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Tini a Tangaroa

Evaluation of the introduction of electronic reporting of catch and effort data from the inshore trawl fishery

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During 2019, the statutory reporting requirements for the inshore trawl fleet changed with the introduction of electronic reporting (ER) for the reporting of fishing activity, catches, the at-sea disposal of catches, and landed catches. This study provides a review of the catch and effort data collected from the inshore trawl fleet following the completion of the first full year of implementation of the ER regime (the 2019/20 fishing year) to evaluate the potential impact on the derivation of CPUE indices for a range of inshore finfish species.

Simple comparisons of the overall (landed) catch composition from each fishery did not reveal appreciable differences in the fisheries between the two time periods, indicating that there was no substantive change in the operation of the fisheries. However, some differences in the distributions of fishing depth and location were apparent between the two time periods. Trawl duration was also variable between the two reporting periods. However, it is likely that such differences are more related to the inter-annual variability in the operation of the inshore trawl fisheries than attributable to the change in reporting regime.

The reporting of the (estimated) weight of species catches from individual trawls was limited to a maximum of 8 species for the TCER form and five species from the TCEPR form. ER has resulted in the more comprehensive reporting of trawl catches, with up to 15–20 species reported from some trawls.

For the dominant species, there is no indication of a change in the reporting of the magnitude of (estimated) catches from individual trawls. However, the trawl catches of less important species were more frequently recorded following the introduction of ER. This change has the potential to introduce biases into the analysis of catch and effort data. The current ‘best practice’ of applying ‘two-stage’ or ‘hurdle’ models in the modelling of CPUE is likely to compensate for some of the changes in reporting, whereby changes in the indices from the positive catch model counter changes in the occurrence model. However, for lower tier species (species catch ranking 6–8) the change in reporting may significantly bias the CPUE models. These biases may be addressed, at least in part, by truncating the ER trawl-based catch data to approximate the level of catch reporting from the preceding period (i.e., limited to the top 5 or 8 species).

The new reporting regime is also likely to have improved the reporting of the legally discarded catches, particularly for the non-QMS species, as indicated by an increase in the frequency of catch reporting via Disposal reports. These changes in the reporting of catch disposals are also likely to have improved the reporting of spiny dogfish and Schedule 6 species catches. These changes in reporting will need to be considered in future analyses of catch and effort data for those species.

Currently, there are four main e-logbook systems in operation in the inshore trawl fisheries. There was no indication that catch and effort reporting differed appreciably between the platforms. A more comprehensive appraisal of the various systems would require a review the specifications, operation, and instructions for each platform, although the technical details of each system were not available for the current study. Any future developments of the ER platforms need to be fully documented to enable an assessment of potential changes in the collection of catch and effort data from the trawl fisheries.

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1. INTRODUCTION

During 2019, the statutory reporting requirements for the inshore trawl fleet changed with the introduction of electronic reporting (ER) for the reporting of fishing activity, catches, the at-sea disposal of catches, and landed catches. The vessels operating in the inshore trawl fisheries are typically less than 28 m in overall length. Prior to the introduction of the Electronic Reporting System (ERS), most of these vessels reported catch and effort data manually via the Trawl Catch and Effort Return (TCER) logbook form. The TCER form recorded the date, start location and depth, target species, trawling speed, and the start and end times of each trawl and the estimated weight of the catch of the eight (8) main species caught. At the completion of each fishing trip, the landed catch of each species (by fish stock) was reported via the Catch Landing Return (CLR) form.

A similar reporting regime operated for larger trawl vessels (typically larger than 28 m) with catch and effort data reported via the Trawl Catch Effort and Processing Return (TCEPR) logbook form. The TCEPR form collected similar information to the TCER form but was limited to reporting the estimated catches of five species per trawl (compared to 8 species from TCER).

The Fisheries (Reporting) Regulations 2017 established the requirements for commercial fishers to provide electronic reporting relating to fish catches, catches of non-fish and protected fish species, processing, disposal, and landing. The technical specifications of the 'e-logbooks' were initially defined by the *Fisheries (E-logbook Technical Specifications) Circular 2017* and refined in *Fisheries (E-logbook Technical Specifications) Circular 2018* and *Fisheries (E-logbook Technical Specifications) Circular (No. 2) 2018*. The codes to be used when completing e-logbooks, and instructions on how to complete the different types of reports, are set out in the *Fisheries (E-logbook Users Instructions and Codes) Circular*, which has likewise been revised a number of times (2017, 2018, 2018 No. 2, 2019).

A transitional period was defined for the introduction of 'e-logbooks', with vessels larger than 28 m required to use 'e-logbooks' from 1 October 2017 (*Fisheries (Reporting) Regulations 2017*, *Fisheries (Transitional Reporting) Amendment Regulations 2018*). For vessels less than 28 m, e-logbooks were introduced from May to December 2019 (as specified *Fisheries (Reporting) Amendment Regulations 2018*), with the required adoption date varying between permit holders according to individual Annual Catch Entitlement holdings.

The ERS is based around the seven reporting components: Trip Start, Fish Catch, Non Fish Protected Species (NFPS) Catch, Processing, Disposal, Landing, and Trip End. Fish Catch reports record the details of the fishing activity and the estimated species catch (Fisheries New Zealand 2019). All vessels are required to report the catch of the top 8 species caught. For vessels under 28 m there is no distinction between Quota Management System (QMS) and non-QMS species when reporting estimated catches. However, vessels over 28 metres are required to estimate catches for the top five QMS species caught and the top three non-QMS species. There is provision for fishers to report more than the top 8 species, although this is not required.

Disposal reports record any catches from a fishing event that are returned to the sea, including QMS species, non-QMS species, fish below a minimum legal size, and fish released under Schedule 6 provisions. Processing reports are generally not required by inshore trawl vessels unless fish product is frozen on board. Landing reports record the destination of the catch at the end of the trip, typically discharged to a Licensed Fish Receiver (LFR).

A number of different providers have developed e-logbook platforms to meet the technical specifications defined by Fisheries New Zealand. Within the inshore trawl fleet, most catch and effort data has been reported using one of the three main e-logbook systems available (eCatch, Olrac, and Deckhand).

For many inshore finfish species, trends in stock abundance are routinely monitored using Catch Per Unit Effort (CPUE) indices. The changes in the specifications and mechanisms for reporting of trawl catch and effort data under the ERS have the potential to alter the reporting of the main catch and effort variables and, potentially, introduce a bias in the time series of CPUE indices. This study provides a review of the catch and effort data collected from the inshore trawl fleet following the completion of the first full year of implementation of the ERS (the 2019/20 fishing year) to evaluate the potential impact on the derivation of CPUE indices for a range of inshore finfish species. The study was funded by Seafood Innovations Limited (SIL) and Fisheries Inshore New Zealand (FINZ).

An earlier study in the project implemented a period of parallel reporting by twenty vessels that were mostly active in the northern snapper (SNA 1) fishery (Middleton 2021). These vessels used the statutory paper forms alongside early adoption of ER. For trawl and bottom longline data, there were indications that electronic reporting was helpful in reducing transcription errors in event times and positions, because these were automatically captured by the reporting software. Errors in fishing duration could still arise if fishing events were not recorded as starting or ending at the correct time, and the possibility of errors in gear and target species codes also remained. There was no evidence of systematic change in the recording of fishing effort (duration, hooks) or estimated catches for trawl and bottom longline, but fishers did make use of the ability to record estimated catches of additional species using the ERS.

2. METHODS

The study encompassed catch and effort data from three spatial components of the inshore bottom trawl fleet: East Coast South Island (ECSI), West Coast South Island (WCSI), and West Coast North Island (WCNI), as defined in Table 1. All effort, catch, and landings data (all species) were extracted for individual fishing trips that landed catch from a specified set of fish stocks and conducted bottom trawl fishing (BT or PRB method codes) predominantly within the defined set of Statistical Areas. Data were extracted from the *kahawai* data repository that stores a groomed version of the Fisheries New Zealand EDW catch and effort database.

The initial data sets encompassed the 2007/08–2019/20 fishing years with 2019/20 representing the first complete fishing year following the introduction of the ERS.

Table 1: Definition of the catch and effort data sets from the three inshore trawl fisheries.

Fishery	Statistical Areas	Fish stock	Reporting type	Fishing years
ECSI	020, 022, 024	FLA 3, RCO 3	TCER, ERS	2007/08–2019/20
WCSI	033, 034, 035, 036	RCO 7, STA 7, TAR 7, WAR 7	TCER, ERS	2007/08–2019/20
WCNI	041, 042, 043, 044, 045, 046, 047	SNA 8, TRE 7	TCER, TCEPR, ERS	2007/08–2019/20

For the paper-based reporting (TCEPR and TCER forms), the corresponding estimated catches were associated with the individual trawl event records, with the individual species catches ranked based on weight (from 1 for the largest). Similarly, for the ERS trawl records, the corresponding estimated catches from the Fish Catch Reports were linked to the individual trawl event record.

For each of the three fishery groupings, the 30 main species caught were identified based on the cumulative weight of the estimated catches from the qualifying fishing trips. The qualifying species codes are defined in Appendix 2.

The data sets were further restricted to include the main vessels operating in each fishery over the last five years, including participation in the fishery during the last two fishing years (2018/19 and 2019/20).

The ER platform used by each vessel was determined based on the configuration of the (platform specific) trip keys (see Appendix 3).

Fishing effort and catch data from the 2017/18, 2018/19, and 2019/20 fishing years were summarised to compare and contrast reporting formats (TCEPR, TCER, ERS). The data sets included the last complete year of manual reporting (2017/18) and the first complete year of ERS (2019/20), and 2018/19 included data from both sources.

The catch metrics included the overall ranking of each species in the catch, the proportion of fishing events that reported the species catch, and the median catch per trawl. There was an increase in the number of species catches reported following the introduction of the ERS (from a maximum of five or eight species from the TCEPR and TCER forms, respectively). For comparative purposes, the ERS catch metrics were also derived for a data set that truncated catches at the top eight species (by weight). For each trawl fishery, the main Catch Disposals from the ERS were summarised by species and Disposal Code (see Appendix 1).

For the ECSI trawl fishery, trawl (estimated) catches and landed catches of individual species were aggregated by fishing trip. The ratio of estimated catch to landed catch was compared by reporting format.

Standardised CPUE indices may be influenced by changes in the level of catch reporting, especially for medium and lower tier species (ranking 4 to 9) (Langley 2019). The WCNI data set was used as a case study to investigate the influence of the change in species catch reporting related to the introduction of the ERS. Six species were selected with overall catch ranking of 4–6. For each species, alternative catch data sets were determined by apportioning the landed catch amongst all associated estimated catch records (all) or amongst only those estimated catches within the top five species reported (top 5). Generic GLM models of the species occurrence (binomial model) and catch magnitude (lognormal model) were configured for the entire data period (2007/08–2019/20) for the all-catch and top5-catch data sets. The trends in the binomial, lognormal, and combined CPUE indices were compared for the two alternative sets of catch data.

3. RESULTS

3.1 Data summary

For the three fisheries, the introduction of the ERS predominantly occurred during the 2018/19 fishing year and was fully implemented in 2019/20 (Figure 1). In the WCNI fishery, one vessel, presumably a larger (> 28 m) trawler, changed reporting from TCEPR format to the ERS at the start of the 2017/18 fishing year. Within each fishery area, multiple ERS platforms have been adopted by the trawl fleet. The Deckhand platform was adopted in each of the three areas, whereas the eCatch platform had a higher adoption rate in the ECSI fishery (Figure 1). This may be related to the smaller size and range of the trawl vessels operating in that fishery because the eCatch platform is reliant on communication via the cellular network.

For each trawl, fishing duration was derived from the start and end times recorded for the trawl. For the three trawl fisheries, individual vessels that conducted trawls during the year immediately prior to the introduction of the ERS (2017/18), and during the first complete year following the introduction of the ERS (2019/20), were identified. The trawl records were restricted to the main area of the operation of each fishery. For each vessel, the median fishing duration in each of the two years and the ratio of the two years were determined for the individual vessels.

The within-vessel comparison minimises the potential influence of changes in the composition of the fleet between years. However, the sample size of qualifying vessels is relatively small in each fishery (WCNI 6 vessels, WCSI 6 vessels, and ECSI 14 vessels). For each fishery, the median fishing duration for an individual vessel varied between the two years by about ± 20% (Figure 2). There was no indication of a systematic change in the median trawl duration associated with the introduction of the ERS.

The reporting of the (estimated) weight of species catches from individual trawls was limited to a maximum of 8 species for the TCER form and five species from the TCEPR form. The number of reported species catches increased considerably with the introduction of the ERS (Figure 3). The four ERS platforms have the facility to report catches for at least 10 species per trawl. Vessels utilising the Deckhand and Cedric platforms typically reported more species catches relative to those vessels using the Olrac and eCatch platforms. However, the number of species reported also varied between the three fishery areas. This may be a function of the operation of the individual vessels participating in each fishery and/or relate to the species diversity in the catches from each area.

For each fishery, the 30 top species were identified based on the cumulative estimated catches from the data set. The rank of the estimated catch by weight was determined for each trawl within the 2017/18–2019/20 fishing years (ascending order, i.e., largest catch assigned rank 1). During the period, the median (and inter-quartile range) of the species catch ranking was determined by reporting type. For comparative purposes, the ERS data were also truncated to only include the ranking of the catches of the top 8 species (to compare with the TCER data). For the same data set, the proportion of trawls with no reported catch of the species was determined and the median (non-zero) estimated catch was also determined.

For the lowest ranked species (i.e., median rank 1–3), the median rankings of the species catches were similar between reporting types (Figure 4). For the other species, the overall ranks were higher from ER due to the larger number of species typically reported from each trawl. The truncation of ER data, to include only the top 8 species catches, yielded species rankings that were generally closely aligned to the TCER data set. For the WCNI data set, the TCEPR records included a smaller number of species overall and the individual species rankings were generally lower, probably due to the lower number of species reported (top 5 rather than top 8 species) (Figure 4).

Similarly, the species occurrence in the (estimated) catch records was broadly similar between the reporting formats (Figure 5). The notable exception was the lower rates of reporting for a range of species in the TCEPR format from the WCNI fishery. Truncating the ERS catch data (top 8 catches only) resulted in a relatively small increase in the proportion of zero catch records for most species, more closely approximating the proportion of zero catches reported via the TCER format (Figure 5).

In general, the median (non-zero, estimated) species catch per trawl was comparable between the reporting formats (Figure 6). Truncating the ERS catches (top 8 species) resulted in a small increase in the median catches due to the exclusion of the smallest catches. For some species, this reduced the difference between the TCER and ERS catches although there is considerable variation in the catches for the most abundant species (Figure 6). Differences in the magnitude of catches between TCEPR and TCER formats will also incorporate vessel specific differences in species catch rates.

In the ECSI trawl fishery, there was a decrease in the reporting of zero catches of the generic flatfish (FLA) species group with the introduction of the ERS (Figure 5). This corresponded to an increase in the zero catches of the individual flatfish species, indicating that a number of vessels were no longer reporting species-specific catches following the introduction of the ERS.

The introduction of the ERS has facilitated the reporting of fish disposals from individual fishing events (Disposal Report). Fish disposals are defined as fish that are returned to the water, eaten, or used for bait. A range of disposal codes have been defined to account for the various types of disposal (Appendix 1). For the WCNI trawl fishery, ERS disposals were recorded for a wide range of non-QMS species (disposal code D), spiny dogfish (M), and fish species listed in Schedule 6 of the Fisheries Act (1996) (Figure 7). Spiny dogfish also dominated the disposals from the WCSI and ECSI trawl fisheries, and a smaller range of non QMS species was also reported (Figure 7).

For the ECSI fishery, the species estimated catches were compared with the landed catches (and main disposals D and M) aggregated for each fishing trip (Figure 8). For many of the finfish species, there was consistency with the magnitude of the catch reported from both sources; for example, BAR, ELE, FLA, GUR, RCO, and TAR. However, for a range of species the estimated catches were considerably less than the landed catch, notably LIN, RSK, SCH, SPD, SSK, and STA. The latter group of species is typically processed at-sea prior to landing. The ratio of the estimated/landed catch tends to approximate the inverse of the conversion factor for the dominant processed state of the species, indicating that the estimated catches are being reported as processed weights rather than greenweight (Figure 8).

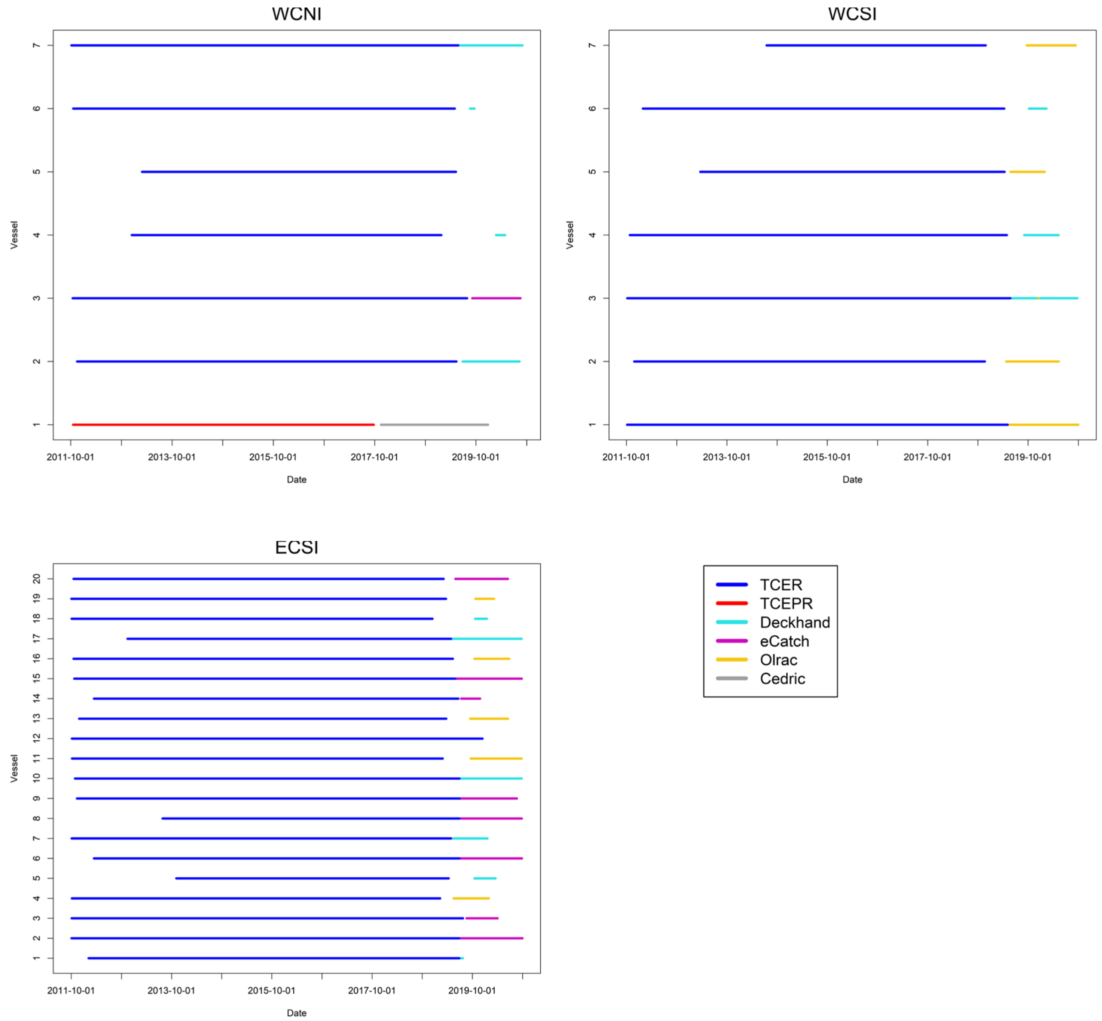

Figure 1: Reporting format by time period for the main vessels operating in each fishery.

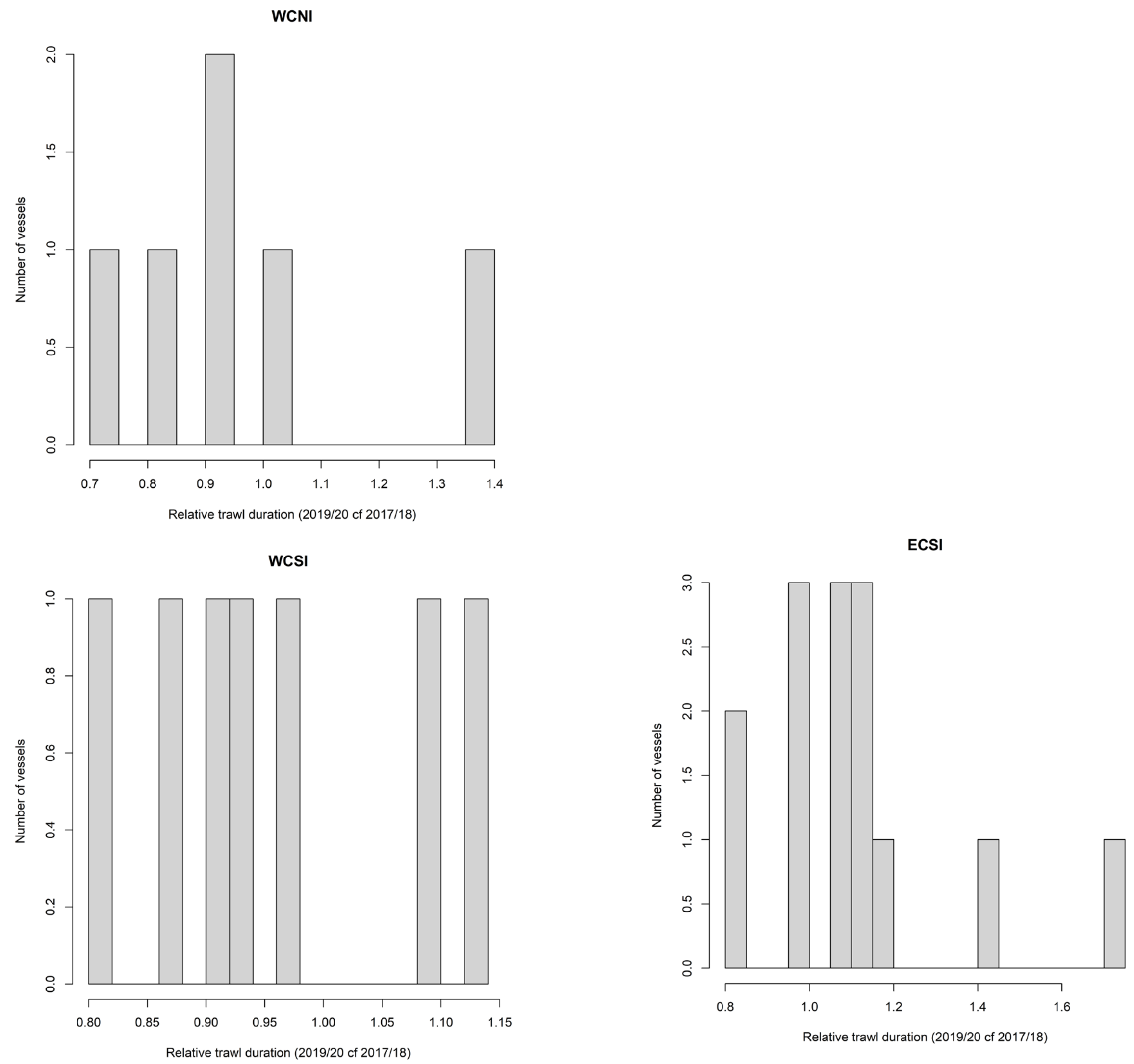

Figure 2: Ratios of the median trawl duration for individual vessels in 2019/20 (ERS) compared with 2017/18 (pre ERS) for the main vessels in each fishery.

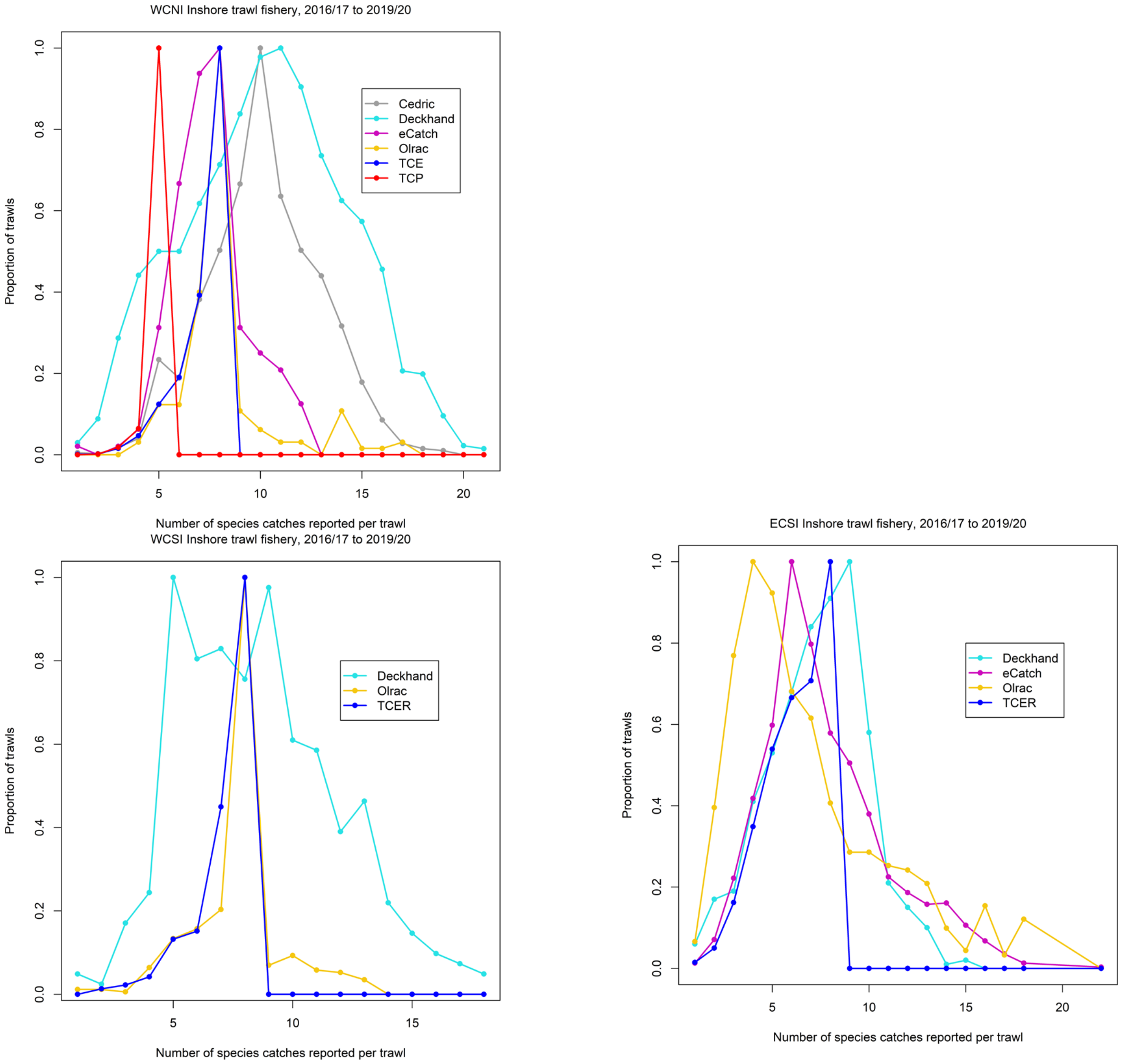

Figure 3: Proportional distributions of the number of species catches reported by trawl for each reporting type and ER platform by fishery (panels).

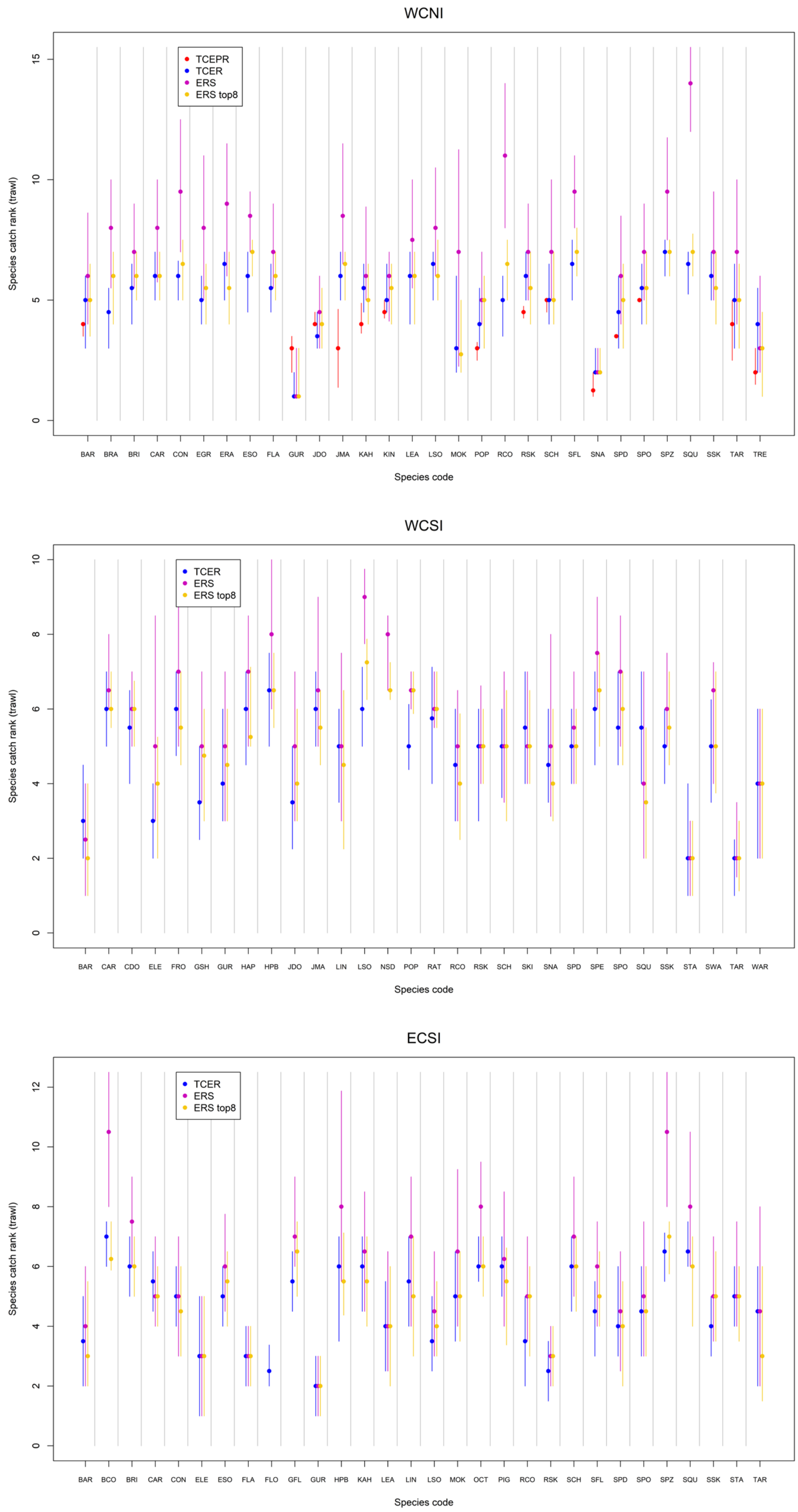

Figure 4: Median and inter-quartile range of the rank of each species (30 main species) in the reported catches by form type from 2017/18 to 2019/20, by fishery.

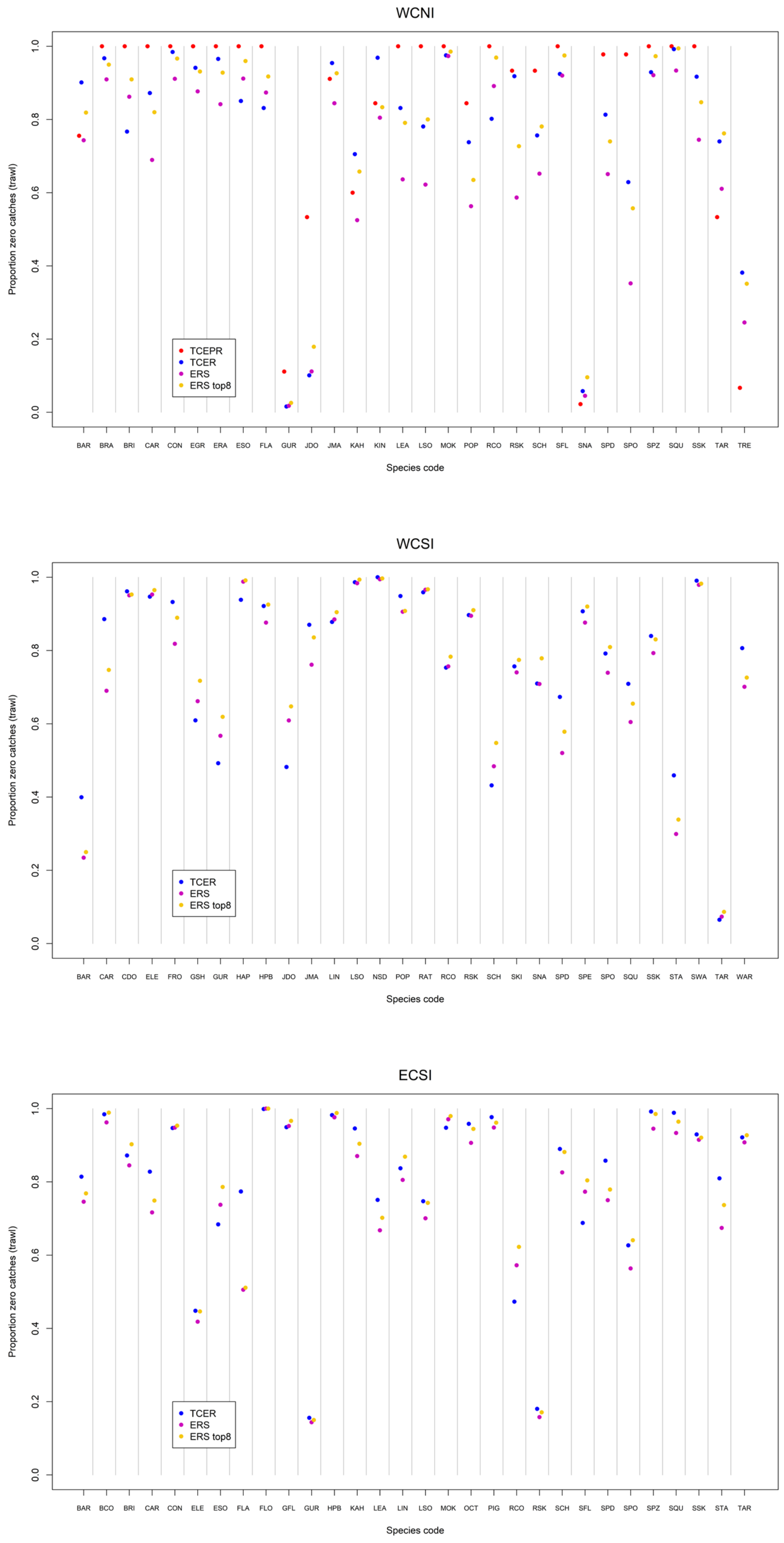

Figure 5: Proportion of zero catches of each species (30 main species) in the trawl data set by form type from 2017/18 to 2019/20, by fishery.

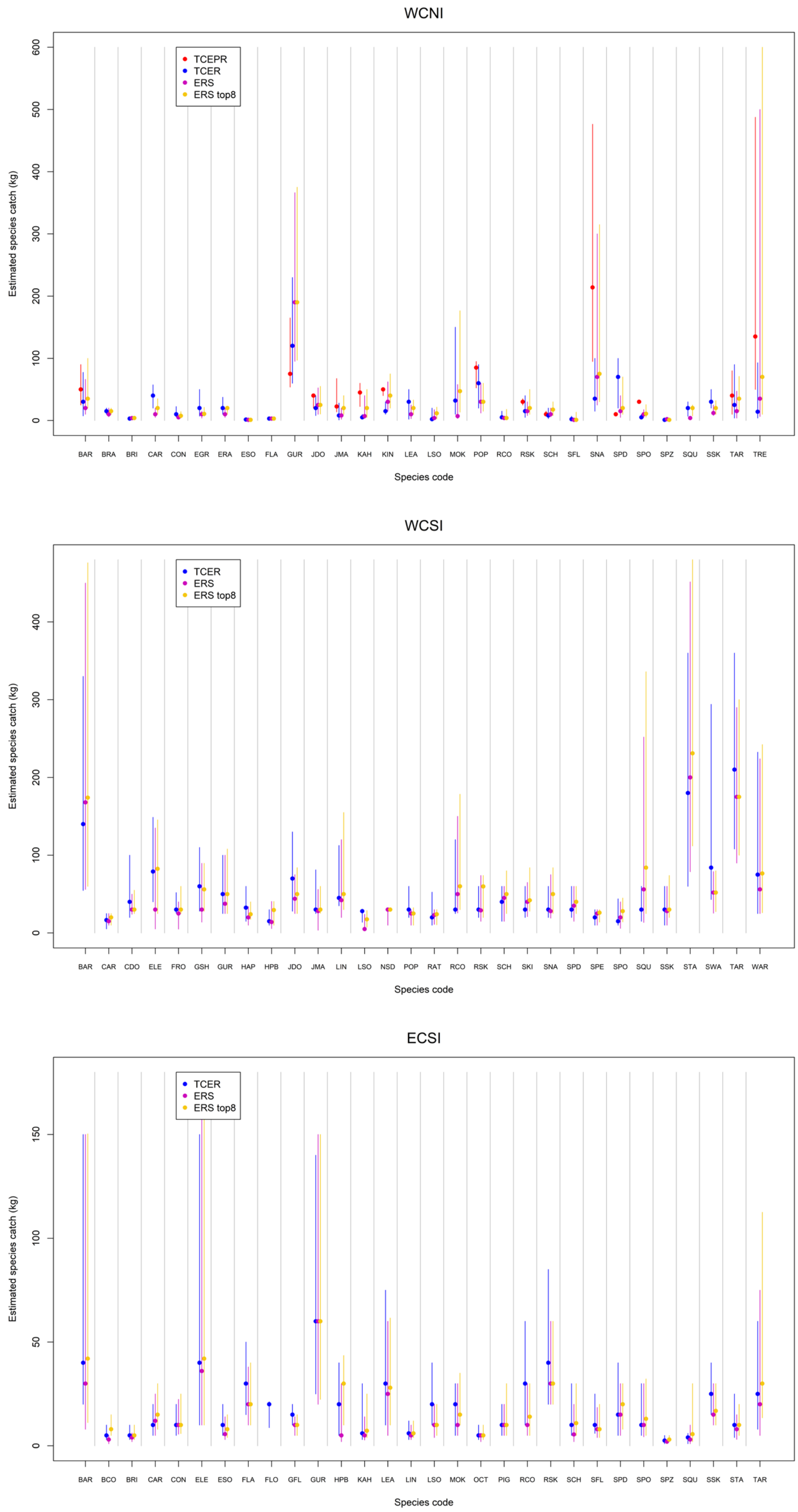

Figure 6: Median and inter-quartile range of the estimated catch (kg) of each species (30 main species) by form type from 2017/18 to 2019/20, by fishery.

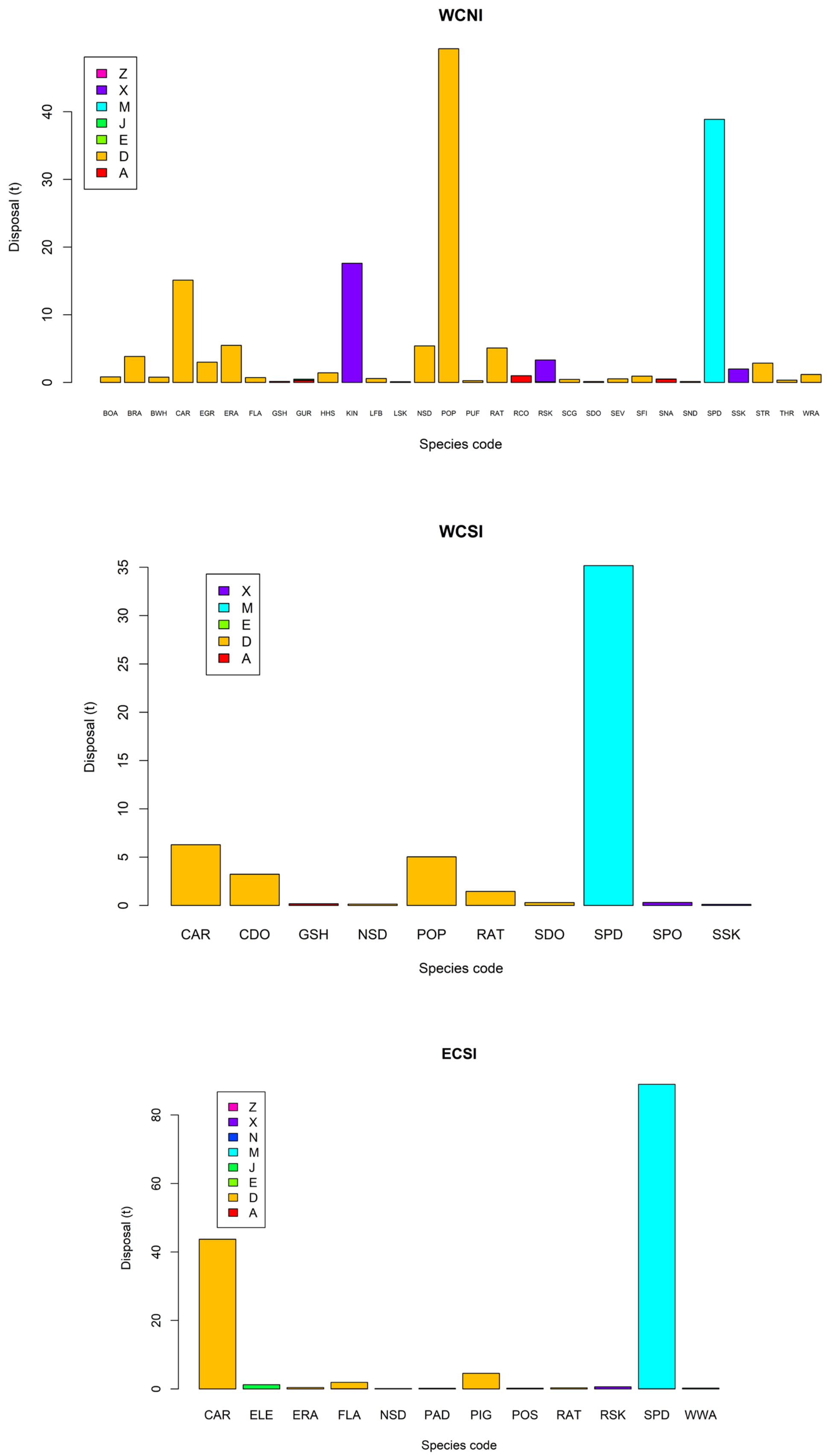

Figure 7: A summary of the ER catch disposals by species and Disposal Code (see Appendix 1) from the 2018/19 and 2019/20 fishing years, by fishery.

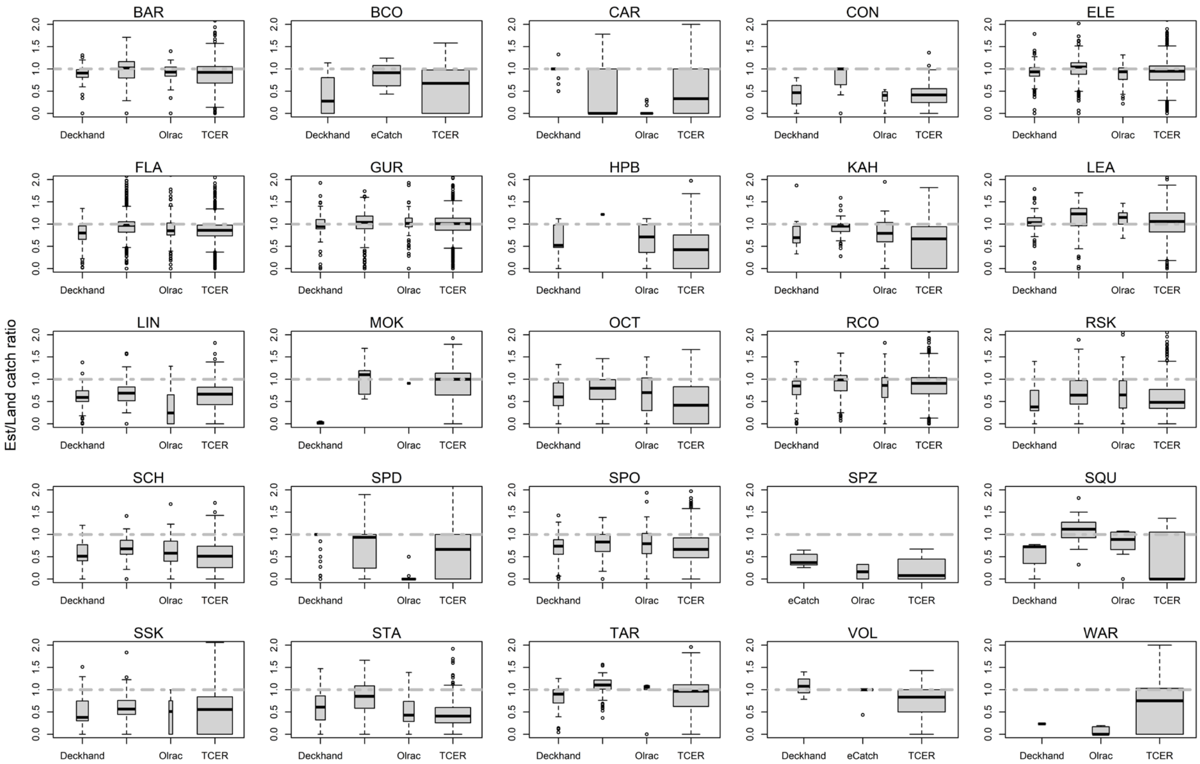

Figure 8: Boxplots of the ratio of estimated and landed catches (aggregated by trip) of individual species by ER platform (Deckhand, eCatch, Olrac) and TCER form from the ECSI trawl fishery from 2016/17 to 2019/20.

3.2 CPUE analyses

The potential impact of changes in catch reporting associated with the introduction of the ERS were investigated for a range of second tier species caught in the WCNI trawl fishery. The selected species (GUR, BAR, JDO, SPO, LEA, and RSK) were typically reported amongst the 4–6th ranked species in the (estimated) catch from individual trawls. Hence, the reporting of these species was likely to be influenced by the change in the level of reporting from TCEPR (5 species) or TCER (8 species) to ERS reporting (up to 15–20 species).

For each species, catch and effort data sets were configured encompassing all trawl records from 2007/08 to 2019/20. For each trip, the landed catch of the relevant species was allocated amongst individual trawl events based on two different criteria: 1) allocated in proportion to all the estimated catches of the species and 2) allocated amongst the estimated catches from trawls where the species occurred within the 5 main species caught. The second approach was intended to represent the minimum level of catch reporting based on the TCEPR format.

For each species, separate CPUE analyses were conducted utilising the two different catch configurations. Generic GLM models were configured to predict the magnitude of the (non-zero) catches (lognormal model) and the occurrence of the species (binomial model). All models included the same set of explanatory variables: fishing year (categoric), fishing vessel, fishing duration, depth, trawl speed, latitude, month (categoric), and target species (categoric). Annual indices were derived from the lognormal model, and binomial models and combined (delta-lognormal) indices were also derived.

In general, for each species the CPUE indices derived from the two catch data sets (all-catch, top-5) are very similar for the years prior to 2017/18 (i.e., prior to the introduction of the ERS) (Figure 9). In the subsequent years, the lognormal indices and binomial indices from the all-catch CPUE models deviated from the top-5 catch models, whereas the combined models were generally comparable for the two catch options. The differences between the corresponding sets of indices are related to the inclusion of additional smaller catches from 2017/18 onwards (ERS data). The effect of the truncation of the smaller catches was variable between species. Excluding a relatively small proportion of the estimated catches will increase the magnitude of the positive catch records because the landed catch is apportioned over a smaller number of records (resulting in an increase in the lognormal indices), and the corresponding decrease in the proportion of positive catch records results in a decrease in the binomial indices (e.g., JDO) (Figure 9). However, when the truncation of the catches results in the removal of all the estimated catch records from a trip, the landed catch is apportioned equally amongst all trawl records, resulting in a higher proportion of positive catch records (binomial indices increase) although the resulting allocated catches are small (lognormal indices decrease) (e.g., LEA) (Figure 9).

For example, the catches of leatherjack (LEA) were infrequently reported as estimated catches prior to 2017/18 and consequently a high proportion of the positive catch records were generated via the allocation of landed catches equally amongst the individual trawls from a fishing trip (Figure 10). However, from 2017/18 the increased species catch reporting resulted in more trawl (estimated) catches being reported and, hence, the landed catch was apportioned amongst fewer trawl records (higher positive catch, lower catch occurrence). The change in species reporting was sufficient to substantially reduce the binomial indices in the latter period to the extent that the smaller increase in the lognormal index did not fully compensate the combined indices (Figure 9). Hence, the change in the reporting regime is likely to directly influence the combined CPUE indices for leatherjacket, whereas the combined CPUE indices for the other species were more similar between the two data sets.

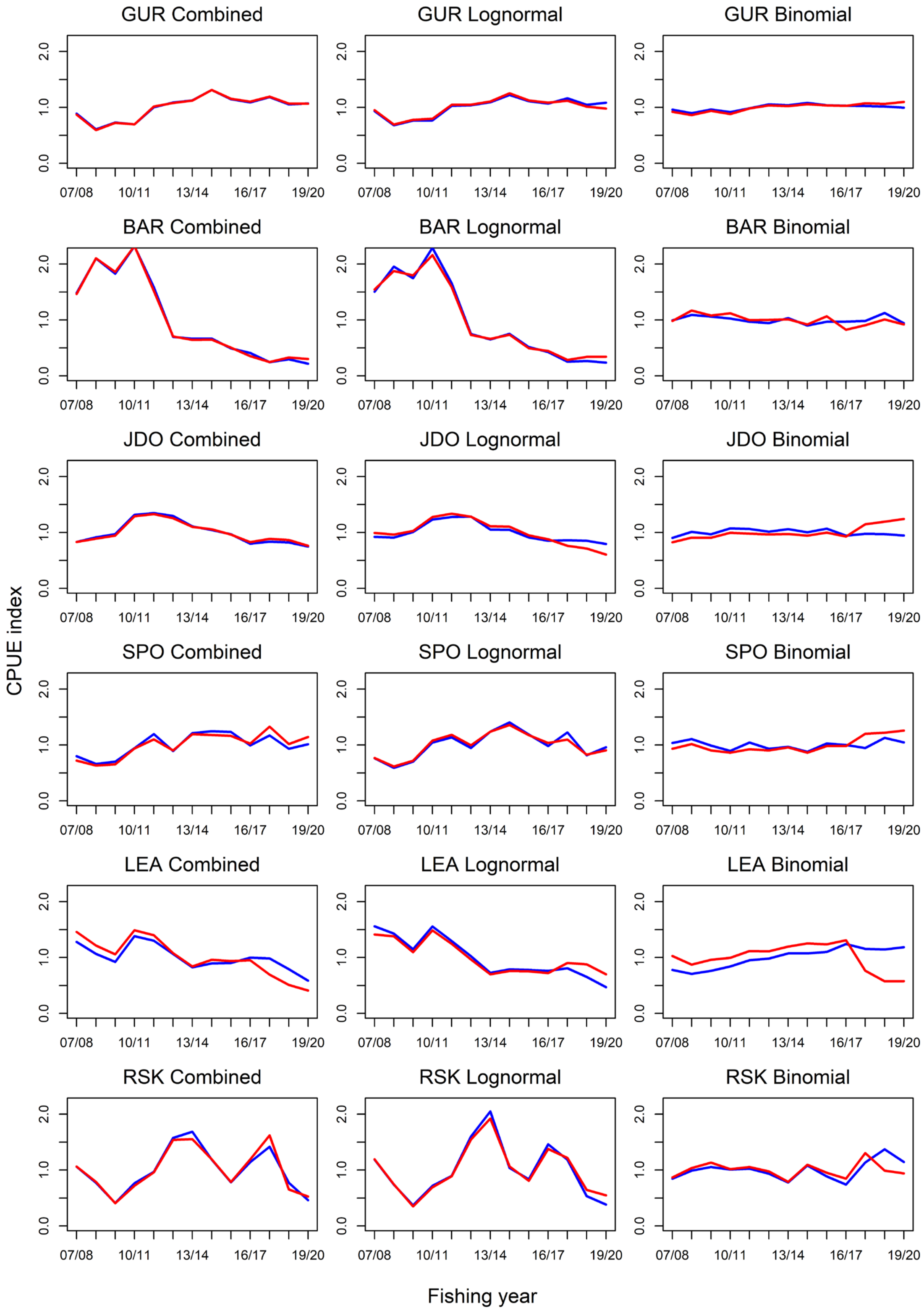

Figure 9: Combined, lognormal, and binomial CPUE indices derived for individual species based of CPUE data sets configured from all species (estimated) catches (red line) and top 5 species (estimated) catches (blue line) from a range of second tier species caught from the WCNI trawl fishery.

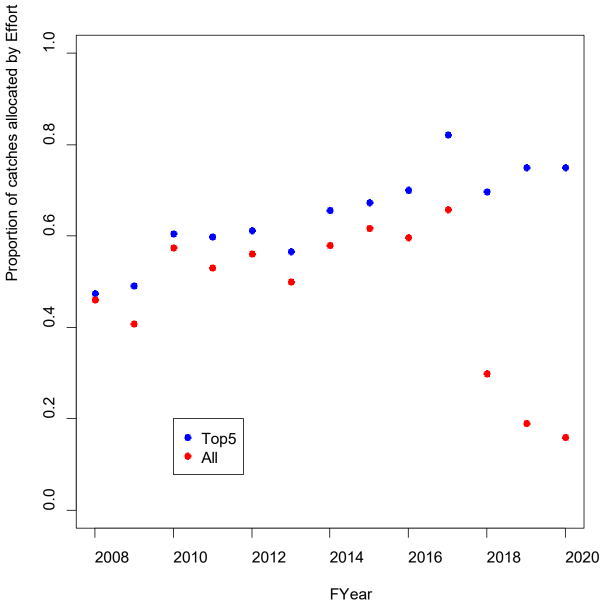

Figure 10: Proportion of the positive leatherjacket (LEA) catch records generated by the allocation of landed catch amongst all fishing effort records from a trip (rather than via allocation based on estimated catches) in the WCNI CPUE data sets derived from all estimated catches or the top 5 estimated catches.

4. DISCUSSION

For the inshore trawl fisheries, the transition from paper-based reporting to ER occurred over a short time period (during May to December 2019) and, hence, there was limited opportunity to directly compare patterns in reporting from the two systems. A small trial was carried out where vessels (primarily in the SNA 1 fishery) reported effort on both the paper and ER systems for one to three months prior to their change in statutory reporting regime. This trial noted the increased number of species reported in estimated catches via ERS but did not reveal any appreciable differences in the quantum of catch or effort (Middleton 2021).

The current study relied on comparing and contrasting the catch and effort reporting between the year immediately prior to the introduction of ER (2017/18) with the first full year of ER data (from 2019/20). The presumption is that there was no appreciable change in the operation of each of the fisheries during the two periods. Simple comparisons of the overall (landed) catch composition from each fishery did not reveal appreciable differences in the fisheries between the two time periods, indicating that there was no substantive change in the operation of the fisheries. However, some differences in the distributions of fishing depth and location were apparent between the two time periods. It is likely that such differences are more related to the inter-annual variability in the operation of the fisheries rather than attributable to the change in reporting regime.

For the inshore trawl fisheries, a key effort metric is the duration and (correspondingly) the distance trawled. The TCER format reported the trawl start location (lat/long) and the start and end time for the trawl requiring trawl duration and distance to be imputed from the start/end time and trawl speed. Hence, comparisons with the ER data were essentially limited to comparing the trawl duration for individual vessels. While trawl duration was relatively variable between the two reporting periods, there was no indication of a systematic change in trawl duration associated with the introduction of ER.

ER has resulted in more comprehensive reporting of the catches from individual trawls. For the dominant species, there is no indication of a change in the reporting of the magnitude of (estimated) catches from individual trawls. However, the trawl catches of less important species were more frequently recorded following the introduction of ER. This change has the potential to introduce biases into the analysis of catch and effort data. The current ‘best practice’ of applying ‘two-stage’ or ‘hurdle’ models in the modelling of CPUE (Langley 2019) is likely to compensate for some of the changes in reporting, whereby changes in the indices from the positive catch model counter changes in the occurrence model. However, for lower tier species (species catch ranking 6–8) the change in reporting may significantly bias the CPUE models. These biases may be addressed, at least in part, by truncating the ER trawl-based catch data to approximate the level of catch reporting from the preceding period (i.e., limited to the top 5 or 8 species).

The new reporting regime is also likely to have improved the reporting of the legally discarded catches, particularly for non-QMS species, as indicated by an increase in the frequency of catch reporting via Disposal reports. These changes in the reporting of catch disposals are also likely to have improved the reporting of spiny dogfish and Schedule 6 species catches. These changes in reporting will need to be considered in future analyses of catch and effort data for those species.

Currently, there are four main e-logbook systems in operation in the inshore trawl fisheries. There was no indication that catch and effort reporting differed appreciably between the platforms, although there are no direct comparisons available and the variability amongst the operation of individual vessels is likely to exceed any differences in reporting between the platforms. A more comprehensive appraisal of the various systems would require a review the specifications, operation, and instructions for each platform, although the technical details of each system were not available for the current study. Some deficiencies are apparent in the existing versions of the ER platforms, specifically the reporting of generic flatfish catch (rather than by individual species) and the reporting of processed catch weights rather than greenweights for some species. Any future developments of the ER platforms need to be fully documented to enable an assessment of potential changes in the collection of catch and effort data from the trawl fisheries.

5. ACKNOWLEDGEMENTS

The study was funded by Seafood Innovations Ltd (SIL) and Fisheries Inshore New Zealand (FINZ) and coordinated by Oliver Wilson. Fisheries New Zealand provided the catch and effort data sets via the kahawai data portal. The results of the study were reviewed by the Stock Assessment Methods Working Group.

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APPENDIX 1: DISPOSAL CODES

Disposal Codes from Fisheries (E-logbook Users Instructions and Codes) Circular 2019.

Part 5: Disposal codes

Disposal type	Disposal code	Required to be recorded on Monthly Harvest Return?
Fish or fish product used for human consumption on board a vessel	E	Yes
Fish or fish product of a stock managed under the QMS that are abandoned in the sea, or accidentally lost at sea, except for fish or fish product to which another disposal code applies	A	Yes
Loss of fish or fish product from a holding container in the water (e.g. through theft, mortality, escape, or damage to fish product)	HW	Yes
Fish or fish product taken or used for bait during the period of a trip	U	Yes
Spiny dogfish that are returned to the water	M	Yes
Blue shark (*Prionace glauca*), mako shark (*Isurus oxyrinchus*) or porbeagle shark (*Lamna nasus*) that are returned to the water dead or near-dead in accordance with the requirements set out for those species in Schedule 6 of the Act	Z	Yes
Fish or fish products of a stock subject to the QMS that are returned to, or abandoned in, the sea in accordance with the requirements set out in section 72(5)(c)(i) to (iii) of the Act	J	Yes
Fish or fish product of a stock not managed under the QMS that are returned to the sea, abandoned in the sea, or accidentally lost at sea	D	No
Fish or fish product placed in a holding receptacle in New Zealand fisheries waters	P	No
Fish of stocks subject to the QMS that are— (a) listed in Schedule 6 of the Act; and (b) not spiny dogfish; and (c) not blue shark, mako shark or porbeagle shark that are returned to the water dead or near-dead; and (d) not rock lobster that must be returned to the sea; and (e) returned to the water in accordance with the requirements set out for the relevant species or class of fish in Schedule 6 of the Act	X	No
Fish below a minimum legal size, width or weight	Y	No
Fish above a maximum legal size, width or weight	G	No
Rock lobster that is alive and must be returned to the sea (excludes rock lobster below a minimum legal size)	K	No
Fish or fish product removed from holding receptacle in New Zealand fisheries waters	N	No

APPENDIX 2: SPECIES CODES

Species codes used in the report.

Species code	Species common name	Scientific name
BAR	Barracouta	*Thyrsites atun*
BCO	Blue cod	*Parapercis colias*
BRA	Short-tailed black ray	*Dasyatis brevicaudata*
BRI	Brill	*Colistium guntheri*
CAR	Carpet shark	*Cephaloscyllium isabellum*
CDO	Capro dory	*Capromimus abbreviatus*
CON	Conger eel	*Conger* spp.
EGR	Eagle ray	*Myliobatis tenuicaudatus*
ELE	Elephantfish	*Callorhinchus milii*
ERA	Electric ray	*Torpedo fairchildi*
ESO	NZ sole	*Peltorhamphus novaezeelandiae*
FLA	Flatfish	Species grouping
FLO	Flounder	
FRO	Frostfish	*Lepidopus caudatus*
GFL	Greenback flounder	*Rhombosolea tapirina*
GSH	Dark ghost shark	*Hydrolagus novaezealandiae*
GUR	Red gurnard	*Chelidonichthys kumu*
HAP	Hapuku	*Polyprion oxygeneios*
HPB	Hapuku/Bass	*Polyprion* spp.
JDO	John dory	*Zeus faber*
JMA	Jack mackerel	*Trachurus* spp.
KAH	Kahawai	*Arripis trutta*
KIN	Kingfish	*Seriola lalandi*
LEA	Leatherjacket	*Parika scaber*
LIN	Ling	*Genypterus blacodes*
LSO	Lemon sole	*Pelotretis flavilatus*
MOK	Blue moki	*Latridopsis ciliaris*
NSD	Northern spiny dogfish	*Squalus griffini*
OCT	Octopus	*Pinnoctopus cordiformis*
PIG	Pigfish	*Congiopodus leucopaecilus*
POP	Porcupine fish	*Tragulichthys jaculiferus*
RAT	Rattails	*Macrouridae*
RCO	Red cod	*Pseudophycis bachus*
RSK	Rough skate	*Dipturus nasutus*
SCH	School shark	*Galeorhinus galeus*
SKI	Gemfish	*Rexea solandri*
SFL	Sand flounder	*Rhombosolea plebeia*
SNA	Snapper	*Chyrsophrys auratus*
SPD	Spiny dogfish	*Squalus acanthias*
SPE	Sea perch	*Helicolenus spp*
SPO	Rig	*Mustelus lenticulatus*
SPZ	Spotted stargazer	*Genyagnus monopterygius*
SQU	Squid	*Nototodarus gouldi, N. sloanii*
SSK	Smooth skate	*Dipturus innominatus*
STA	Giant stargazer	*Kathetostoma* spp
SWA	Silver warehou	*Seriolella punctata*
TAR	Tarakihi	*Nemadactylus macropterus*
TRE	Trevally	*Pseudocaranx dentex*
WAR	Blue warehou	*Seriolella brama*

APPENDIX 3: IDENTIFICATION OF ER SOFTWARE

Information on the ER reporting platform used to submit a particular record is now available from the Fisheries New Zealand Enterprise Data Warehouse. However, this was not available when the ER regime was first introduced and, for this study, the ER platform was inferred from the format of the trip identifier.

The Fisheries (E-logbook Technical Specifications) Circular (No.2) 2018 specified that Event IDs must be unique and in the form of a 36-character string representing the hexadecimal form of a 128-bit integer (globally unique identifiers, GUIDs; e.g., 2226a625-af1c-4a94-a103-42514028684d). However, the specifications for the Trip ID were less prescriptive; trip identifiers were specified as strings that must be unique for the given vessel and client numbers. In practice, different e-logbook providers were found to have taken different approaches to meeting the requirement around Trip IDs.

Integer Trip IDs of length 6 were associated with the use of the Windows-based CEDRIC platform (https://www.fishserve.co.nz/information/cedric). CEDRIC was originally designed to support voluntary electronic reporting under the ‘paper’ form regime of the 2001 reporting regulations but was updated to support the requirements of the 2017 regulations for trawling, purse seining and bottom longlining. In particular, it was the only ER platform available for the early adoption of ER for trawling by vessels over 28 m from 1 October 2017.

Deckhand (https://deckhand.nz) typically produced Trip IDs of 40 characters, comprising a GUID prefixed with the string ’rtd-’. The prefix is assumed to be related to the fact that the iPad-based Deckhand platform was originally developed by Australian company Real Time Data, before being adapted for ER in New Zealand in partnership with FishServe Innovations New Zealand (FINNZ).

The Trip IDs from eCatch (https://ecatch.co.nz/), which runs on iOS or Android smartphones or tablets, are 36-character GUIDs, i.e. the same format as event IDs. The Windows based Olrac (https://marine.olsps.com/fisheries-electronic-logbook-solutions/) platform, distributed by Electronic Navigation Limited, produces 15-character Trip IDs.

The ER platform used was therefore inferred using the following SQL code:

```
CASE WHEN CHAR_LENGTH(TRIM(trip_id)) = 6 THEN 'CEDRIC'
     WHEN CHAR_LENGTH(TRIM(trip_id)) = 7 AND TRIM(trip_id) ~ '^[0-9]{6}' THEN 'CEDRIC'
     WHEN CHAR_LENGTH(TRIM(trip_id)) = 15 THEN 'Olrac'
     WHEN CHAR_LENGTH(TRIM(trip_id)) = 36 THEN 'eCatch'
     WHEN CHAR_LENGTH(TRIM(trip_id)) > 36 AND POSITION ('rtd-' IN trip_id) > 0 THEN 'Deckhand'
     ELSE 'Unknown'
END AS er_software
```