6714	150.2566	-36.5654	150.2718	143
147	NSW	16-Aug-14	5:04	2:04	-36.1722	150.4160	-36.2591	150.3855	521
143	NSW	16-Aug-14	8:53	1:58	-36.4159	150.3611	-36.5025	150.3620	622
145	NSW	16-Aug-14	12:02	2:01	-36.4576	150.3397	-36.3632	150.3597	518
134	NSW	16-Aug-14	16:20	2:00	-36.5999	150.1316	-36.7102	150.1266	91
146	NSW	17-Aug-14	5:03	2:00	-36.3579	150.3191	-36.4527	150.2935	201
144	NSW	17-Aug-14	8:16	2:02	-36.4120	150.1878	-36.3185	150.2343	88
169	NSW	23-Aug-14	5:32	2:11	-35.0615	151.0882	-34.9709	151.1341	454
168	NSW	23-Aug-14	8:50	2:03	-34.9542	151.1350	-35.0458	151.0954	448
178	NSW	23-Aug-14	13:55	2:17	-34.6892	150.9171	-34.5702	150.9600	82
179	NSW	23-Aug-14	16:58	2:02	-34.5831	151.0087	-34.6851	150.9803	110
185	NSW	24-Aug-14	5:05	2:01	-34.3165	151.4206	-34.4020	151.3608	421
182	NSW	24-Aug-14	8:32	2:00	-34.5240	151.3116	-34.6148	151.2663	475
180	NSW	24-Aug-14	11:32	1:54	-34.6264	151.2649	-34.7108	151.2267	378
183	NSW	24-Aug-14	14:55	2:02	-34.6049	151.2441	-34.5152	151.2822	338
193	NSW	25-Aug-14	5:12	2:05	-34.2393	151.4621	-34.3286	151.4047	411
191	NSW	25-Aug-14	8:15	2:00	-34.3179	151.3674	-34.4054	151.3124	260
190	NSW	25-Aug-14	11:11	2:00	-34.3571	151.3029	-34.2733	151.3647	183
188	NSW	25-Aug-14	13:47	2:04	-34.2742	151.3535	-34.3711	151.2860	174
189	NSW	25-Aug-14	16:36	2:16	-34.3824	151.2421	-34.2859	151.2972	152
195	NSW	1-Sep-14	5:23	2:11	-34.0316	151.3451	-34.1385	151.2952	130
194	NSW	1-Sep-14	8:25	2:05	-34.1852	151.2696	-34.2748	151.2035	130
187	NSW	1-Sep-14	11:25	2:00	-34.2769	151.1726	-34.3731	151.1297	128
201	NSW	8-Sep-14	6:15	2:24	-33.6994	151.9394	-33.6219	151.9997	668
205	NSW	8-Sep-14	10:07	2:00	-33.5839	152.0067	-33.6661	151.9481	576
202	NSW	8-Sep-14	13:36	2:00	-33.6314	151.9669	-33.7225	151.8922	549
204	NSW	8-Sep-14	16:52	2:21	-33.6642	151.8456	-33.5867	151.9128	219
200	NSW	9-Sep-14	5:31	2:29	-33.7125	151.5367	-33.6250	151.6225	124
197	NSW	9-Sep-14	9:07	2:09	-33.6247	151.5186	-33.7064	151.4225	91
196	NSW	9-Sep-14	11:51	2:09	-33.6908	151.4039	-33.6033	151.4681	62
198	NSW	9-Sep-14	14:52	2:05	-33.5950	151.5083	-33.6619	151.4089	73
199	NSW	11-Sep-14	5:15	2:08	-33.6750	151.7303	-33.5939	151.8119	137
203	NSW	11-Sep-14	8:13	2:03	-33.6219	151.8522	-33.7072	151.7808	174
19	West	25-Jul-14	9:02	1:57	-38.4447	141.0220	-38.4081	140.9180	154
18	West	25-Jul-14	12:03	2:00	-38.4458	140.8650	-38.4127	140.7766	320
17	West	25-Jul-14	14:51	1:59	-38.3870	140.7526	-38.3422	140.6592	216
1	West	26-Jul-14	11:05	1:32	-37.1339	138.2666	-37.1475	138.3389	450
2	West	26-Jul-14	15:30	1:59	-37.1456	138.8080	-37.1666	138.9342	165
8	West	27-Jul-14	7:12	2:01	-37.3940	139.2546	-37.3244	139.2090	150
5	West	27-Jul-14	10:21	1:58	-37.4379	139.2302	-37.5296	139.2648	139
9	West	27-Jul-14	14:45	2:01	-37.6462	139.6266	-37.7319	139.7203	175
14	West	3-Aug-14	7:05	1:58	-38.2983	140.5359	-38.2516	140.4589	250
13	West	3-Aug-14	9:46	1:59	-38.2428	140.4452	-38.1892	140.3641	185
12	West	3-Aug-14	12:52	1:59	-38.2134	140.3154	-38.2748	140.4297	410
15	West	3-Aug-14	15:40	2:00	-38.2891	140.5326	-38.3408	140.6620	188
19a	West	4-Aug-14	7:05	1:59	-38.4546	141.1046	-38.4987	141.2079	147
20	West	4-Aug-14	10:41	1:59	-38.6824	141.2417	-38.7388	141.3478	480
25	West	4-Aug-14	15:39	2:01	-38.6743	141.4068	-38.5842	141.4580	150
21	West	5-Aug-14	7:06	2:01	-38.6762	141.2624	-38.7314	141.3766	410
22	West	5-Aug-14	10:10	1:59	-38.7335	141.4573	-38.6559	141.3698	180

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Shot code	Zone	Shot date	Time of shot	Shot duration (hrs)	Start point		End point		Mean depth (m)
					Latitude	Longitude	Latitude	Longitude	
24	West	5-Aug-14	13:03	1:58	-38.6857	141.4215	-38.6483	141.2990	180
27	West	6-Aug-14	6:57	2:01	-38.7264	141.4499	-38.7678	141.5807	190
26	West	6-Aug-14	10:16	1:59	-38.8286	141.5144	-38.8178	141.4100	650
38	West	8-Aug-14	12:14	1:59	-39.9483	143.1776	-40.0545	143.2300	480
40	West	8-Aug-14	15:30	1:54	-40.0747	143.2248	-40.1553	143.2631	660
48	West	9-Aug-14	7:06	1:59	-41.5442	144.4165	-41.6471	144.4452	380
47	West	9-Aug-14	10:31	1:59	-41.6198	144.4110	-41.7183	144.4688	510
49	West	9-Aug-14	13:50	2:01	-41.7400	144.4491	-41.8373	144.4957	700
50	West	10-Aug-14	7:19	1:59	-41.8585	144.5343	-41.9382	144.5845	500
44	West	11-Aug-14	7:15	2:01	-41.0319	143.8551	-40.9513	143.7756	585
43	West	11-Aug-14	10:50	1:59	-40.9645	143.8296	-40.8902	143.7496	450
39	West	12-Aug-14	7:08	2:02	-40.0379	143.2185	-40.1392	143.2695	530
41	West	12-Aug-14	10:51	2:04	-40.2025	143.2976	-40.3047	143.3404	550
42	West	12-Aug-14	15:34	2:00	-40.5932	143.5241	-40.6816	143.5954	200
37	West	13-Aug-14	6:56	1:59	-39.3230	142.7422	-39.2385	142.6747	470
36a	West	13-Aug-14	12:18	2:00	-38.9614	142.3493	-38.8986	142.2426	180
35	West	13-Aug-14	15:02	1:59	-38.8814	142.2661	-38.8284	142.1407	178
36	West	14-Aug-14	6:45	1:47	-38.9018	142.3265	-38.8585	142.2197	157
32	West	14-Aug-14	11:30	1:58	-38.8905	142.2237	-38.8335	142.0939	175
33	West	14-Aug-14	14:38	1:59	-38.8941	142.0498	-38.9332	142.1658	640
30	West	15-Aug-14	7:07	2:01	-38.9207	142.1861	-38.8758	142.0708	450
34	West	15-Aug-14	10:17	1:57	-38.8694	142.1432	-38.8122	142.0227	175
31	West	15-Aug-14	13:46	1:58	-38.8429	142.0588	-38.7936	141.9366	175
28	West	16-Aug-14	7:08	2:00	-38.8252	141.8216	-38.8423	141.9567	350
29	West	16-Aug-14	10:04	1:58	-38.8410	141.9600	-38.8765	142.0894	350
62	West	21-Aug-14	7:20	1:58	-43.2080	145.3603	-43.2938	145.4513	175
63	West	21-Aug-14	10:52	1:58	-43.4107	145.6546	-43.4748	145.7652	168
64	West	21-Aug-14	13:28	1:12	-43.4580	145.7754	-43.4925	145.8264	158
65	West	21-Aug-14	15:51	1:58	-43.5652	145.8780	-43.6534	145.9487	160
61	West	22-Aug-14	7:07	2:01	-43.2612	145.3774	-43.1894	145.2746	465
58	West	23-Aug-14	11:39	2:08	-42.2407	144.7671	-42.3315	144.7956	500
52	West	24-Aug-14	12:21	1:59	-41.9675	144.6562	-42.0641	144.7160	183
54	West	25-Aug-14	7:02	1:23	-42.1080	144.6950	-42.1674	144.7211	475
55	West	25-Aug-14	9:14	1:52	-42.1400	144.7094	-42.0534	144.6663	510
56	West	25-Aug-14	14:44	1:59	-42.1271	144.6816	-42.2192	144.7255	640
59	West	26-Aug-14	6:59	2:00	-42.4046	144.7929	-42.4938	144.8196	680
57	West	26-Aug-14	11:28	1:37	-42.2534	144.8171	-42.1779	144.7923	175
46	West	27-Aug-14	6:52	1:27	-41.3314	144.2865	-41.3752	144.3535	375
45	West	27-Aug-14	9:28	1:59	-41.3677	144.3259	-41.3094	144.2259	480
42a	West	28-Aug-14	6:42	1:59	-40.7195	143.6249	-40.8031	143.7028	184
16	West	31-Aug-14	7:57	1:59	-38.3883	140.6149	-38.3451	140.5219	505
11a	West	31-Aug-14	12:19	2:00	-38.1805	140.3462	-38.1133	140.2383	185
11	West	31-Aug-14	14:54	2:00	-38.1062	140.2282	-38.0264	140.1307	190
10	West	1-Sep-14	6:54	1:09	-37.9245	139.9737	-37.8639	139.8831	235
3	West	1-Sep-14	13:53	1:59	-37.5502	139.2622	-37.4763	139.1756	350
4	West	2-Sep-14	6:47	1:59	-37.4755	139.1835	-37.5521	139.2505	370
6	West	2-Sep-14	9:48	1:59	-37.5811	139.2350	-37.5167	139.1394	440
7	West	2-Sep-14	13:09	1:33	-37.5237	139.0852	-37.4572	139.0768	640

Summer and winter survey model fits for 11 main quota species and Blue Grenadier

Blue Warehouse – Winter 2014

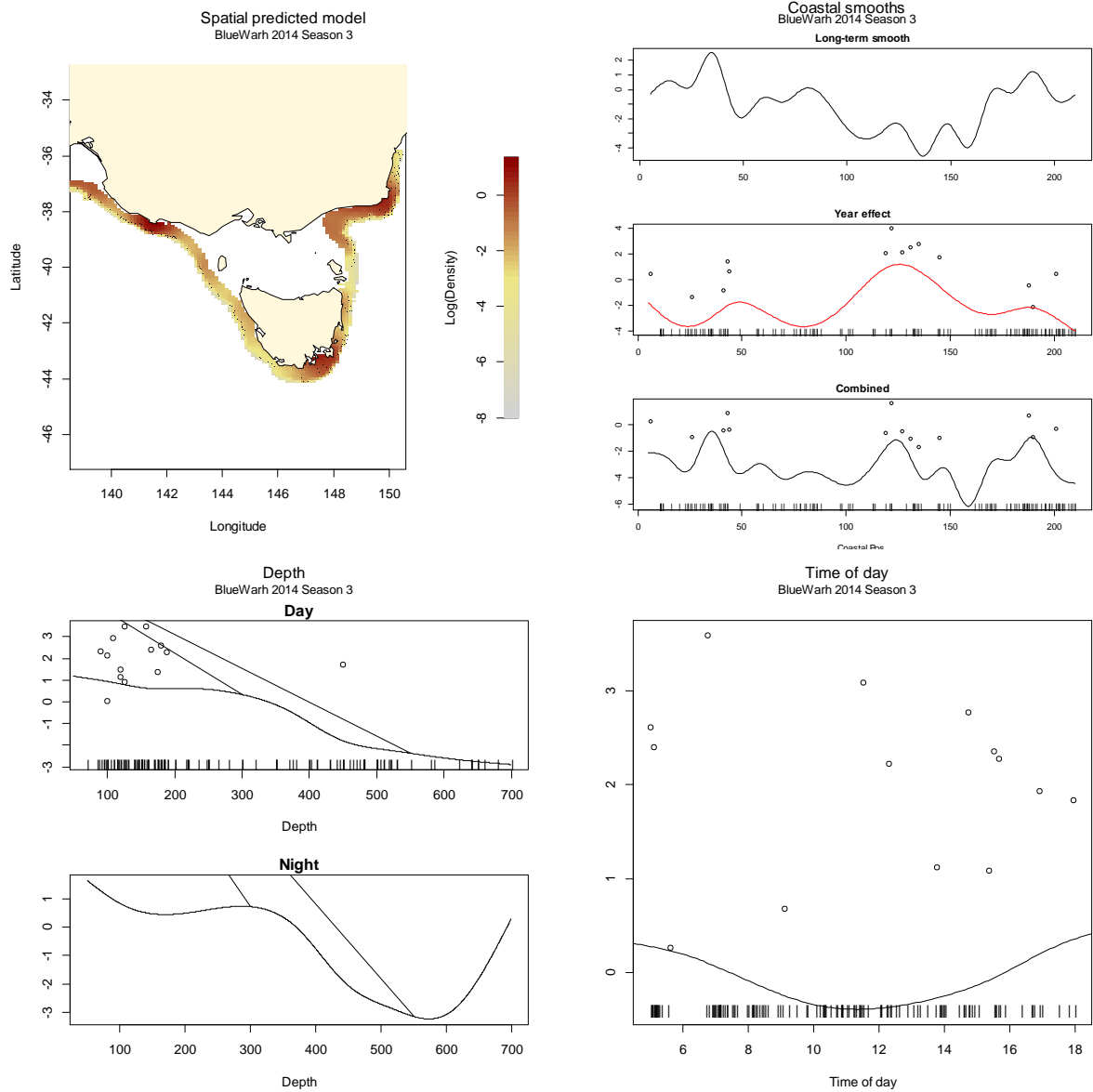


Figure 29. Winter survey model fits for Blue Warehouse.

Jackass Morwong – Winter 2014

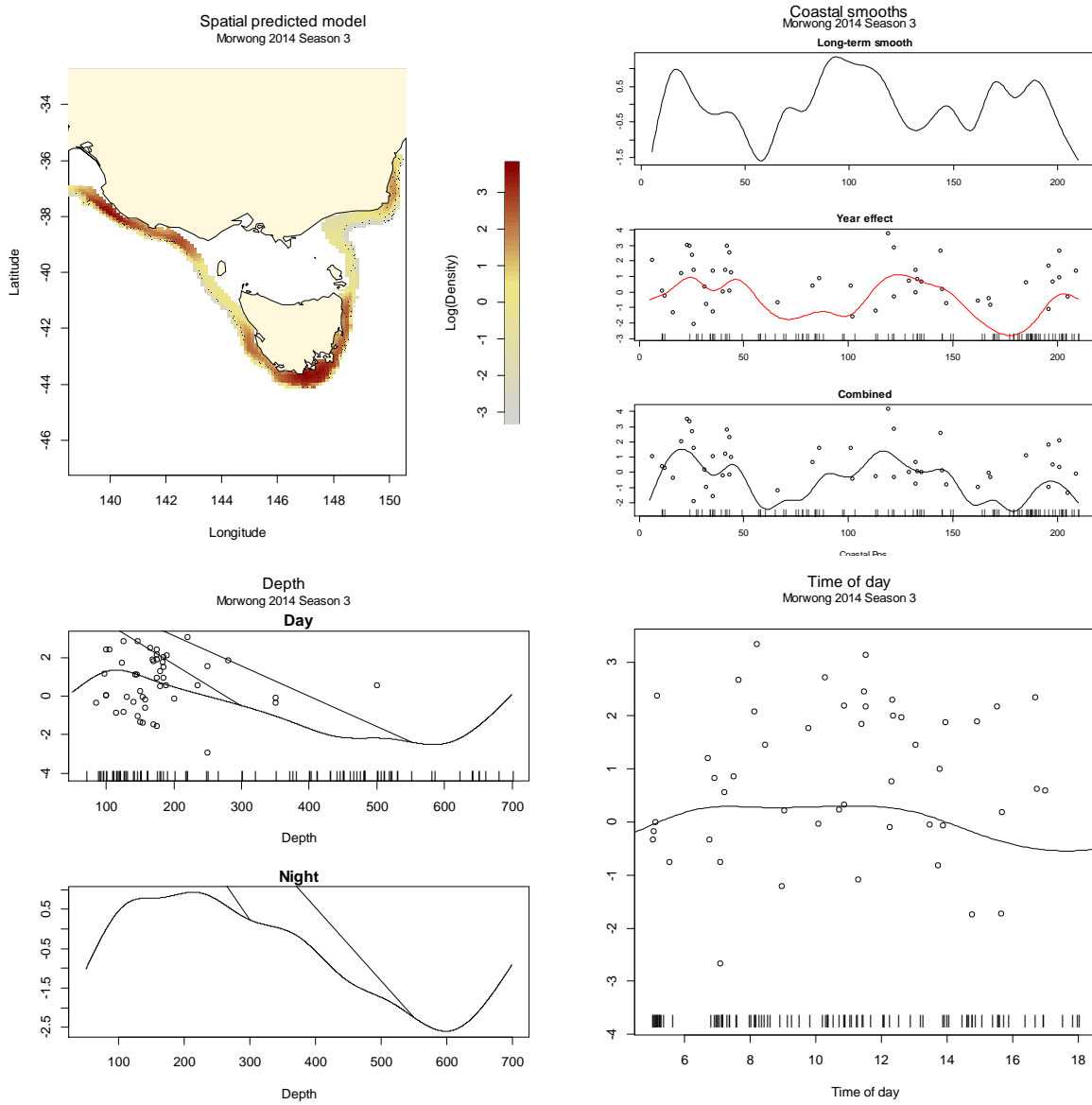


Figure 30. Winter survey model fits for Jackass Morwong.

John Dory – Winter 2014

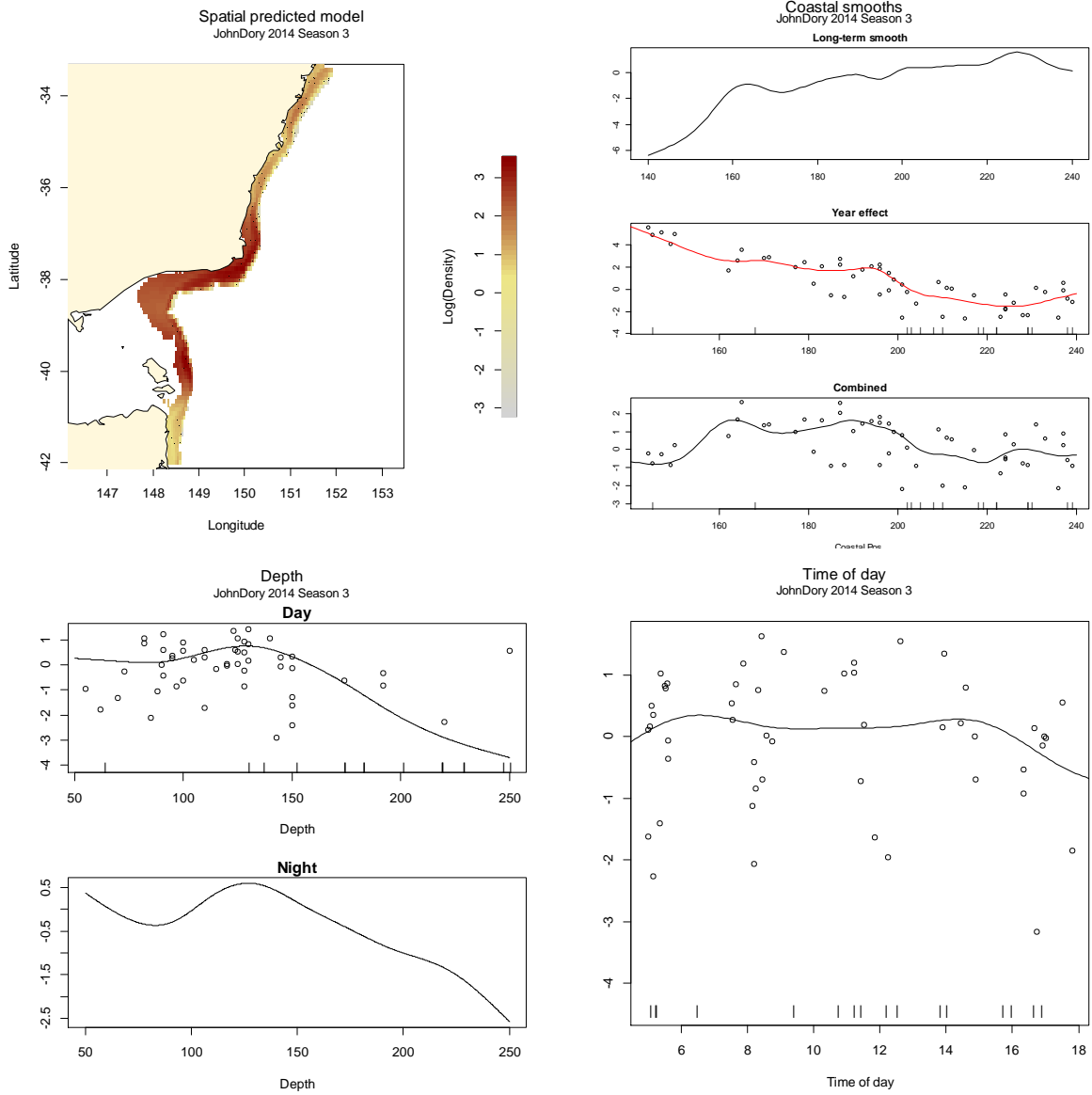


Figure 31. Winter survey model fits for John Dory.

Gemfish – Winter 2014

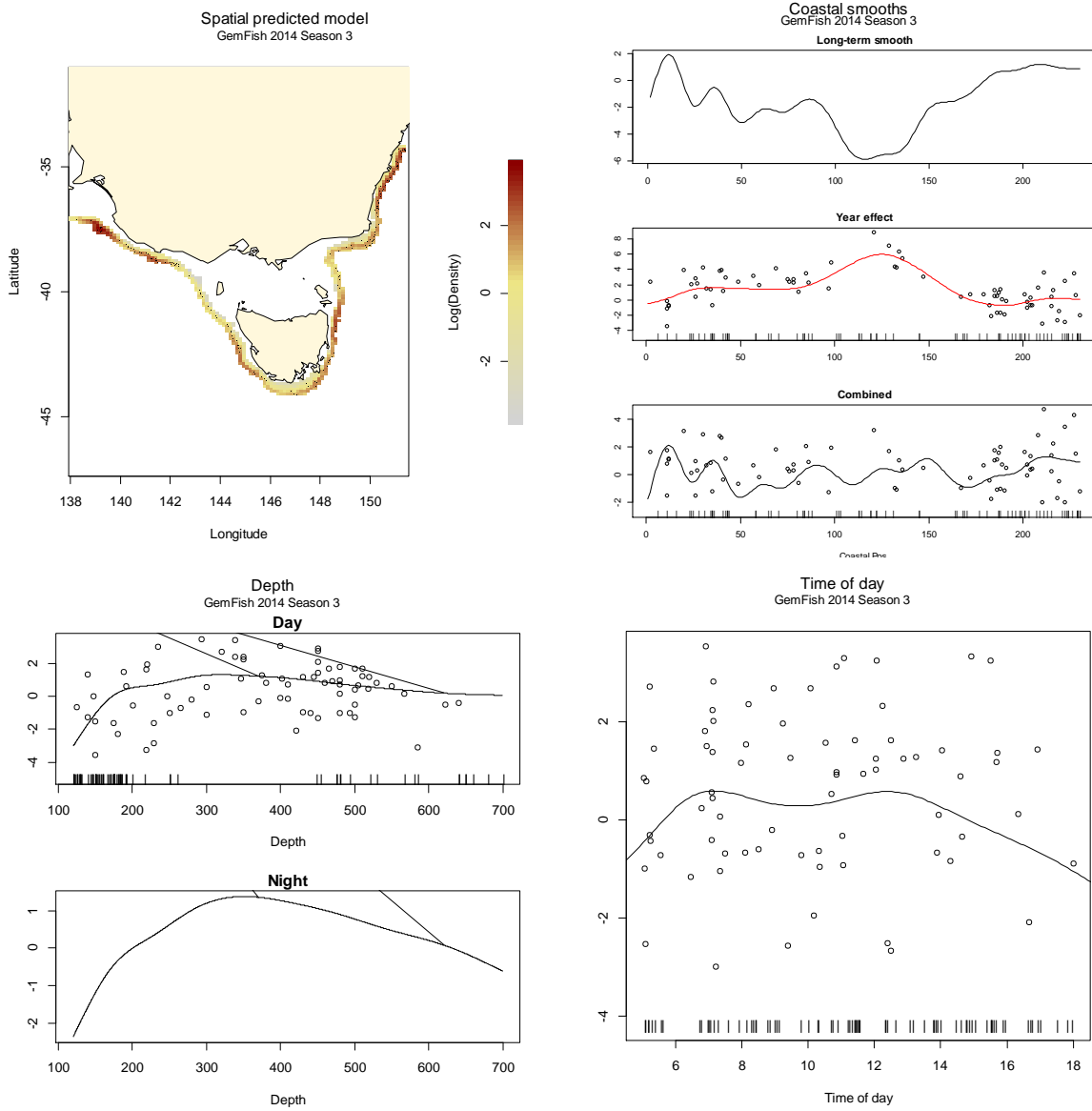


Figure 32. Winter survey model fits for Gemfish.

Tiger Flathead – Winter 2014

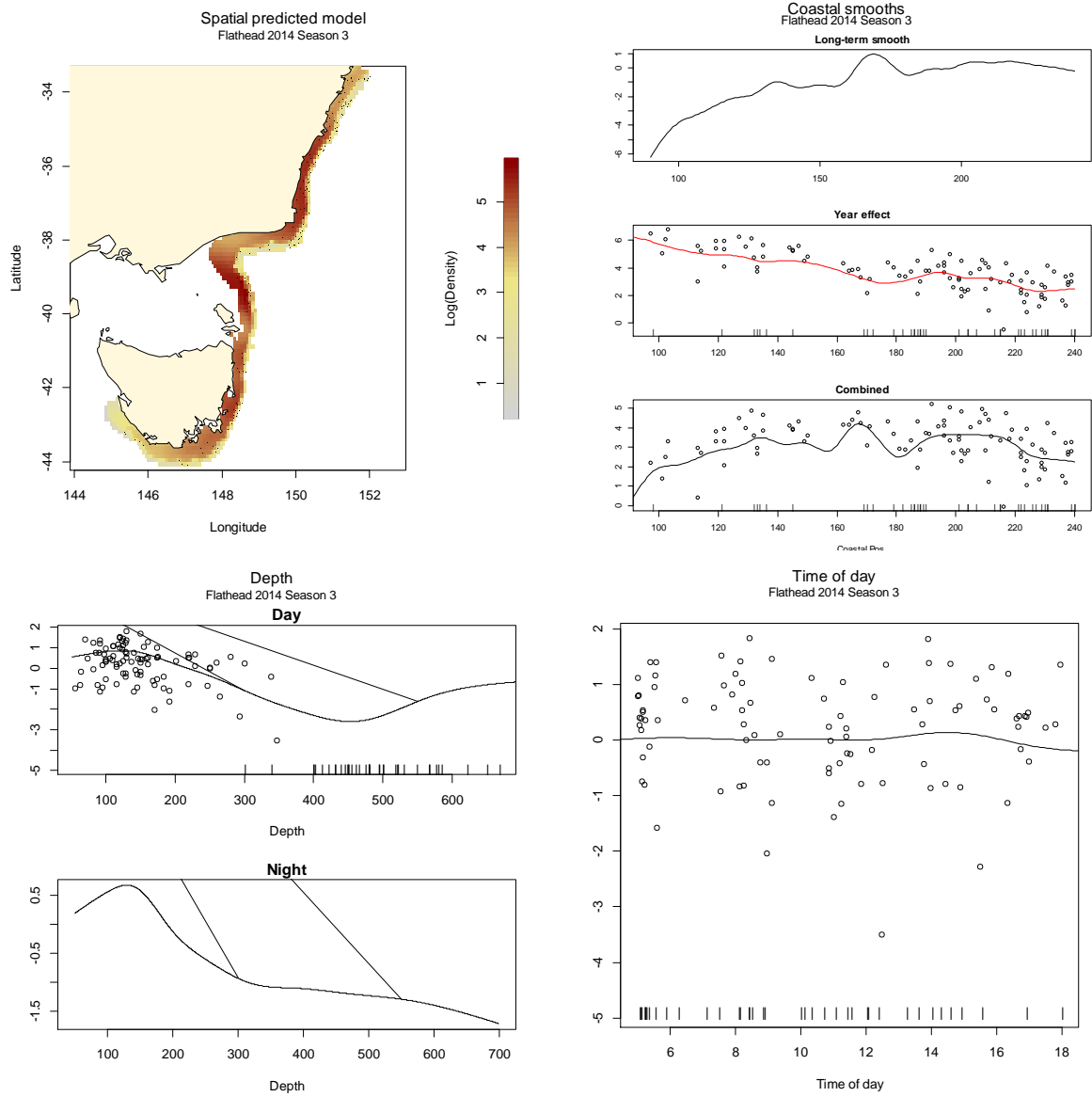


Figure 33. Winter survey model fits for Tiger Flathead.

Pink Ling – Winter 2014

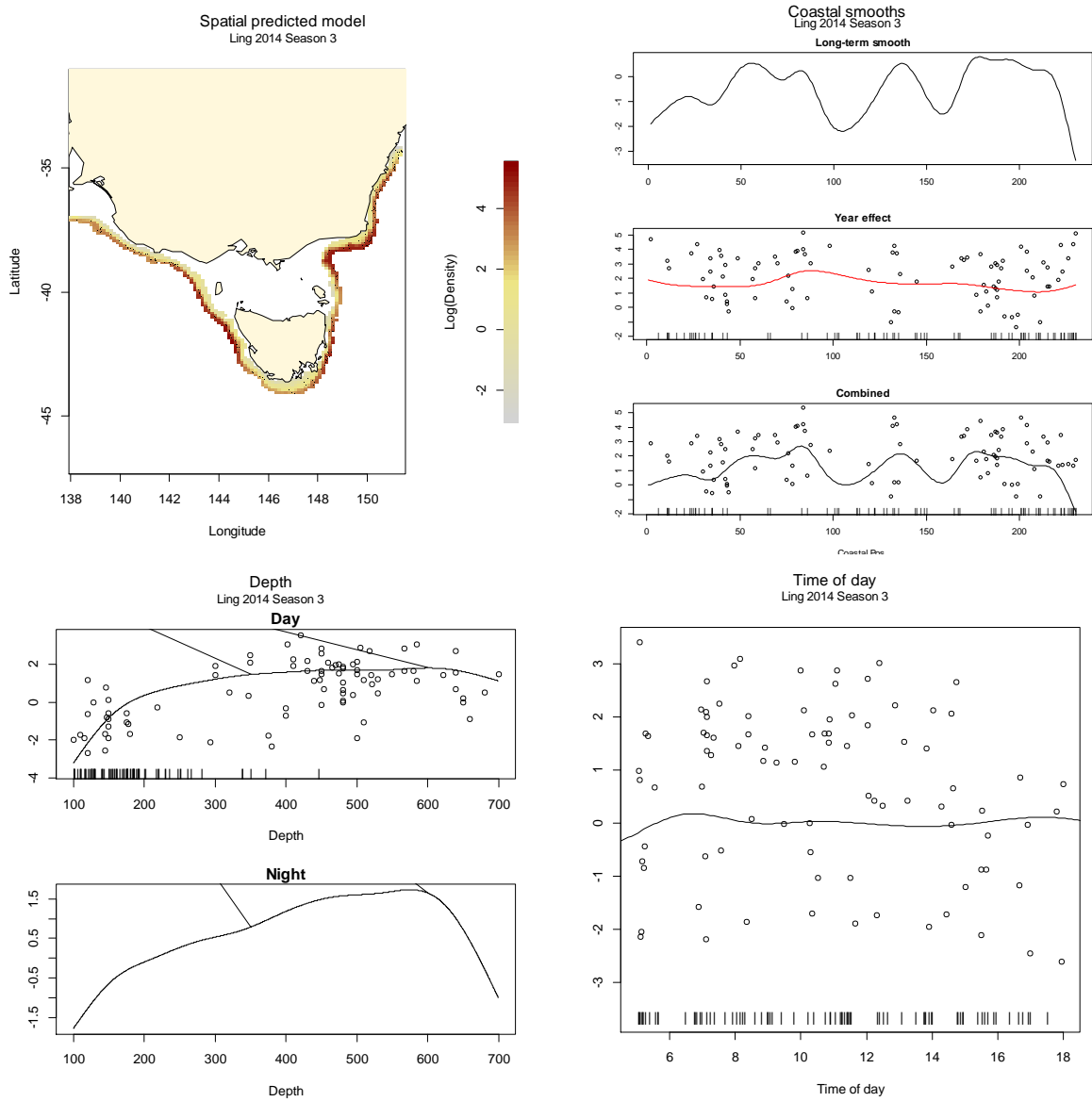


Figure 34. Winter survey model fits for Pink Ling.

Silver Trevally – Winter 2014

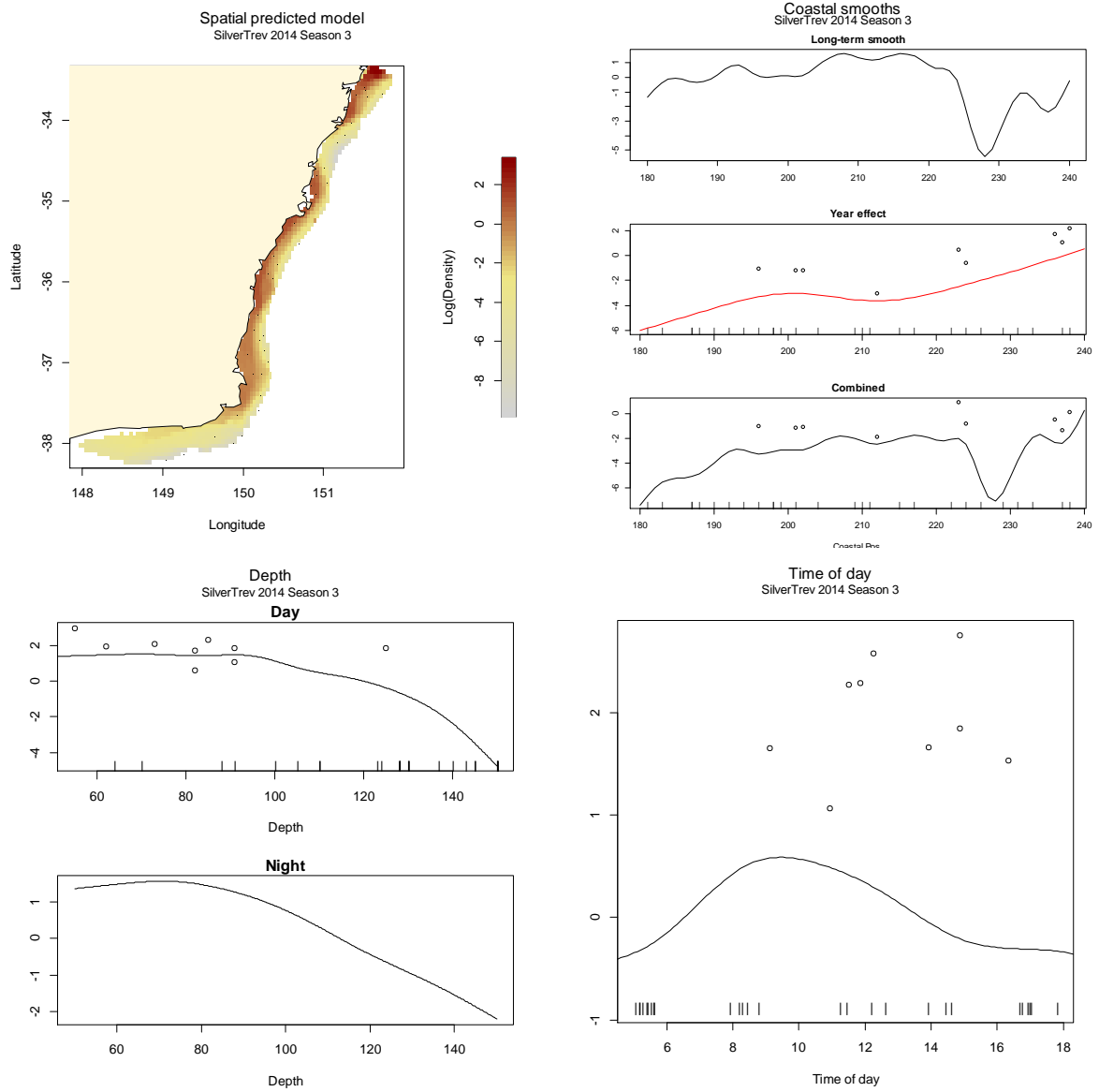


Figure 35. Winter survey model fits for Silver Trevally.

Redfish – Winter 2014

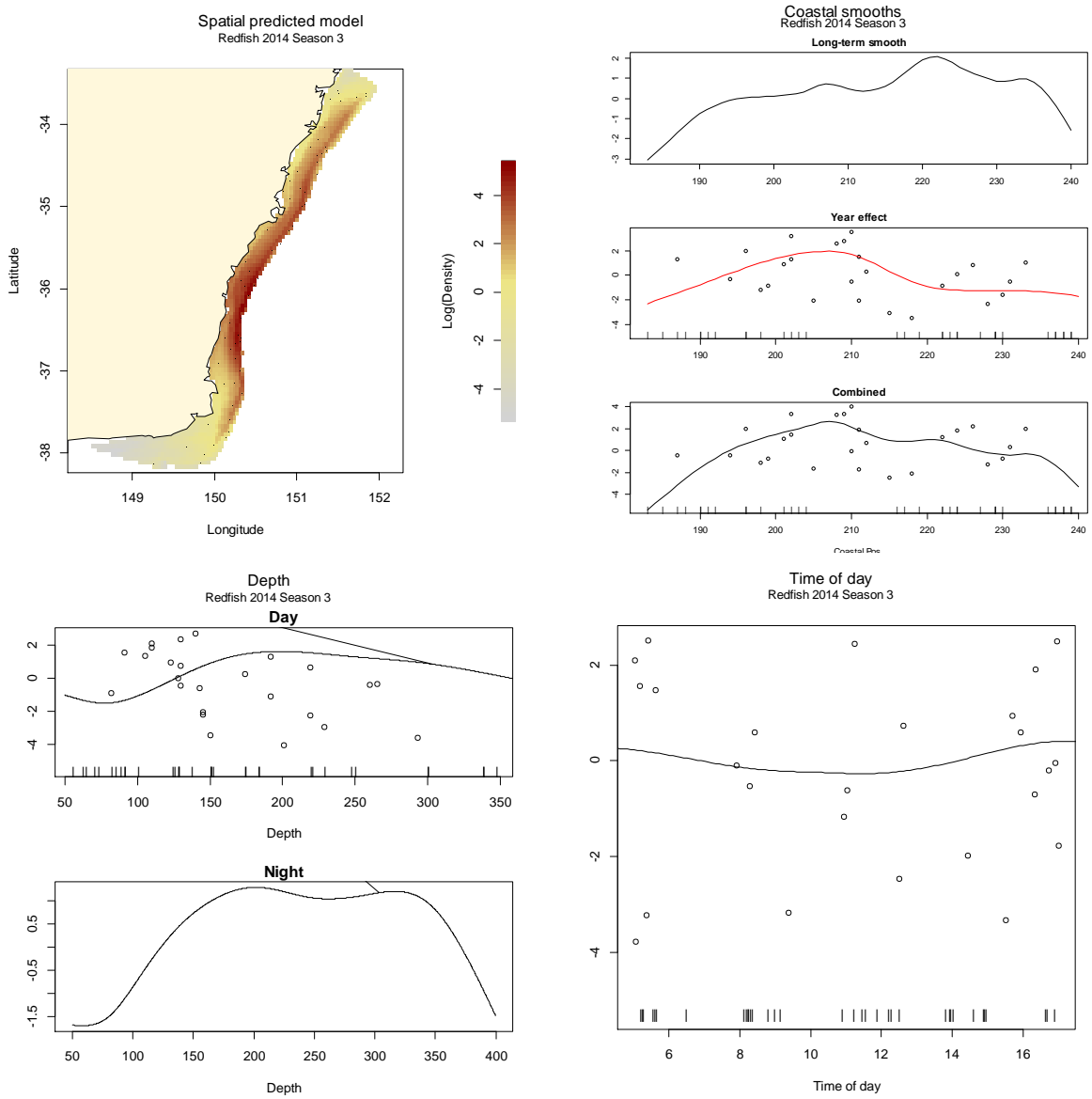


Figure 36. Winter survey model fits for Redfish.

Blue-eye Trevalla – Winter 2014

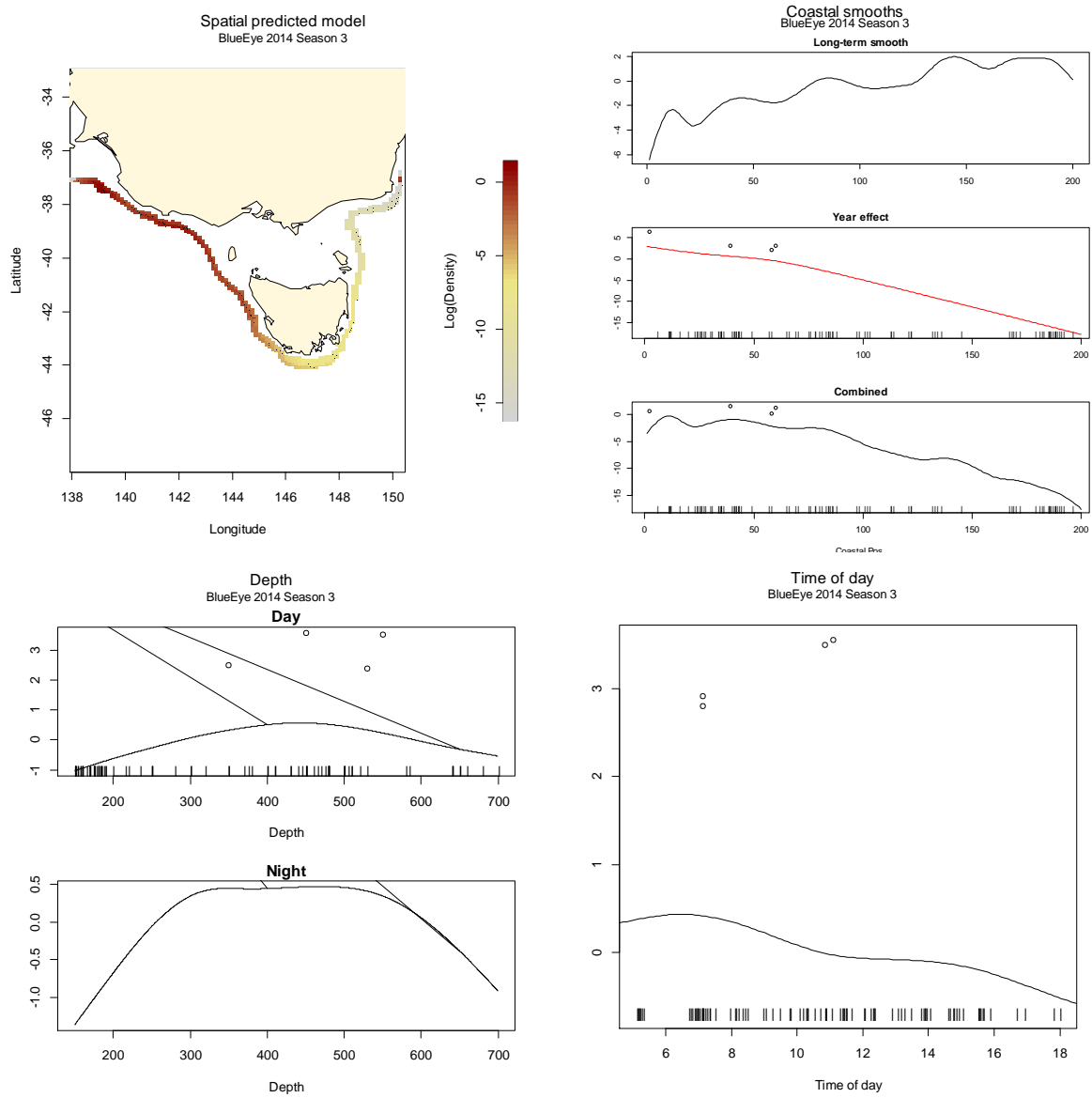


Figure 37. Winter survey model fits for Blue-eye Trevalla.

Mirror Dory – Winter 2014

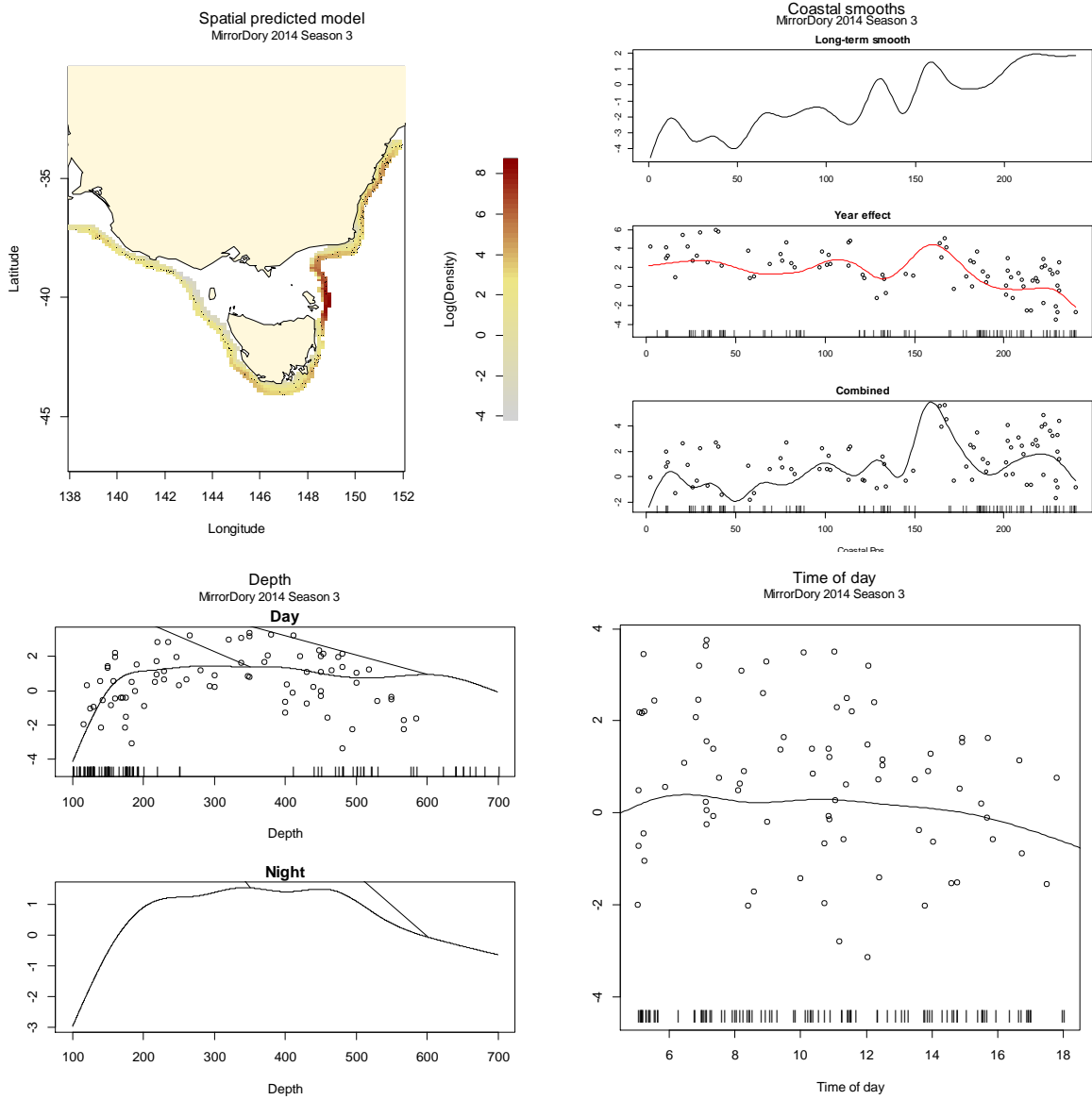


Figure 38. Winter survey model fits for Mirror Dory.

Silver Warehou – Winter 2014

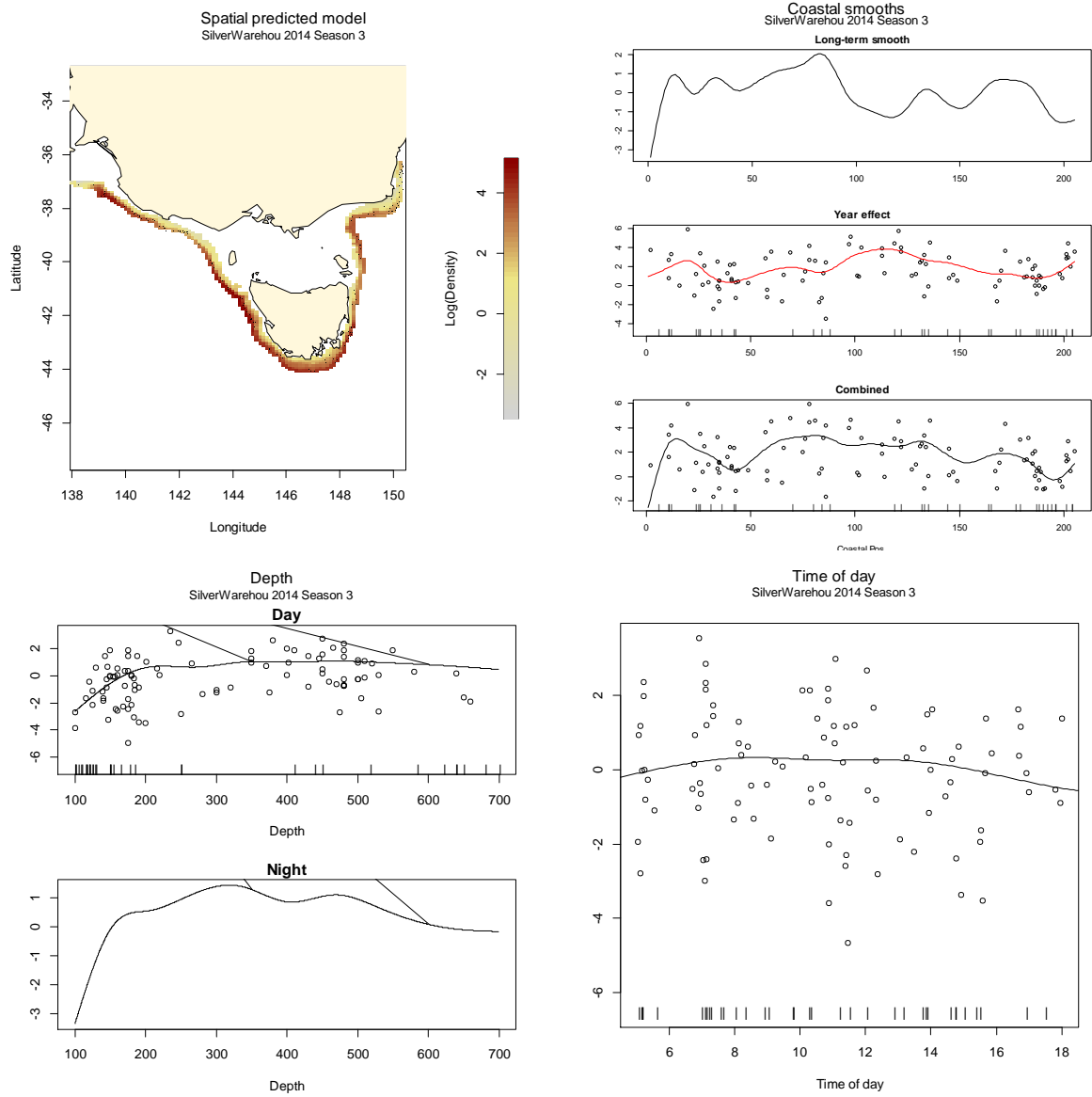


Figure 39. Winter survey model fits for Silver Warehou.

Blue Grenadier – Winter 2014

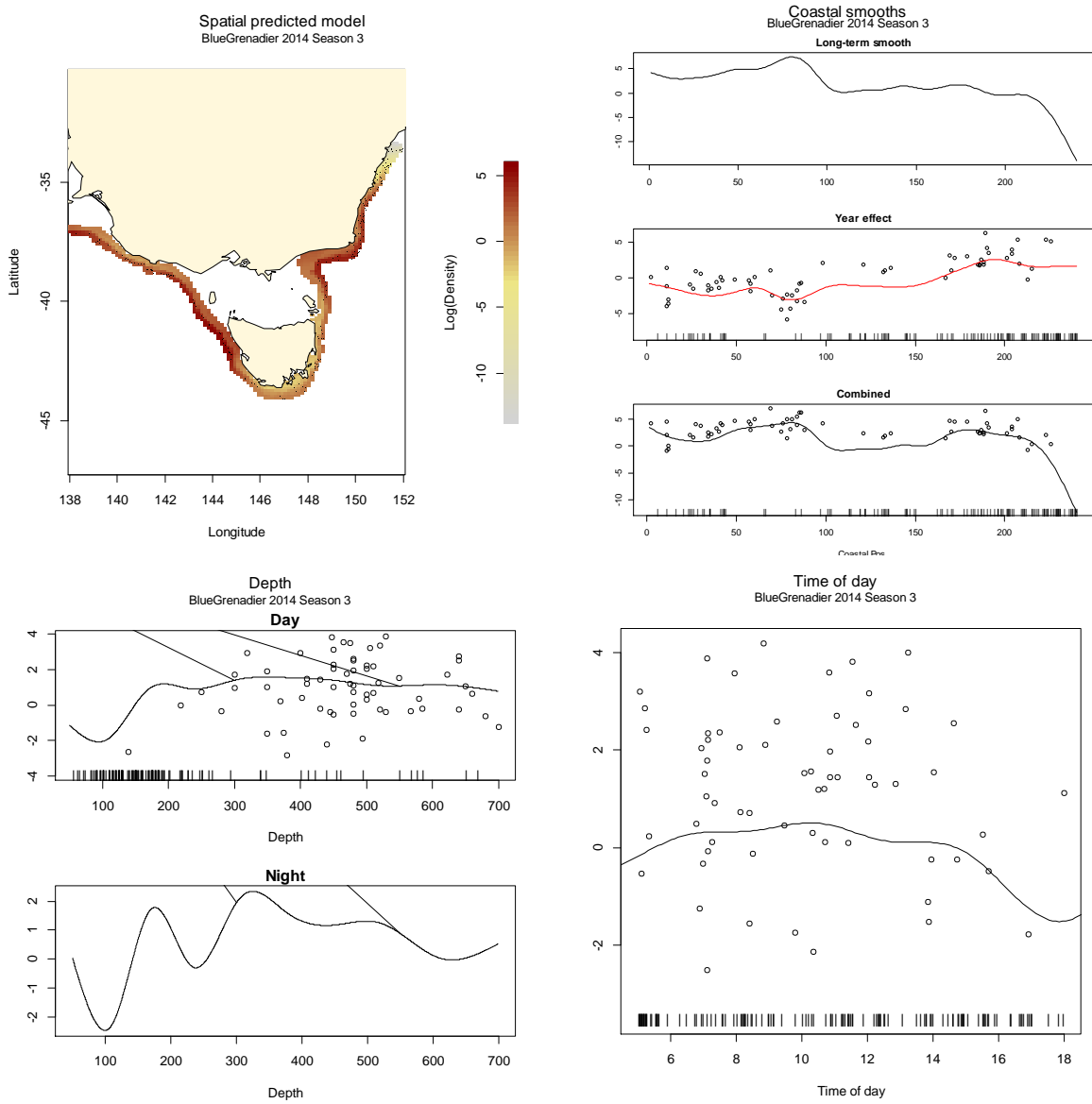


Figure 40. Winter survey model fits for Blue Grenadier.