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Further Results of Comparative Fishing Between the Canadian Coast Guard Ship (CGSS) *Teleost* and CCGS *Capt Jacques Cartier*/*John Cabot* in the Newfoundland and Labrador Region in Fall, with a Focus on Deep Water Species

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

Comparative fishing has been ongoing since 2021 in the Newfoundland and Labrador Region as the multispecies survey transitions to new vessels, the Canadian Coast Guard Ship (CCGS) *Capt Jacques Cartier* and CCGS *John Cabot*. Analysis of this program was considered across two CSAS peer review meetings. Here we present results from Part II as they relate to the fall survey. Data collected in 2023, when added to previously collected data from 2021–22, were sufficient to estimate an additional seven deep water taxa conversions for the CCGS *Teleost* fall time series. Sixteen deep water taxa were determined to require no conversion. Additionally, following the recommendations from Part I, several taxa groupings were modified and reassessed for both the CCGS *Teleost* and CCGS *Alfred Needler*. Based on these regroupings, an additional eight conversion factors were determined for the CCGS *Teleost* and nine for the CCGS *Alfred Needler*.

1. INTRODUCTION

The Newfoundland and Labrador (NL) fall multispecies survey covers Northwest Atlantic Fisheries Organization (NAFO) Divisions 2HJ3KLNO (Figure 1), extending from the Labrador Shelf in the North to the Grand Bank in the South. Data from these surveys inform stock assessment and fisheries management, ecosystem assessments, species at risk (SAR), marine conservation monitoring, and a variety of research programs. Since the mid-1990s, this survey has been conducted using the Canadian Coast Guard Ship (CCGS) *Teleost* (generally for Divisions 2HJ3K + 3L strata ≥750 m) and CCGS *Alfred Needler* (for Divisions. 3KLNO), hereafter referred to as the "*Teleost*" (TEL) and "*Needler*" (AN).

The *Teleost* and *Needler* are now being replaced with the CCGS *Capt Jacques Cartier* and the CCGS *John Cabot*, hereafter referred to as the "*Cartier* (CAR)" and "*Cabot* (CAB)", or collectively referred to as "CAX". Comparative fishing between the old and new vessels was undertaken to ensure that data collected from these new vessels is comparable to that from the old vessels and can be used to extend the existing survey data time series. This involves fishing old and new vessels side by side to quantify differences in catch size and composition (by species, size, etc.). A portion of results from the fall comparative fishing program are provided in Trueman et al. (2025). Here we continue analyses following the recommendations of DFO (2024). This includes the fall 2023 comparative fishing analysis for deep water species with the *Teleost*, as well as a re-evaluation of species groupings for the *Needler* and the *Teleost*.

2. METHODS

2.1. COMPARATIVE FISHING PROGRAM

Comparative fishing methods are detailed in Trueman et al. (2025), Wheeland et al. (2024) and DFO (2024). In fall 2023, additional comparative fishing was completed between the *Teleost* and *Cabot* to fill in data gaps in deep water tows (>1000 m), and shallow water coverage for Snow Crab (Wheeland et al. in prep[1]). A shadow survey approach was used for the deep water sets in NAFO Divisions 2J (n = 28) and 3L (n = 14), meaning paired tows were completed at regular survey stations chosen according to the stratified random design. In NAFO Division 3K, targeted shallow water comparative sets were carried out (n = 22) at set locations chosen based on known distribution of small Snow Crab and in strata <250 m.

At each station, the vessels within a pair fished as close together in space and time as operationally feasible. Most sets were completed side by side (69% of paired tows in fall 2023), with vessels instructed to tow at the same time, 0.5 nautical miles (nm) apart, and complete parallel tows. If the amount of fishable bottom was limited (e.g., steep slope), then one of two alternative approaches was conducted:

1. vessels could complete a "single file/follow the leader" tow, where both vessels tow at the same time with the trawl path of the rear vessel not overlapping that of the vessel in front (23%);

[1] Wheeland, L., Trueman, S., Pantin, J., Baker, K., and Mullowney, D. In prep. On the Relative Catchability of Snow Crab in the Newfoundland and Labrador Multispecies Trawl Surveys. DFO Can. Sci. Advis. Sec. Res. Doc.

2. if both a side by side or single file tow could not be completed safely, a “one then the other” tow was carried out where one vessel completed a tow first, and the second vessel would immediately fish along the same ground, attempting to avoid the exact line of the previous vessel (8%).

The proportion of sets that could not fish side by side was higher in this season than was previously completed in the NL comparative fishing program. This was due to sampling in this study being largely focused on the shelf edge where the steep depth contours result in very narrow survey strata.

Distance between tows within a pair ranged from 0.11 to 1.31 nm, but was 0.56 ± 0.27 nm on average, with larger distance discrepancies for single file tows than other tow types. Depth difference within a pair averaged 16.69 ± 1.34 m (0–61 m range). To ensure paired tows were being conducted properly, tows were evaluated for difference in time, distance, and depth between the vessels as per the methods outlined in Wheeland et al. (2024). Nine sets were identified as being out of range for original set check parameters, however following further review, all sets were found to be sufficient for paired comparisons as per the guidelines established in Wheeland et al. (2024) and were included in the analysis.

2.1.1. Gear Performance and Geometry

Trawl mensuration data from the *Teleost* and *Cabot* were evaluated previously for comparative sets in 2021 and 2022 (DFO 2024), showing similar trawl performance and geometry (measured using a Scanmar system). However, these years did not include comparative fishing at depths >750 m, therefore additional comparisons were completed here for deep sets completed in fall 2023. During the 2023 fall comparative fishing, a total of 42 successful paired sets were completed by the *Teleost* and *Cabot* for depths >750 m of which 41 paired sets with complete logged Scanmar data were included in the analysis.

A large disagreement between the conductivity, temperature, depth (CTD) instrument measurement of depth versus the Scanmar measured depth flagged a data quality control issue resulting in two paired sets being dropped from trawl measurement comparisons.

Scanmar data indicated the *Teleost*’s trawl was spreading significantly more than the *Cabot*’s trawl in deepwater comparative tows even though there was not a significant difference in mean depths occupied, or towing speeds between both vessels. In general, the trawl geometry and performance of the *Teleost* was found to be different compared to the *Cabot* during the fall 2023 comparative fishing especially when compared to the 2022 fall analysis, with differences largely attributed to depth. Full details can be found in Nguyen and Walsh (in prep[2]).

2.2. COMPARATIVE FISHING DATA ANALYSIS

2.2.1. Species Grouping Modifications

During the review of the fall 2021–22 comparative fishing analysis several of the proposed species taxa groupings were identified as being too broad, and these groupings have since been adjusted.

Previously, all skates, except Thorny Skate (*Amblyraja radiata*), were grouped together as other skates; however, due to wide behavioural differences between the skate species in this group, it

[2] Nguyen, T., and Walsh, S.J. In prep. Trawl Geometry and Performance During Comparative Fishing in the Newfoundland and Labrador Region. DFO Can. Sci. Advis. Sec. Res. Doc.

was deemed too broad for appropriate application and therefore all skates were considered separately. Given low presence in the catches, insufficient data were available to complete conversion factor analysis on any skate species besides Thorny Skate and Smooth Skate (*Malacoraja senta*).

All eel species were considered separately. The eelpouts group (*Lycodes* sp.) was also rearranged, such that the Ocean Pout (*Macrozoarces americanus*), Soft Eelpout (*Melanostigma atlanticum*), and Green Ocean Pout (*Gymnelis viridis*) were removed from the larger main eelpout grouping, and wolf eel species were placed in their own group (*Lycenchelys* sp.).

The sculpins group was adjusted by adding Sea Ravens (*Hemitripterus americanus*) to the overall sculpins group rather than considering the species on its own.

Northern Shrimp (*Pandalus borealis*) and Striped Shrimp (*Pandalus montaguii*) were the only non-grouped shrimp species, and remaining shrimp species were grouped as benthic crawler shrimp, benthic shrimp, benthopelagic shrimp, and pelagic shrimp (Table 1).These shrimp groupings were defined based on expert opinion with consideration of habitat and other biological characteristics.

Table 1. Outline of modified shrimp groupings for conversion factor analysis.

Operational Code	Group	Species Included
8160	Benthic Crawler Shrimp	*Steromastis* sp., *Munida* sp., and *Munidopsis* sp.
8120	Benthic Shrimp	*Eualus belcheri*, *Sclerocrangon* sp., *Sabinea septemcarinata*, *Sabinea sarsi*, & *Argis* sp.
8010	Benthopelagic Shrimp	*Benthesicymus* sp., *Aristeus* sp., *Eualus fabricii*, *Eualus macilentus*, *Eualus gaimardii*, *Spirontocaris* sp., *Lebbeus* sp., *Dichelopandalus* sp., *Atlantopandalus* sp., *Sabinea hystrix*, & *Pontophilus* sp.,
8040	Pelagic Shrimp	*Aristaeopsis* sp., *Gennadas* sp., *Sergestes* sp., *Sergia* sp., *Acanthephyra* sp., *Pasiphaea* sp., & *Parapasiphae* sp.

Several of the invertebrate groups were also evaluated for re-structuring, including bivalves, gastropods, sea cucumbers, sea stars, and sea urchins. The bivalve grouping was adjusted by removing the Iceland and Sea Scallops (*Chlamys islandica*, *Placopecten magellanicus*, respectively) which were both considered by species, and all other remaining species were kept in the overall bivalves group. Gastropods were left at the grouped level for Gastropoda, except nudibranchs (Nudibranchia) which were considered separately. The gastropods were not further broken down due to known inconsistency in the identification of species at sea. Sea cucumbers were only considered at the grouped level since at-sea identification issues precluded reliable comparisons for individual species within the group. Misidentification issues were also found for some sea stars, however it was determined identification of Common Mud Stars (*Ctenodiscus crispatus*), cushion stars (*Ceramaster granularis),* Rigid Cushion Stars (*Hippasteria phrygiana*), and Henricia sea stars (*Henricia* sp.) was reliable and thus these were separated from the main group for separate conversion factor analysis. The full sea stars group (including the four species listed above) also remained to inform ecological research at higher taxonomic resolution. The sea urchin group was broken down into two groups, sea urchins (*Strongylocentrotus* sp., *Brisaster* sp., and *Phormosoma* sp.), and sand dollars (Clypeasteroida).

2.2.2. Data Analysis

In the analysis of comparative fishing data, the goal is to estimate the relative fishing efficiency by numbers of individuals and/or weight of catch between a pair of vessel-gear combinations. Conversion factors are defined as an estimate of relative catch efficiency (ρ), or catch efficiency at length $\rho(l)$, with the conversion factor being the ratio of catchabilities between the old and new vessels. When $\rho < 1$ indicates the new vessels catch a greater amount, while a $\rho > 1$ indicates the new vessel catches less. If $\rho = 1$, conversion of catches between vessels is not required.

A suite of 13 binomial (Table 2) and beta-binomial models (Table 3) with various assumptions were fit for all species with sufficient sample size (minimum 25 paired tows) and length information to estimate size-disaggregated conversion factors for catch numbers by length. Length was included in the models as a fixed effect and applied as a smoothing effect based on a general additive smooth function, for both model types. For the beta-binomial models the same smooth construct is also applied to the over dispersion parameter. The station effect was included as a random effect on the intercept to accommodate different underlying densities of species across sets sampled and, in the more complicated models, it was included on the smoother to allow for a station and length interaction effect. However, to accurately model this interaction, a large amount of data was required and there were very few cases of the more complex models converging for species in the NL data set. Full model formulation is detailed in Trueman et al. 2025. When conversion factor estimates were not statistically different than one (i.e., 95% Confidence Interval [CI] covers rho = 1), old and new catchabilities were considered equivalent, with no conversion factor required. When a size-based conversion was recommended, the conversion factor estimate from the 0.5 and 99.5 length percentiles was used as a constant below or above those lengths, respectively, to account for very low sample sizes at these extreme lengths.

Conversion factors were also estimated for catch of a species aggregated across all sizes (size-aggregated models). The same model formulations as above were used for catch number conversions (i.e., abundance); however, the binomial and beta-binomial models were not appropriate for catch weight (i.e., biomass) since they both use a discrete probability distribution. Instead, a model using a Tweedie distribution was implemented such that overdispersion in the catch weights could be properly accounted for along a continuous probability distribution (Trueman et al. 2025).

3. RESULTS AND DISCUSSION

Conversion factors presented here for the *Teleost* are an extension of those presented for the fall series in Trueman et al. 2025 and are applicable to NAFO Divisions 2HJ3K and 3L deep (>750 m). The fall 2023 program fills the previously identified data gap for deep water tows (Figure 1). Conversion factors presented for the *Needler* are applicable for NAFO Divisions 3KL, as per those presented in Trueman et al. 2025.

The results are provided through detailed figures (Figure 2–Figure 80) and tables (Table 4–Table 9) which support decisions for the application of conversion factors. We provide some interpretation for commercially harvested species and some species of conservation concern.

3.1. CCGS *TELEOST* – SIZE-DISAGGREGATED ANALYSIS

3.1.1. Greenland Halibut (*Reinhardtius hippoglossoides*)

Greenland Halibut were caught in 261 sets with a length range of 5–96 cm represented in the comparative fishing data (Figure 3–Figure 12). Length-disaggregated analysis indicated a significant length effect in catchability differences, with the best model selected BB4. However, this length effect was predominately for small fish (<20 cm), and for most of the length range there was no difference in relative catchability. The delta value compared to lowest Bayesian Information Criterion (ΔBIC) between BB4 and BB1 was < 2, suggesting no extra variability in catchability was being explained by the length effect in BB4, however delta value compared to lowest Aikaike Information Criterion (ΔAIC) was >2.

With BB4, there was a significant effect of depth found in the residuals (Table 5). However, this depth effect was likely confounded with size. Greenland Halibut are known to shift their distribution deeper as they get older and larger (Wheeland and Morgan 2020), with the smallest fish found in the shallowest waters within the range of this species. This size dependence to distribution was evident within the comparative tows (Figure 12).

Length sensitivity tests indicated the small fish conversion held through the 2.5–97.5 percentile range. Additionally, a sensitivity test was completed by splitting the paired data for Greenland Halibut into <750 m and ≥750 m depth bins. In this test, the shallower bin yielded a significant length effect, and the deeper bin had no significant conversion, supporting the interpretation of an interaction between size and depth for conversions in this species.

Overall, the implementation of a length-based conversion factor is recommended so that smaller Greenland Halibut are appropriately accounted for going forward. The final model selected was BB4 and a length-based conversion is to be implemented for Greenland Halibut (Table 8).

Notably, size-aggregated analysis for abundance and biomass resulted in no significant conversion factor. However, as the main divergence in relative catchability is in the catch numbers for very small fish, one would not expect to observe a significant difference in biomass. For abundance, the overall catch numbers of the small sizes were likely low and therefore the difference did not show up in the aggregated data. No depth effect was noted in the residuals for the aggregated models.

3.1.2. Roughhead Grenadier (*Macrourus berglax*)

Roughhead Grenadier were caught in 171 sets with a size range of 1–45 cm (anal length, measured from rostrum to anal fin) (Figure 13–Figure 17). No significant length effect was found with BB1 selected as the best model fit, resulting in no significant conversion required. No issues were found in the residuals and station effect distribution, and results for size-aggregated analysis agreed with no significant conversion required for abundance or biomass. No conversion is required for Roughhead Grenadier for the *Teleost* fall time series.

3.1.3. Common Grenadier (*Nezumia bairdii*)

Common Grenadier were caught in 96 sets with a size range of 1–17 cm, anal length (Figure 18–Figure 23). No significant length effect was found, and the final model selected (BB1) resulted in no significant conversion. No significant conversion was found for abundance and biomass in the size-aggregated analysis, agreeing with the conclusion that no conversion is required for Common Grenadier in the *Teleost* fall time series.

3.1.4. Roundnose Grenadier (*Coryphaenoides rupestris*)

Roundnose Grenadier were caught in 68 sets with a length range of 1–20 cm (anal length) represented in the paired sets (Figure 24–Figure 27). Like the Common Grenadier, no significant length effect of conversion factor was found for Roundnose Grenadier (best model BB1). Residuals indicated good model fit, and the distribution of station effect was attributed to poor representation of catches in NAFO Divisions 2H and 3K. Additionally, size-aggregated analysis agreed that no conversion is required for abundance and biomass. No conversion factor is needed for Roundnose Grenadier.

3.1.5. Smooth Skate (*Malacoraja senta*)

Smooth Skate were caught in 56 sets with a length range of 9–60 cm (Figure 28–Figure 31). Size-disaggregated analysis showed no significant size effect or conversion factor (best model BB1), and this was consistent across size-aggregated analyses. No conversion factor is needed for Smooth Skate.

3.2. CCGS *TELEOST* – SIZE-AGGREGATED ANALYSIS

Size-aggregated analysis (Figure 32–Figure 67) was completed for all species listed above, as well as for additional deep water species and any species groupings that required modification as outlined in Section 2.2.1.

Additionally, further analysis was carried out for lumpsuckers (*Eumicrotremus sp.*) and Common Lumpfish (*Cyclopterus lumpus*) due to their importance in ongoing ecosystem monitoring, and due to the status of the Common Lumpfish under the SAR Act and the Committee on the Status of Endangered Wildlife in Canada status of Threatened. Conclusions for these two taxa could not be made during the first set of analyses due to insufficient sample size, but the additional sets added in NAFO Division 3K in 2023 allowed for conversion factors to be estimated (Table 7, Figure 45–Figure 46).

Details on how the results are presented are outlined in Figure 2. Details on conversions and model outputs for the *Teleost* are provided in Table 7.

3.3. CCGS *ALFRED NEEDLER* UPDATES

An analysis was completed for any species or species grouping that was adjusted based on the modifications outlined in Section 2.2.1 and still met minimum sample size requirements for size-aggregated analysis. This included benthic shrimp, benthopelagic shrimp, pelagic shrimp, eelpouts, gastropods, Henricia sea stars, Common Mud Stars, Rigid Cushion Stars, all sea stars grouped, sculpins, sea cucumbers, sea urchins, and Smooth Skate. The results are summarized in Table 8 and detailed in Figure 68–Figure 80.

4. CONCLUSIONS

This document is a continuation of analyses from the 2021–23 comparative fishing program in the NL Region. Used in conjunction with previously completed paired tows, the data obtained during the fall 2023 comparative fishing program provided sufficient coverage of deep slope habitats to allow for the estimation of representative conversion factors for the *Teleost* fall series for multiple deep water species. Additionally, the fall 2023 data permitted the reevaluation of two species previously considered data deficient. A re-evaluation of taxa grouping following Part I yielded additional conversion factors for fall *Teleost* and *Needler*. For the *Teleost*, conversion factors were defined for seven deep water taxa, including one length-based conversion factor for Greenland Halibut, and 16 taxa showed no significant difference in relative catchability. Of the redefined species groupings, eight additional conversion factors were estimated, and two were deemed to have insufficient data.

Conversion factors were defined for nine re-evaluated taxa groupings for the *Needler*, and four taxa required no conversion factors.

These results should be considered alongside those documented elsewhere from the comparative fishing program. A full list of documents from Parts I and II can be found on the CSAS Science Advisory Schedule.

5. ACKNOWLEDGEMENTS

The Comparative Fishing program could not have been undertaken without the massive effort, sacrifice, and dedication from sea-going staff and shore support! Thank you also to all Coast Guard crew aboard these vessels, without whom fishing operations would not be possible.

Authorship note: beyond the lead S. Trueman, authors are listed alphabetically.

6. REFERENCES CITED

DFO. 2024. Newfoundland & Labrador Comparative Fishing Analysis – Part 1. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2024/002. (Erratum: August 2024).

Trueman, S., Wheeland, L., Benoît, H., Munro, H., Nguyen, T., Novaczek, E., Skanes, K., and Yin, Y. 2025. Results of Comparative Fishing Between the CCGS *Teleost* and CCGS *Alfred Needler* with the CCGS *John Cabot* and CCGS *Capt. Jacques Cartier* in the Newfoundland and Labrador Region in 2021 and 2022. DFO Can. Sci. Advis. Sec. Res. Doc. 2025/021. v + 237 p.

Wheeland, L.J., and Morgan, M.J. 2020. Age-specific shifts in Greenland Halibut (*Reinhardtius hippoglossoides*) distribution in response to changing ocean climate. ICES J. Mar. Sci. 77: 230–240.

Wheeland, L., Skanes, K., and Trueman, S. 2024. Summary of Comparative Fishing Data collected in Newfoundland and Labrador from 2021-2022. Can. Tech. Rep. Fish. Aquat. Sci. 3579: iv +132 p.

7. TABLES

Table 2. A set of binomial models with various assumptions for the length effect and station effect in the relative catch efficiency. A smoothing length effect can be considered, and the station effect can be added to the intercept, without interaction with the length effect, or added to both the intercept and smoother to allow for interaction between the two effects.

Model	$log(\rho)$	Length Effect	Station Effect
$BI0$	β_0	constant	not considered
$BI1$	$\beta_0 + \delta_{0,i}$	constant	intercept
$BI2$	$\mathbf{X}_f^T \boldsymbol{\beta}_f + \mathbf{X}_r^T \mathbf{b}$	smoothing	not considered
$BI3$	$\mathbf{X}_f^T \boldsymbol{\beta}_f + \mathbf{X}_r^T \mathbf{b} + \delta_{0,i}$	smoothing	intercept
$BI4$	$\mathbf{X}_f^T (\boldsymbol{\beta}_f + \boldsymbol{\delta}_i) + \mathbf{X}_r^T (\mathbf{b} + \boldsymbol{\epsilon}_i)$	smoothing	intercept, smoother

Table 3. A set of beta-binomial models with various assumptions for the length effect and station effect in the relative catch efficiency, and the length effect on the variance parameter. A smoothing length effect can be considered in both the conversion factor and the variance parameter. A possible station effect can be added to the intercept, without interaction with the length effect, or added to both the intercept and the smoother to allow for interaction between the two effects.

Model	$log(\rho)$	$log(\phi)$	Length Effects	Station Effect
$BB0$	β_0	γ_0	constant/constant	not considered
$BB1$	$\beta_0 + \delta_{0,i}$	γ_0	constant/constant	intercept
$BB2$	$\mathbf{X}_f^T \boldsymbol{\beta}_f + \mathbf{X}_r^T \mathbf{b}$	γ_0	smoothing/constant	not considered
$BB3$	$\mathbf{X}_f^T \boldsymbol{\beta}_f + \mathbf{X}_r^T \mathbf{b}$	$\mathbf{X}_f^T \boldsymbol{\gamma} + \mathbf{X}_r^T \mathbf{g}$	smoothing/smoothing	not considered
$BB4$	$\mathbf{X}_f^T \boldsymbol{\beta}_f + \mathbf{X}_r^T \mathbf{b} + \delta_{0,i}$	γ_0	smoothing/constant	intercept
$BB5$	$\mathbf{X}_f^T \boldsymbol{\beta}_f + \mathbf{X}_r^T \mathbf{b} + \delta_{0,i}$	$\mathbf{X}_f^T \boldsymbol{\gamma} + \mathbf{X}_r^T \mathbf{g}$	smoothing/smoothing	intercept
$BB6$	$\mathbf{X}_f^T (\boldsymbol{\beta}_f + \boldsymbol{\delta}_i) + \mathbf{X}_r^T (\mathbf{b} + \boldsymbol{\epsilon}_i)$	γ_0	smoothing/constant	intercept, smoother
$BB7$	$\mathbf{X}_f^T (\boldsymbol{\beta}_f + \boldsymbol{\delta}_i) + \mathbf{X}_r^T (\mathbf{b} + \boldsymbol{\epsilon}_i)$	$\mathbf{X}_f^T \boldsymbol{\gamma} + \mathbf{X}_r^T \mathbf{g}$	smoothing/smoothing	intercept, smoother

Table 4. Relative evidence for length-disaggregated binomial and beta-binomial models for the Canadian Coast Guard Ship (CCGS) Teleost *and CCGS* John Cabot/Capt Jacques Cartier *comparative fishing analysis based on the Aikaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) and delta (Δ) values compared to lowest AIC/BIC per species. Entries with '-' indicate models that did not converge. BB6 did not converge for any species and is not included in the table.*

Value	Species	BI0	BI1	BI2	BI3	BI4	BB0	BB1	BB2	BB3	BB4	BB5
AIC	Greenland Halibut	19086	17514	18990	17485	-	17630	17101	17605	17556	17083	-
ΔAIC	Greenland Halibut	2003	431	1907	402	-	547	18	522	473	0	-
BIC	Greenland Halibut	19094	17530	19014	17517	-	17646	17125	17637	17604	17123	-
ΔBIC	Greenland Halibut	1971	407	1890	394	-	523	2	514	481	0	-
AIC	Roughhead Grenadier	6159	5926	6163	5928	6065	6038	5898	6041	-	5899	-
ΔAIC	Roughhead Grenadier	262	28	266	30	168	140	0	143	-	2	-
BIC	Roughhead Grenadier	6167	5941	6186	5958	6119	6053	5921	6072	-	5938	-
ΔBIC	Roughhead Grenadier	246	20	266	37	198	133	0	151	-	17	-
AIC	Common Grenadier	1589	1371	1592	1362	-	1397	1295	1402	1405	1296	1300
ΔAIC	Common Grenadier	294	76	297	68	-	102	0	107	110	1	6
BIC	Common Grenadier	1595	1383	1610	1386	-	1409	1313	1426	1441	1326	1342
ΔBIC	Common Grenadier	282	70	297	74	-	96	0	113	128	13	29
AIC	Roundnose Grenadier	3354	2257	3333	2258	-	2315	2138	2318	2305	2141	2138
ΔAIC	Roundnose Grenadier	1217	119	1195	120	-	178	0	180	168	3	0
BIC	Roundnose Grenadier	3360	2269	3351	2281	-	2327	2156	2341	2341	2170	2179
ΔBIC	Roundnose Grenadier	1205	113	1195	125	-	171	0	185	185	15	23
AIC	Smooth Skate	644	609	641	607	-	604	597	604	608	595	-
ΔAIC	Smooth Skate	49	14	46	12	-	9	2	9	13	0	-
BIC	Smooth Skate	650	620	659	631	-	616	615	628	643	625	-
ΔBIC	Smooth Skate	35	6	44	16	-	1	0	13	29	10	-

Table 5. P-values associated with tests for a smooth effect of depth, a smooth effect of time of day, and fixed effects of year, Northwest Atlantic Fisheries Organization (NAFO) Division, diurnal period (day/night), and partner vessel and on the normalized quantile residuals from the length-disaggregated selected best model. Values <0.05 are indicated in bold.

Vessel pair	Common Name	Model	s(Depth)	s(Time)	Year	NAFO Division	Diurnal Period	Partner Vessel
TEL:CAX	Greenland Halibut	BB4	**0.03**	0.29	0.33	0.15	0.66	0.79
TEL:CAX	Greenland Halibut	BB1	0.10	0.26	0.69	0.32	0.40	0.54
TEL:CAX	Roughhead Grenadier	BB1	0.52	0.52	0.06	0.30	0.53	0.75
TEL:CAX	Common Grenadier	BB1	0.48	0.82	0.73	0.86	0.82	0.49
TEL:CAX	Roundnose Grenadier	BB1	0.74	0.40	0.50	0.62	0.49	0.79
TEL:CAX	Smooth Skate	BB1	0.34	0.57	0.57	0.07	0.86	0.86

Table 6. Summary of recommendations for species for which length-disaggregated conversion factor models were applied. For species where length was not determined to be significant, rho ± standard error (SE) estimates are provided here. "n.s." indicates a non-significant conversion where the 95% confidence intervals overlap with a constant conversion between vessels, and no conversion factor is recommended for these species. For the species where a length-based conversion was found, the percentiles at which a constant conversion is to be applied is also provided.

Species	Determination	Details	Rho	SE Rho	Percentile Lengths
Greenland Halibut	Conversion required	Length-based	See Table 8		9, 59 cm (0.5 – 99.5 percentile)
Roughhead Grenadier	No conversion	n/a	1.08 (n.s.)	0.06	-
Common Grenadier	No conversion	n/a	0.84 (n.s.)	0.16	-
Roundnose Grenadier	No conversion	n/a	1.22 (n.s.)	0.19	-
Smooth Skate	No conversion	n/a	0.76 (n.s.)	0.12	-

Table 7. Relative evidence for size-aggregated binomial and beta-binomial models for Canadian Coast Guard Ship (CCGS) Teleost *and CCGS* John Cabot/Capt Jacques Cartier *fall catch counts based on Aikaike's Information Criterion (AIC) and the Bayesian Information Criterion (BIC) values, and estimates of the conversion factor Rho, and approximate 95% confidence intervals, for catches in numbers and in weights for taxa for which length-disaggregated analyses were also undertaken. Recall that a single model was used for catch weights and thus AIC and BIC values are not shown. Entries with '-' indicate models that did not converge.*

Species	Code	BI1 (AIC)	BB0 (AIC)	BB1 (AIC)	BI1 (BIC)	BB0 (BIC)	BB1 (BIC)	Model Selected	Rho (CI), numbers	p-value, numbers	Rho (CI), weights	p-value, weights	Recommendation
Greenland Halibut	892	1905.62	1904.93	1906.90	1912.75	1912.06	1917.59	BB0	1.01 (0.94-1.08)	0.83	0.94 (0.87-1.01)	0.11	see length-disaggregated results
Roughhead Grenadier	474	901.65	900.15	902.13	907.94	906.43	911.55	BB0	1.05 (0.96-1.16)	0.31	1.04 (0.91-1.19)	0.57	No conversion
Common Grenadier	478	469.10	461.40	461.80	474.22	466.53	469.49	BB0	0.94 (0.75-1.17)	0.59	1.04 (0.85-1.27)	0.69	No conversion
Roundnose Grenadier	481	445.79	444.57	446.56	450.23	449.01	453.22	BB0	1.19 (0.95-1.5)	0.12	1.17 (0.95-1.44)	0.13	No conversion
Smooth Skate	91	186.92	186.90	188.90	190.97	190.95	194.97	BB0	0.78 (0.58-1.06)	0.11	0.94 (0.59-1.49)	0.78	No conversion
Atlantic Gymnast	168	78.20	75.23	77.22	80.79	77.82	81.11	BB0	0.79 (0.4-1.58)	0.51	0.48 (0.22-1.04)	0.06	No conversion
Barracudina and Lancetfish	316	1101.16	1085.00	1085.70	1107.39	1091.24	1095.05	BB0	0.97 (0.79-1.19)	0.78	0.93 (0.77-1.12)	0.44	No conversion
Goitre Blacksmelt	202	353.76	349.73	351.51	357.59	353.56	357.24	BB0	0.96 (0.68-1.37)	0.84	0.82 (0.59-1.14)	0.23	No conversion
Black Dogfish	27	99.08	98.72	100.72	101.59	101.24	104.50	BB0	0.97 (0.66-1.43)	0.87	1.17 (0.89-1.55)	0.26	No conversion
Boa Dragonfish	230	233.99	228.84	230.82	237.89	232.74	236.68	BB0	0.73 (0.48-1.13)	0.16	0.83 (0.52-1.32)	0.42	No conversion
Eelpouts	726	1232.50	1230.18	1232.17	1239.18	1236.86	1242.18	BB0	0.9 (0.81-1.01)	0.07	0.82 (0.73-0.92)	0.00	Abundance and biomass conversion
Other Grenadiers	470	50.94	50.43	52.43	53.38	52.87	56.09	BB0	1.44 (0.73-2.84)	0.29	1.15 (0.47-2.8)	0.75	No conversion
Atlantic Hagfish	12	73.24	72.81	74.81	75.68	75.24	78.46	BB0	1.57 (0.87-2.83)	0.14	2.13 (1.12-4.03)	0.02	Biomass conversion
Blue Hake	432	471.39	470.60	472.60	475.71	474.92	479.08	BB0	1.04 (0.88-1.22)	0.65	1.07 (0.89-1.29)	0.48	No conversion
Lanternfish	272	1486.04	1464.95	1460.89	1492.03	1470.93	1469.86	BB1	0.99 (0.79-1.24)	0.90	0.94 (0.81-1.08)	0.37	No conversion
Longnosed Eel	373	545.07	541.60	543.07	549.76	546.29	550.10	BB0	1.2 (0.99-1.46)	0.07	1.32 (1.11-1.57)	<0.01	Abundance and biomass conversion
Loosejaw	303	99.31	97.43	99.39	102.11	100.23	103.59	BB0	1.49 (0.81-2.74)	0.20	1.03 (0.52-2.03)	0.93	No conversion
Lumpsuckers	843	105.97	104.36	106.35	107.63	106.03	108.85	BB0	0.94 (0.48-1.85)	0.85	0.65 (0.35-1.18)	0.16	No conversion
Common Lumpfish	849	76.03	NA	NA	79.60	NA	NA	B1	1.41 (0.92-2.16)	0.11	1.07 (0.68-1.68)	0.78	No conversion

Species	Code	BI1 (AIC)	BB0 (AIC)	BB1 (AIC)	BI1 (BIC)	BB0 (BIC)	BB1 (BIC)	Model Selected	Rho (CI), numbers	p-value, numbers	Rho (CI), weights	p-value, weights	Recommendation
Scopelosaurus	300	93.80	91.58	93.58	97.07	94.85	98.49	BB0	0.65 (0.36-1.15)	0.14	0.4 (0.23-0.71)	<0.01	Biomass conversion
Sculpins	810	1197.55	1178.17	1177.85	1203.95	1184.58	1187.46	BB0	1.01 (0.83-1.23)	0.95	1 (0.84-1.2)	0.97	No conversion
Deepsea Cat Shark	56	65.46	65.44	67.44	68.12	68.11	71.44	BB0	1.63 (1.03-2.58)	0.04	1.64 (1.04-2.59)	0.03	Abundance and biomass conversion
Smoothheads	164	79.46	79.09	81.09	81.82	81.44	84.62	BB0	1.47 (0.73-2.94)	0.28	2.45 (0.49-12.31)	0.28	No conversion
Atlantic Snipe Eel	368	87.48	80.46	82.46	90.28	83.26	86.67	BB0	1.03 (0.53-1.98)	0.94	1.13 (0.46-2.77)	0.79	No conversion
Shortnose Snipe Eel	369	210.76	205.80	207.60	214.50	209.55	213.21	BB0	0.96 (0.6-1.52)	0.85	0.79 (0.48-1.31)	0.36	No conversion
Tapirfish	386	162.03	161.34	163.34	166.21	165.53	169.63	BB0	0.96 (0.7-1.33)	0.82	1.22 (0.84-1.76)	0.29	No conversion
Viperfish	207	294.47	290.10	291.84	298.48	294.12	297.87	BB0	0.66 (0.46-0.97)	0.03	0.65 (0.46-0.92)	0.02	Abundance and biomass conversion
Wolf Eel	747	128.52	125.47	127.35	131.63	128.58	132.02	BB0	1.5 (0.86-2.61)	0.16	1.77 (1.05-3)	0.03	Biomass conversion
Bivalves	3995	107.02	103.32	105.30	110.08	106.38	109.88	BB0	-	-	-	-	Insufficient data
Benthic Shrimp	8120	776.78	758.66	752.80	781.82	763.71	760.37	BB1	1.4 (0.93-2.1)	0.11	1.06 (0.83-1.34)	0.65	No conversion
Benthopelagic Shrimp	8010	649.48	637.76	-	654.75	643.03	-	BB0	1.9 (1.39-2.61)	<0.01	1.8 (1.42-2.27)	<0.01	Abundance and biomass conversion
Pelagic Shrimp	8040	839.69	819.03	812.14	844.77	824.11	819.77	BB1	1.47 (0.78-2.79)	0.23	1.24 (0.91-1.7)	0.17	No conversion
Gastropods	3175	540.39	520.22	522.08	546.19	526.01	530.78	BB0	0.83 (0.62-1.13)	0.24	0.56 (0.38-0.81)	<0.01	Biomass conversion
Iceland Scallop	4167	71.71	69.59	71.58	74.30	72.18	75.47	BB0	-	-	-	-	Insufficient Data
Rigid Cushion Star	8479	425.88	418.81	420.81	431.60	424.53	429.39	BB0	0.75 (0.58-0.97)	0.03	0.62 (0.45-0.84)	<0.01	Abundance and biomass conversion
Cushion Star	8478	134.70	128.95	130.92	138.08	132.33	135.99	BB0	1.15 (0.66-2)	0.63	0.93 (0.52-1.68)	0.82	No conversion
Henricia Star	8483	397.33	384.88	386.78	402.52	390.07	394.56	BB0	0.88 (0.63-1.24)	0.47	0.59 (0.42-0.83)	<0.01	Biomass conversion
Common Mud Star	8407	600.92	591.95	593.39	605.83	596.86	600.76	BB0	0.42 (0.3-0.6)	<0.01	0.19 (0.13-0.27)	<0.01	Abundance and biomass conversion
Sea Urchins	8360	434.05	428.87	430.51	438.94	433.76	437.84	BB0	0.52 (0.36-0.75)	<0.01	0.49 (0.32-0.77)	<0.01	Abundance and biomass conversion
Sea Cucumbers	8290	93.76	89.96	91.96	96.03	92.23	95.36	BB0	0.81 (0.4-1.64)	0.55	0.78 (0.29-2.07)	0.61	No conversion
All Sea Stars	8390	1434.48	1411.65	1412.45	1441.30	1418.47	1422.68	BB0	0.7 (0.58-0.85)	<0.01	0.44 (0.35-0.55)	<0.01	Abundance and biomass conversion

Table 8. Relative evidence for size-aggregated binomial and beta-binomial models for Canadian Coast Guard Ship (CCGS) Alfred Needler *and CCGS* John Cabot *fall catch counts for modified species groupings based on Aikaike's Information Criterion (AIC) and the Bayesian Information Criterion (BIC) values, and estimates of the conversion factor Rho, and approximate 95% confidence intervals, for catches in numbers and in weights for taxa for which length-disaggregated analyses were also undertaken. Recall that a single model was used for catch weights and thus AIC and BIC values are not shown. Entries with '-' indicate models that did not converge.*

Species	Code	BI1 (AIC)	BB0 (AIC)	BB1 (AIC)	BI1 (BIC)	BB0 (BIC)	BB1 (BIC)	Model Selected	Rho (CI), numbers	p-value, numbers	Rho (CI), weights	p-value, weights	Recommendation
Benthic Shrimp	8120	247.95	244.05	245.85	250.82	246.92	250.15	BB0	0.58 (0.34-0.99)	0.05	0.57 (0.39-0.82)	<0.01	Abundance and biomass conversion
Benthopelagic Shrimp	8010	295.86	289.66	291.55	299.52	293.32	297.04	BB0	0.85 (0.53-1.36)	0.49	0.43 (0.25-0.72)	<0.01	Biomass conversion
Pelagic Shrimp	8040	262.48	257.85	257.66	265.53	260.90	262.23	BB0	2.67 (1.48-4.84)	<0.01	1.23 (0.77-1.96)	0.39	Abundance conversion
Eelpouts	726	492.56	489.00	490.78	497.19	493.63	497.74	BB0	0.72 (0.62-0.85)	<0.01	0.83 (0.72-0.95)	0.01	Abundance and biomass conversion
Gastropods	3175	201.22	195.68	197.67	205.01	199.46	203.34	BB0	0.54 (0.33-0.9)	0.02	0.25 (0.13-0.45)	<0.01	Abundance and biomass conversion
Henricia Star	8483	135.68	131.98	133.98	138.96	135.26	138.89	BB0	0.65 (0.37-1.17)	0.15	0.56 (0.42-0.76)	<0.01	Biomass conversion
Common Mud Star	8407	175.60	174.76	176.76	178.71	177.87	181.42	BB0	0.29 (0.15-0.55)	<0.01	0.09 (0.04-0.17)	<0.01	Abundance and biomass conversion
Rigid Cushion Star	8479	89.43	87.20	89.19	92.36	90.13	93.59	BB0	0.95 (0.51-1.77)	0.88	1.08 (0.53-2.19)	0.83	No conversion
All Sea Stars	8390	445.01	443.62	445.62	449.99	448.59	453.08	BB0	0.39 (0.28-0.55)	<0.01	0.33 (0.22-0.50)	<0.01	Abundance and biomass conversion
Sculpins	810	478.93	470.91	472.77	483.77	475.75	480.02	BB0	0.71 (0.51-0.97)	0.03	0.47 (0.36-0.63)	<0.01	Abundance and biomass conversion
Sea Cucumbers	8290	176.36	174.41	176.35	179.02	177.08	180.35	BB0	0.69 (0.44-1.09)	0.11	0.85 (0.52-1.40)	0.53	No conversion
Sea Urchins	8360	77.14	76.40	78.40	78.81	78.06	80.90	BB0	0.88 (0.4-1.93)	0.74	0.54 (0.24-1.22)	0.14	No conversion
Smooth Skate	91	53.79	53.68	55.68	55.88	55.77	58.82	BB0	0.87 (0.48-1.59)	0.65	1.67 (0.66-4.20)	0.28	No conversion

Table 9. Conversions (± Standard Error [SE]) required for Greenland Halibut to be used for CCGS Teleost*, and CCGS* John Cabot/Capt Jacques Cartier *for fall Division 2HJ3K + 3L deep conversion by length (cm). Conversions below 9 cm should be applied at 1.57 ± 0.16 and above 59 cm at 1.02 ± 0.08.*

Length (cm)	Conversion	SE
9	1.57	0.16
10	1.45	0.12
11	1.35	0.09
12	1.26	0.07
13	1.18	0.06
14	1.12	0.05
15	1.07	0.05
16	1.03	0.05
17	1.00	0.05
18	0.97	0.05
19	0.96	0.04
20	0.95	0.04
21	0.94	0.04
22	0.94	0.04
23	0.94	0.04
24	0.94	0.04
25	0.94	0.04
26	0.94	0.04
27	0.94	0.04
28	0.94	0.04
29	0.94	0.04
30	0.94	0.04
31	0.94	0.04
32	0.94	0.04
33	0.94	0.04
34	0.94	0.04
35	0.95	0.04
36	0.95	0.04
37	0.95	0.04
38	0.96	0.04
39	0.96	0.04
40	0.97	0.04
41	0.97	0.04
42	0.98	0.04
43	0.99	0.04
44	0.99	0.04
45	1.00	0.05
46	1.00	0.05
47	1.00	0.05
48	1.01	0.05
49	1.01	0.05
50	1.01	0.05
51	1.01	0.05
52	1.01	0.06
53	1.01	0.06
54	1.02	0.06
55	1.02	0.07
56	1.02	0.07
57	1.02	0.07
58	1.02	0.08
59	1.02	0.08

8. FIGURES

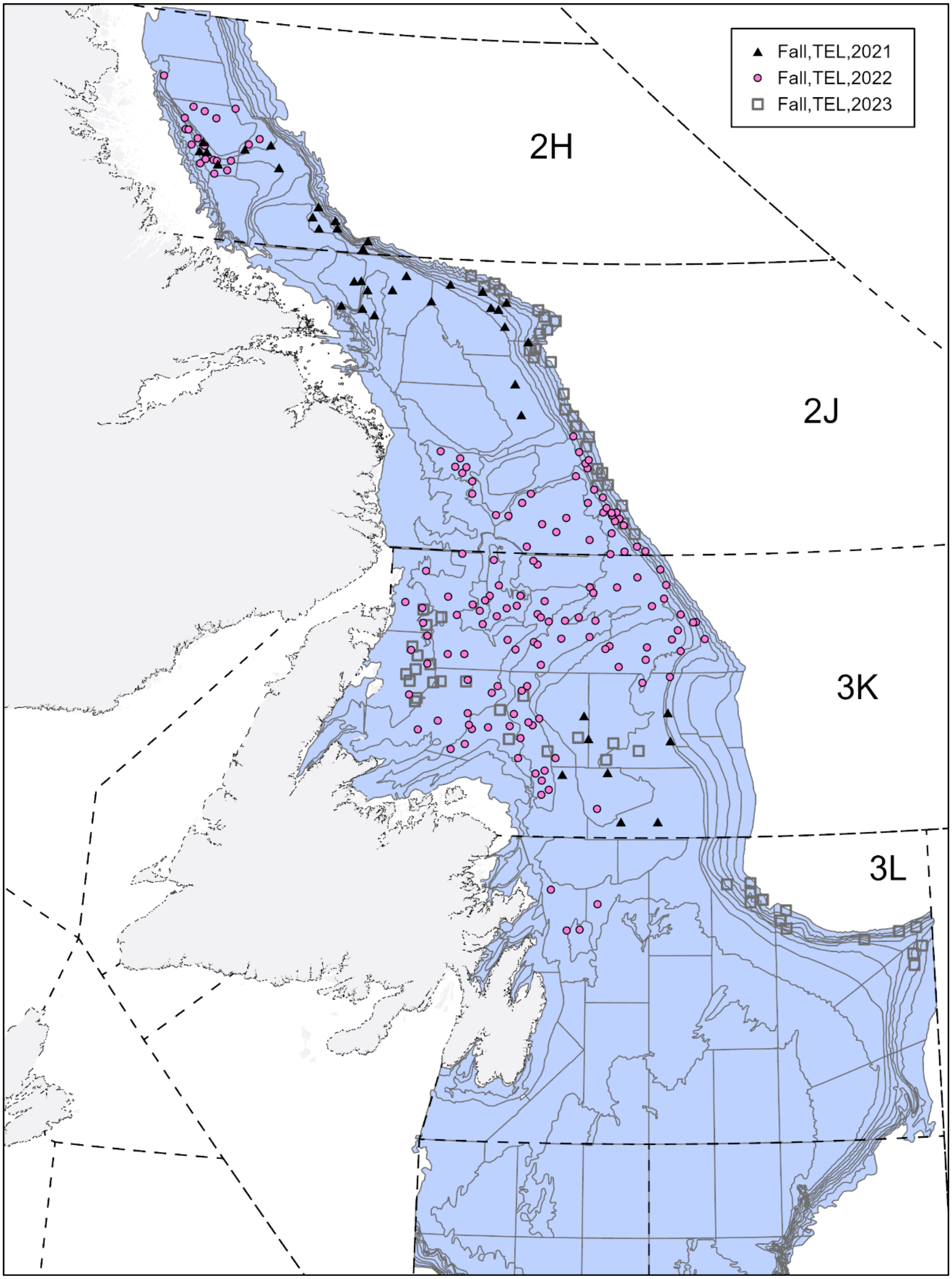


Figure 1. Paired sets completed with the CCGS Teleost *in fall from 2021–23. Blue area shows the DFO Newfoundland and Labrador Multispecies survey strata for fall (NAFO Divisions 2HJ3KLNO).*

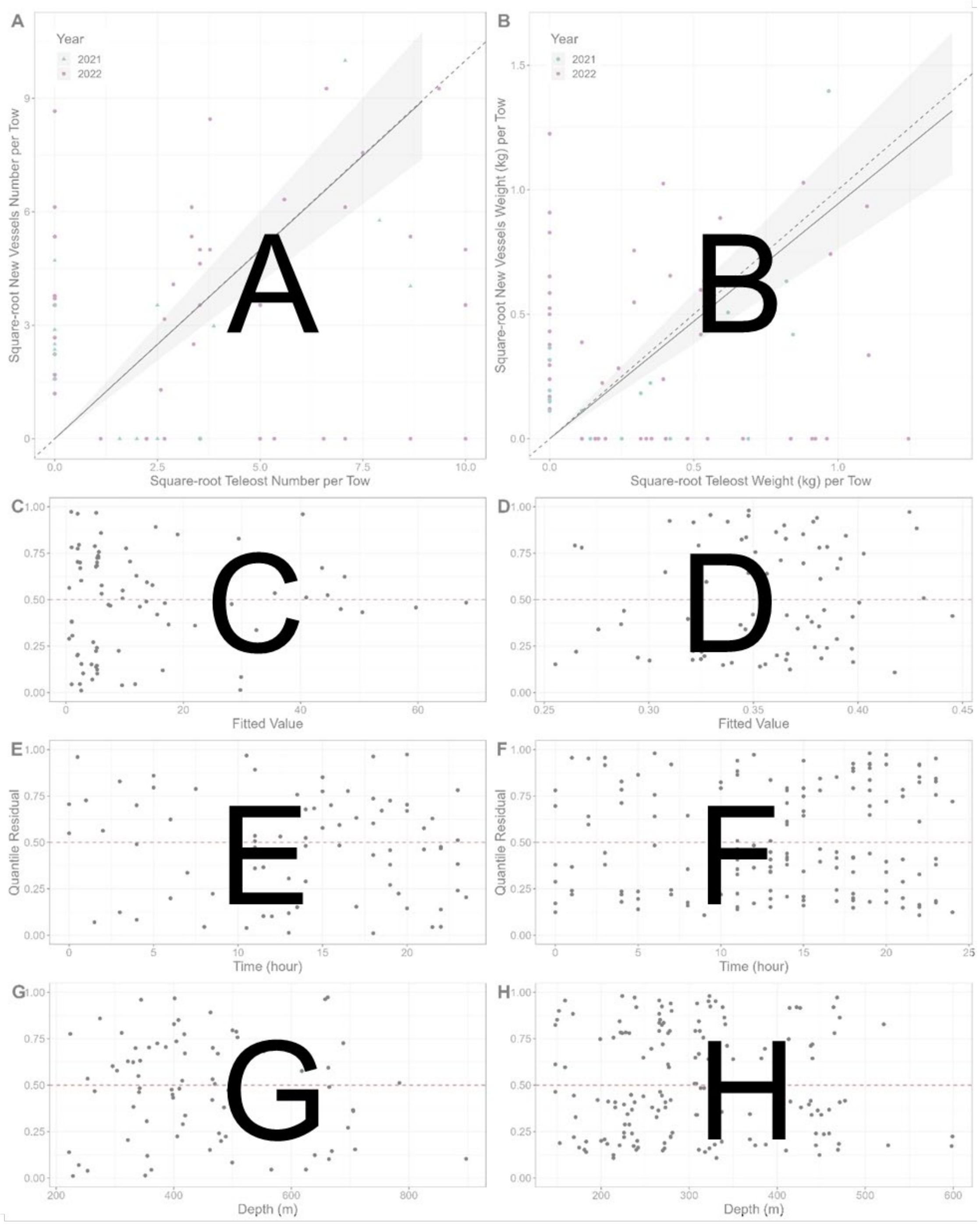


Figure 2. An outline for the interpretation of the figures presenting the data and results for taxa where size-aggregated analyses were completed. Panel A is the biplot of the square-root of CCGS Capt Jacques Cartier/John Cabot *catch numbers against the square-root of CCGS* Teleost *or CCGS* Alfred Needler *catch numbers, where the solid black line and shaded interval show the estimated conversion and approximate 95% CI from the best size-aggregated model. Panel B is the same as A except for catch weights. Below A and B are the quantile residuals from the analysis of catch numbers, and weights plotted as a function of the fitted values (panels C and D, respectively), time (panels E and F, respectively), and depth (panels G and H, respectively). Captions for the individual taxa figures only state the species and vessel pairing visualized in the figure.*

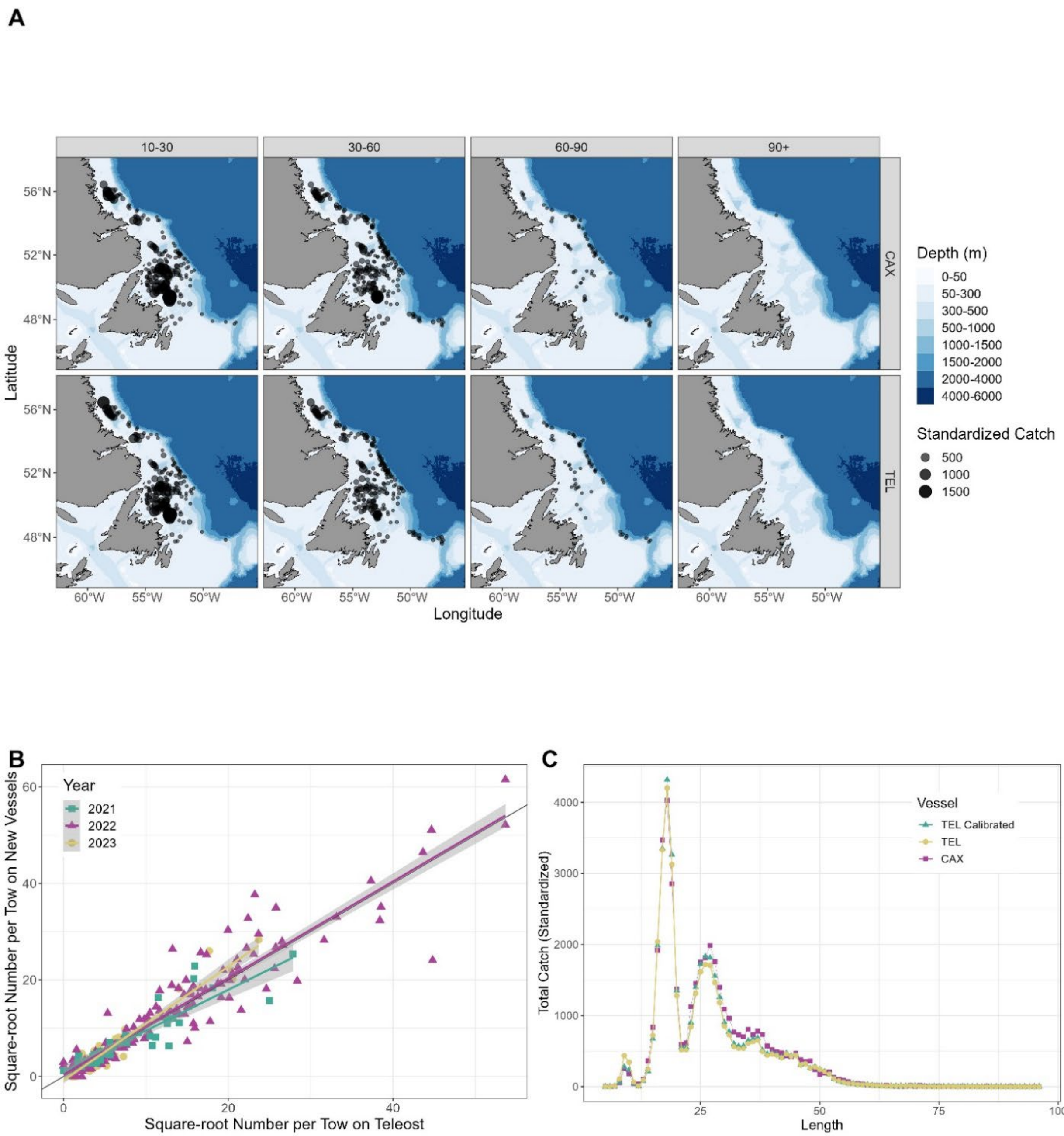
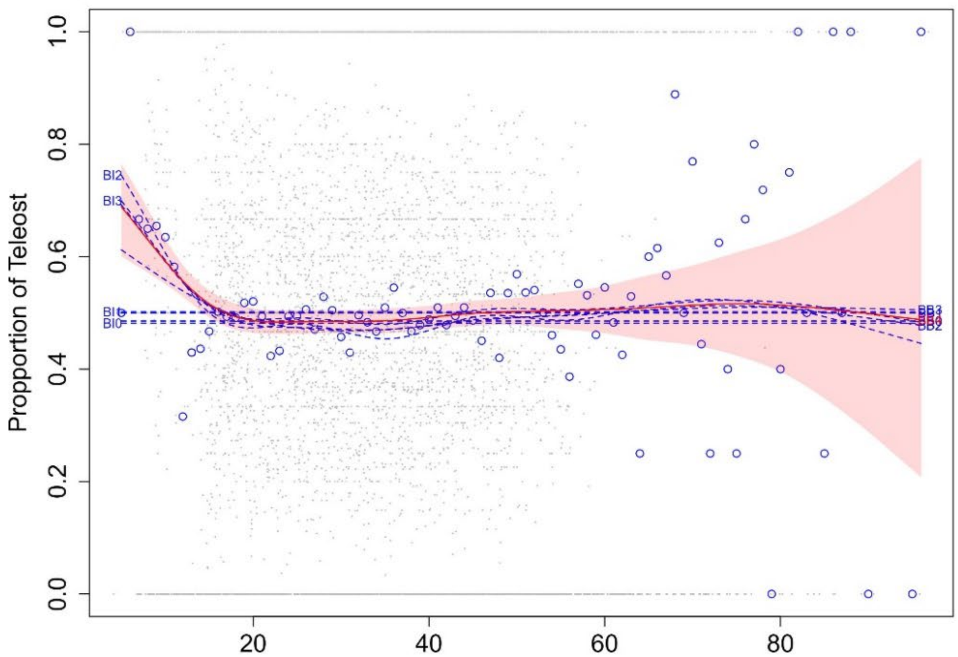


Figure 3. Results for length-disaggregated comparative fishing analyses for Greenland Halibut for model BB4, between the CCGS Teleost *("TEL") and CCGS* Capt Jacques Cartier/John Cabot *("CAX") for fall NAFO Divisions 2HJ3K + 3L deep. (A) map of catches by length group (length in cm specified in top panel) by the CCGS* Capt Jacques Cartier/John Cabot *(top) and the CCGS* Teleost *(bottom) in comparative fishing sets, where circle size is proportional catch weight. (B) Biplot of the square-root of CCGS* Capt Jacques Cartier/John Cabot *catch numbers against the square-root of CCGS* Teleost *catch numbers. (C) Total length frequencies (cm) for catches made by the CCGS* Teleost *(yellow), by the CCGS* Capt Jacques Cartier/John Cabot *(purple), and CCGS* Teleost *catches with the conversion factor applied (green).*

A



B

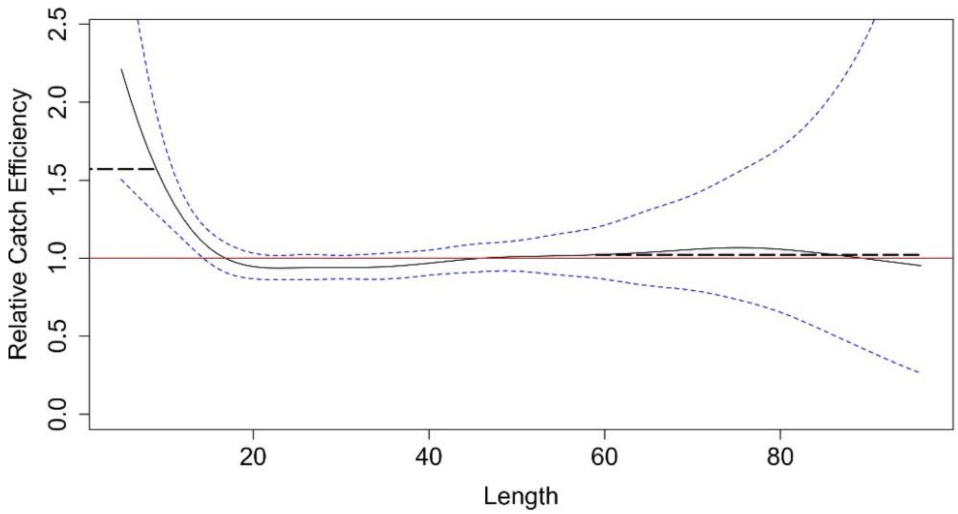


Figure 4. Greenland Halibut conversion factor for model BB4 between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO Divisions 2HJ3KL. (A) Estimated length-specific catch proportion functions,* $logit(p_{Ai}(l))$*, for each converged model, with the selected model plotted using a red line along with its approximate 95% CI (shaded area), as well as the length class-specific mean empirical proportion of total catch in a pair made by the CCGS* Teleost *(blue dots). (B) Estimated relative catch efficiency (conversion factor) function from the best model (black line) with 95% CI (dashed blue lines). The horizontal red line indicates equivalent efficiency between vessels.*

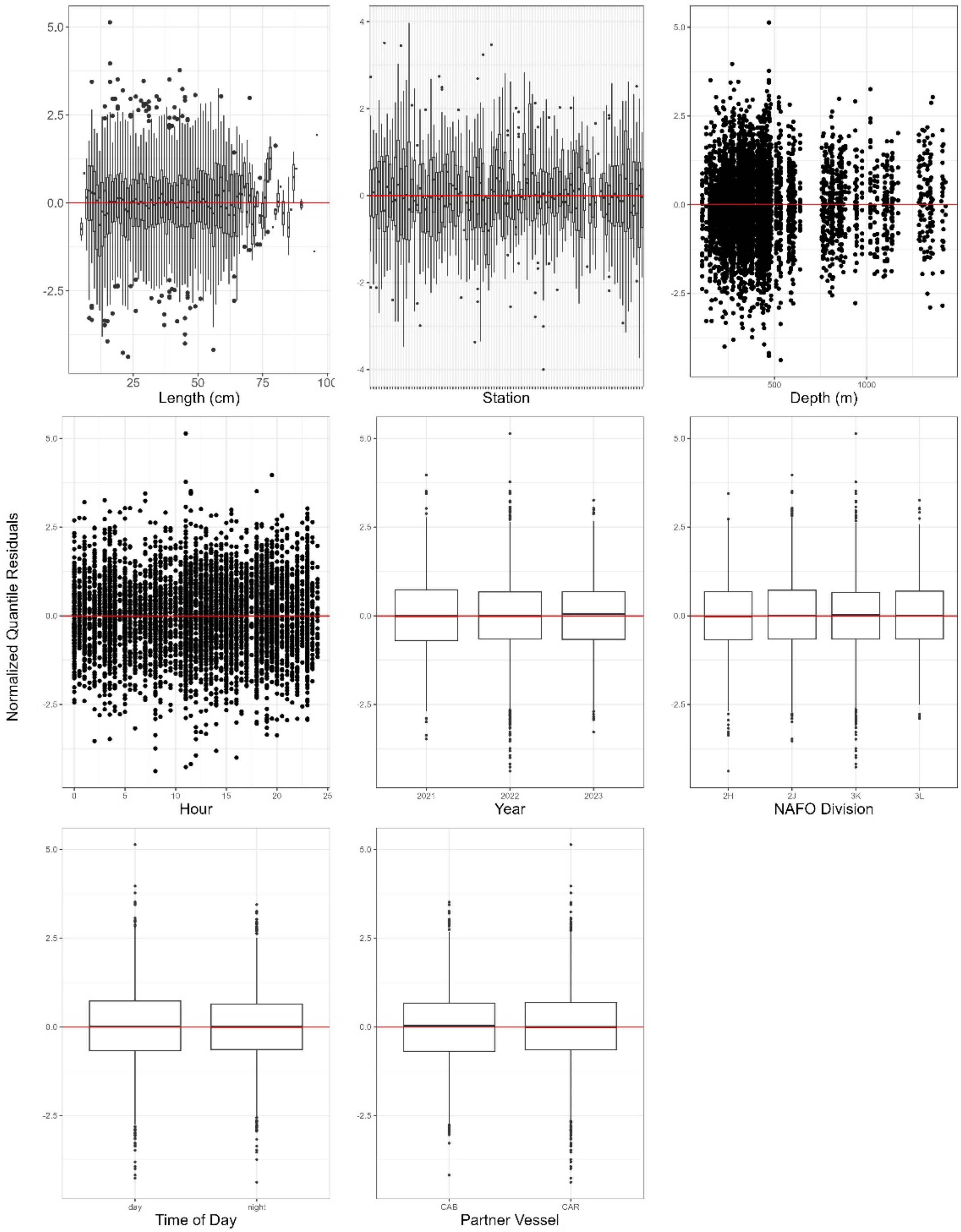


Figure 5. Normalized quantile residuals as a function of length, station, depth, hour, year, NAFO Division, diel period, and partner vessel for Greenland Halibut for length-disaggregated conversion factor analysis, model BB4, for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO Divisions 2HJ3K + 3L deep.*

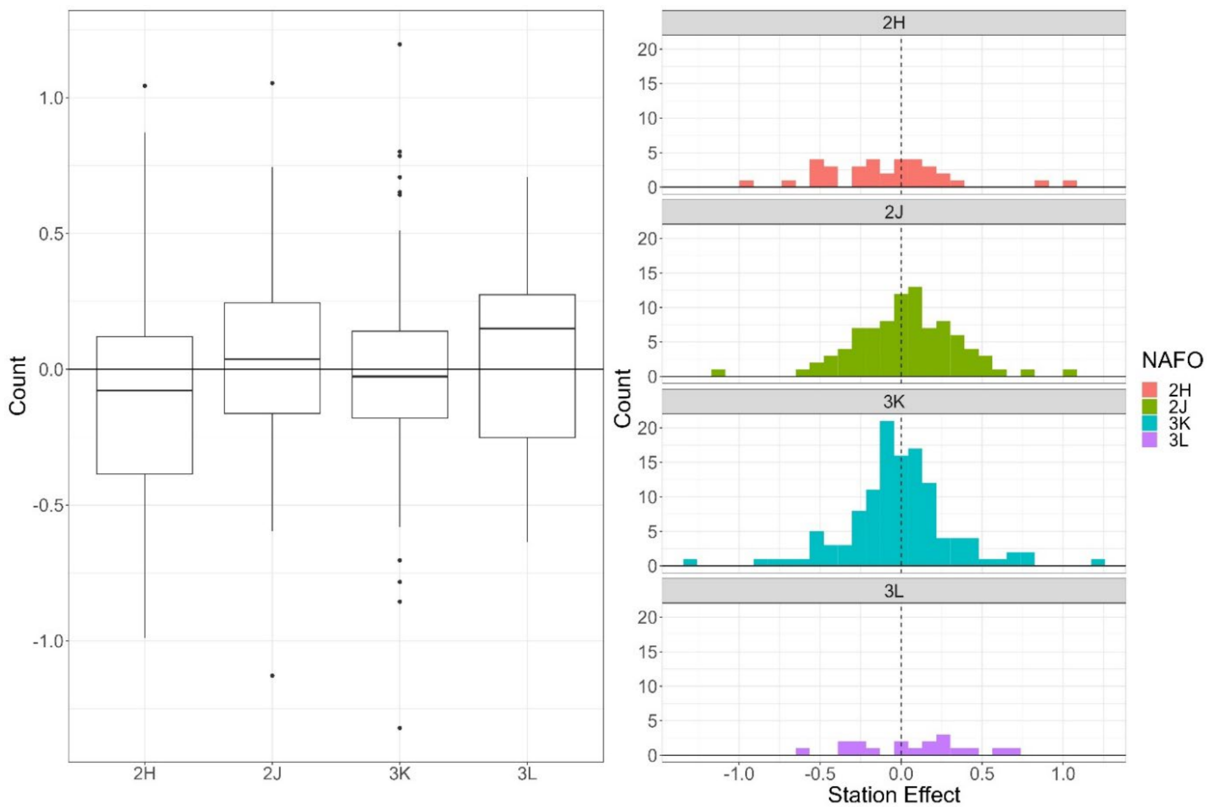


Figure 6. Boxplot (left) and histogram (right) of station effect by NAFO Division for model BB4 for Greenland Halibut conversion factor analysis between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *in fall NAFO Divisions 2HJ3K + 3L deep.*

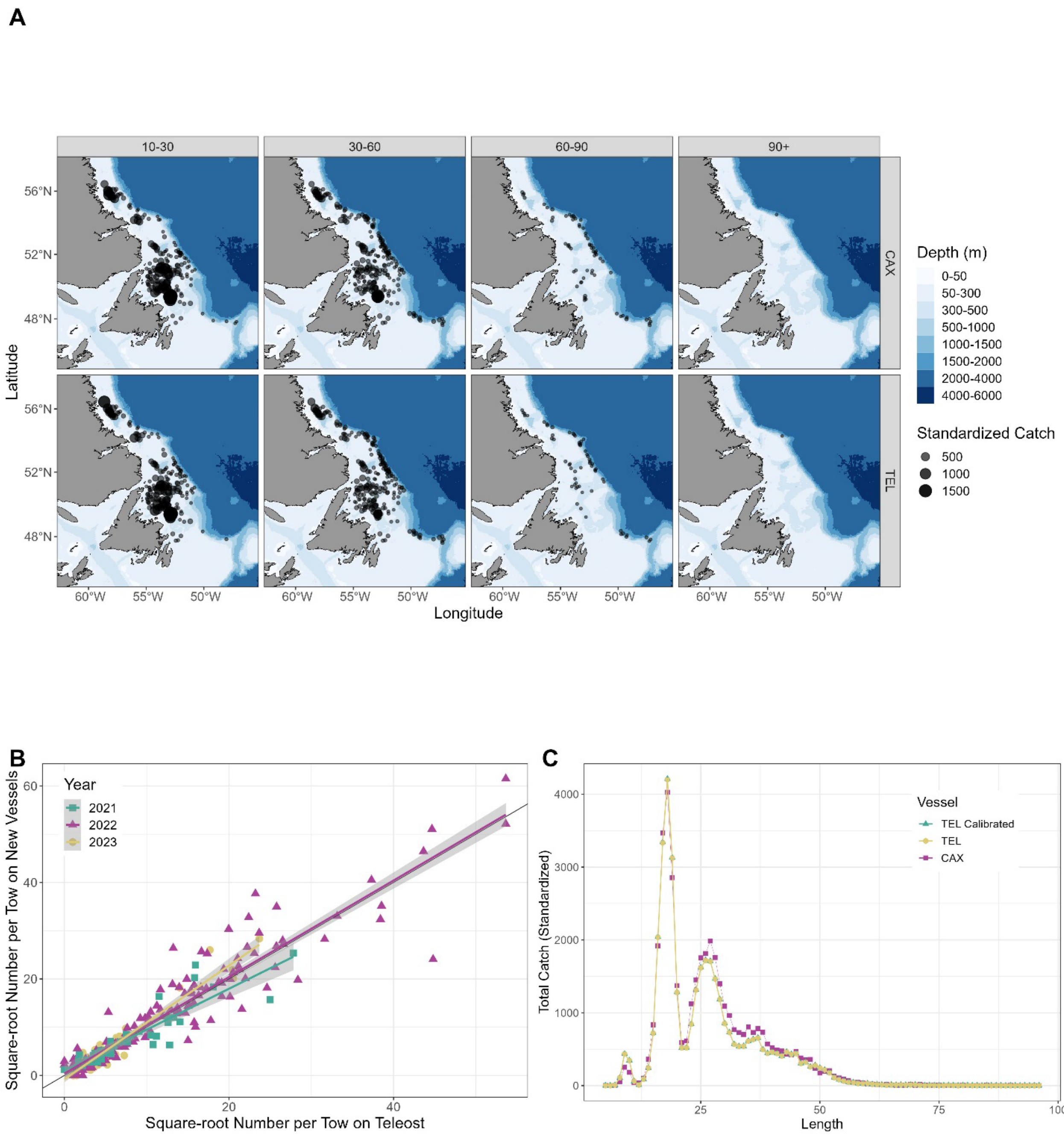
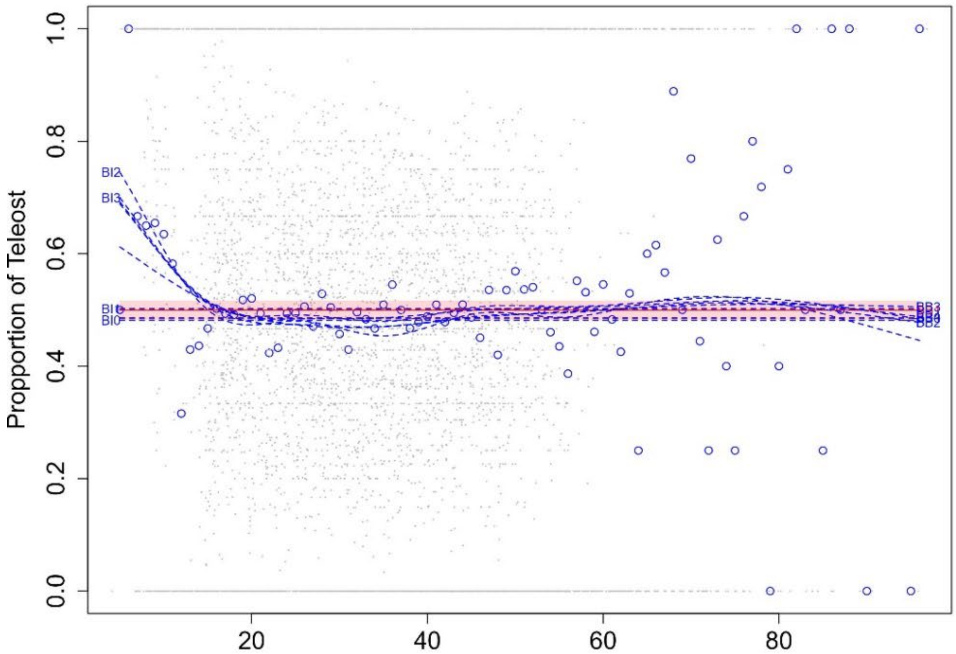


Figure 7. Results for length-disaggregated comparative fishing analyses for Greenland Halibut for model BB1, between the CCGS Teleost *("TEL") and CCGS* Capt Jacques Cartier/John Cabot *("CAX") for fall NAFO Divisions 2HJ3K + 3L deep. (A) map of catches by length group (length in cm specified in top panel) by the CCGS* Capt Jacques Cartier/John Cabot *(top) and the CCGS* Teleost *(bottom) in comparative fishing sets, where circle size is proportional catch weight. (B) Biplot of the square-root of CCGS* Capt Jacques Cartier/John Cabot *catch numbers against the square-root of CCGS* Teleost *catch numbers. (C) Total length frequencies (cm) for catches made by the CCGS* Teleost *(yellow), by the CCGS* Capt Jacques Cartier/John Cabot *(purple), and CCGS* Teleost *catches with the conversion factor applied (green).*

A



B

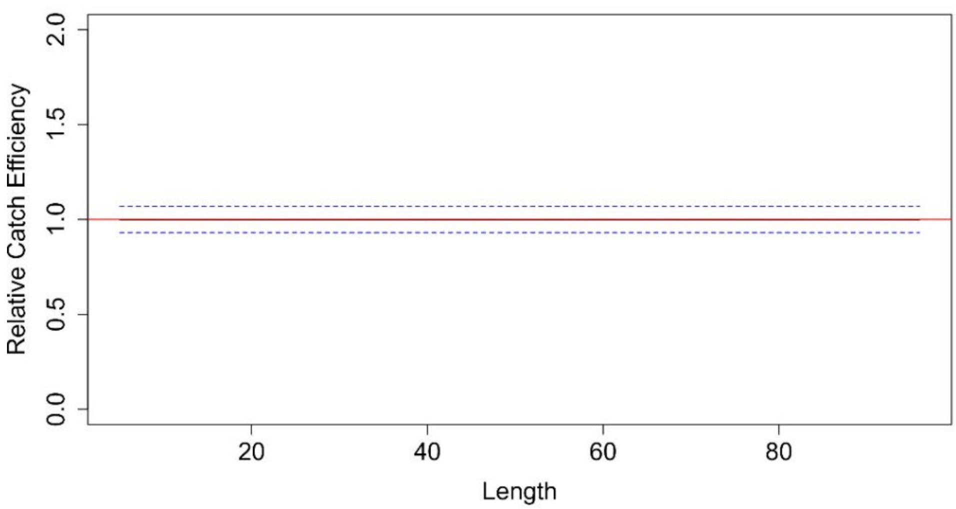


Figure 8. Greenland Halibut conversion factor for model BB1 between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO Divisions 2HJ3KL. (A) Estimated length-specific catch proportion functions, $logit(p_{Ai}(l))$, for each converged model, with the selected model plotted using a red line along with its approximate 95% CI (shaded area), as well as the length class-specific mean empirical proportion of total catch in a pair made by the CCGS* Teleost *(blue dots). (B) Estimated relative catch efficiency (conversion factor) function from the best model (black line) with 95% CI (dashed blue lines). The horizontal red line indicates equivalent efficiency between vessels.*

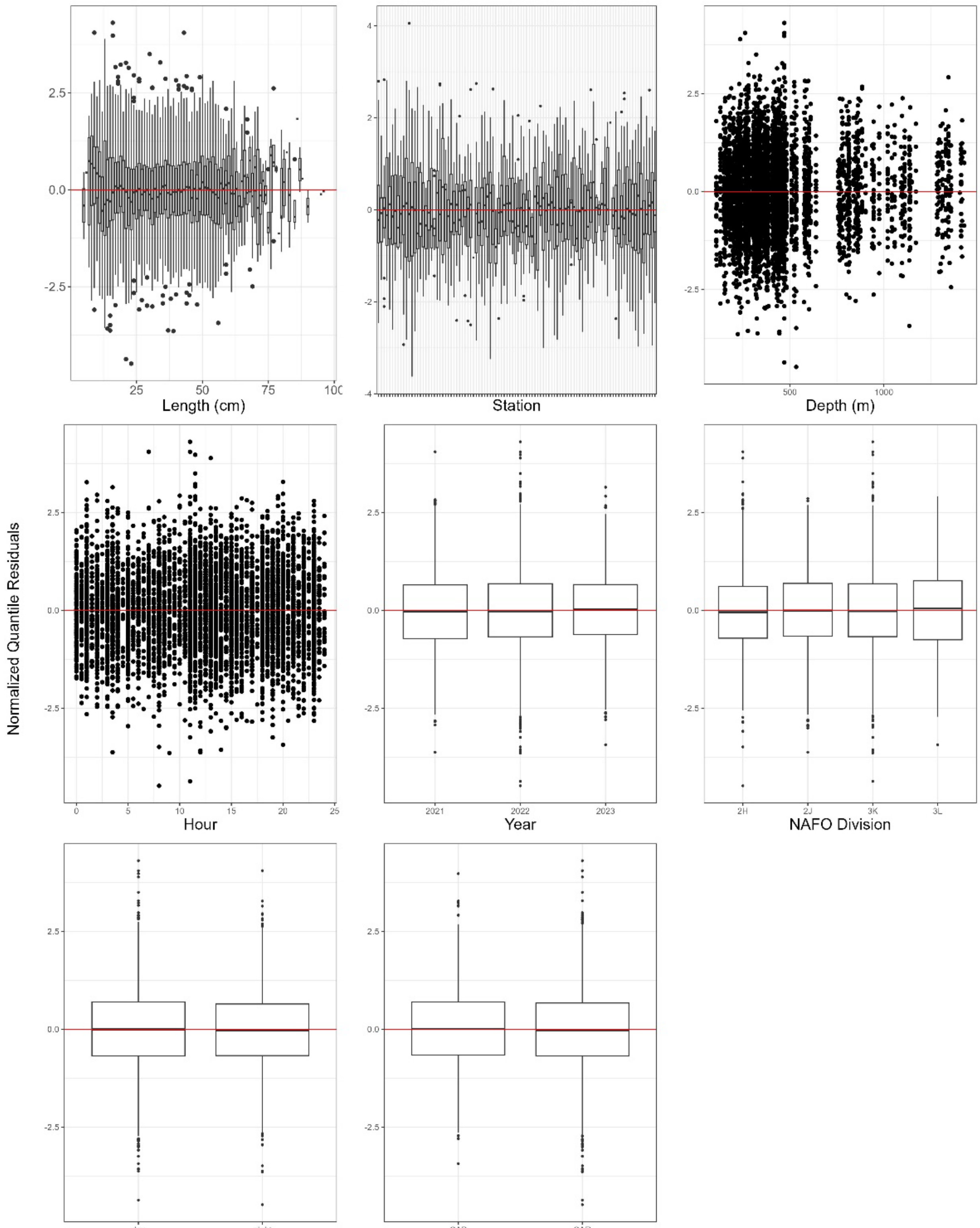


Figure 9. Normalized quantile residuals as a function of length, station, depth, hour, year, NAFO Division, diel period, and partner vessel for Greenland Halibut for length-disaggregated conversion factor analysis, model BB1, for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO Divisions 2HJ3K + 3L deep.*

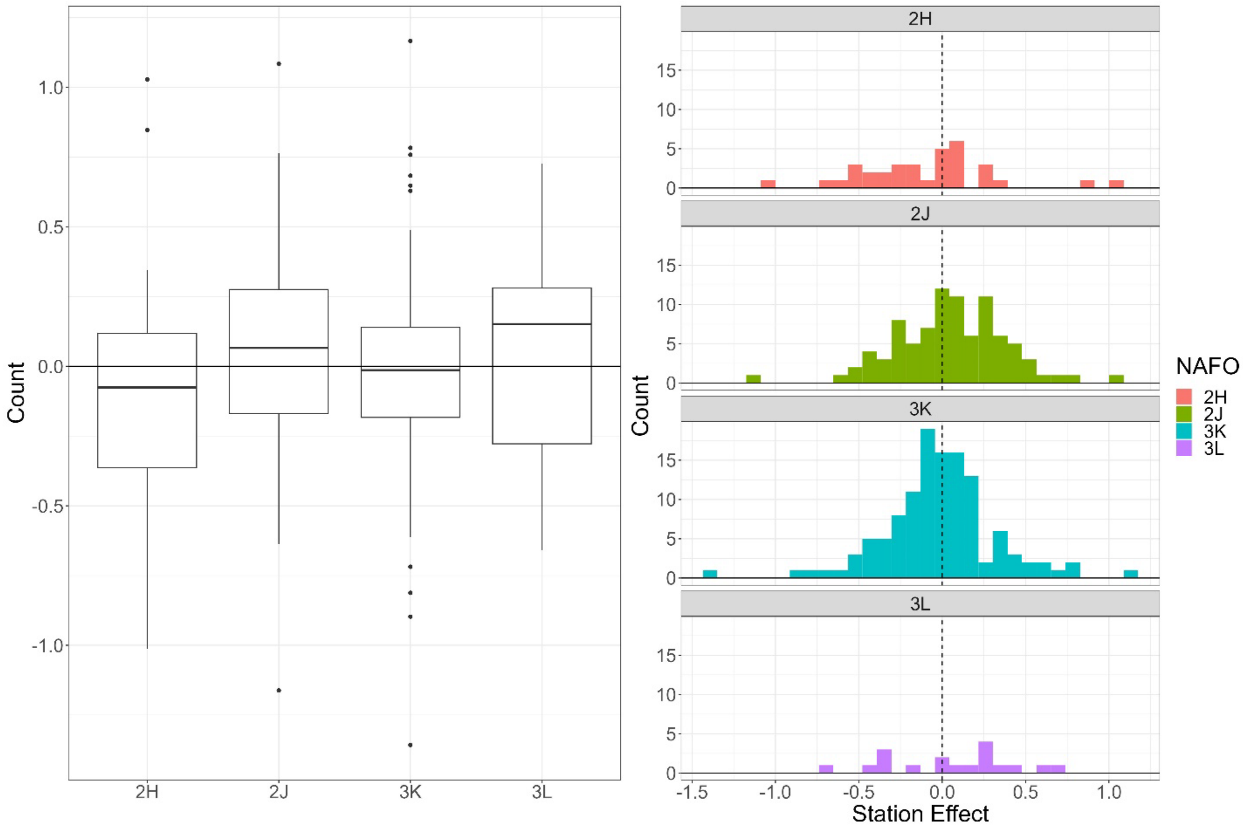


Figure 10. Boxplot (left) and histogram (right) of station effect by NAFO Division for model BB1 for Greenland Halibut conversion factor analysis between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *in fall NAFO Divisions 2HJ3K + 3L deep.*

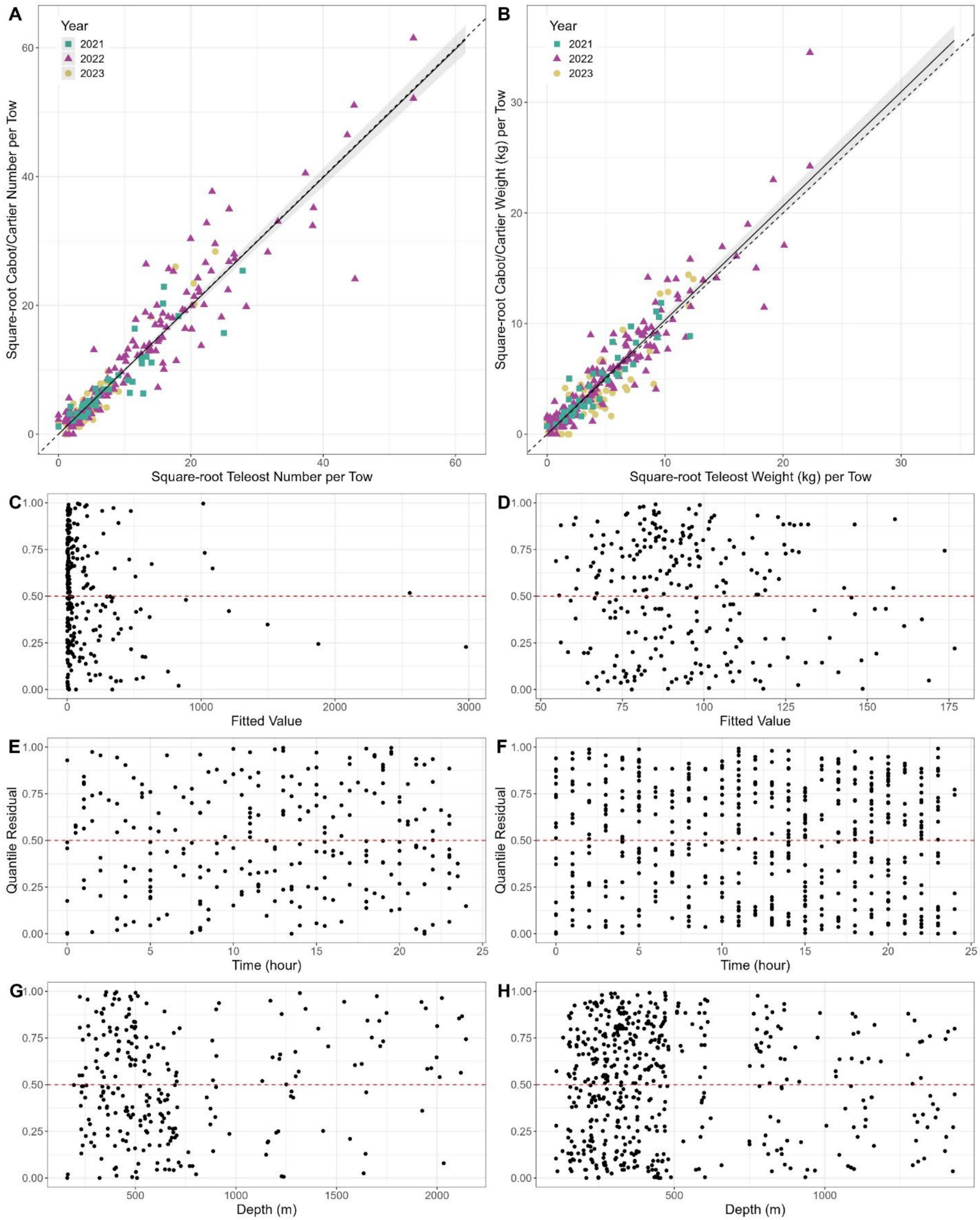


Figure 11. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Greenland Halibut, fall NAFO Divisions 2HJ3K + 3L deep.*

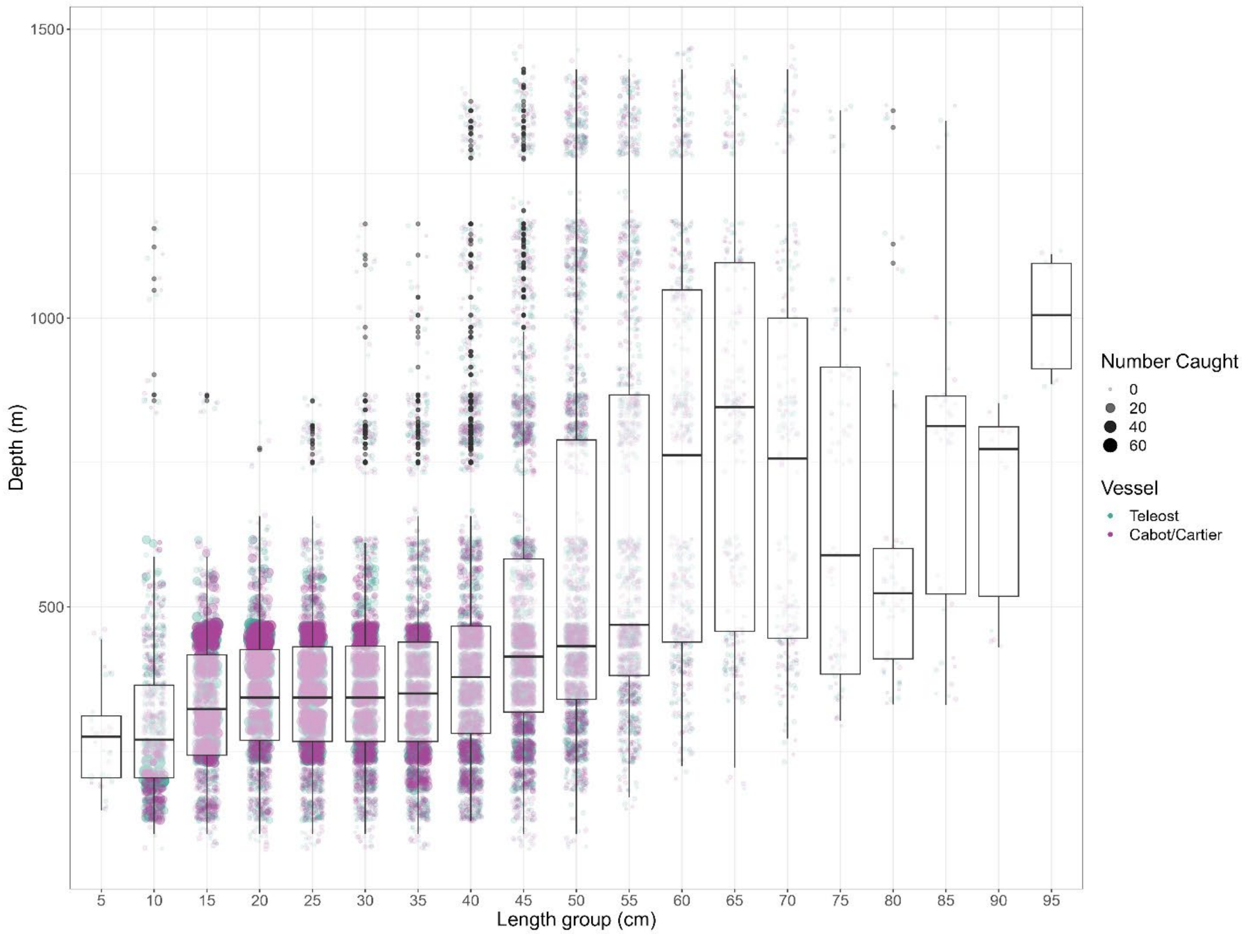


Figure 12. Distribution of catch (number caught) of Greenland Halibut by length group (5 cm bins) and depth (m) for the CCGS Teleost *(green) and CCGS* Capt Jacques Cartier/John Cabot *(purple). Boxplots overlaid on top show the median number caught by both vessels and range of catch over depth.*

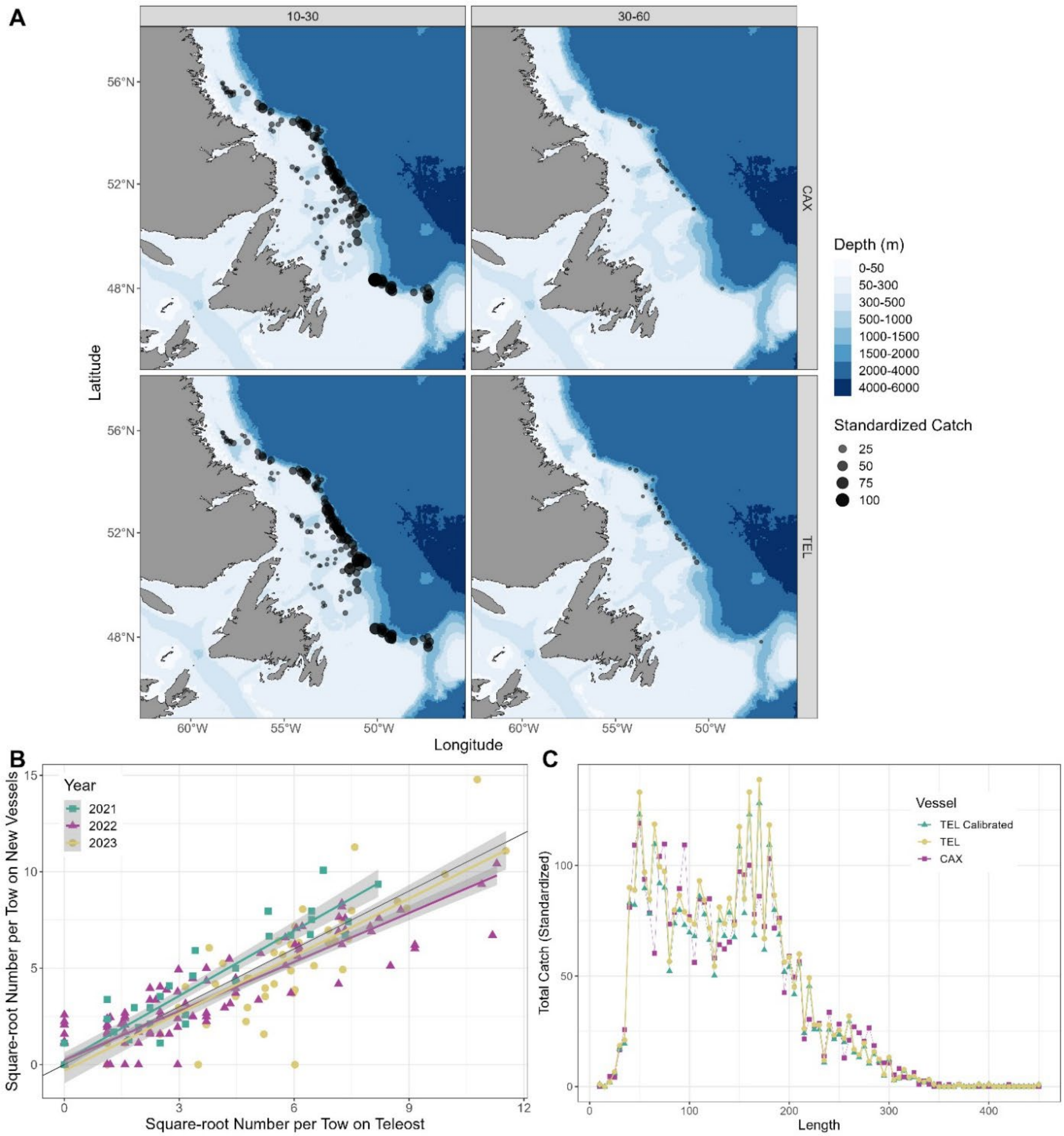


Figure 13. Results for length-disaggregated comparative fishing analyses for Roughhead Grenadier for best model selected, between the CCGS Teleost *("TEL") and CCGS* Capt Jacques Cartier/John Cabot *("CAX") for fall NAFO Divisions 2HJ3K + 3L deep. (A) map of catches by length group (length in cm specified in top panel) by the CCGS* Capt Jacques Cartier/John Cabot *(top) and the CCGS* Teleost *(bottom) in comparative fishing sets, where circle size is proportional catch weight. (B) Biplot of the square-root of CCGS* Capt Jacques Cartier/John Cabot *catch numbers against the square-root of CCGS* Teleost *catch numbers. (C) Total length frequencies (mm) for catches made by the CCGS* Teleost *(yellow), by the CCGS* Capt Jacques Cartier/John Cabot *(purple), and CCGS* Teleost *catches with the conversion factor applied (green).*

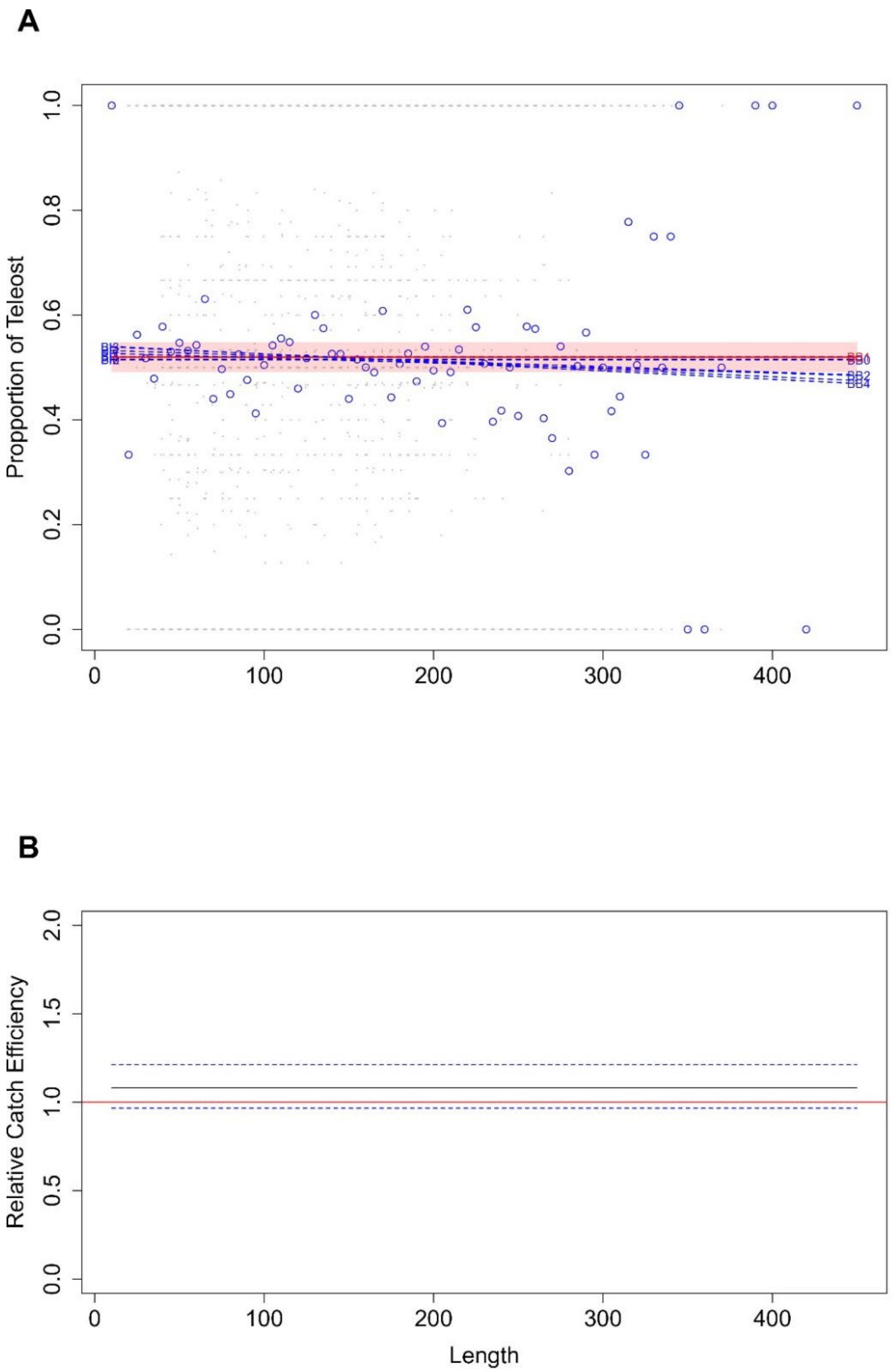


Figure 14. Roughhead Grenadier conversion factor for best model selected between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO divisions 2HJ3KL. (A) Estimated length-specific catch proportion functions, $logit(p_{Ai}(l))$, for each converged model, with the selected model plotted using a red line along with its approximate 95% CI (shaded area), as well as the length class-specific mean empirical proportion of total catch in a pair made by the CCGS* Teleost *(blue dots). (B) Estimated relative catch efficiency (conversion factor) function from the best model (black line) with 95% CI (dashed blue lines). The horizontal red line indicates equivalent efficiency between vessels.*

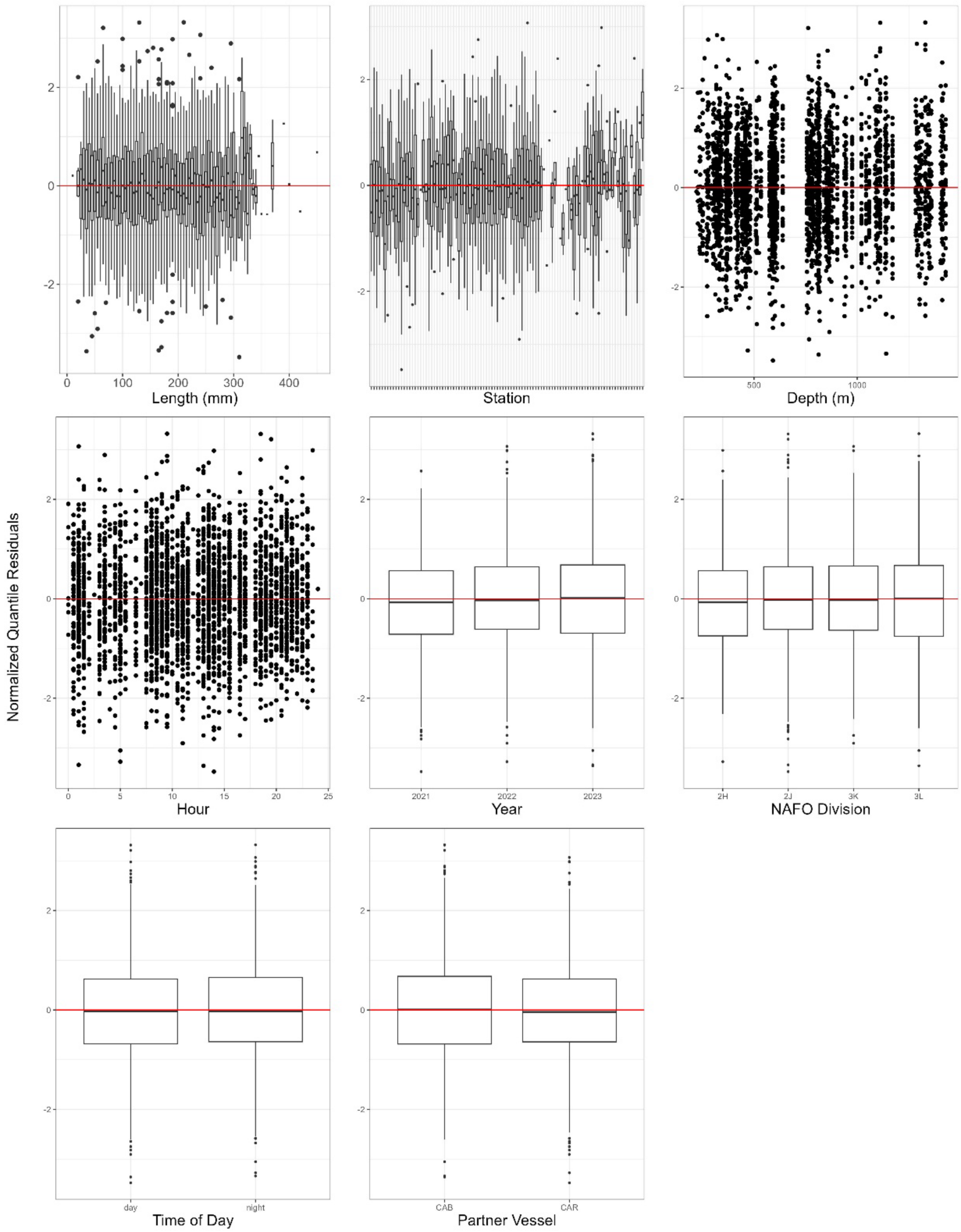


Figure 15. Normalized quantile residuals as a function of length, station, depth, hour, year, NAFO Division, diel period, and partner vessel for Roughhead Grenadier for length-disaggregated conversion factor analysis, best model selected, for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO Divisions 2HJ3K + 3L deep.*

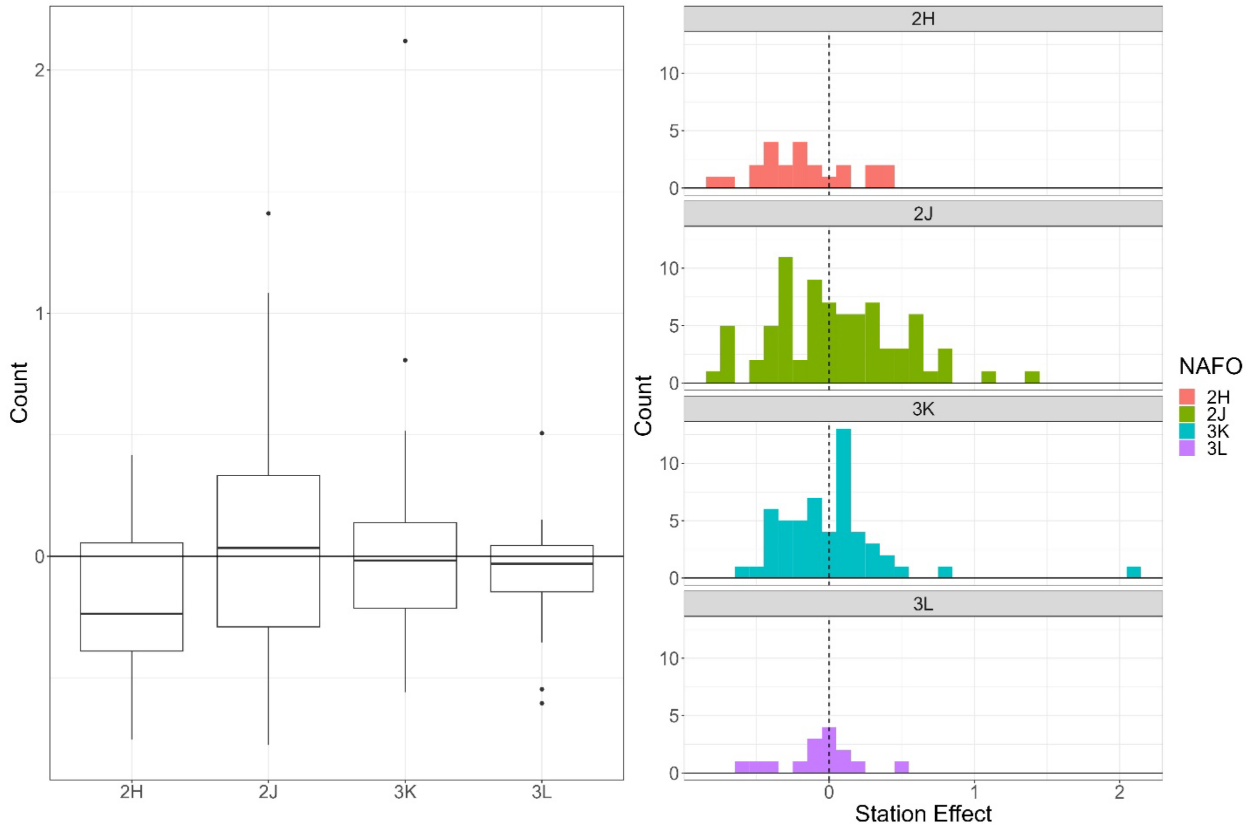


Figure 16. Boxplot (left) and histogram (right) of station effect by NAFO Division for best model selected for Roughhead Grenadier conversion factor analysis between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *in fall NAFO Divisions 2HJ3K + 3L deep.*

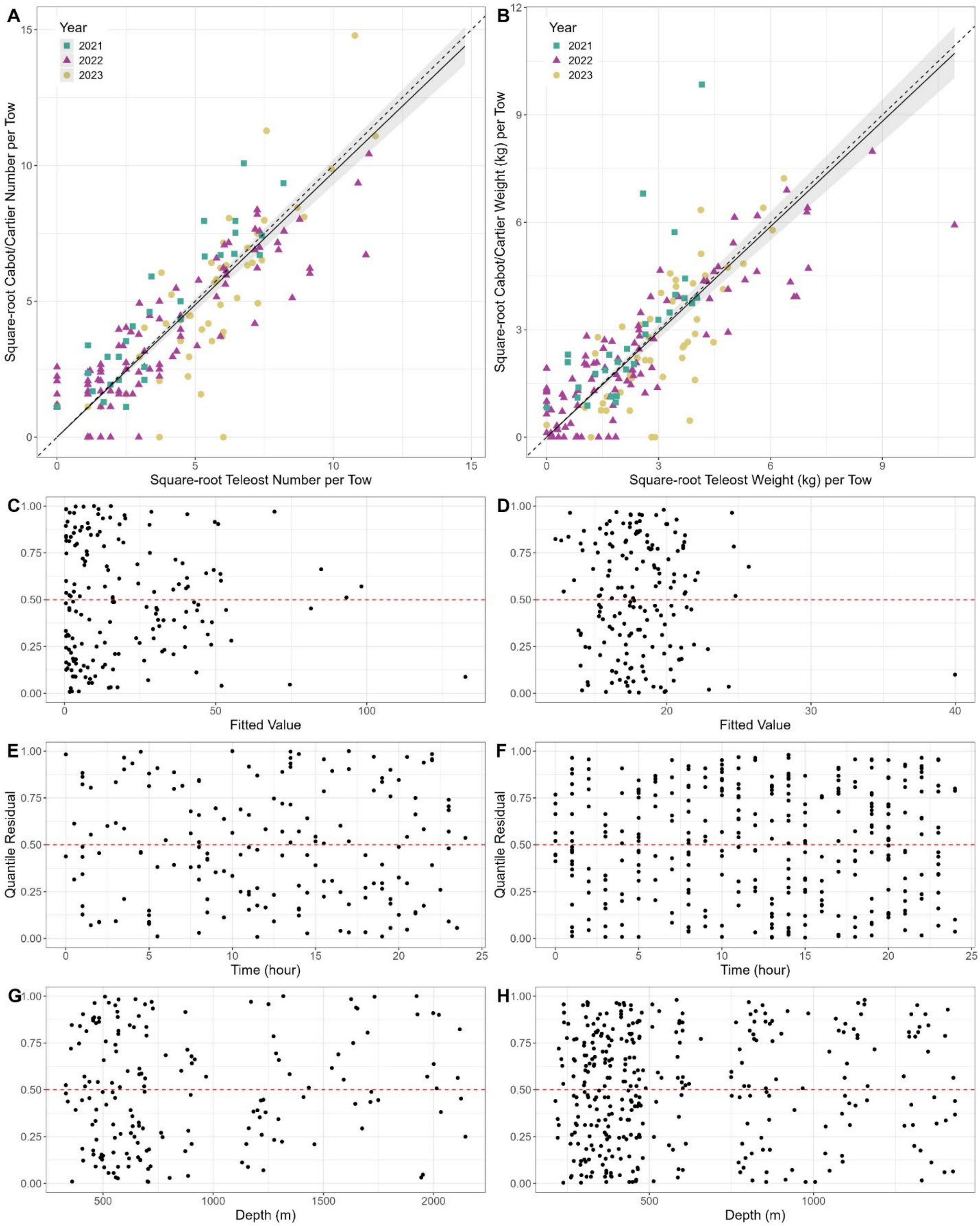


Figure 17. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Roughhead Grenadier, fall NAFO Divisions 2HJ3K + 3L deep.*

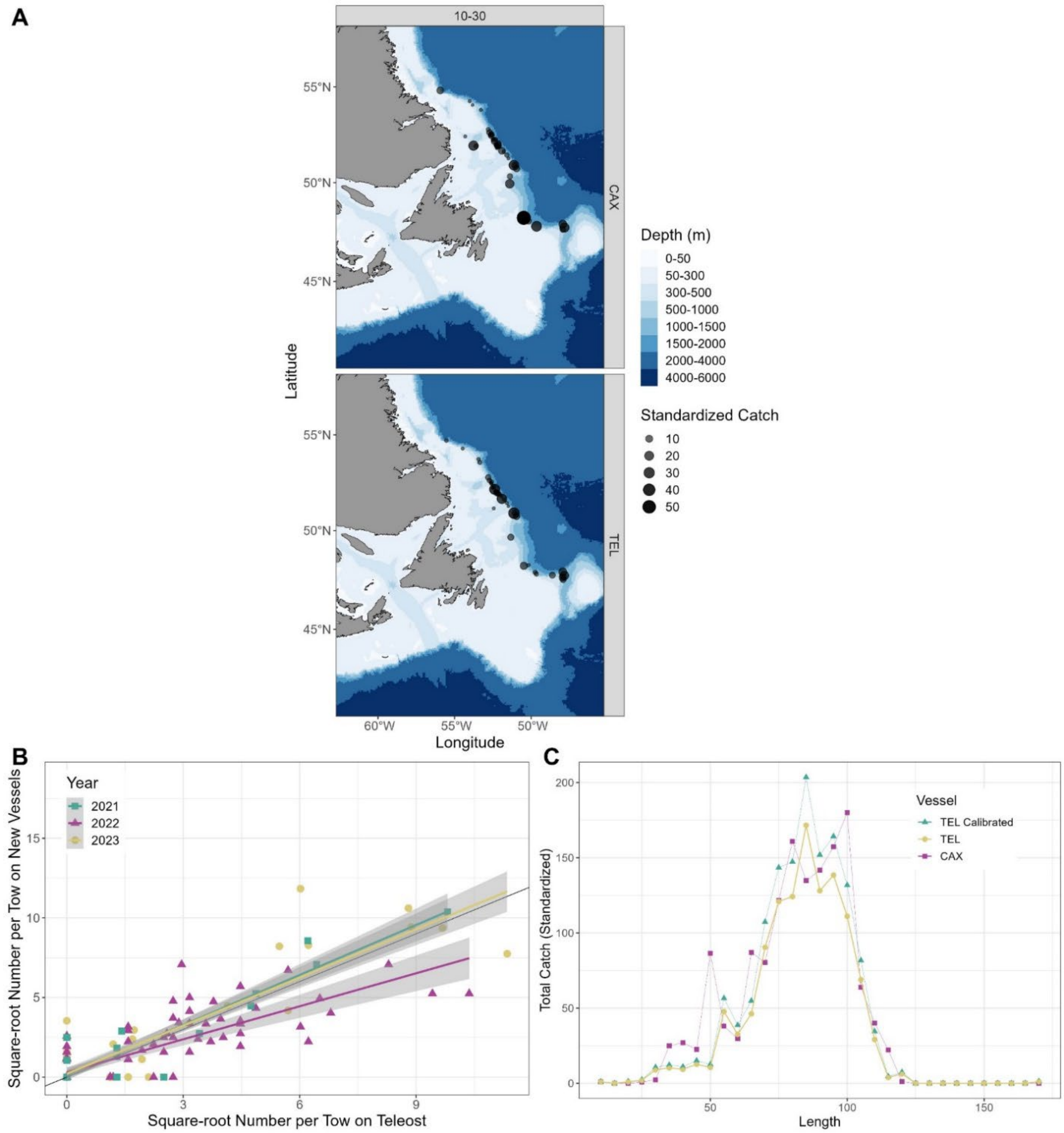
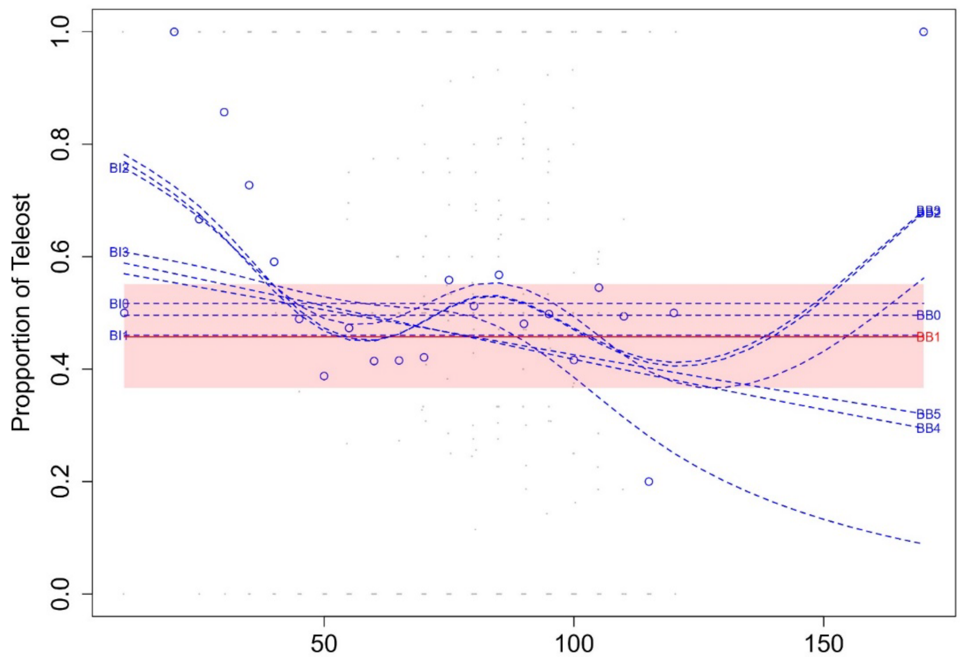


Figure 18. Results for length-disaggregated comparative fishing analyses for Common Grenadier for best model selected, between the CCGS Teleost *("TEL") and CCGS* Capt Jacques Cartier/John Cabot *("CAX") for fall NAFO Divisions 2HJ3K + 3L deep. (A) map of catches by length group (length in cm specified in top panel) by the CCGS* Capt Jacques Cartier/John Cabot *(top) and the CCGS* Teleost *(bottom) in comparative fishing sets, where circle size is proportional catch weight. (B) Biplot of the square-root of CCGS* Capt Jacques Cartier/John Cabot *catch numbers against the square-root of CCGS* Teleost *catch numbers. (C) Total length frequencies (mm) for catches made by the CCGS* Teleost *(yellow), by the CCGS* Capt Jacques Cartier/John Cabot *(purple), and CCGS* Teleost *catches with the conversion factor applied (green).*

A



B

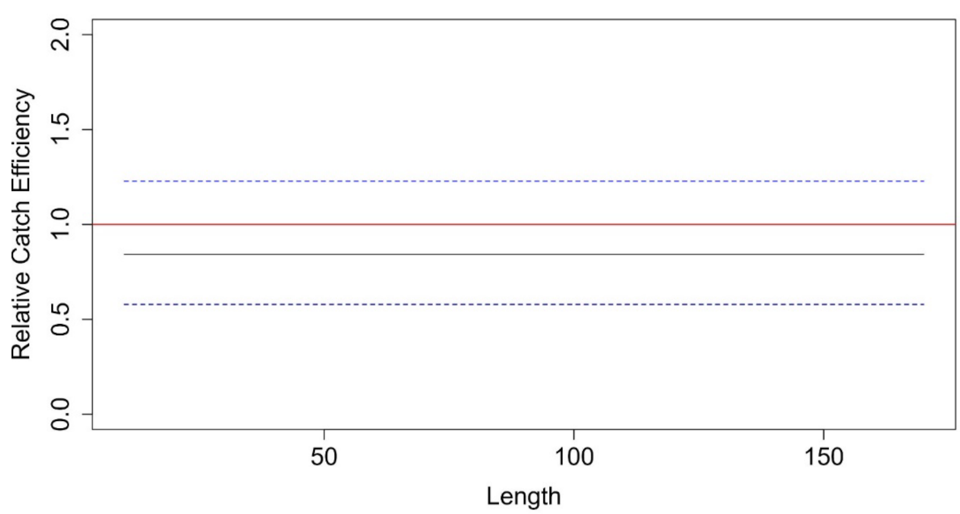


Figure 19. Common Grenadier conversion factor for best model selected between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO Divisions 2HJ3KL. (A) Estimated length-specific catch proportion functions, $logit(p_{Ai}(l))$, for each converged model, with the selected model plotted using a red line along with its approximate 95% CI, shaded area, as well as the length class-specific mean empirical proportion of total catch in a pair made by the CCGS* Teleost *(blue dots). (B) Estimated relative catch efficiency (conversion factor) function from the best model (black line) with 95% CI (dashed blue lines). The horizontal red line indicates equivalent efficiency between vessels.*

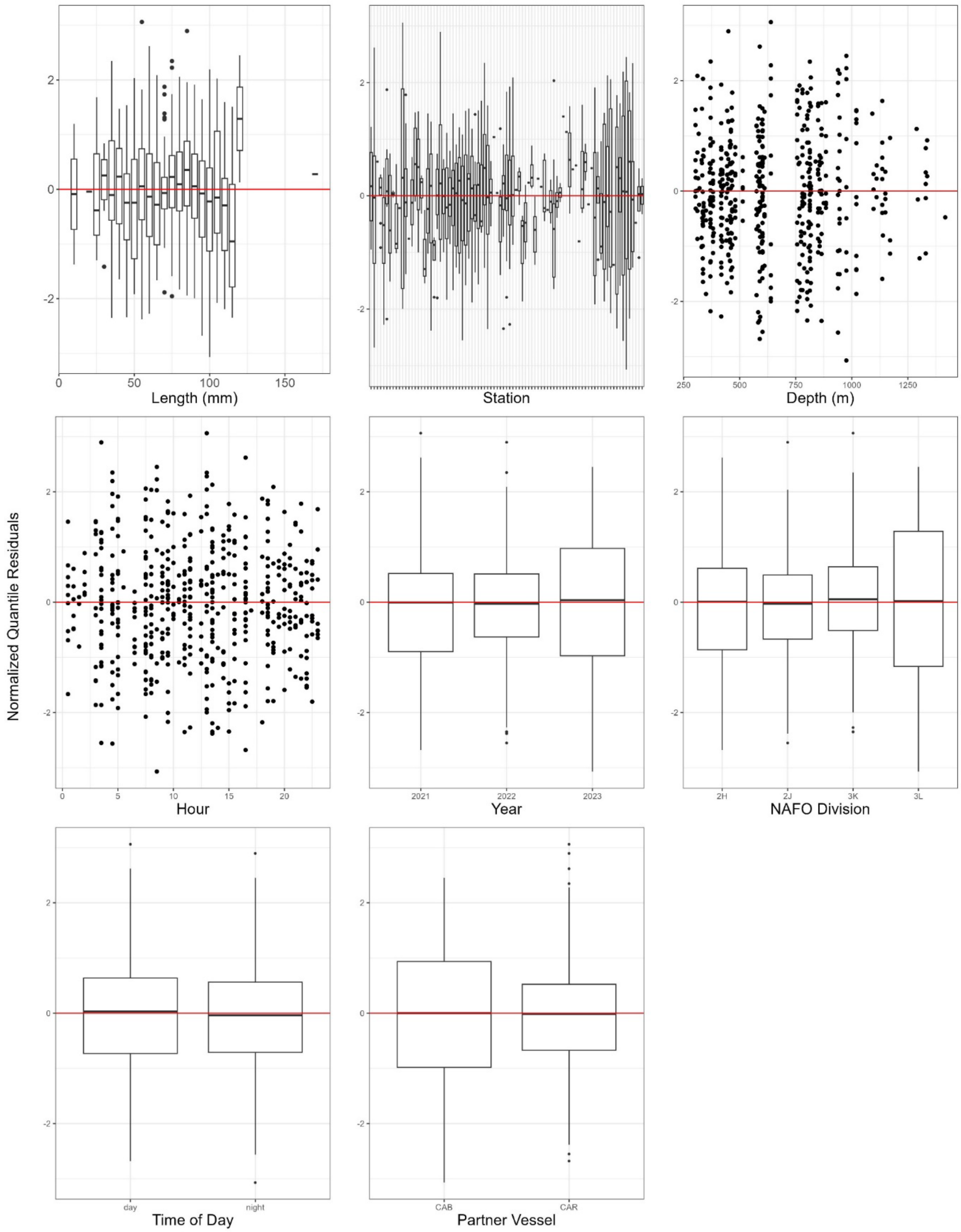


Figure 20. Normalized quantile residuals as a function of length, station, depth, hour, year, NAFO Division, diel period, and partner vessel for Common Grenadier for length-disaggregated conversion factor analysis, best model selected, for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO Divisions 2HJ3K + 3L deep.*

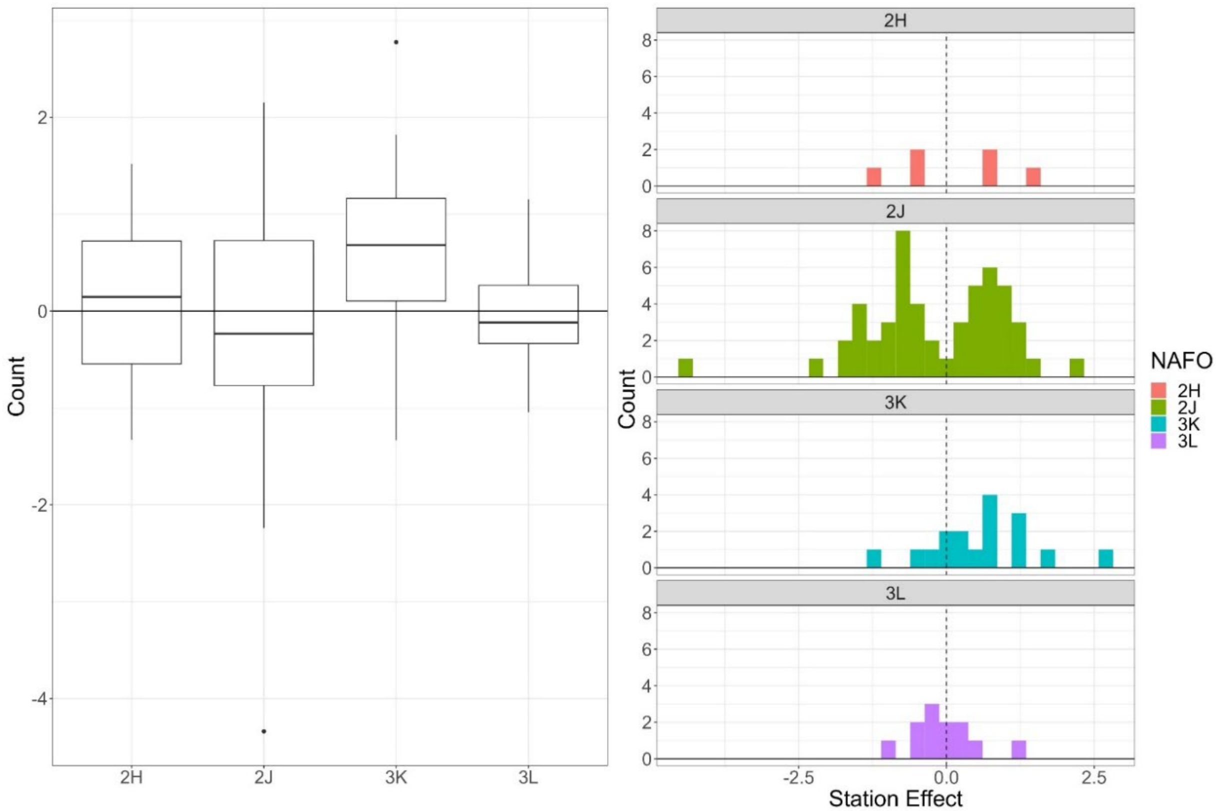


Figure 21. Boxplot (left) and histogram (right) of station effect by NAFO Division for best model selected for Common Grenadier, conversion factor analysis between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *in fall NAFO Divisions 2HJ3K + 3L deep.*

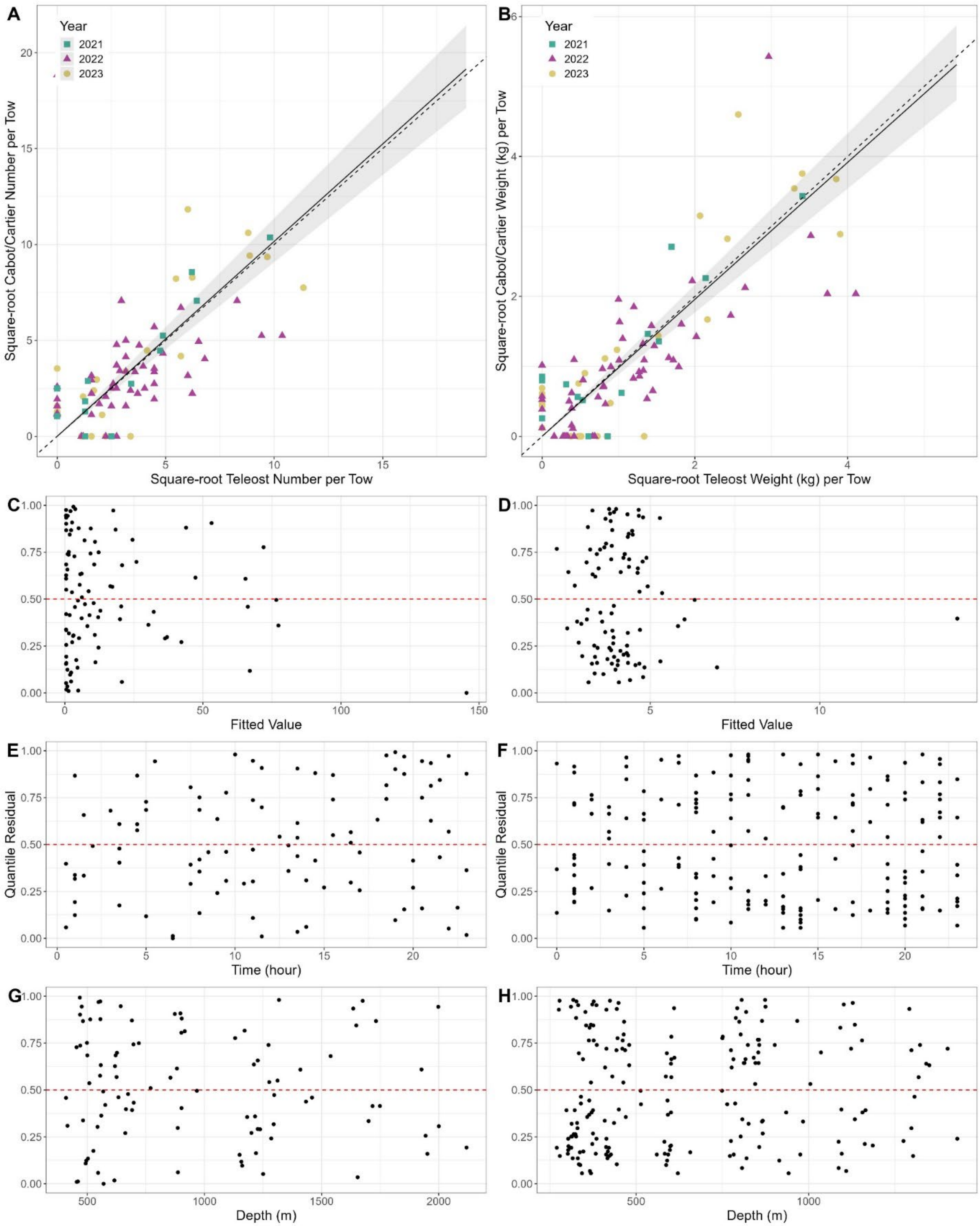


Figure 22. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Common Grenadier, fall NAFO Divisions 2HJ3K + 3L deep.*

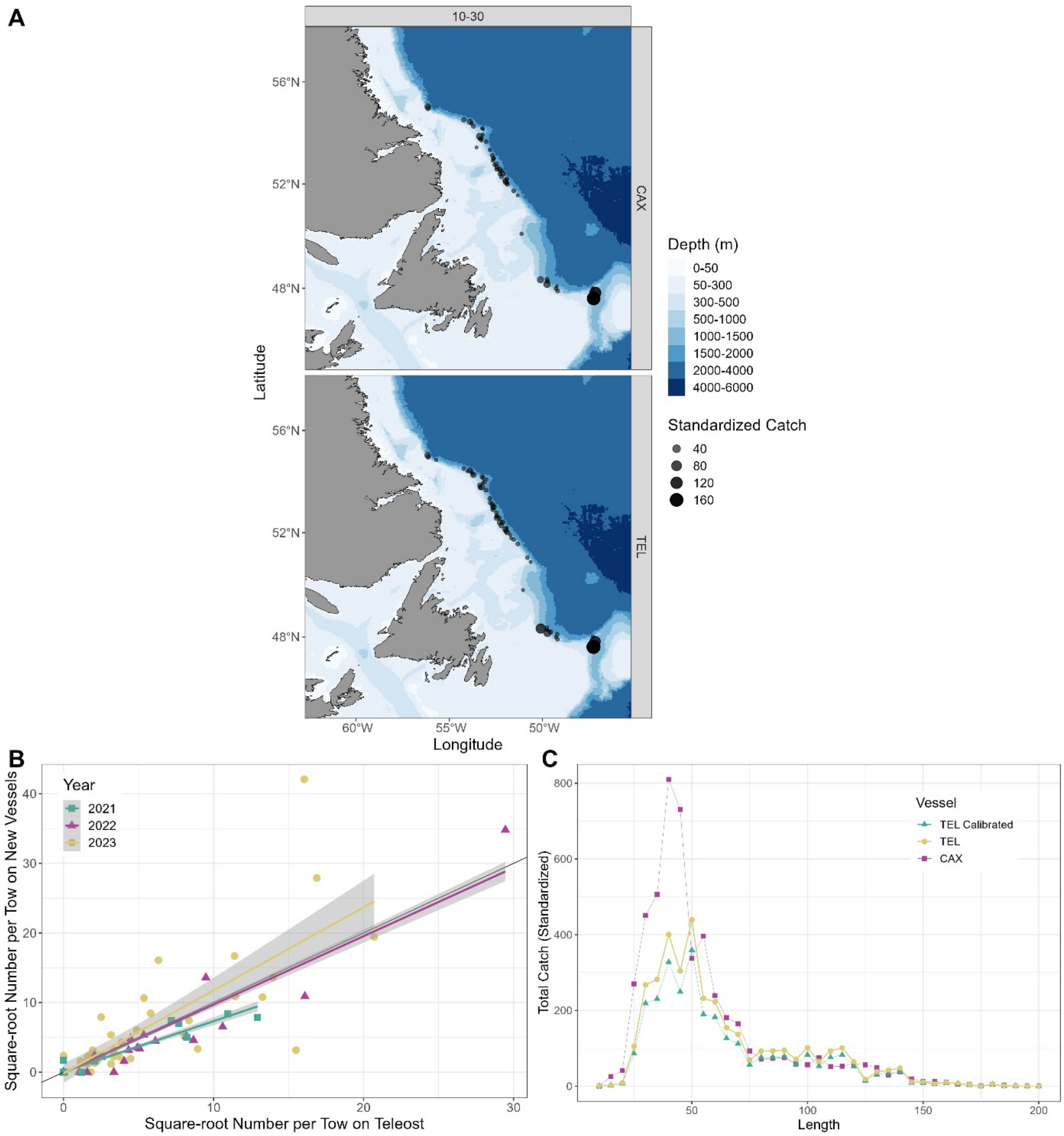


Figure 23. Results for length-disaggregated comparative fishing analyses for Roundnose Grenadier for best model selected, between the CCGS Teleost *("TEL") and CCGS* Capt Jacques Cartier/John Cabot *("CAX") for fall NAFO Divisions 2HJ3K + 3L deep. (A) map of catches by length group (length in cm specified in top panel) by the CCGS* Capt Jacques Cartier/John Cabot *(top) and the CCGS* Teleost *(bottom) in comparative fishing sets, where circle size is proportional catch weight. (B) Biplot of the square-root of CCGS* Capt Jacques Cartier/John Cabot *catch numbers against the square-root of CCGS* Teleost *catch numbers. (C) Total length frequencies (mm) for catches made by the CCGS* Teleost *(yellow), by the CCGS* Capt Jacques Cartier/John Cabot *(purple), and CCGS* Teleost *catches with the conversion factor applied (green).*

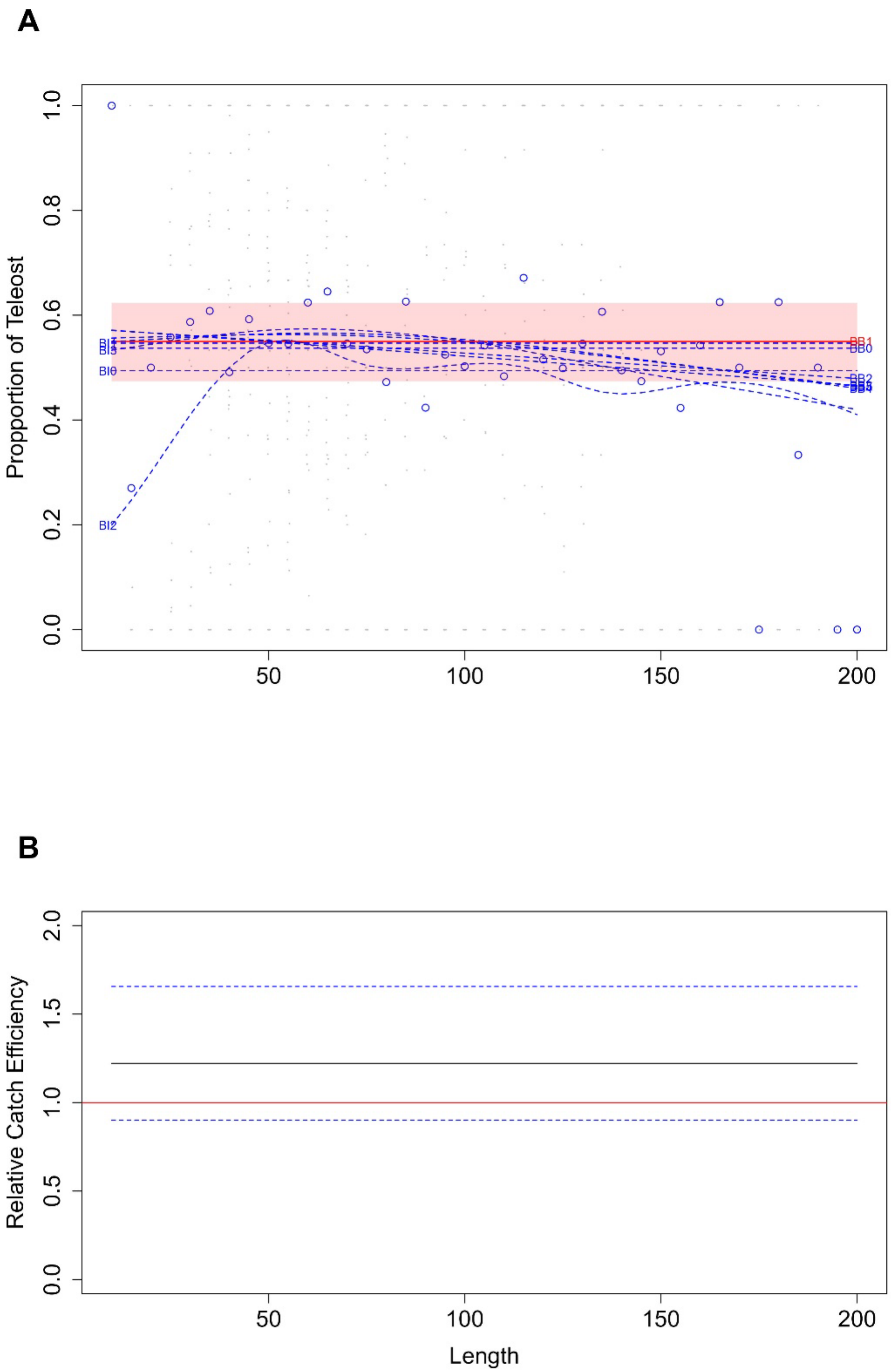


Figure 24. Roundnose Grenadier conversion factor for best model selected between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO Divisions 2HJ3KL. (A) Estimated length-specific catch proportion functions, $logit(p_{Ai}(l))$, for each converged model, with the selected model plotted using a red line along with its approximate 95% CI; shaded area, as well as the length class-specific mean empirical proportion of total catch in a pair made by the CCGS* Teleost *(blue dots). (B) Estimated relative catch efficiency (conversion factor) function from the best model (black line) with 95% CI (dashed blue lines). The horizontal red line indicates equivalent efficiency between vessels.*

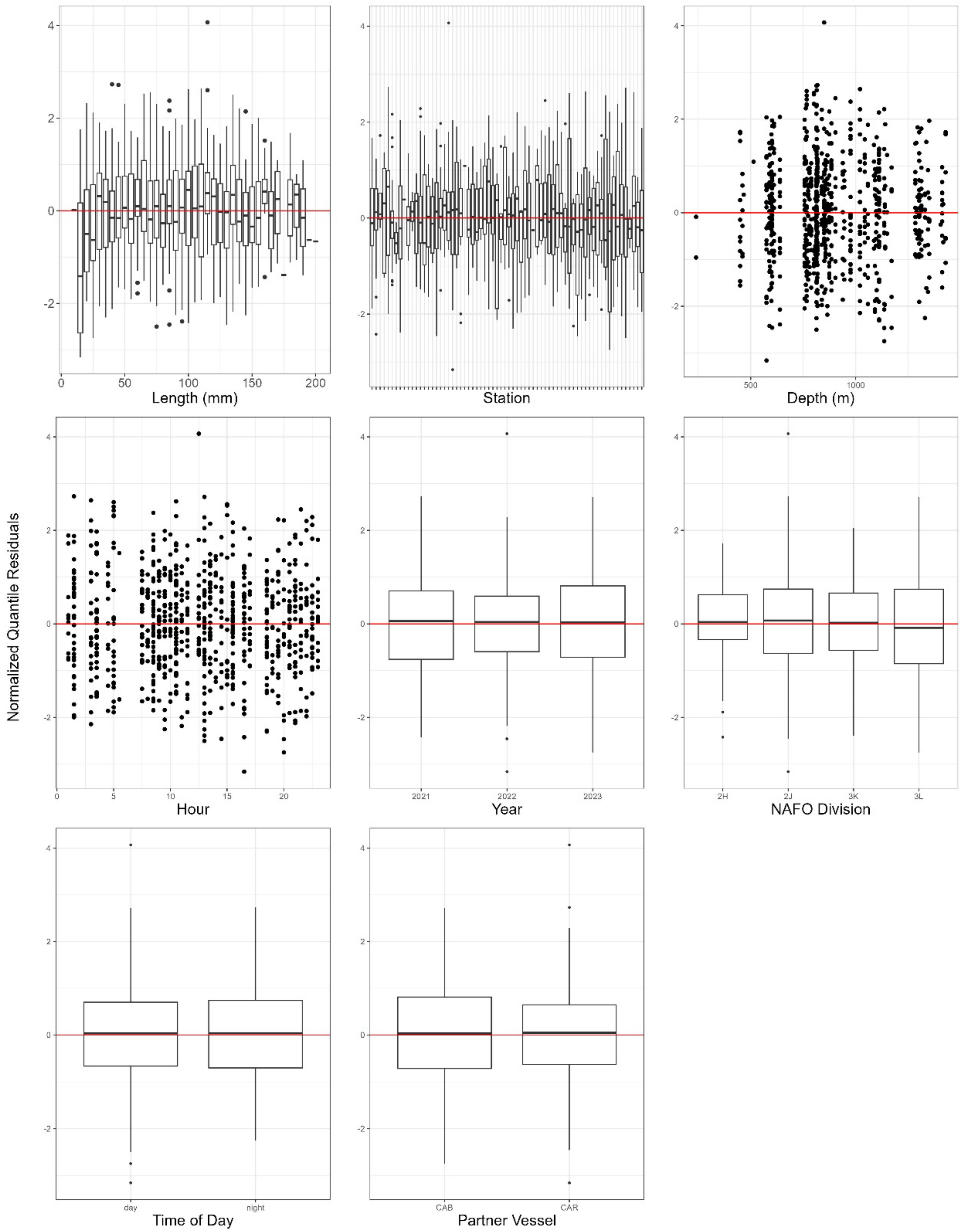


Figure 25. Normalized quantile residuals as a function of length, station, depth, hour, year, NAFO Division, diel period, and partner vessel for Roundnose Grenadier for length-disaggregated conversion factor analysis, best model selected, for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO Divisions 2HJ3K + 3L deep.*

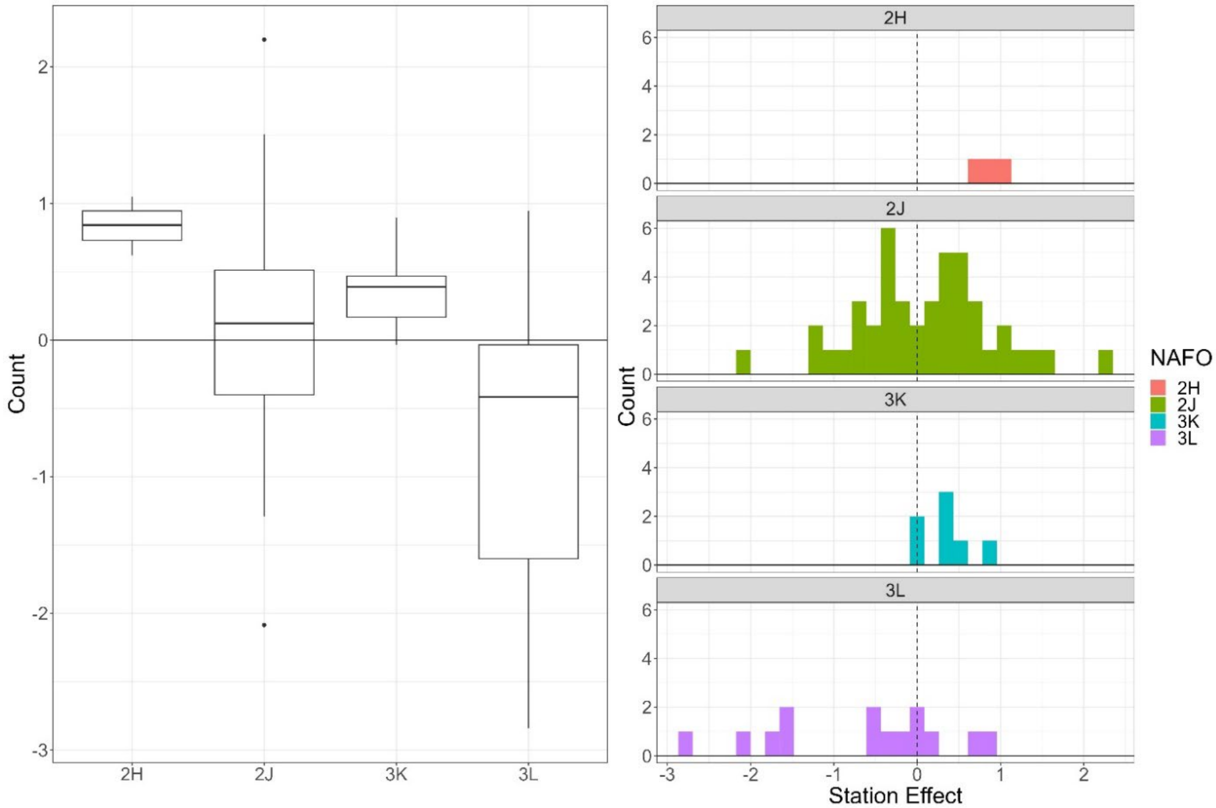


Figure 26. Boxplot (left) and histogram (right) of station effect by NAFO Division for best model selected for Roundnose Grenadier, conversion factor analysis between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *in fall NAFO Divisions 2HJ3K + 3L deep.*

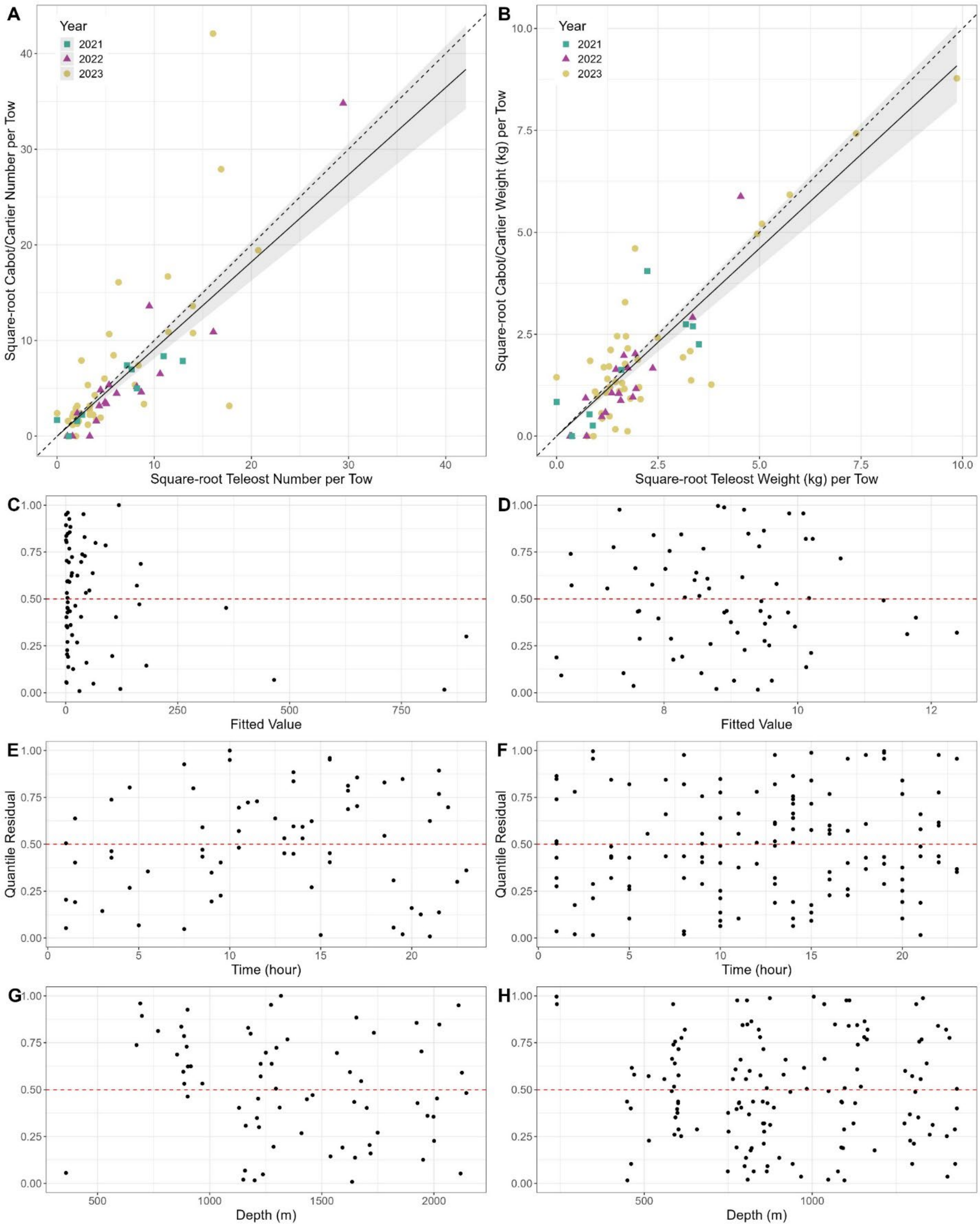


Figure 27. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Roundnose Grenadier, fall NAFO Divisions 2HJ3K + 3L deep.*

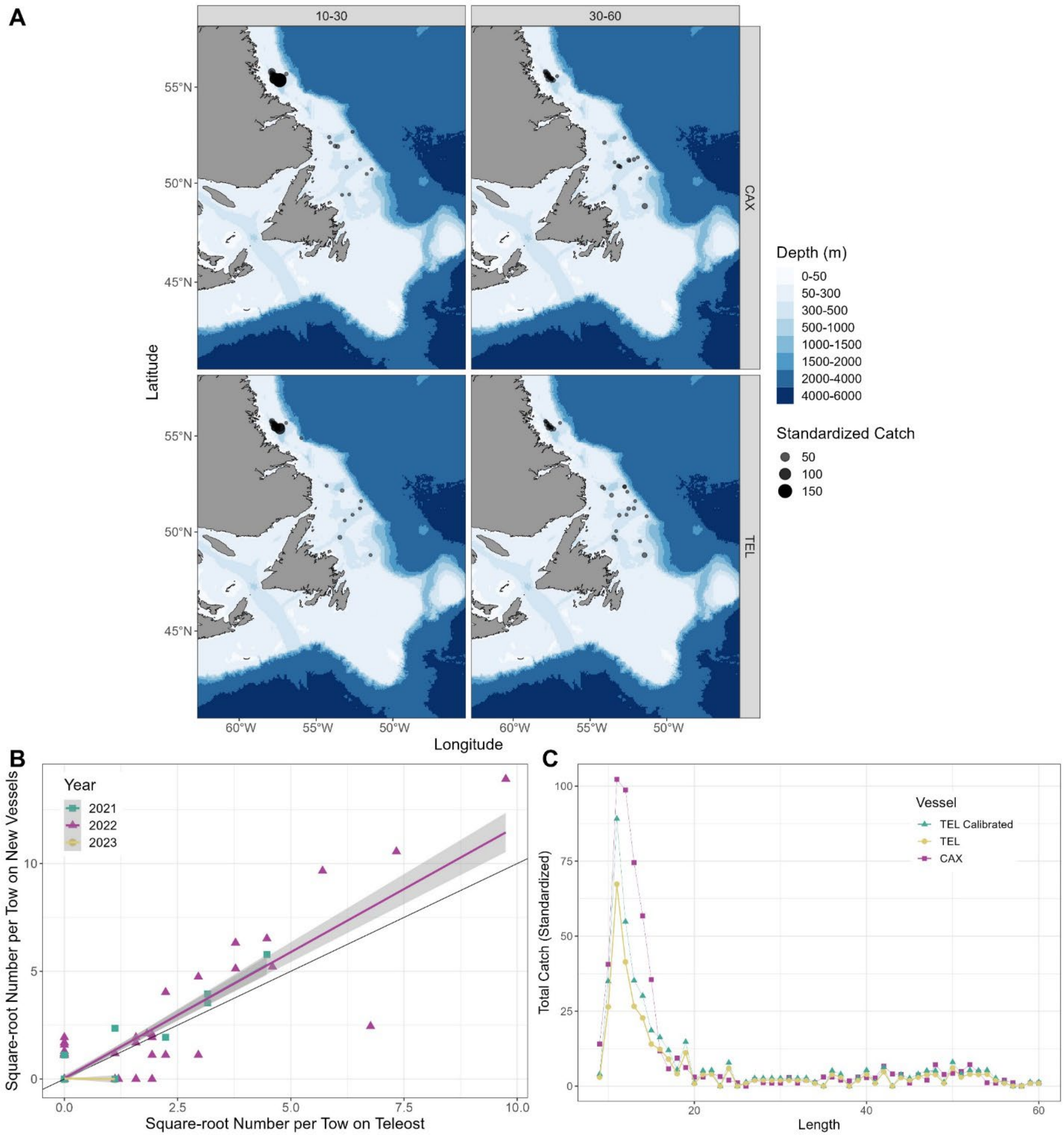


Figure 28. Results for length-disaggregated comparative fishing analyses for Smooth Skate for best model selected, between the CCGS Teleost *("TEL") and CCGS* Capt Jacques Cartier/John Cabot *("CAX") for fall NAFO Divisions 2HJ3K + 3L deep. (A) map of catches by length group (length in cm specified in top panel) by the CCGS* Capt Jacques Cartier/John Cabot *(top) and the CCGS* Teleost *(bottom) in comparative fishing sets, where circle size is proportional catch weight. (B) Biplot of the square-root of CCGS* Capt Jacques Cartier/John Cabot *catch numbers against the square-root of CCGS* Teleost *catch numbers. (C) Total length frequencies (cm) for catches made by the CCGS* Teleost *(yellow), by the CCGS* Capt Jacques Cartier/John Cabot *(purple), and CCGS* Teleost *catches with the conversion factor applied (green).*

A

B

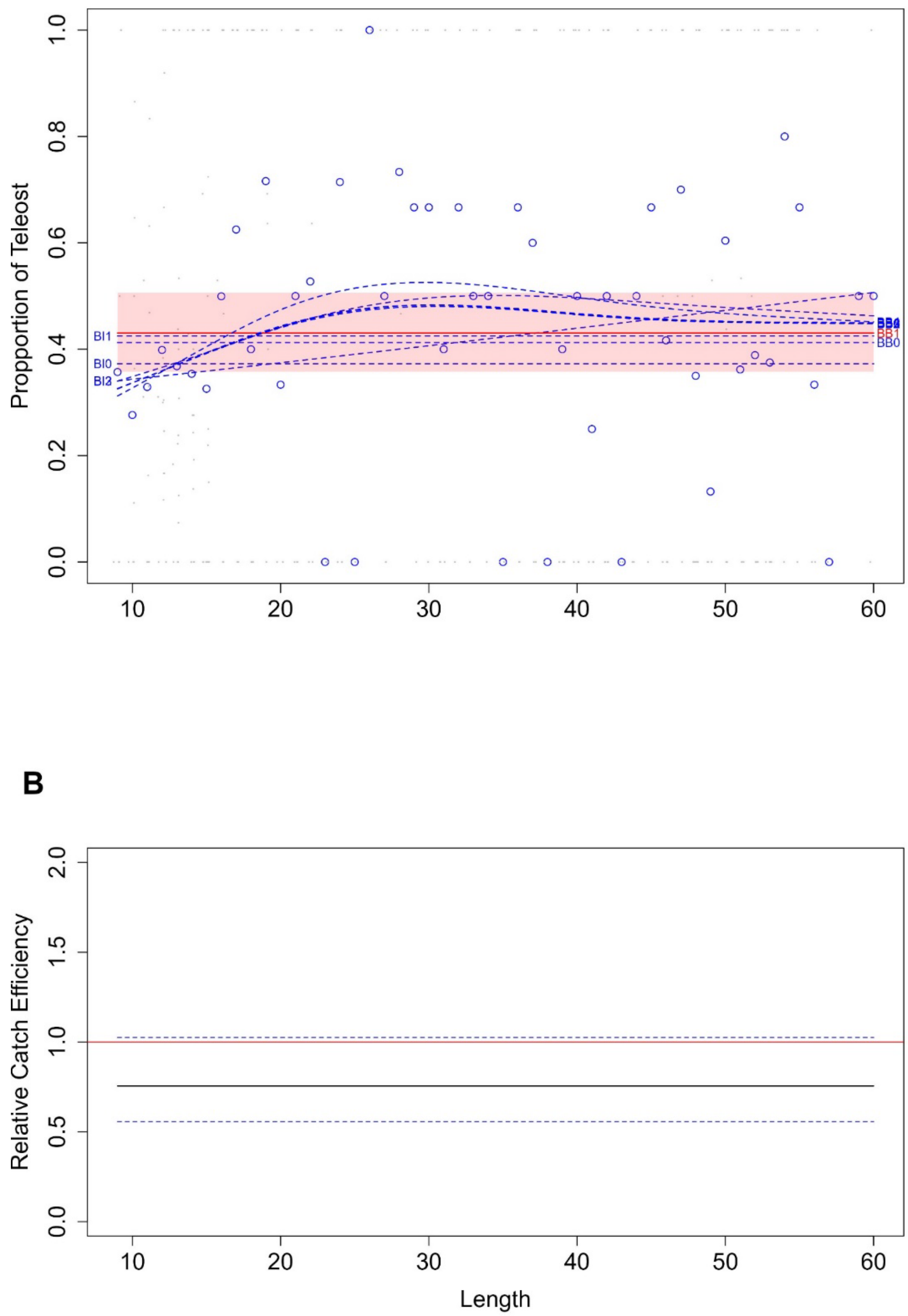


Figure 29. Smooth Skate conversion factor for best model selected between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO Divisions 2HJ3KL. (A) Estimated length-specific catch proportion functions,* $logit(p_{Ai}(l))$*, for each converged model, with the selected model plotted using a red line along with its approximate 95% CI, shaded area, as well as the length class-specific mean empirical proportion of total catch in a pair made by the CCGS* Teleost *(blue dots). (B) Estimated relative catch efficiency (conversion factor) function from the best model (black line) with 95% CI (dashed blue lines). The horizontal red line indicates equivalent efficiency between vessels.*

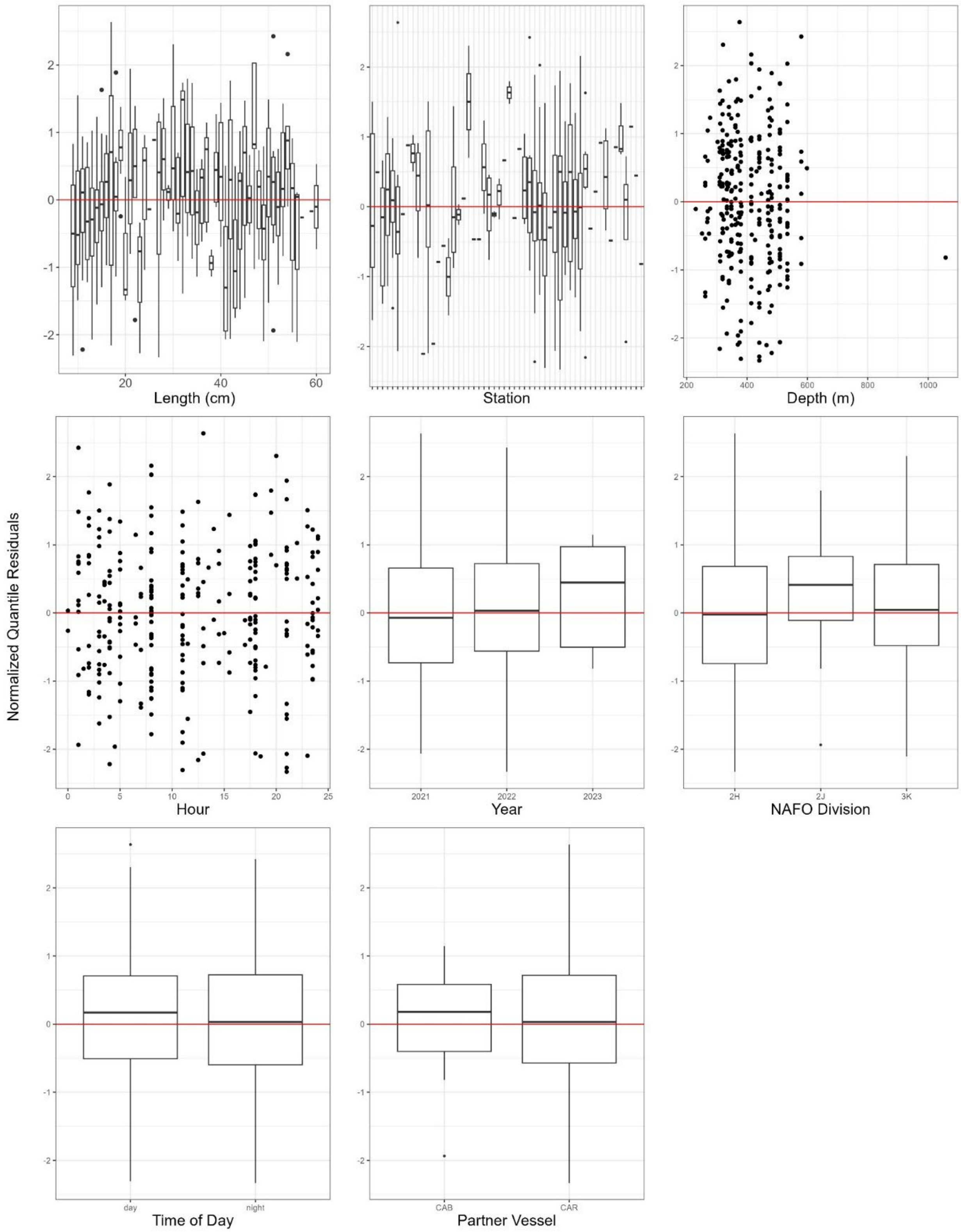


Figure 30. Normalized quantile residuals as a function of length, station, depth, hour, year, NAFO Division, diel period, and partner vessel for Smooth Skate for length-disaggregated conversion factor analysis best model selected, for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for fall NAFO Divisions 2HJ3K + 3L deep.*

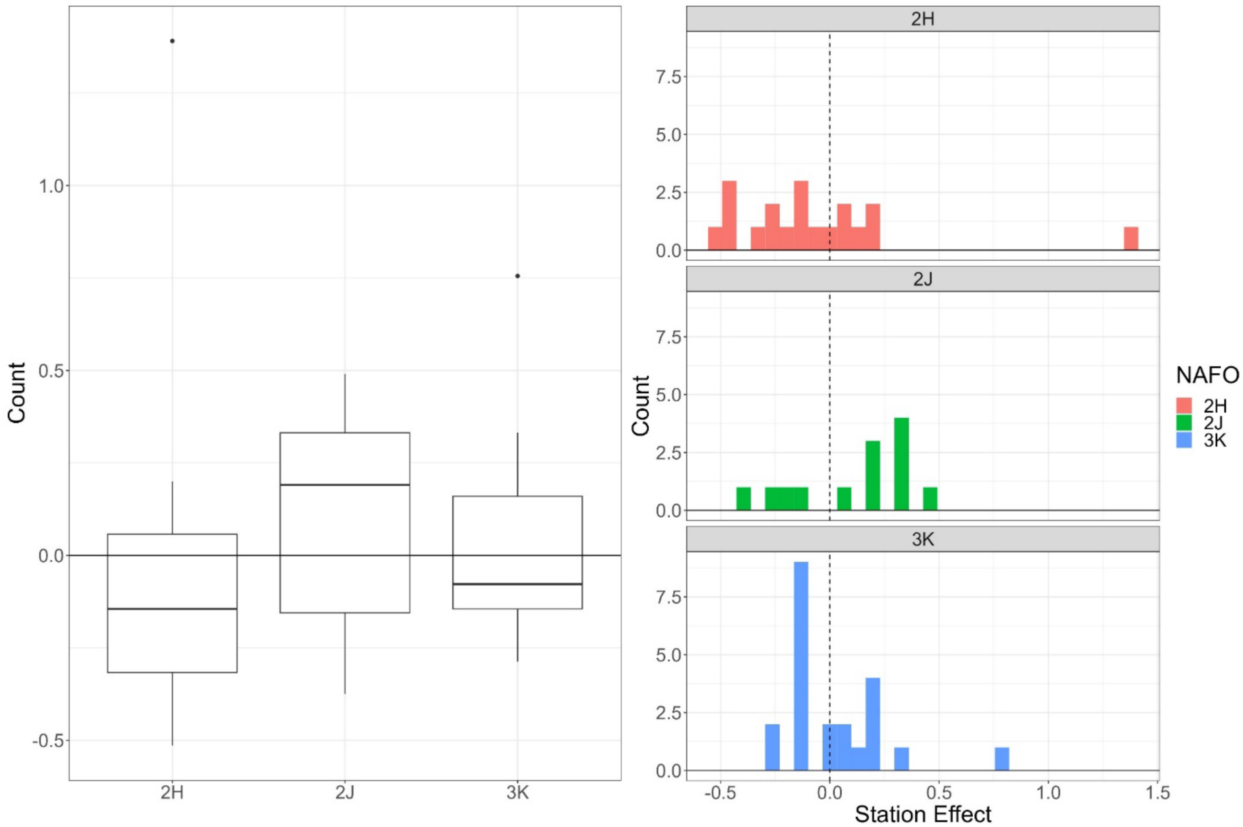


Figure 31. Boxplot (left) and histogram (right) of station effect by NAFO Division for best model selected for Smooth Skate, conversion factor analysis between the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *in fall NAFO Divisions 2HJ3K + 3L deep.*

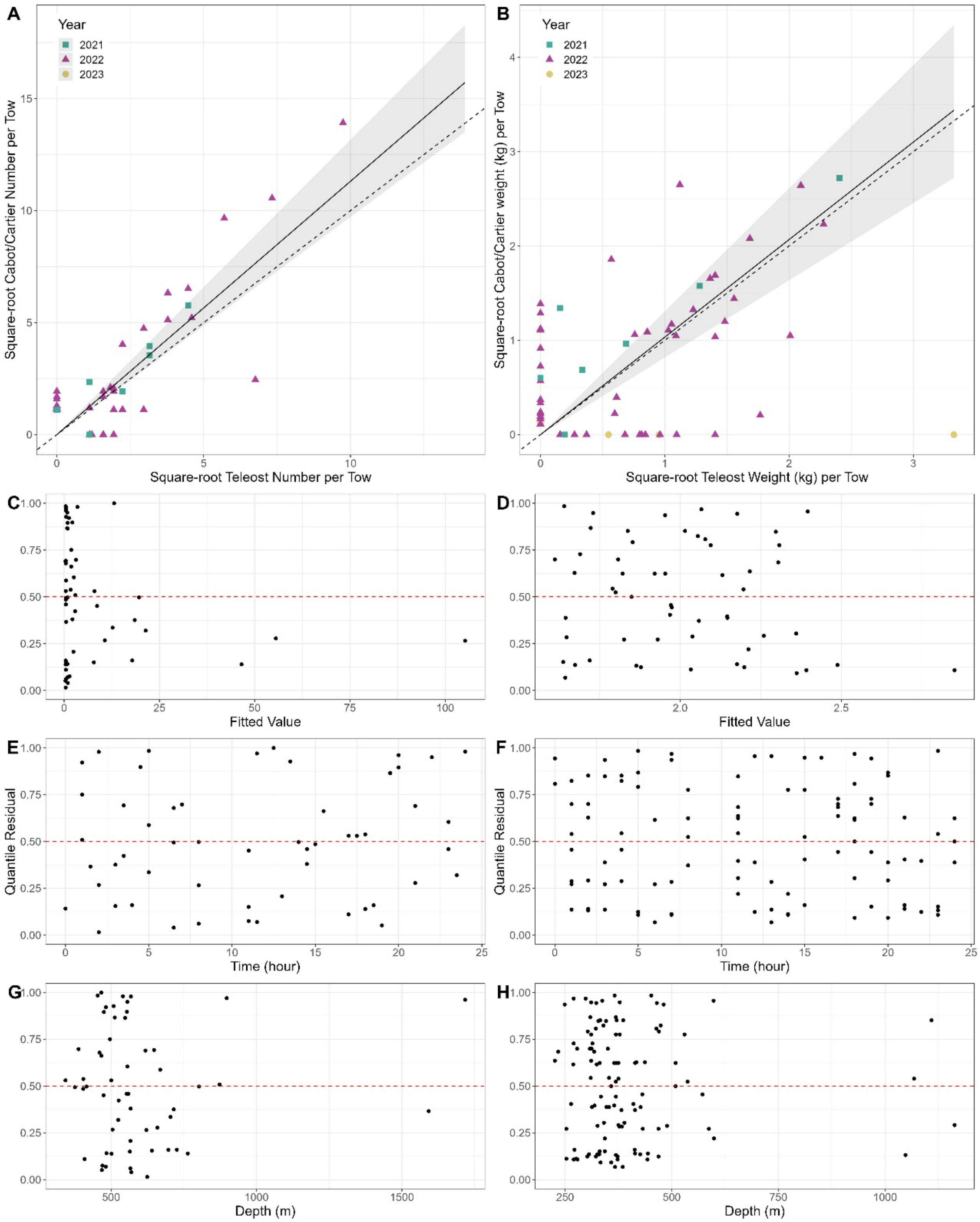


Figure 32. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Smooth Skate, fall NAFO Division 2HJ3K + 3L deep.*

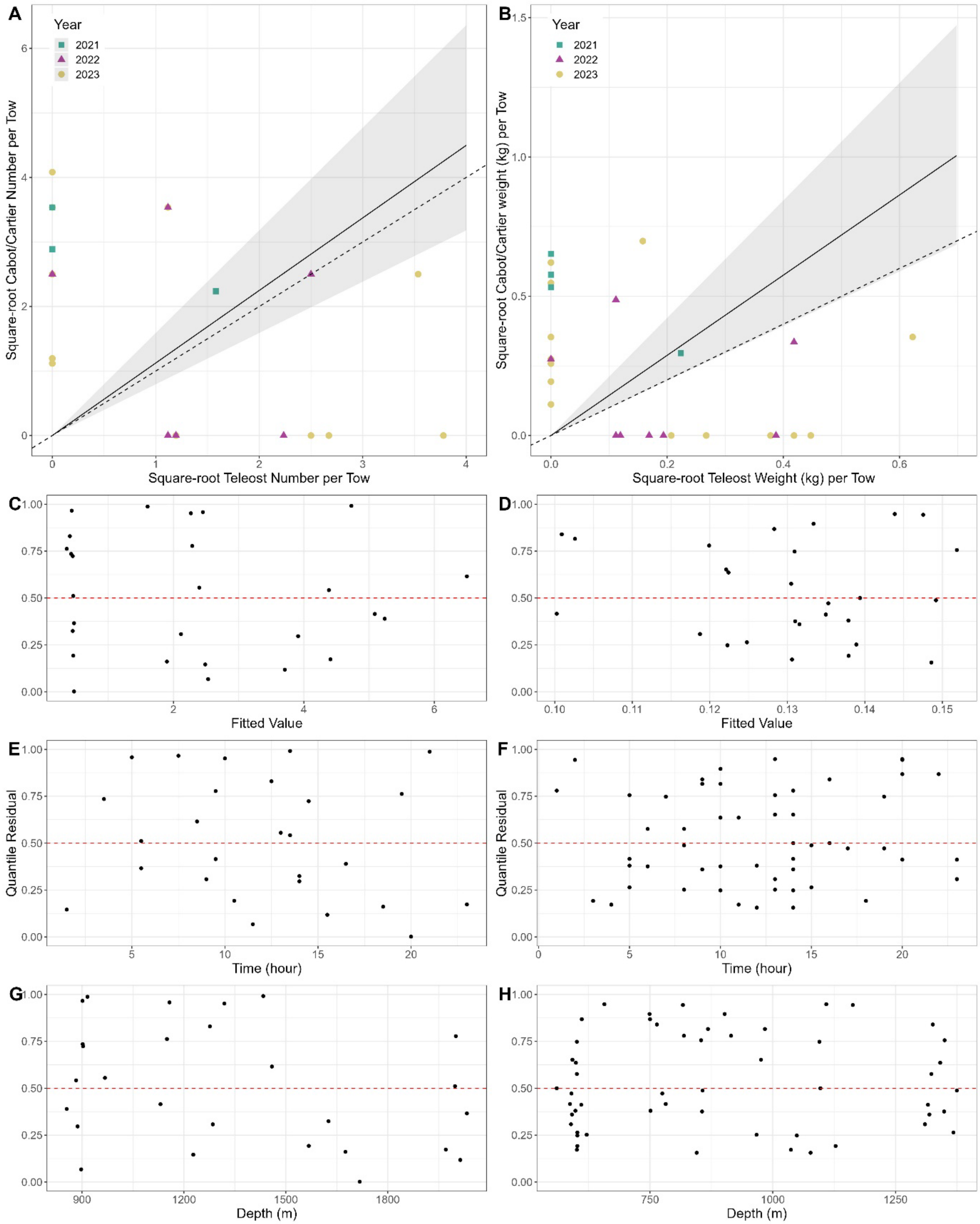


Figure 33. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Atlantic Gymnast (*Xenodermichthys copei*), fall NAFO Division 2HJ3K + 3L deep.*

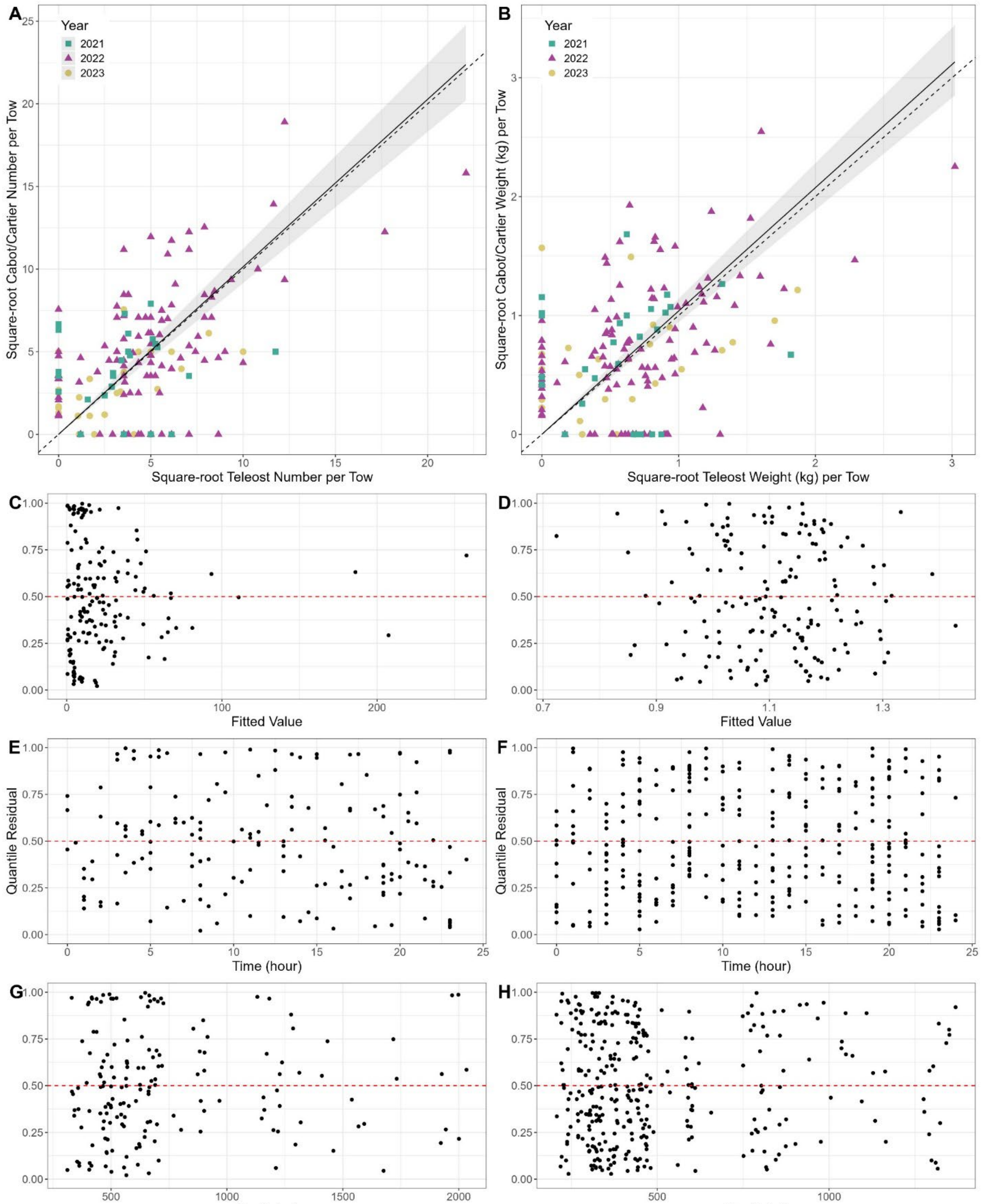


Figure 34. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of barracudina and lancetfish (*Paralepis *sp. and* Notolepis *sp.), fall NAFO Divisions 2HJ3K + 3L deep.*

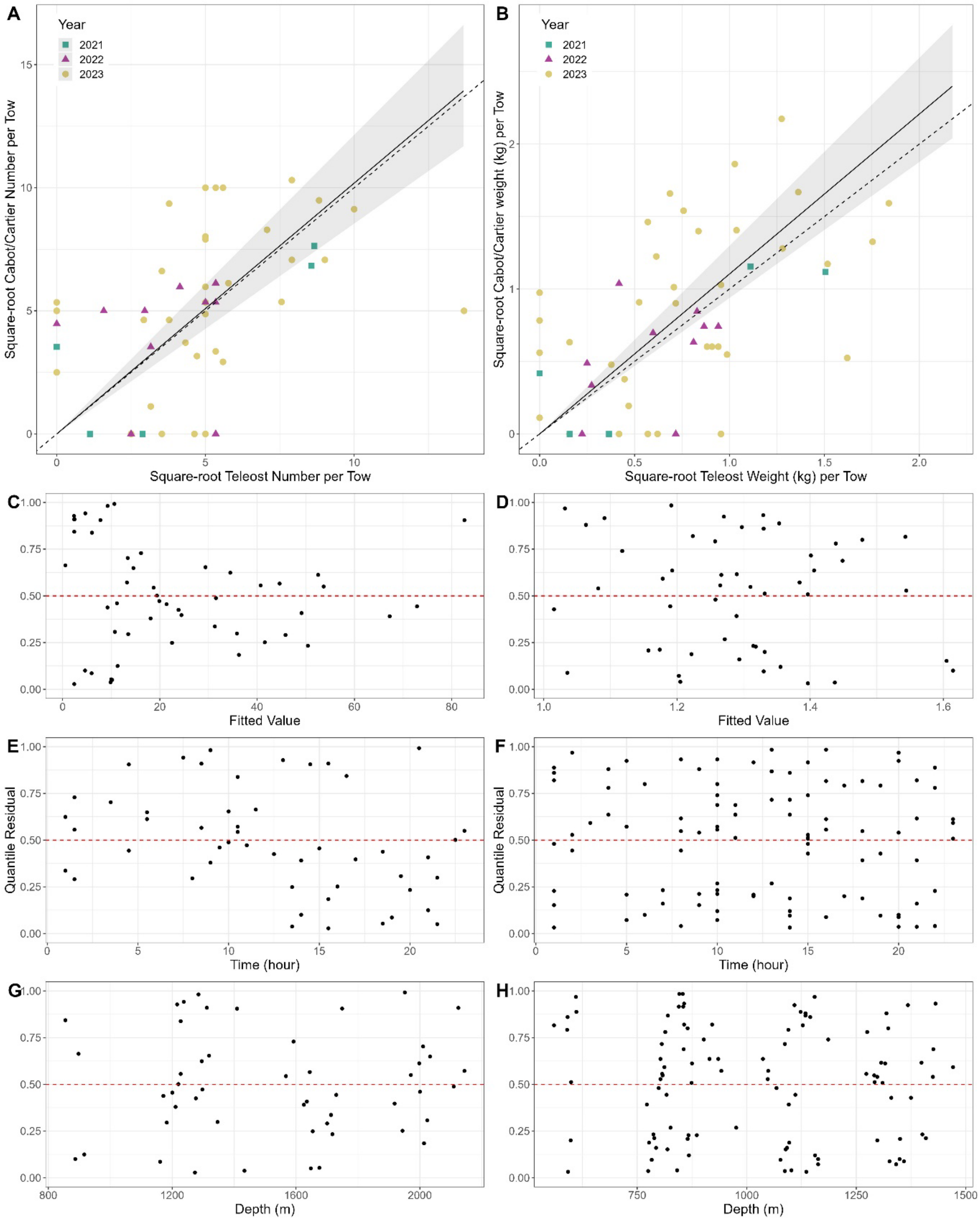


Figure 35. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Goitre Blacksmelt (*Bathylagus euryops*), fall NAFO Divisions 2HJ3K + 3L deep.*

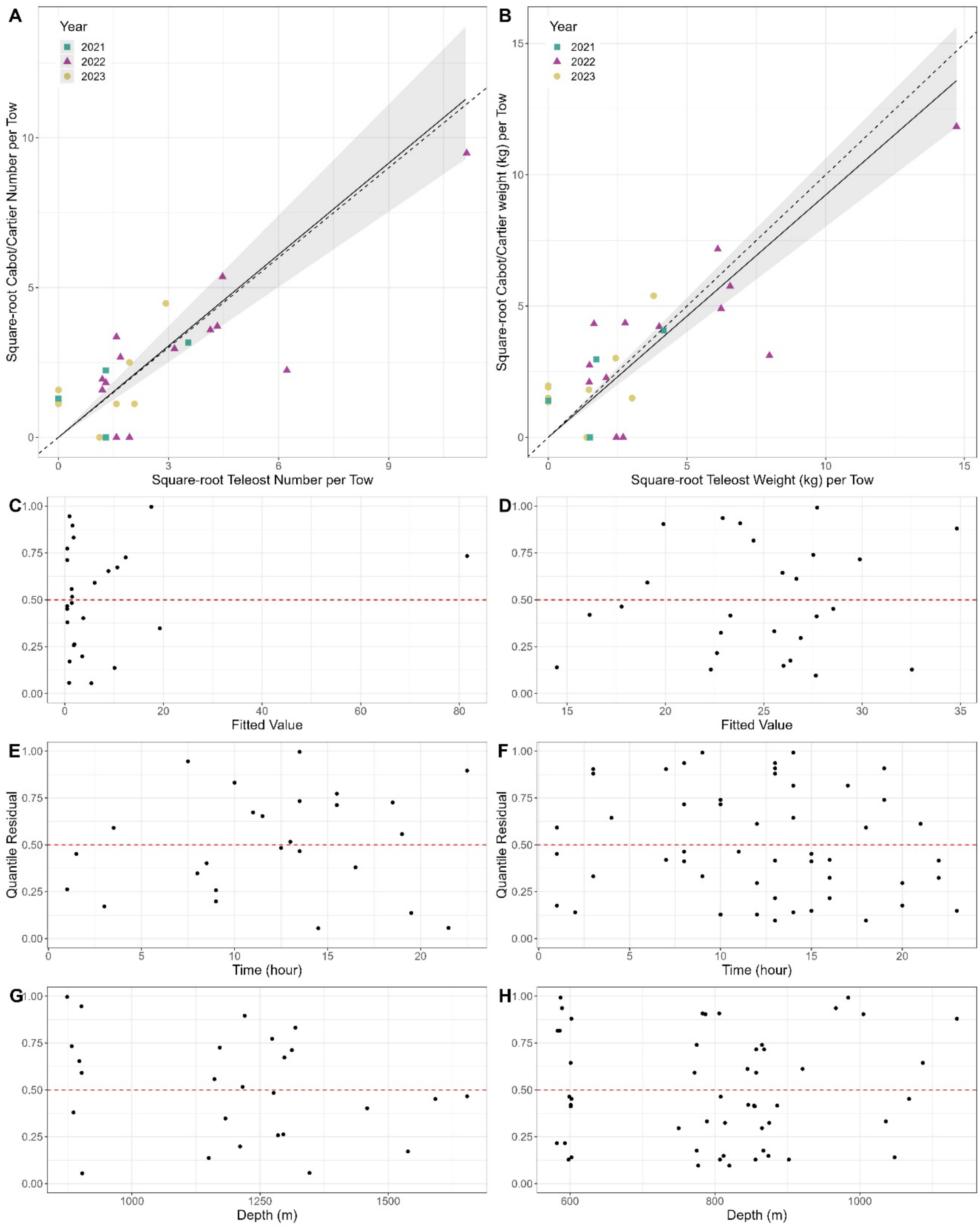


Figure 36. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Black Dogfish (*Centroscyllium fabricii*), fall NAFO Divisions 2HJ3K + 3L deep.*

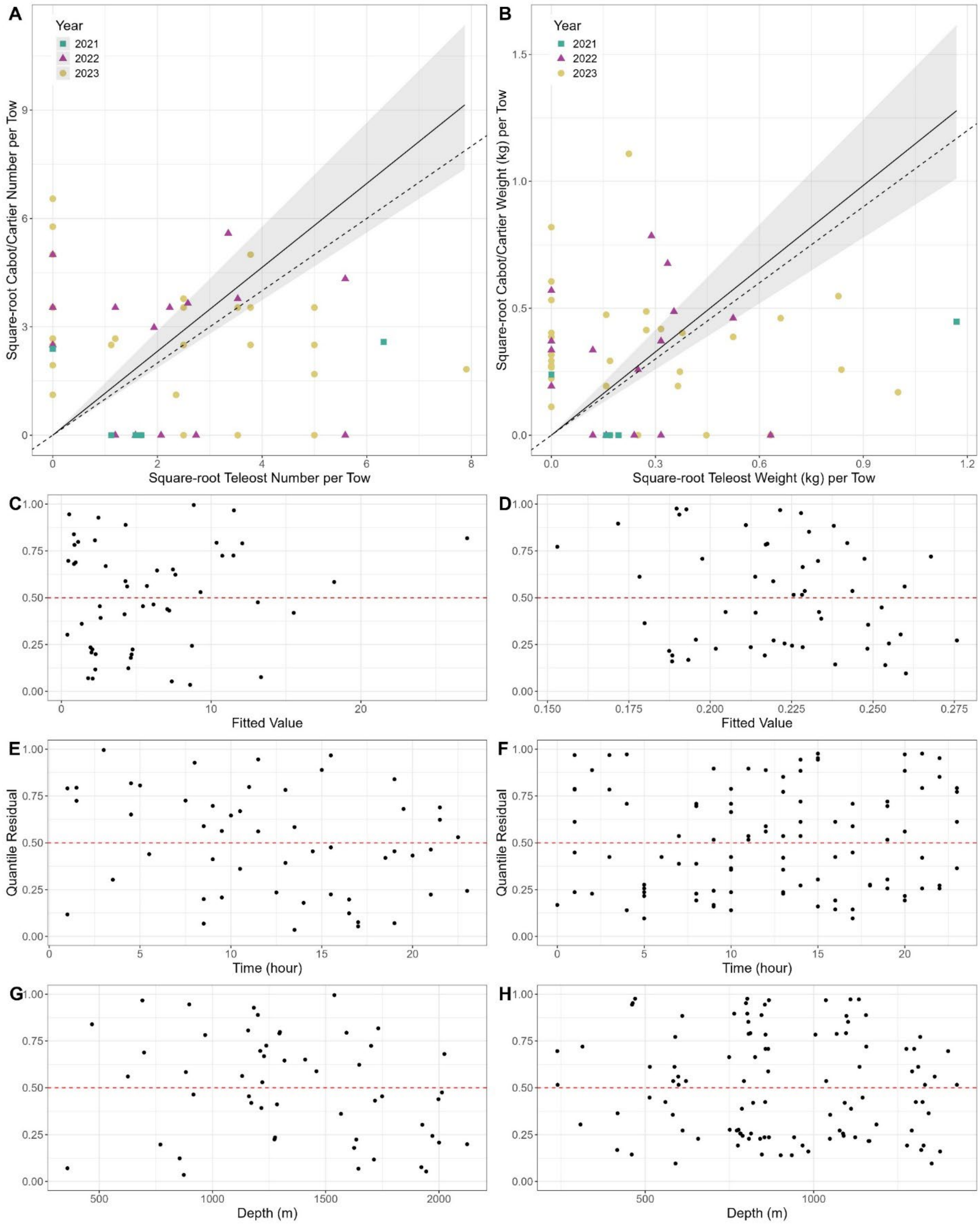


Figure 37. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Boa Dragonfish (*Stomias boa ferox*), fall NAFO Divisions 2HJ3K + 3L deep.*

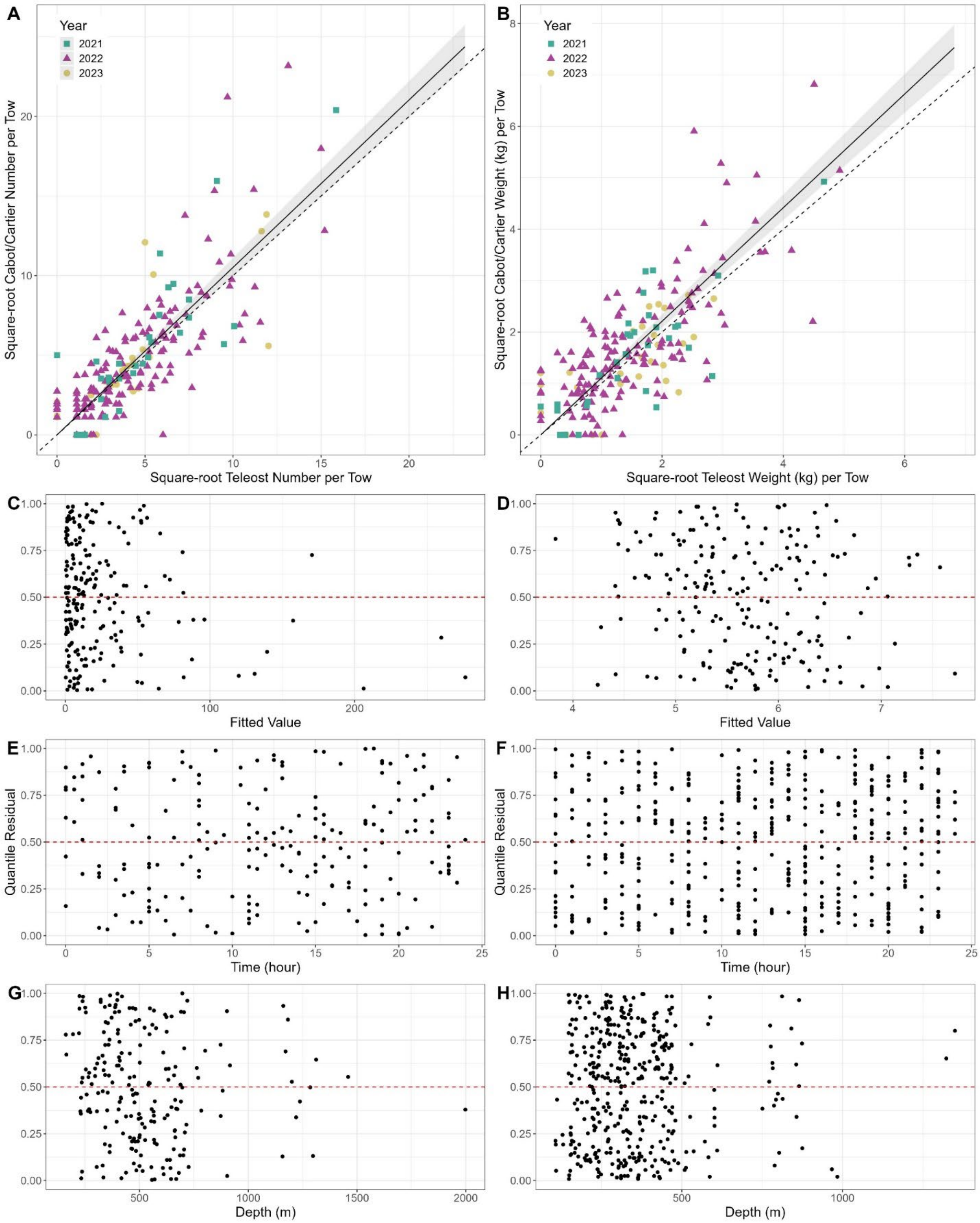


Figure 38. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of eelpouts, fall NAFO Divisions 2HJ3K + 3L deep.*

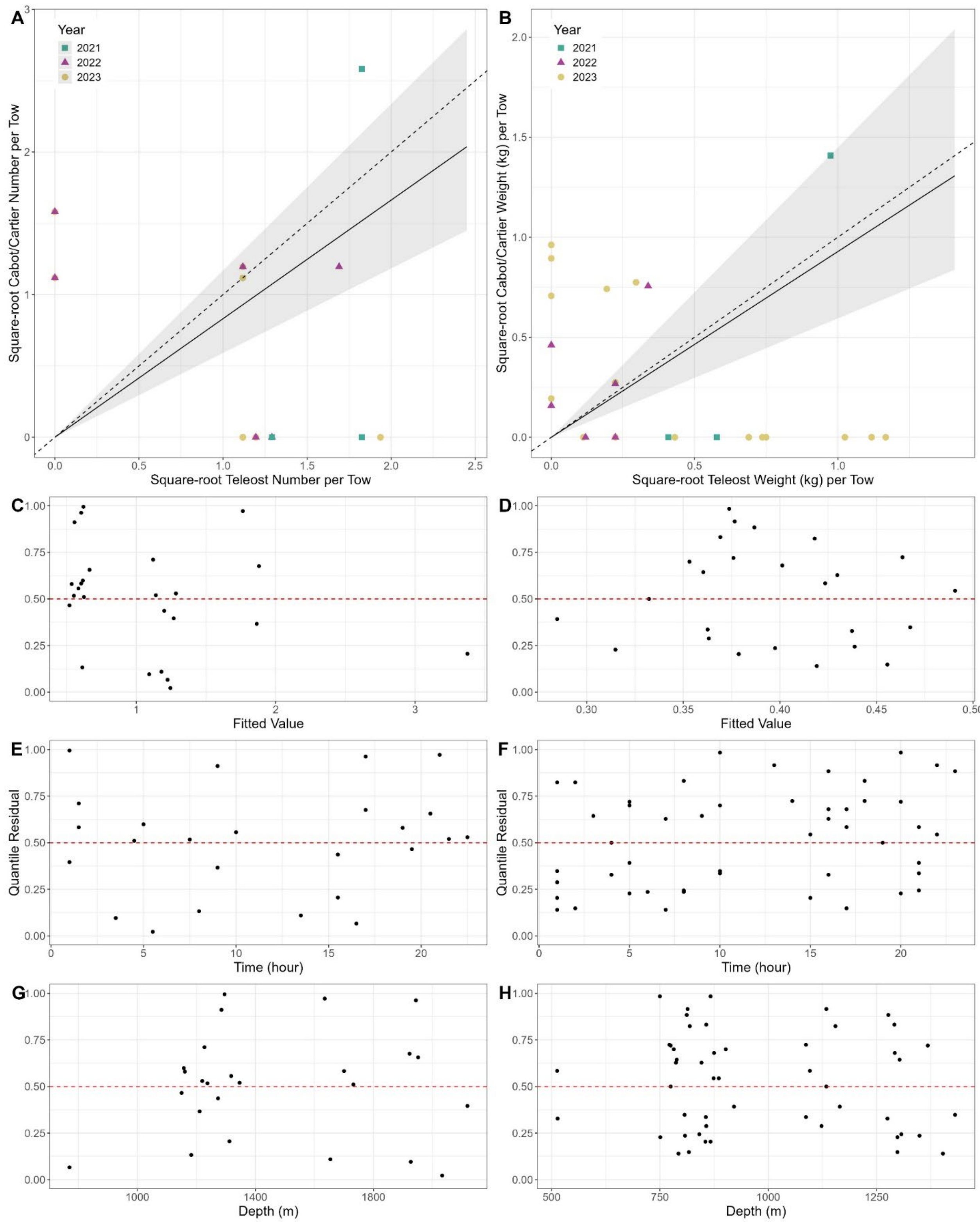


Figure 39. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of other grenadiers (*Trachyrhynchus *sp.,* Coelorhynchus *sp.), fall NAFO Divisions 2HJ3K + 3L deep.*

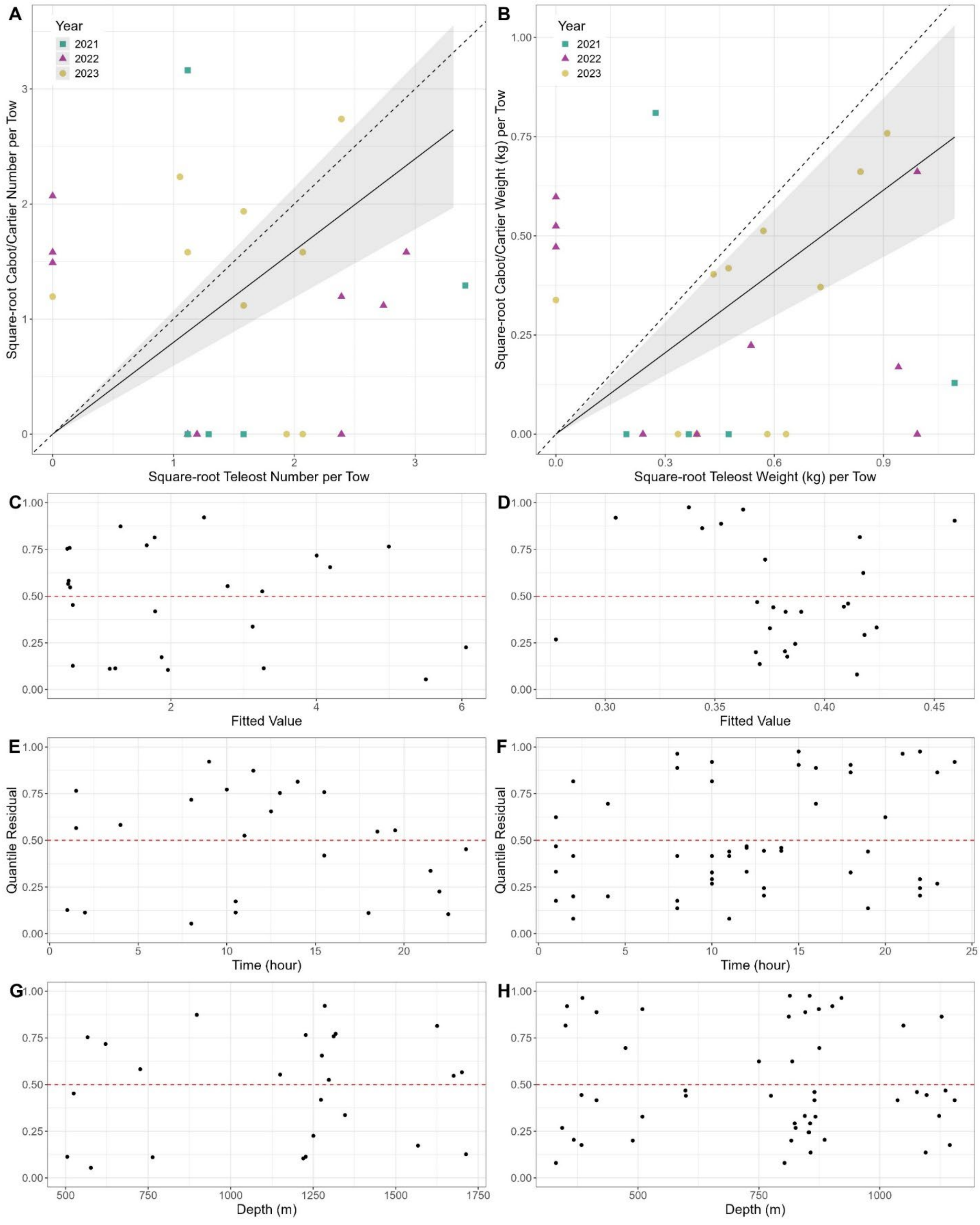


Figure 40. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Atlantic Hagfish (*Myxine glutinosa*), fall NAFO Divisions 2HJ3K + 3L deep.*

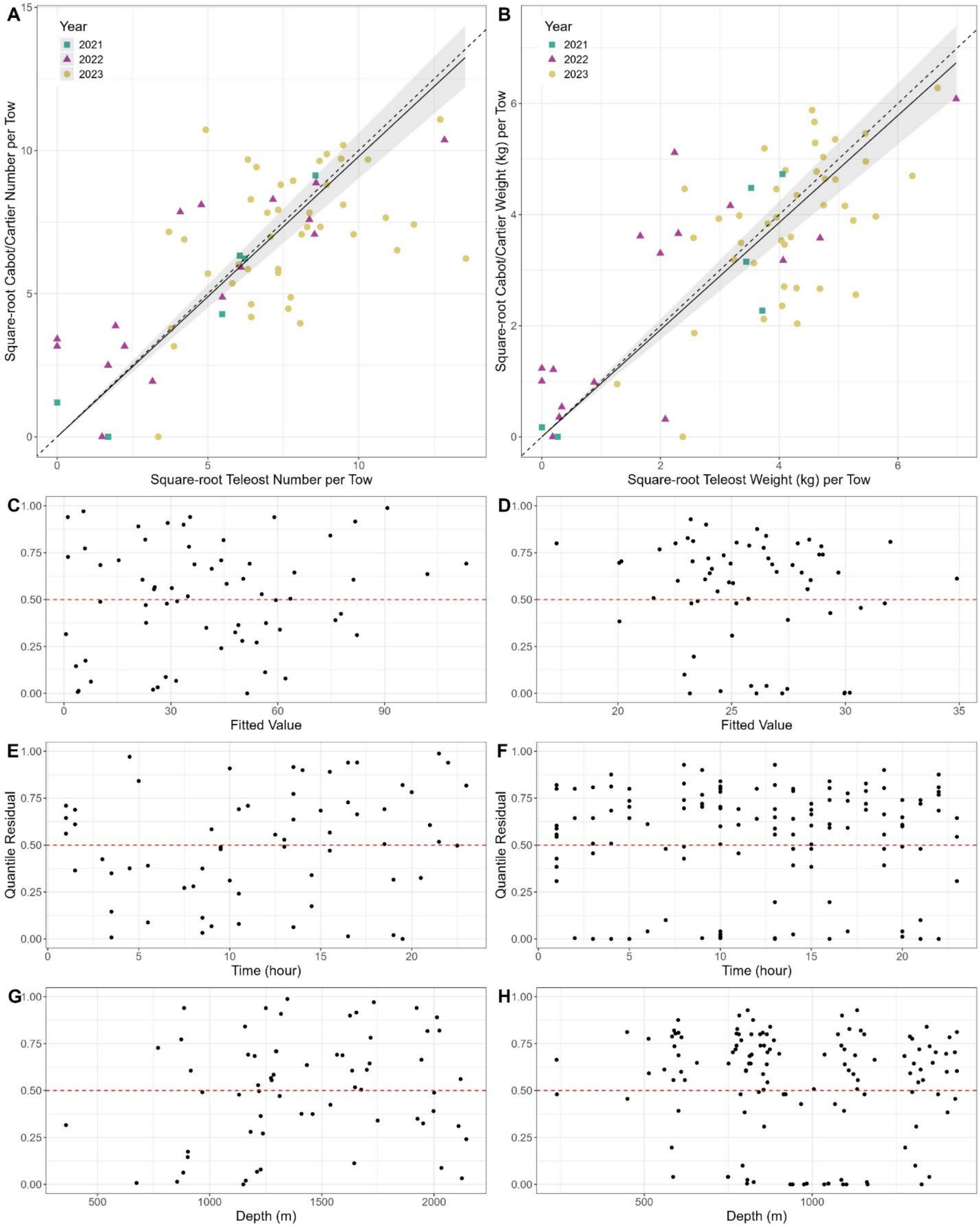


Figure 41. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Blue Hake (*Antimora rostrata*), fall NAFO Divisions 2HJ3K + 3L deep.*

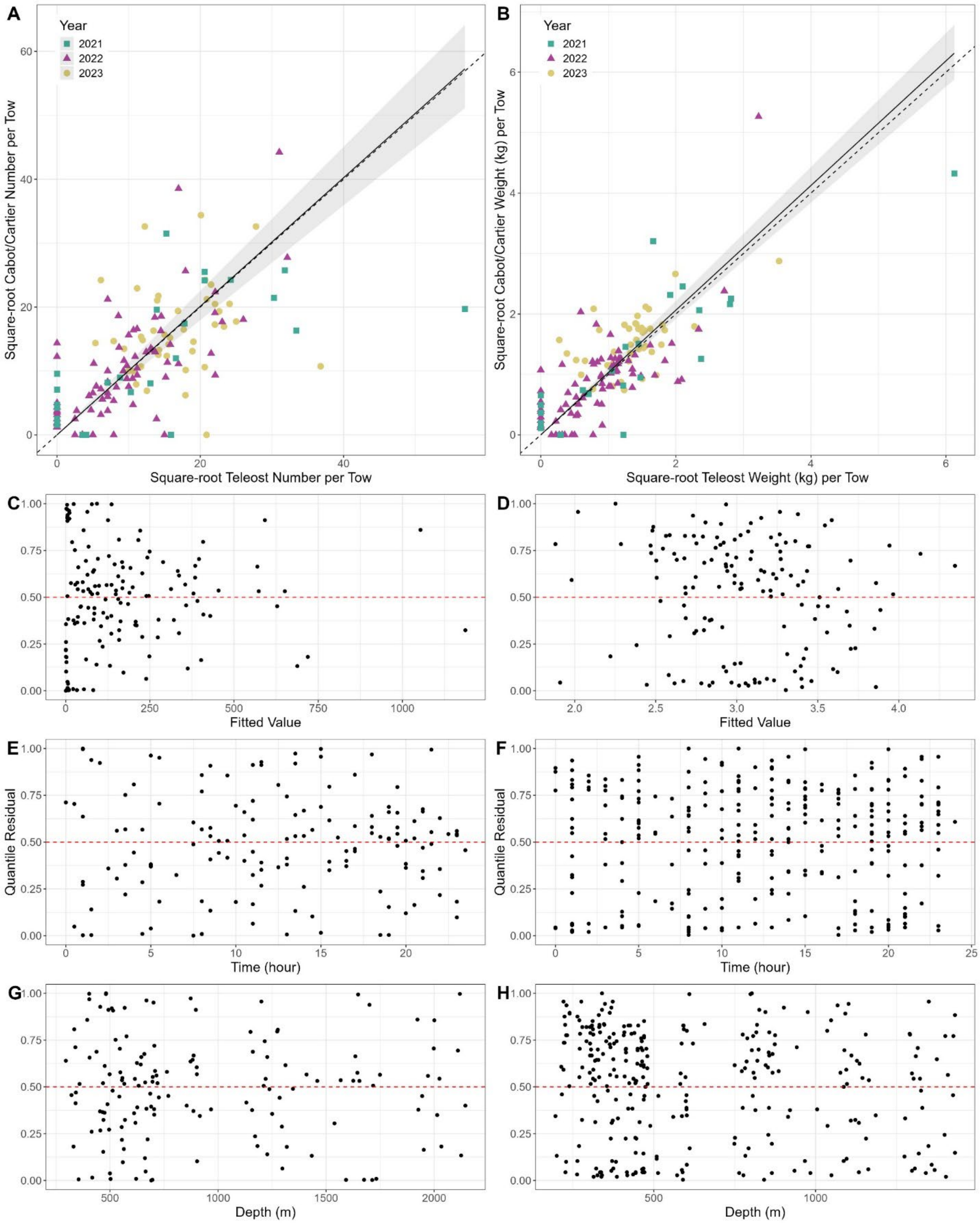


Figure 42. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of lanternfish (*Myctophidae*), fall NAFO Divisions 2HJ3K + 3L deep.*

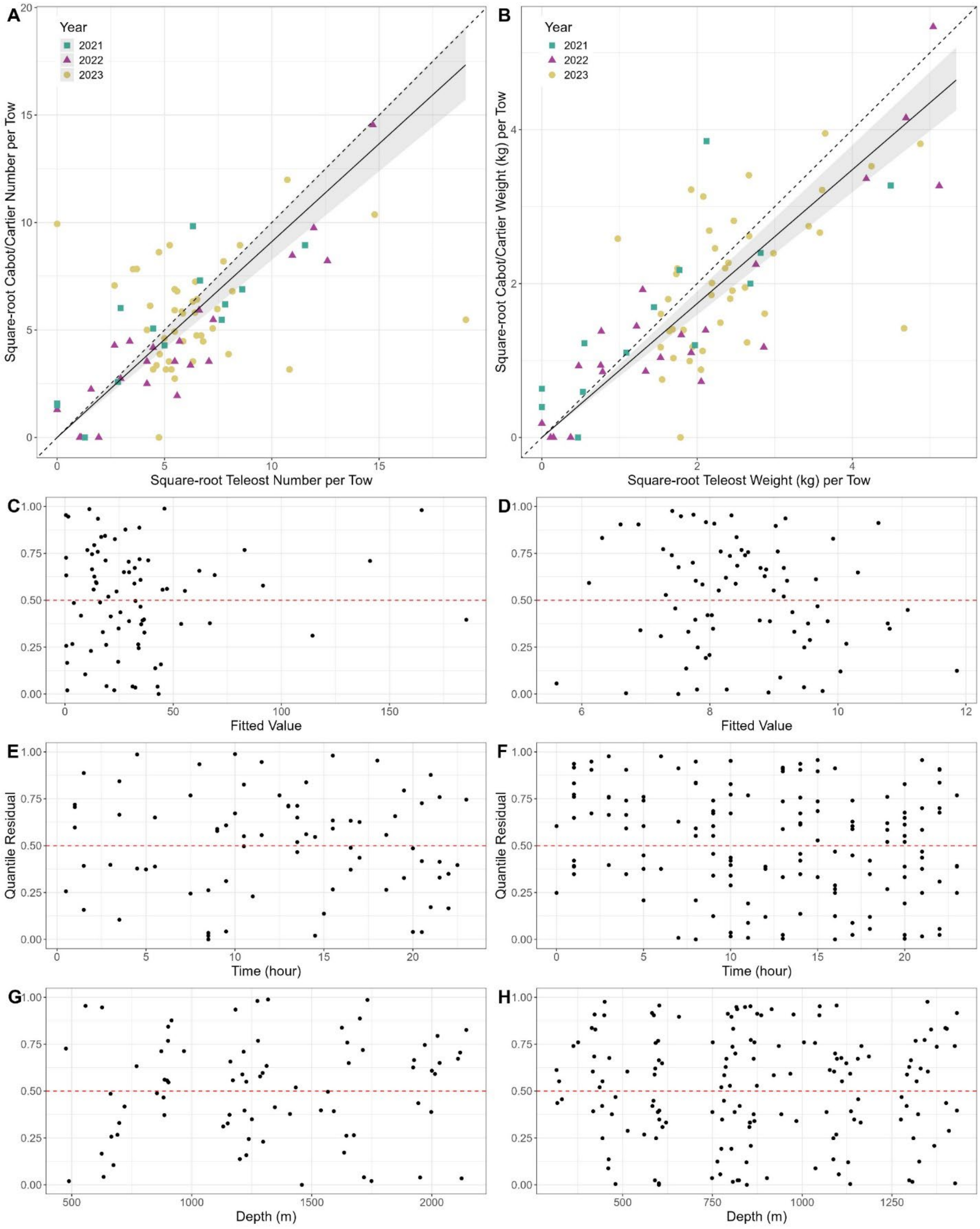


Figure 43. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Longnose Eel (*Synaphobranchus kaupii*), fall NAFO Divisions 2HJ3K + 3L deep.*

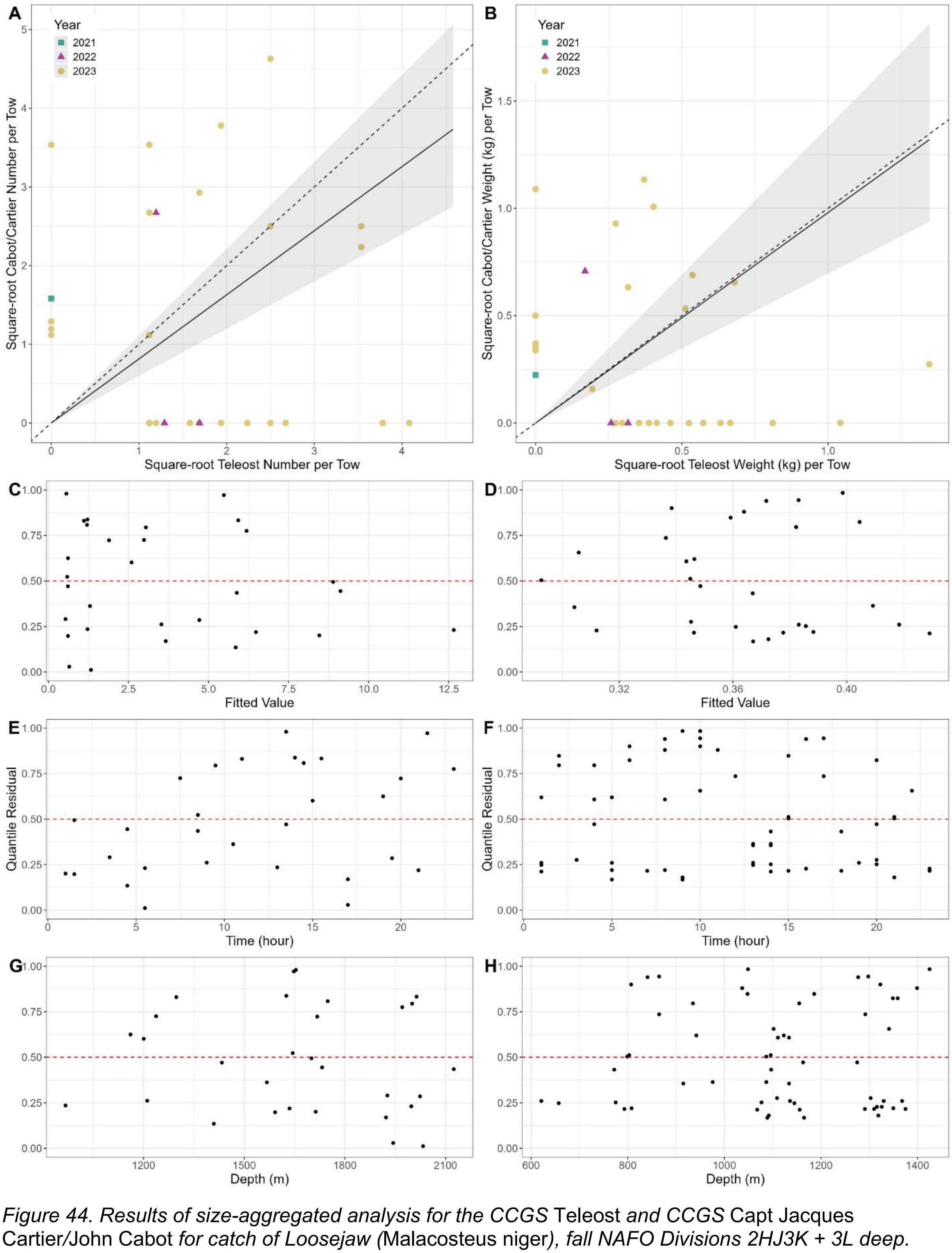


Figure 44. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Loosejaw (*Malacosteus niger*), fall NAFO Divisions 2HJ3K + 3L deep.*

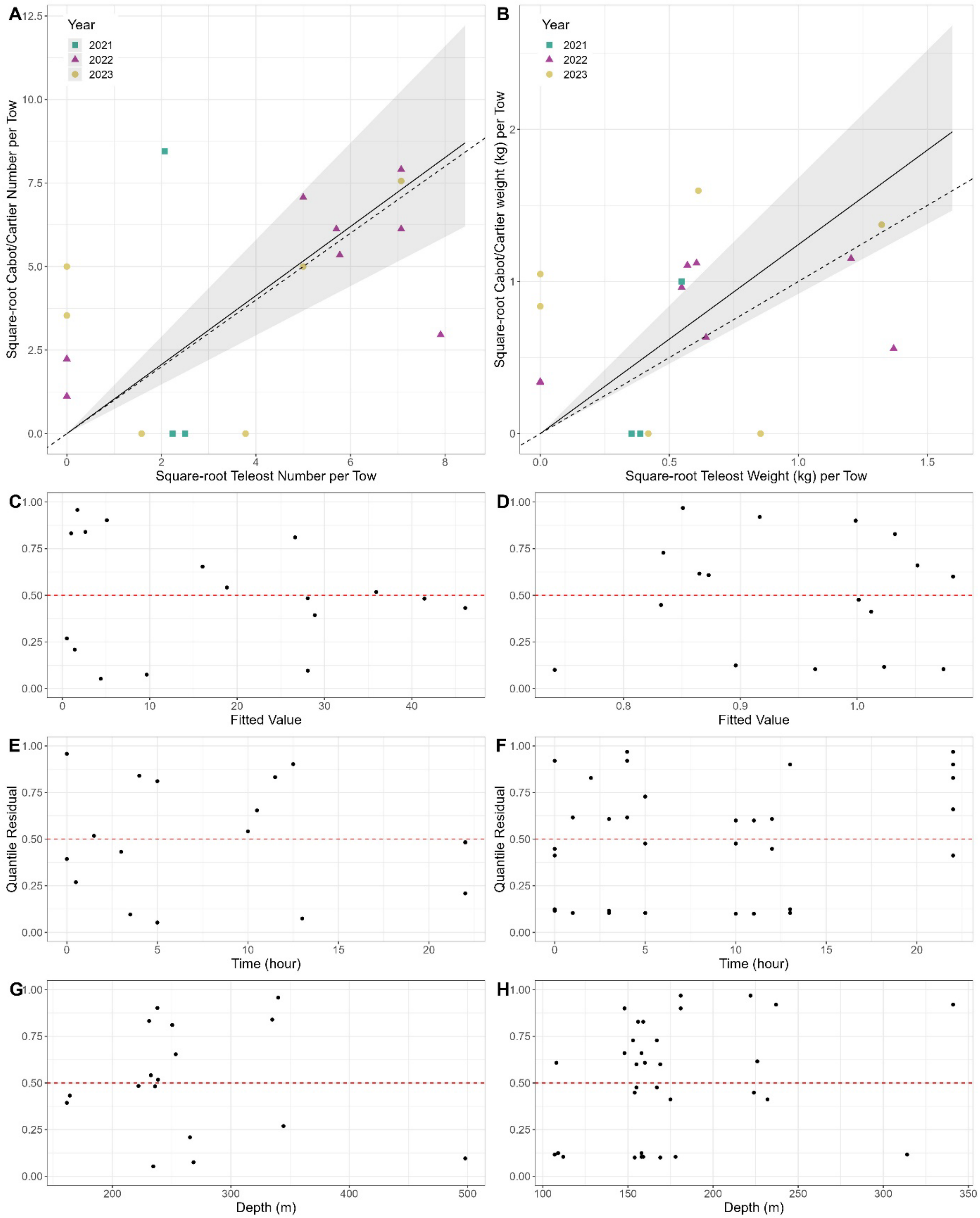


Figure 45. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of lumpsuckers (*Eumicrotremus *sp.), fall NAFO Divisions 2HJ3K + 3L deep.*

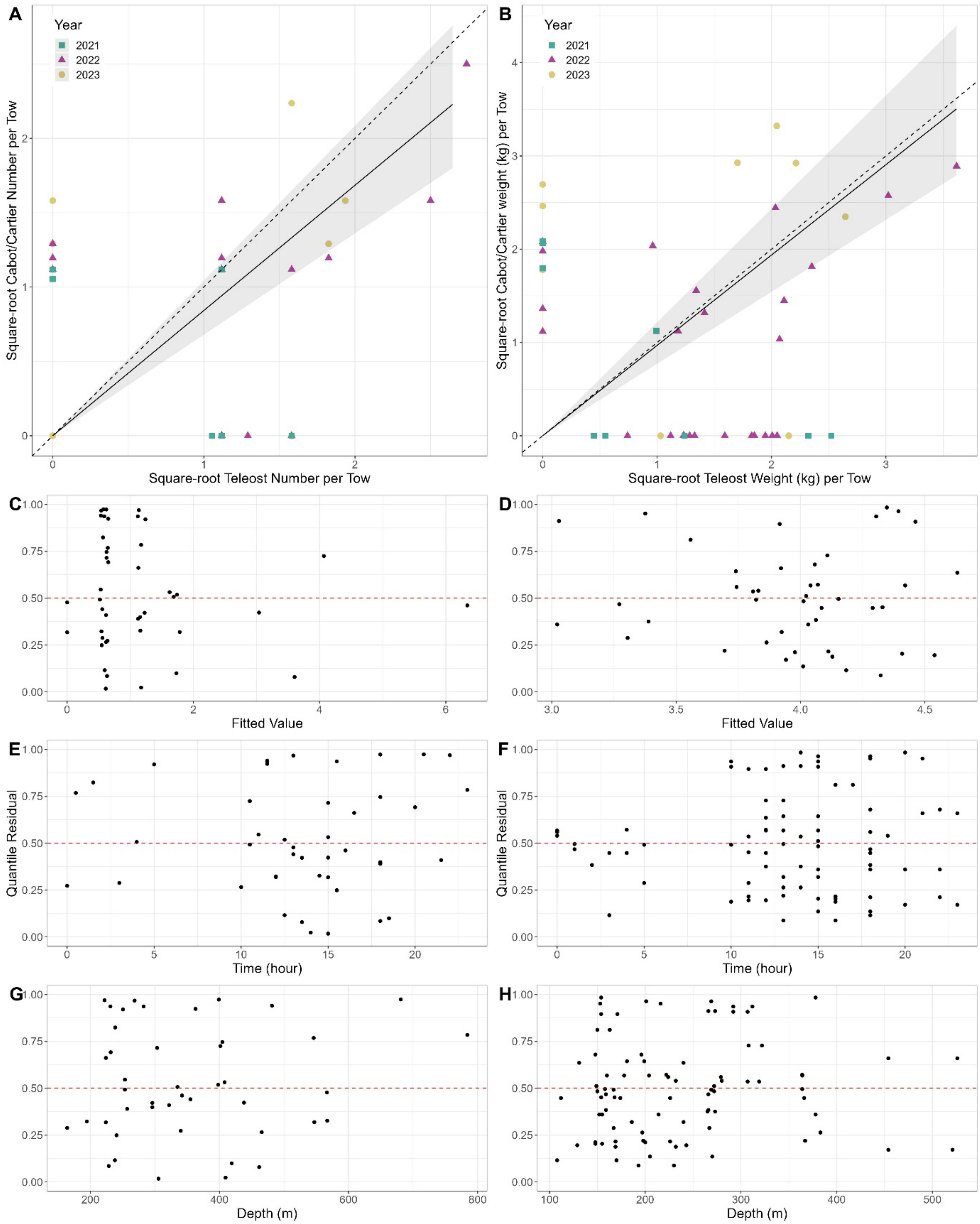


Figure 46. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Common Lumpfish (*Cyclopterus lumpus*), fall NAFO Divisions 2HJ3K + 3L deep.*

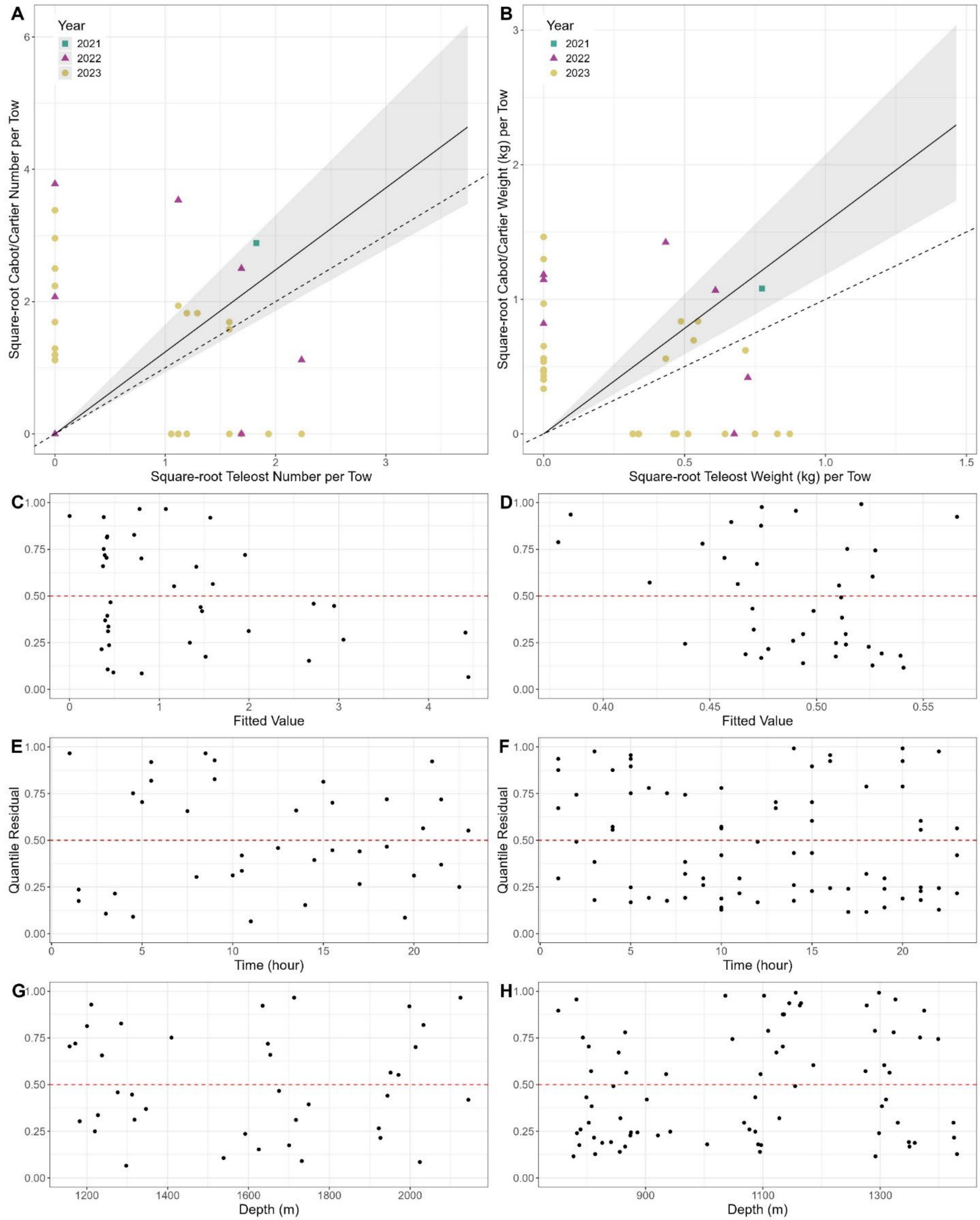


Figure 47. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of scopelosaurus (*Scopelosaurus *sp.), fall NAFO Divisions 2HJ3K + 3L deep.*

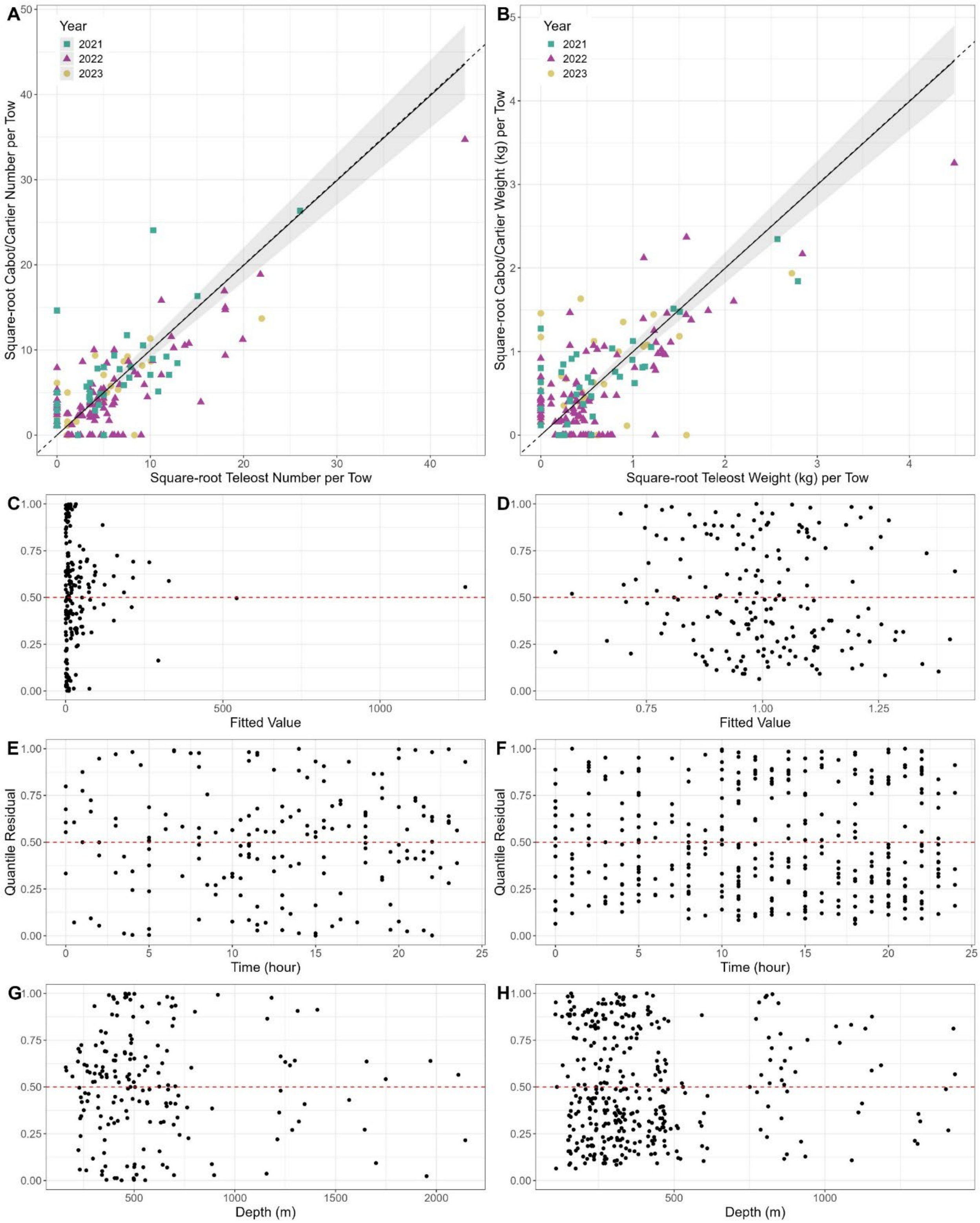


Figure 48. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of sculpins (*Artediellus *sp.,* Triglops *sp.,* Gymnocanthu *sp.,* Cottunculus *sp.,* Icelus *sp.,* Myoxocephalus *sp.,* Hemitripterus americanus*), fall NAFO Divisions 2HJ3K + 3L deep.*

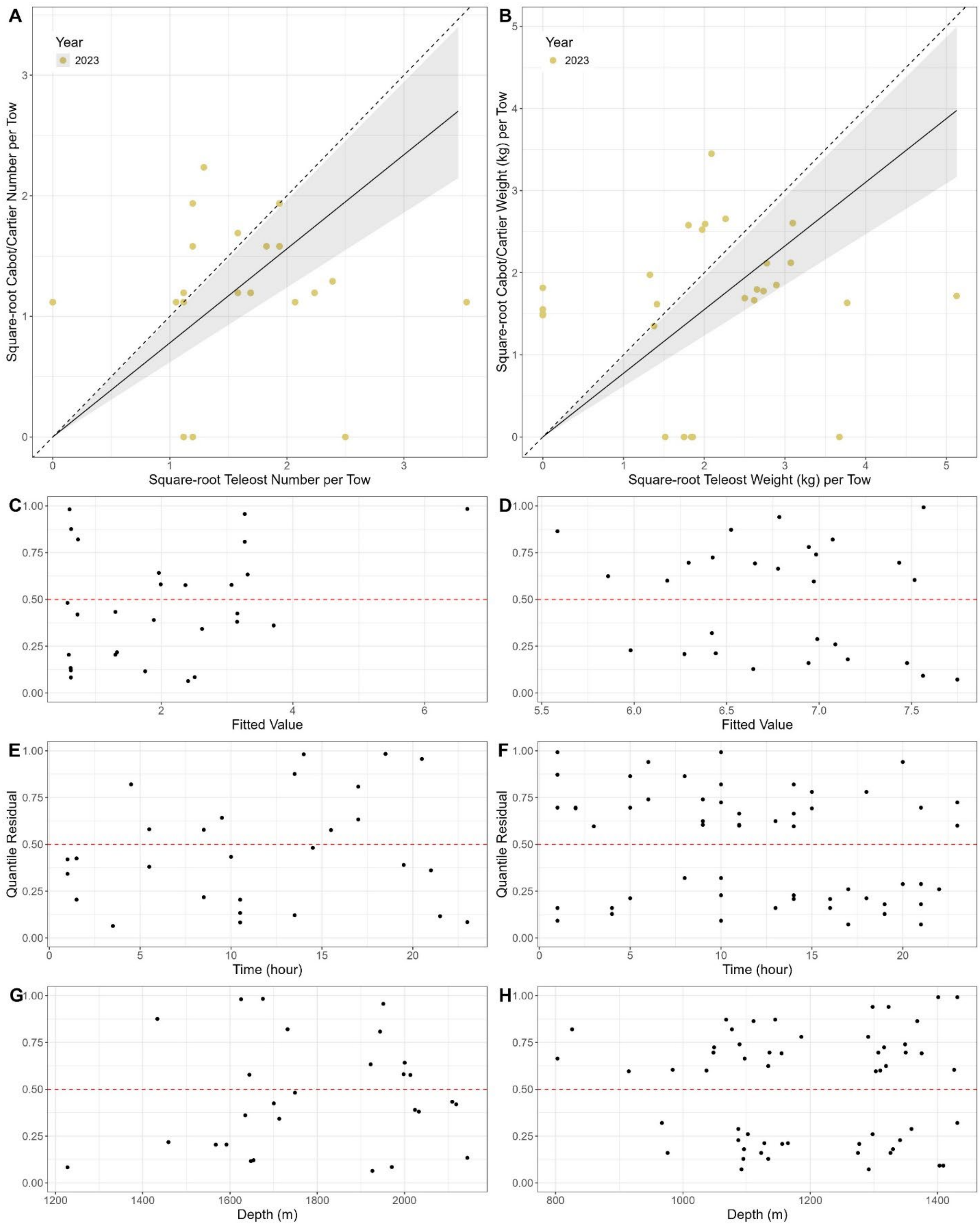


Figure 49. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Deepsea Cat Shark (*Apristurus profundorum*), fall NAFO Divisions 2HJ3K + 3L deep.*

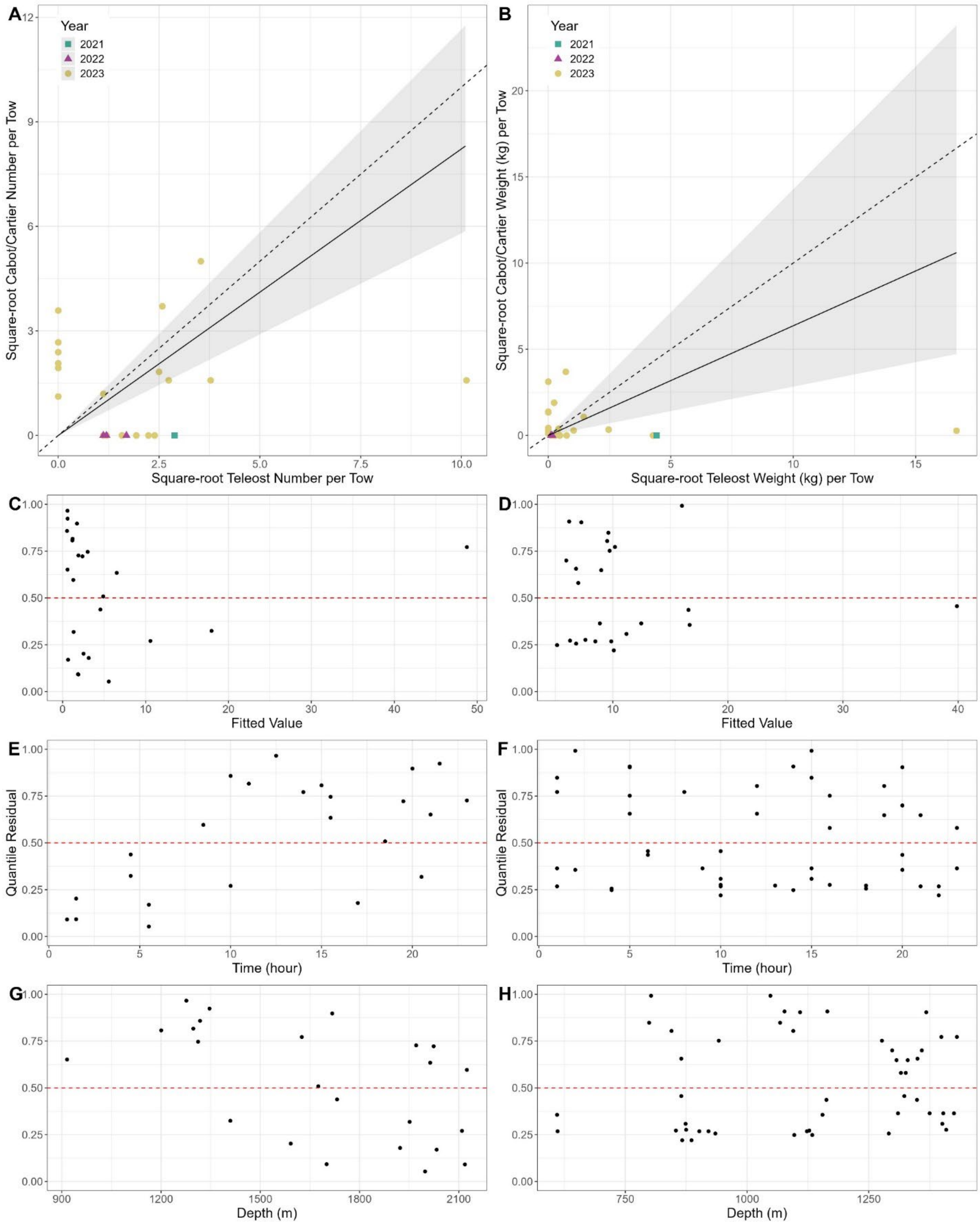


Figure 50. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of smoothheads (*Alepocephalidae*), fall NAFO Divisions 2HJ3K + 3L deep.*

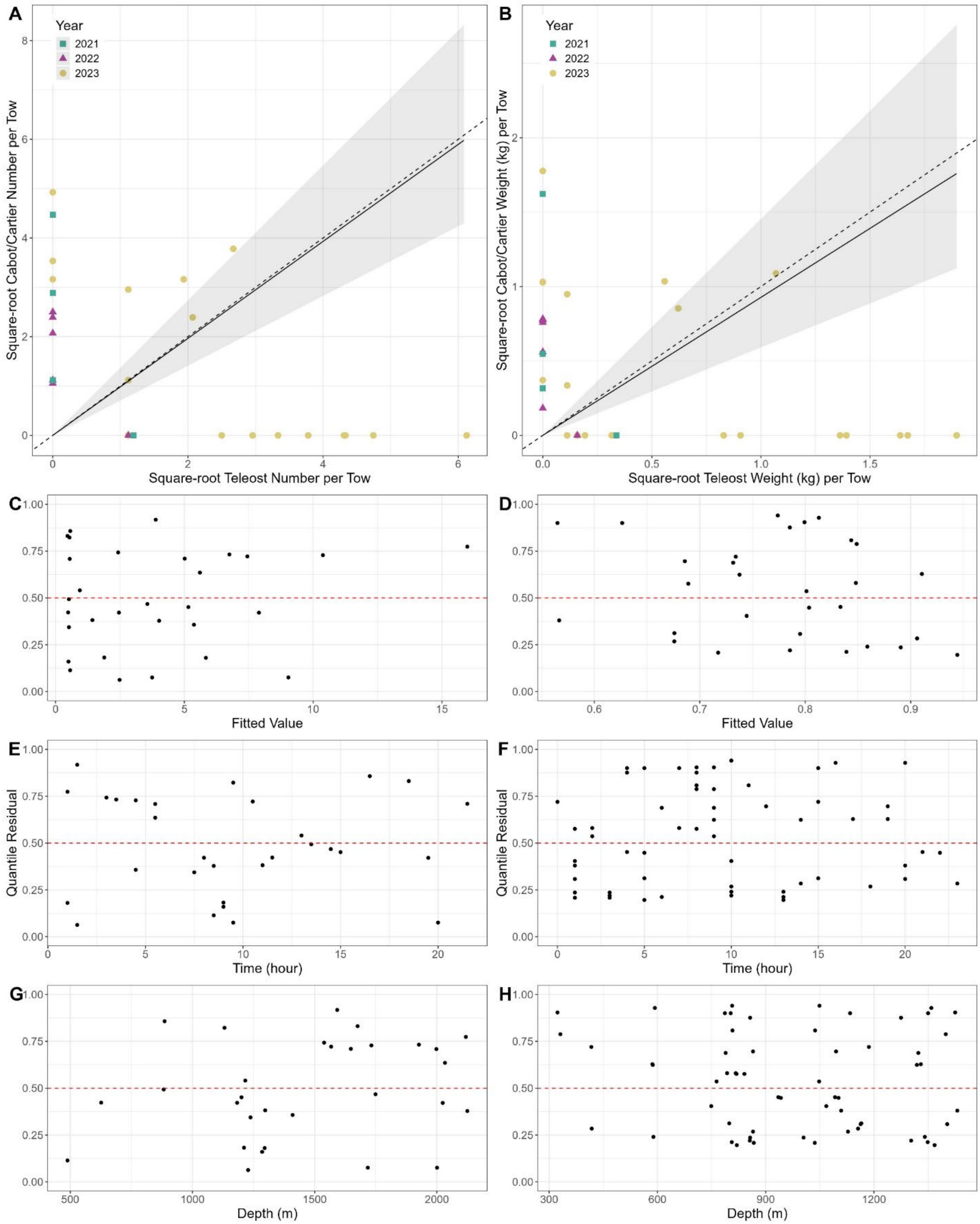


Figure 51. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Atlantic Snipe Eel (*Nemichthys scolopaceus*), fall NAFO Divisions 2HJ3K + 3L deep.*

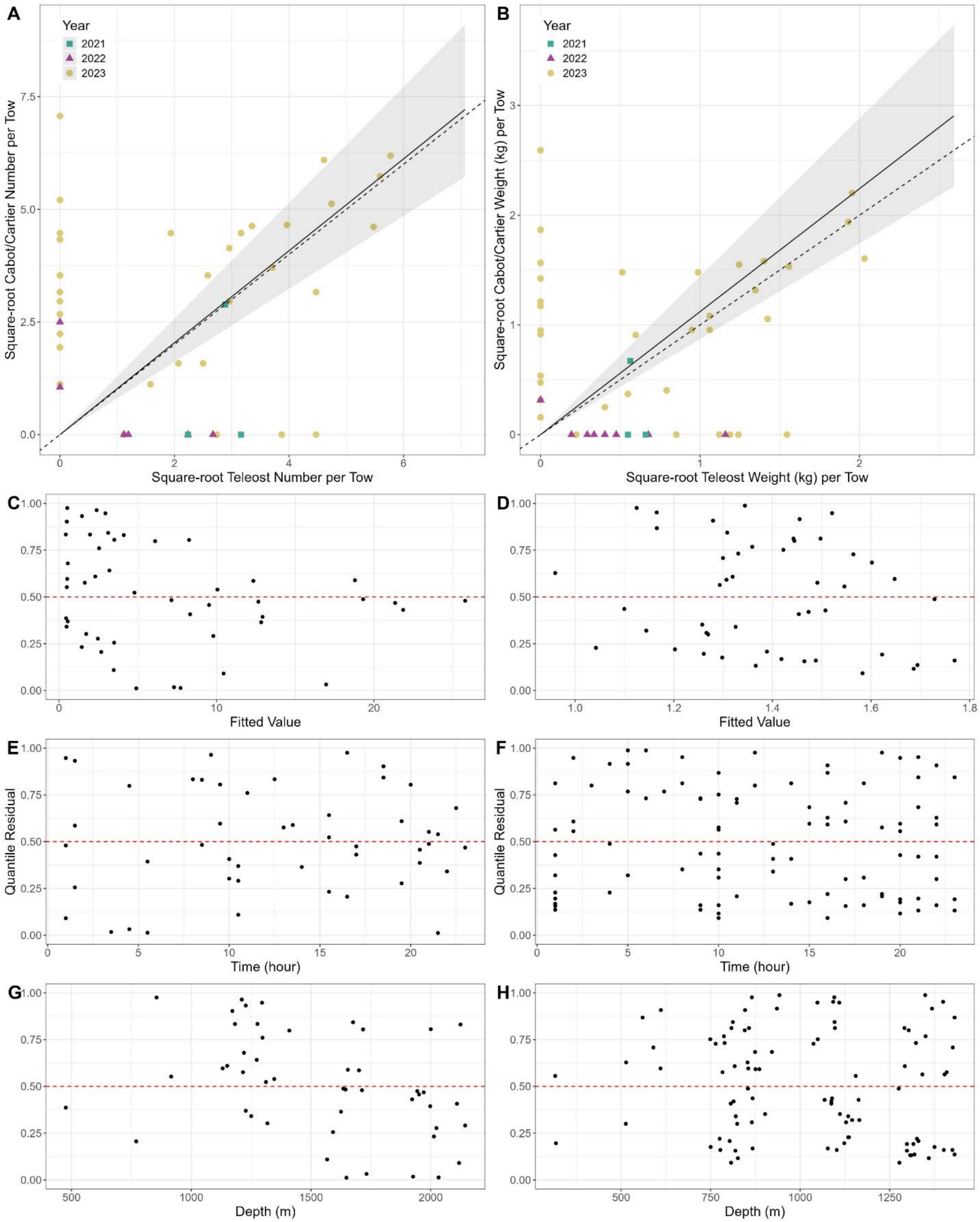


Figure 52. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Shortnose Snipe Eel (*Serrivomer beanii*), fall NAFO Divisions 2HJ3K + 3L deep.*

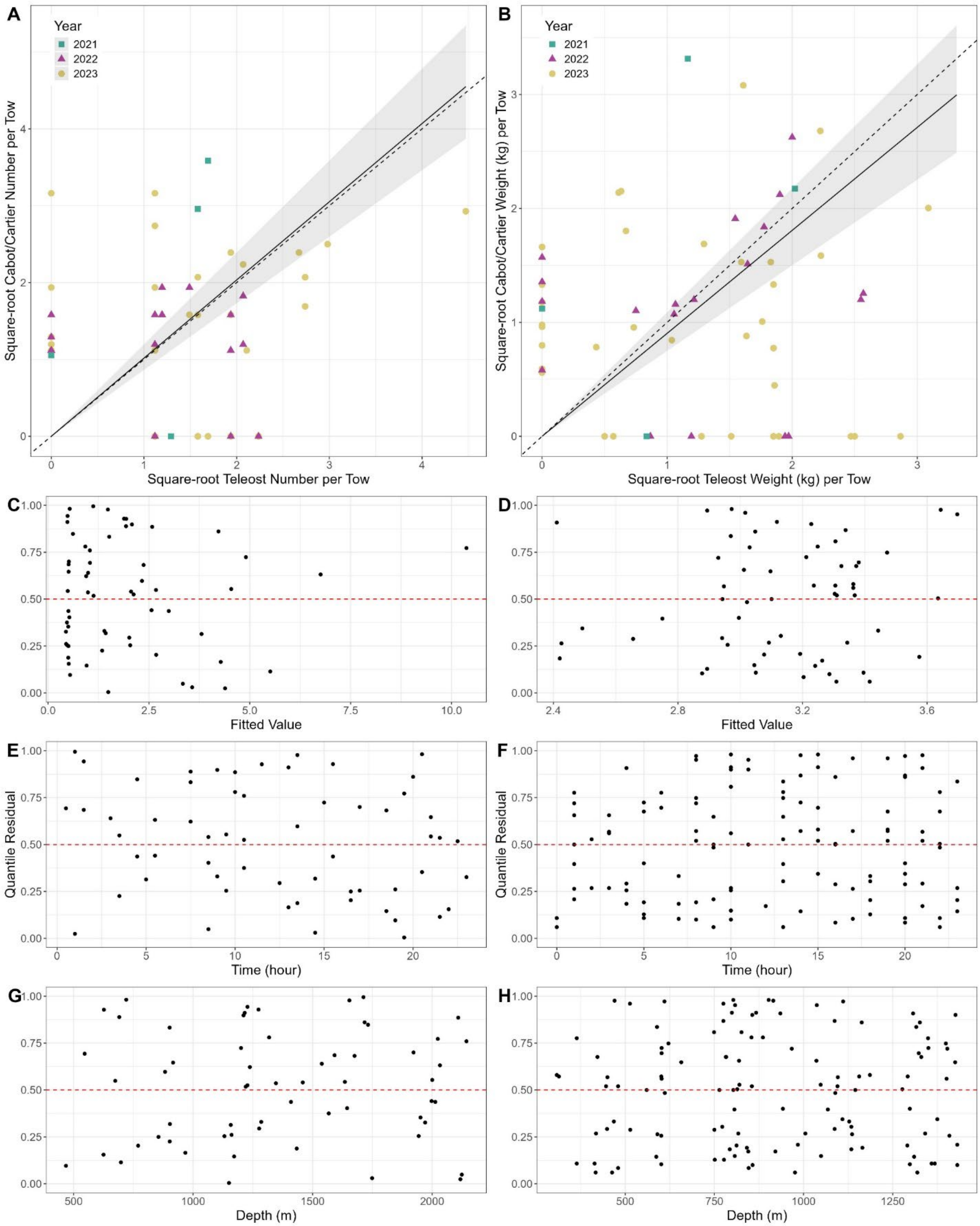


Figure 53. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of tapirfish (*Notacanthus *sp.,* Macdonaldia *sp.), fall NAFO Divisions 2HJ3K + 3L deep.*

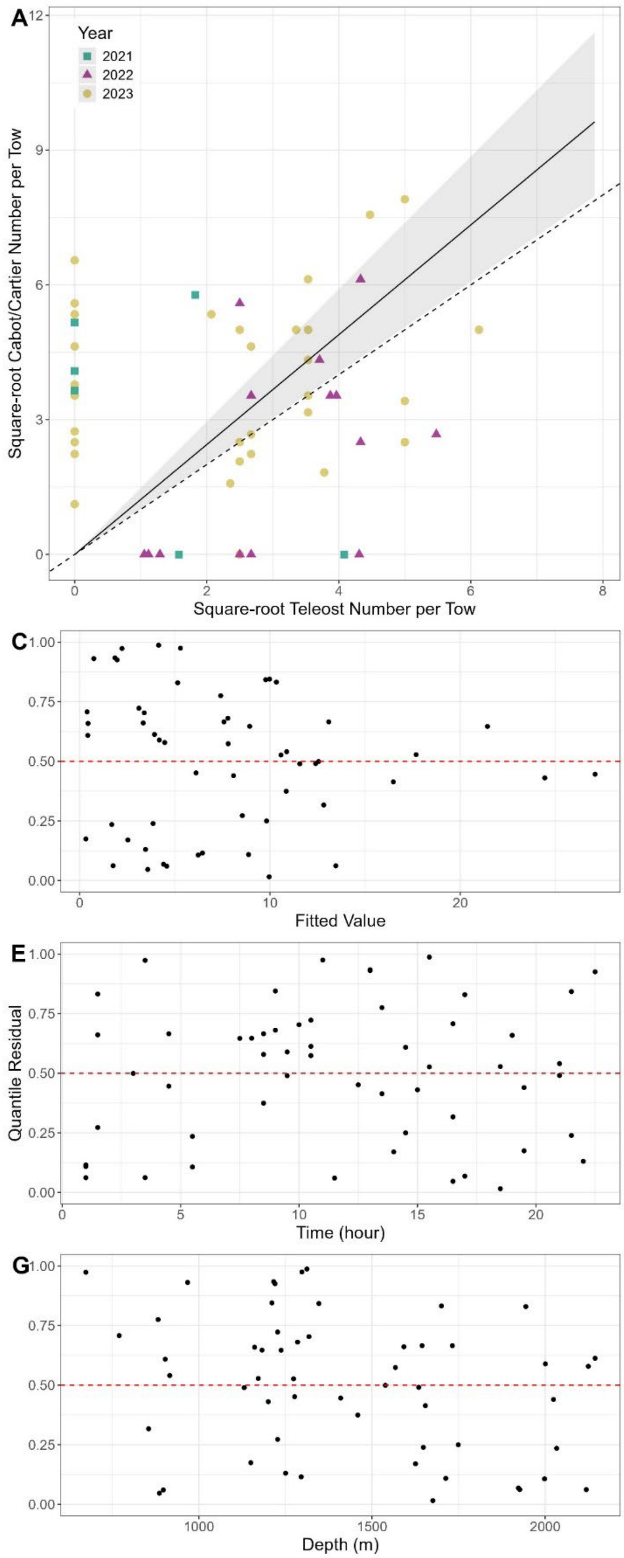


Figure 54. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of viperfish (*Chauliodontidae*), fall NAFO Divisions 2HJ3K + 3L deep.*

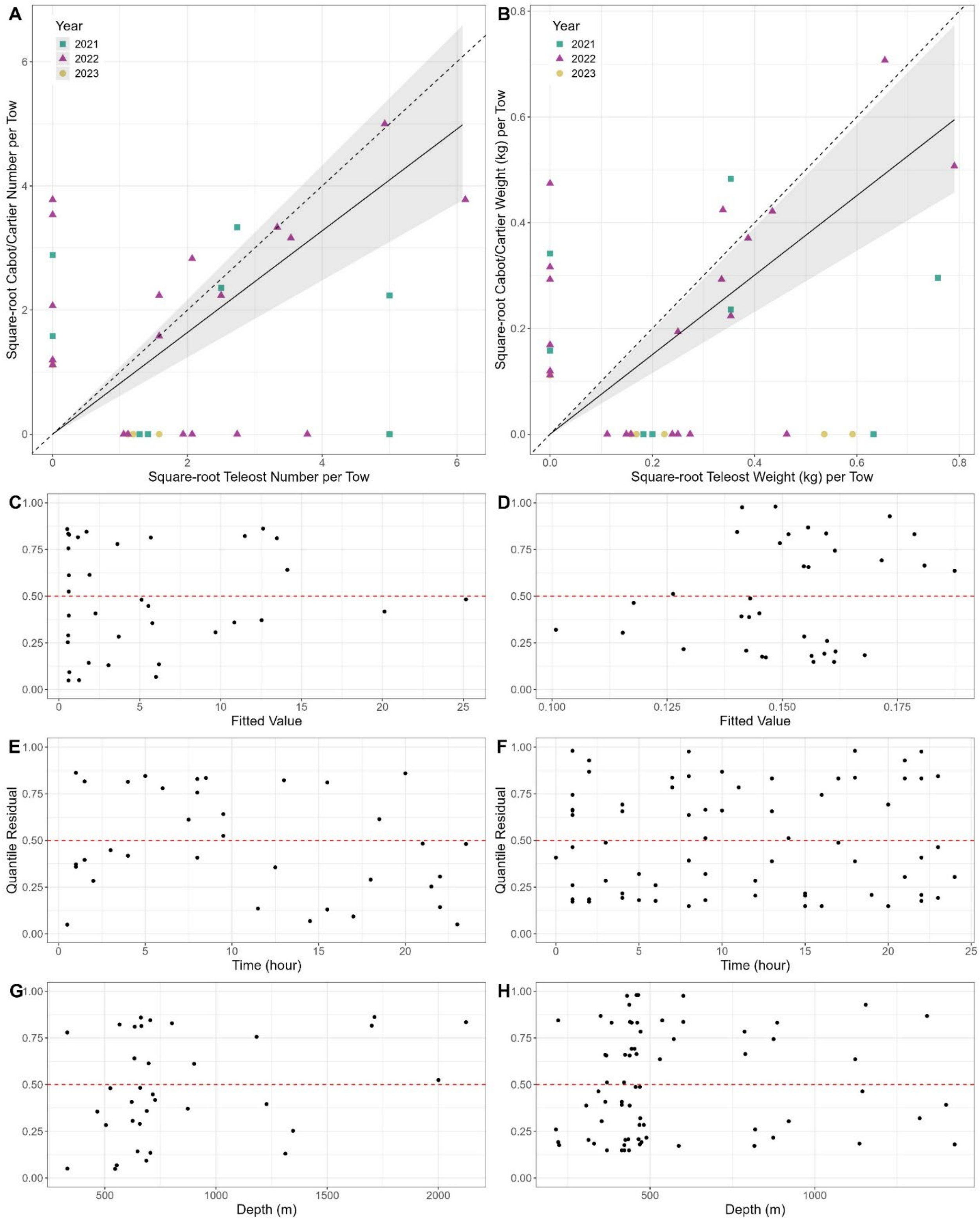


Figure 55. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of wolf eel (*Lycenchelys *sp.), fall NAFO Divisions 2HJ3K + 3L deep.*

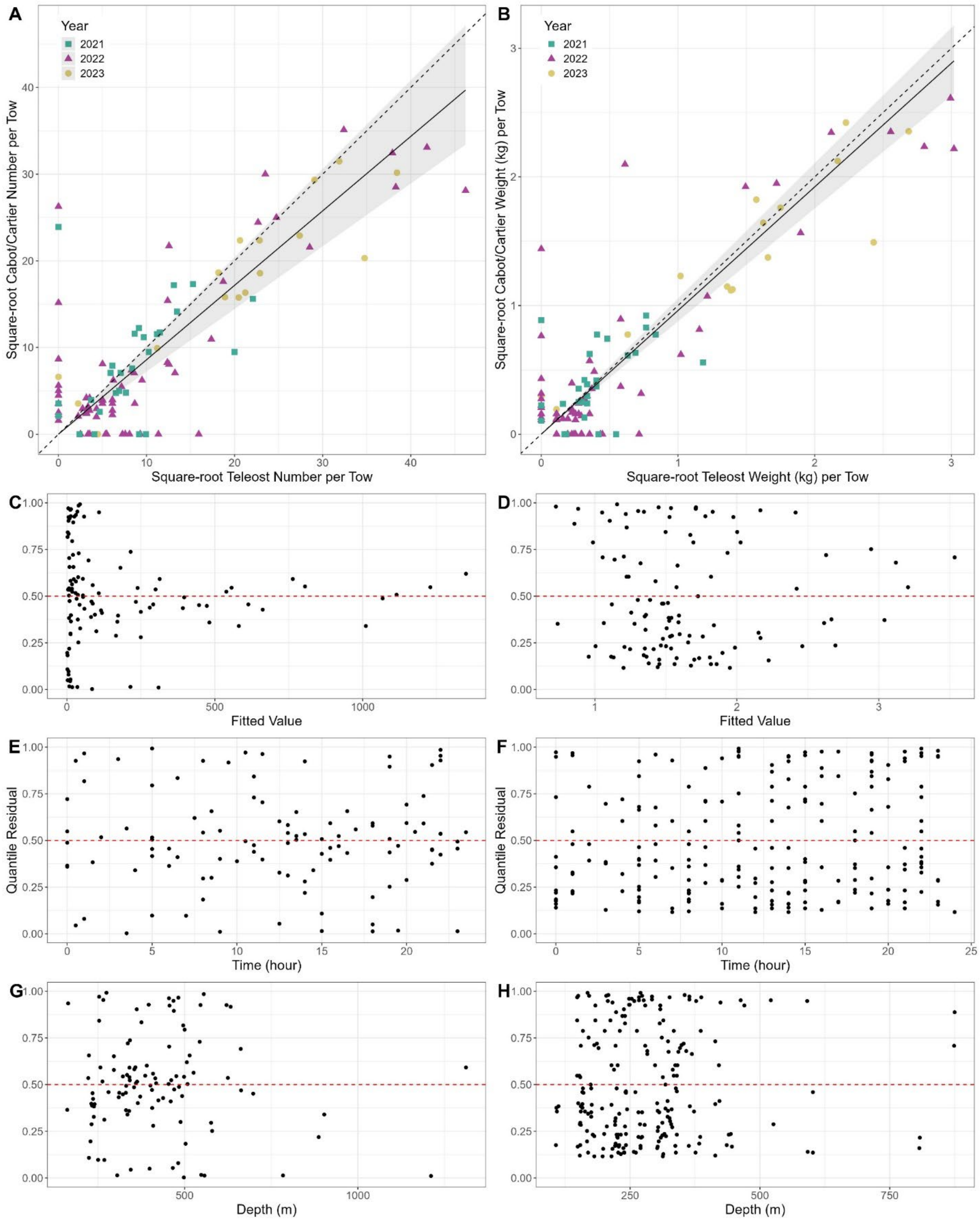


Figure 56. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of benthic shrimps (*Eualus belcheri*,* Sclerocrangon *sp.,* Sabinea septemcarinata*,* Sabinea sarsi*,* Argis *sp.), fall NAFO Divisions 2HJ3K + 3L deep.*

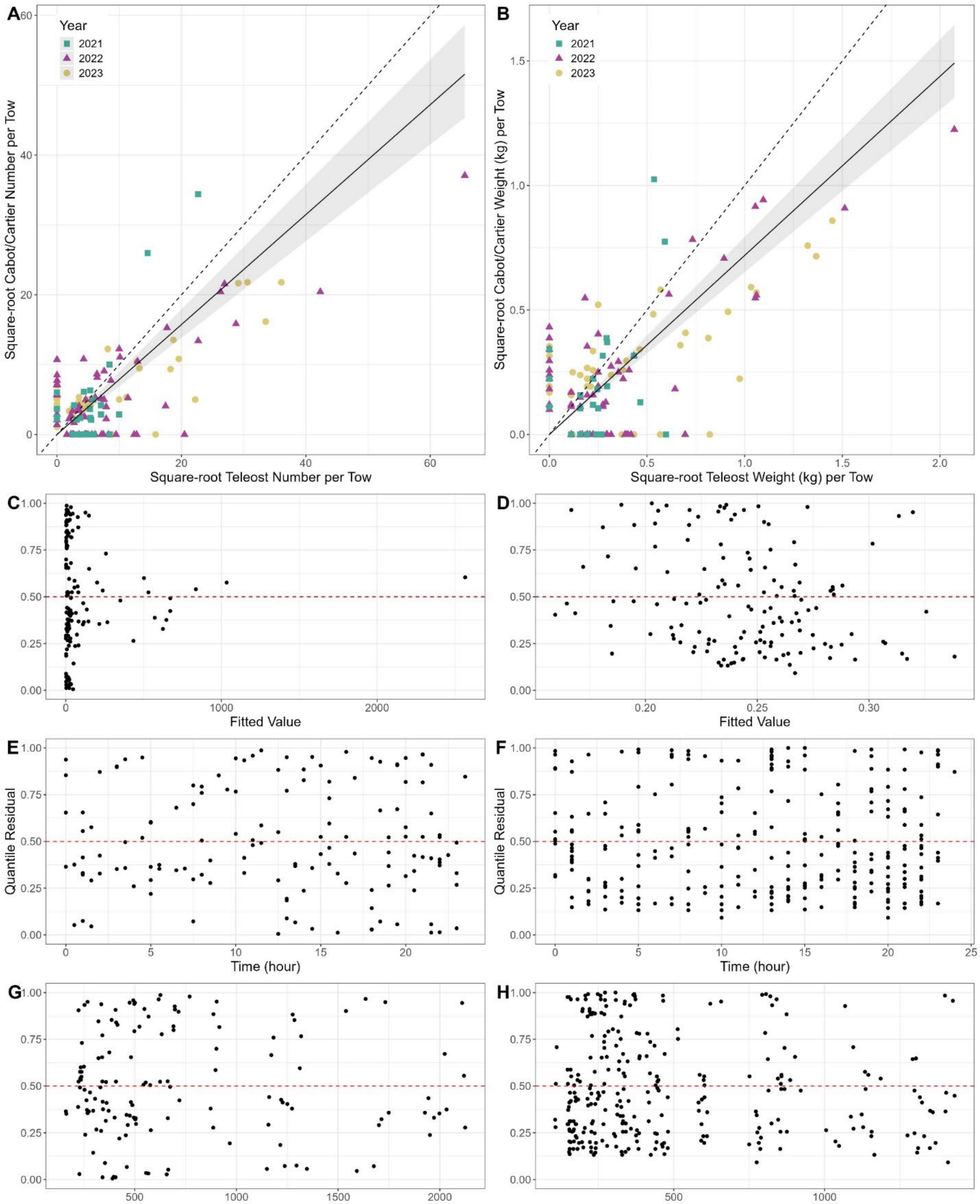


Figure 57. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of benthopelagic shrimps (*Benthesicymus *sp.,* Aristeus *sp.,* Eualus *sp.,* Spirontocaris *sp.,* Lebbeus *sp.,* Dichelopandalus *sp.,* Atlantopandalus *sp.,* Sabinea hystrix*,* Pontophilus *sp.), fall NAFO Divisions 2HJ3K + 3L deep.*

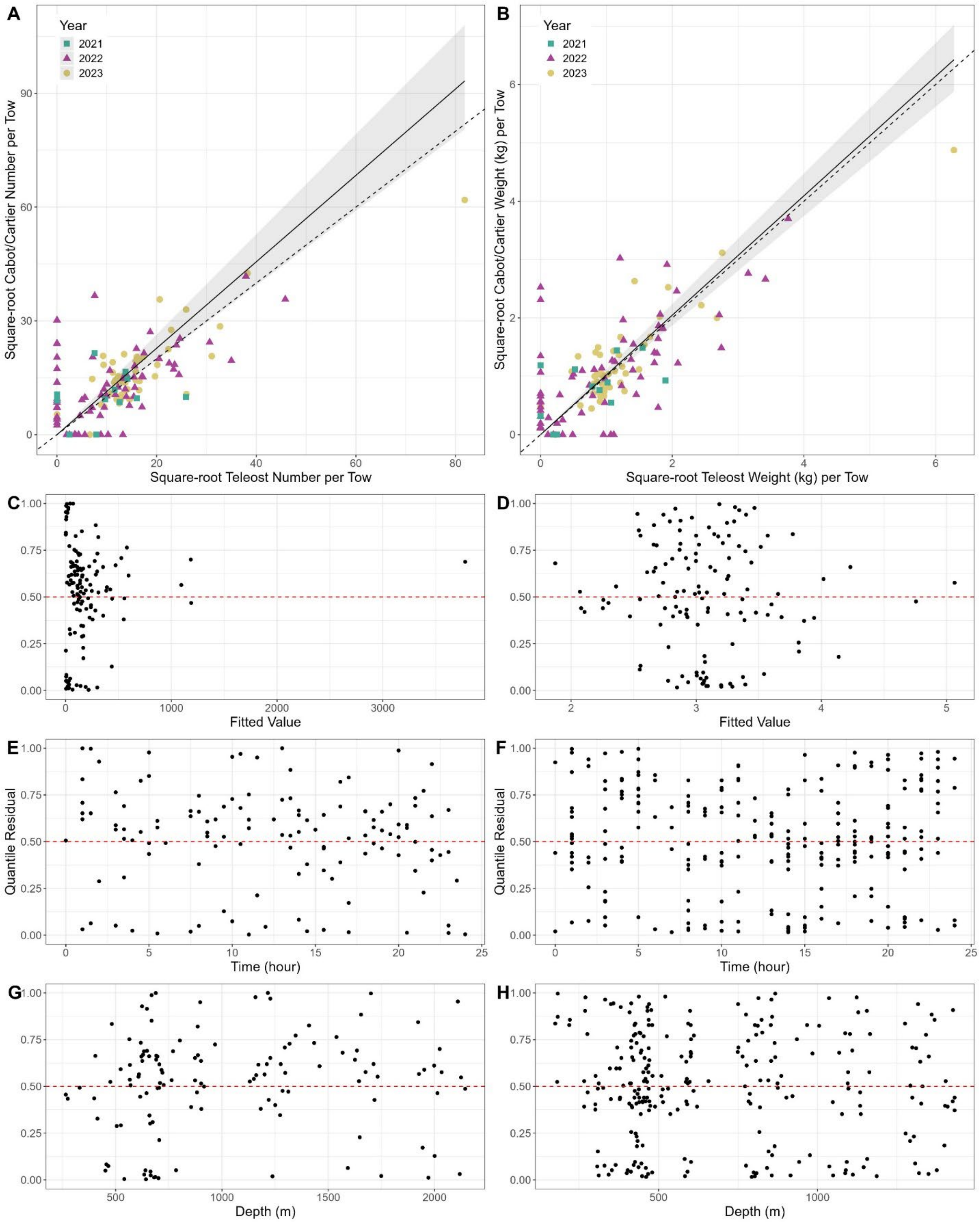


Figure 58. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of pelagic shrimps (*Aristaeopsis *sp.,* Gennadas *sp.,* Sergestes *sp.,* Sergia *sp.,* Acanthephyra *sp.,* Pasiphaea *sp.,* Parapasiphae *sp.), fall NAFO Divisions 2HJ3K + 3L deep.*

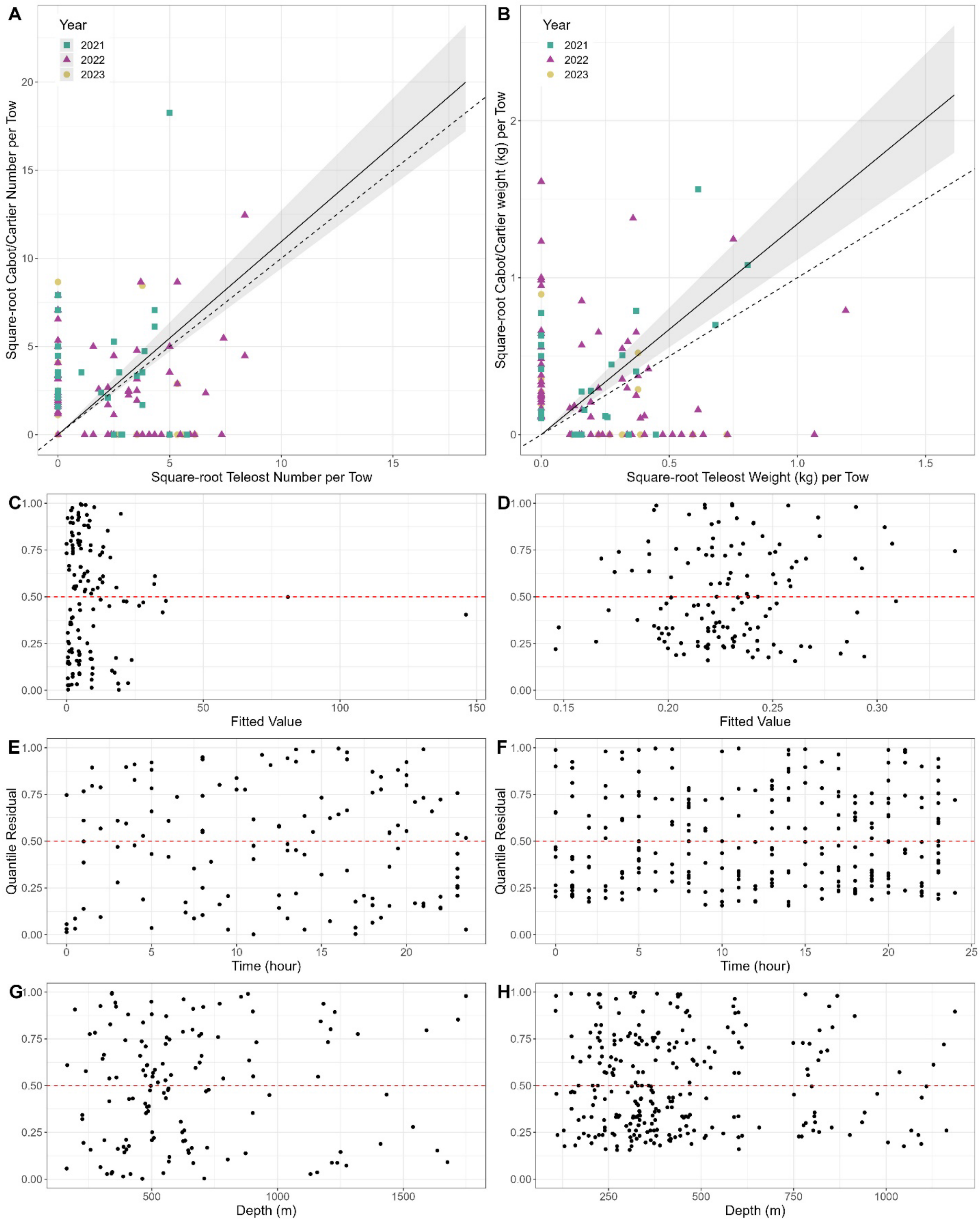


Figure 59. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of gastropods (Gastropoda, excluding Nudibranchia), fall NAFO Divisions 2HJ3K + 3L deep.*

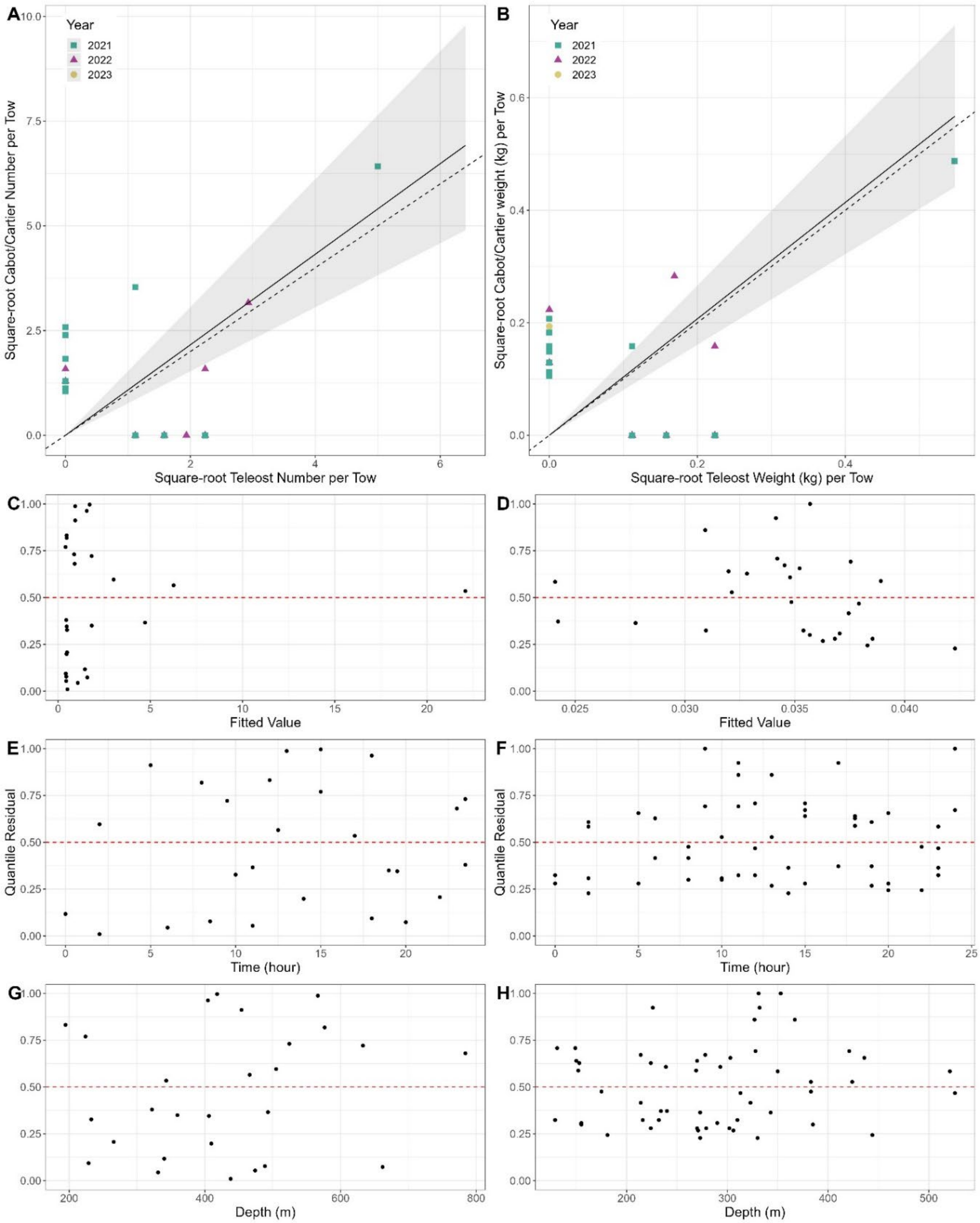


Figure 60. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Iceland Scallop (*Chlamys islandica*), fall NAFO Divisions 2HJ3K + 3L deep.*

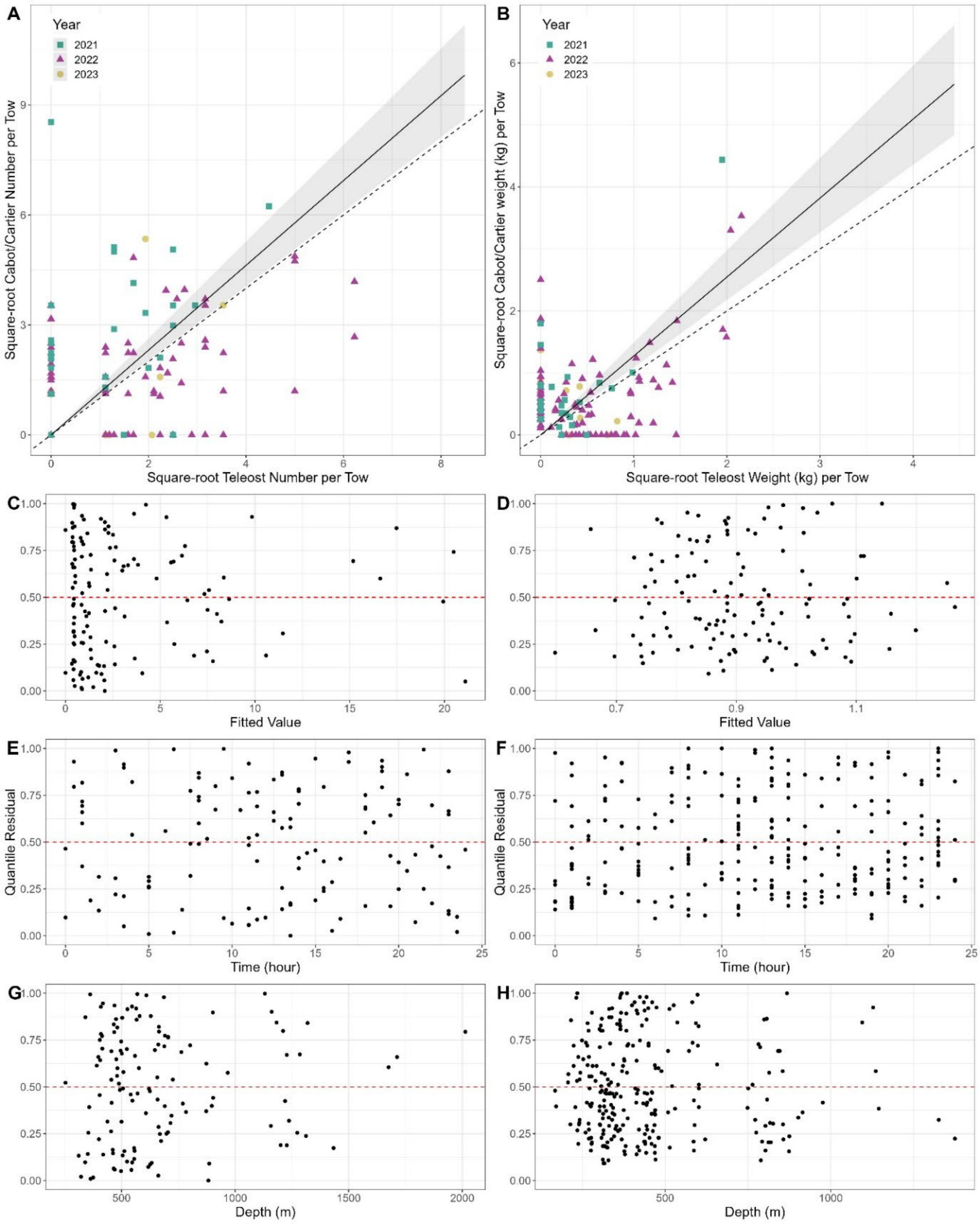


Figure 61. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Rigid Cushion Star (*Hippasteria phrygiana*), fall NAFO Divisions 2HJ3K + 3L deep.*

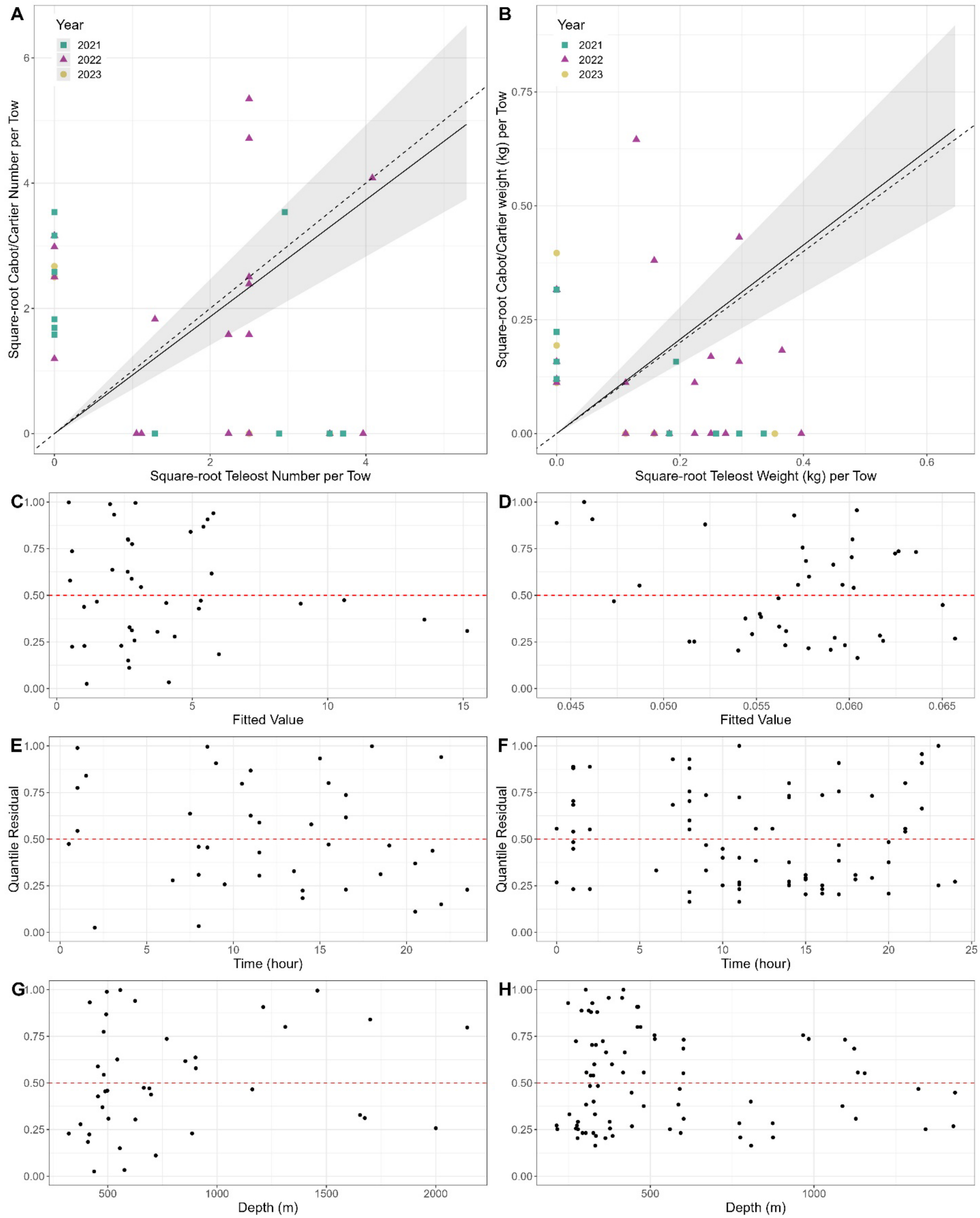


Figure 62. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of cushion star (*Ceramaster granularis*), fall NAFO Divisions 2HJ3K + 3L deep.*

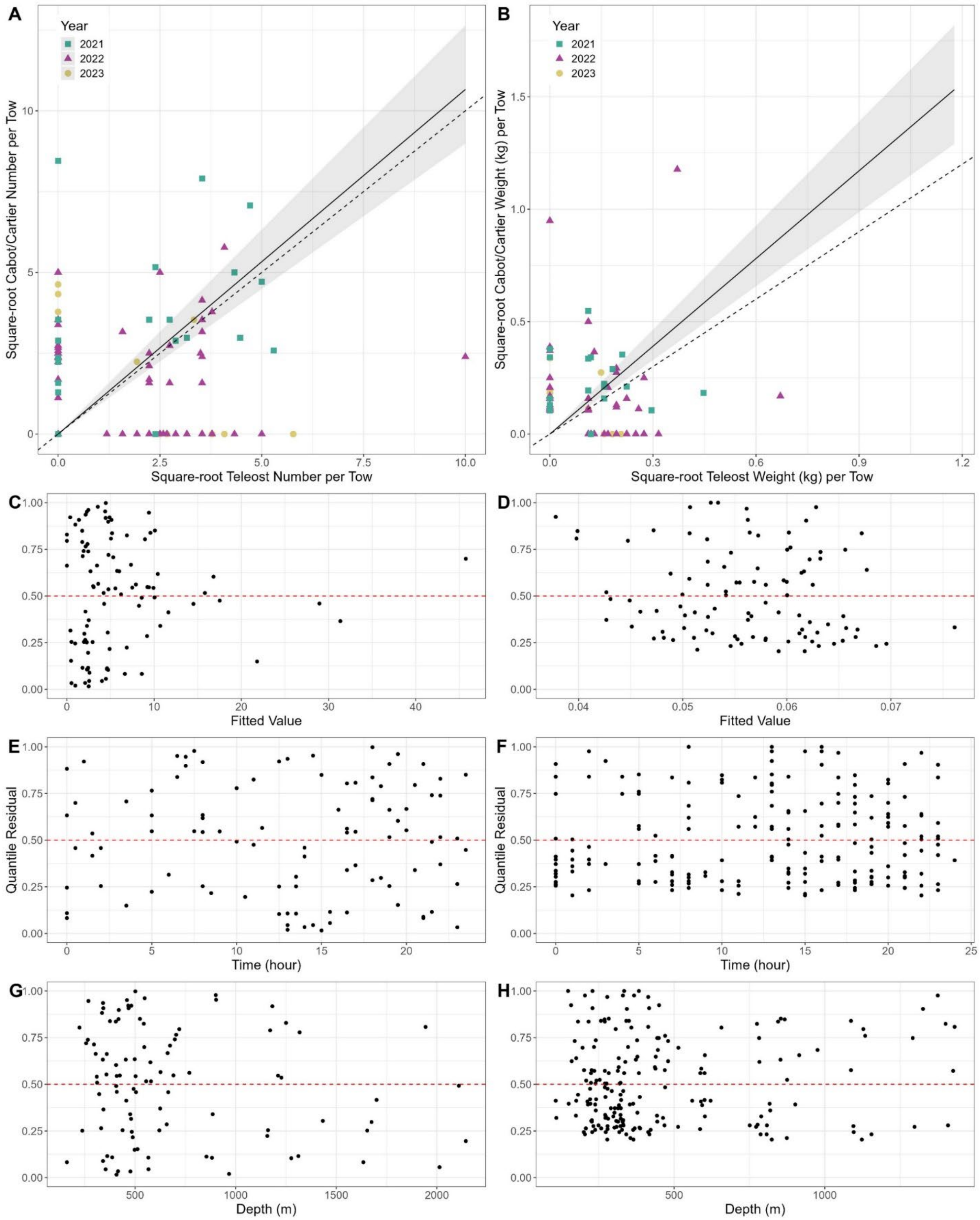


Figure 63. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Henricia sea stars (Henricia sp.), fall NAFO Divisions 2HJ3K + 3L deep.*

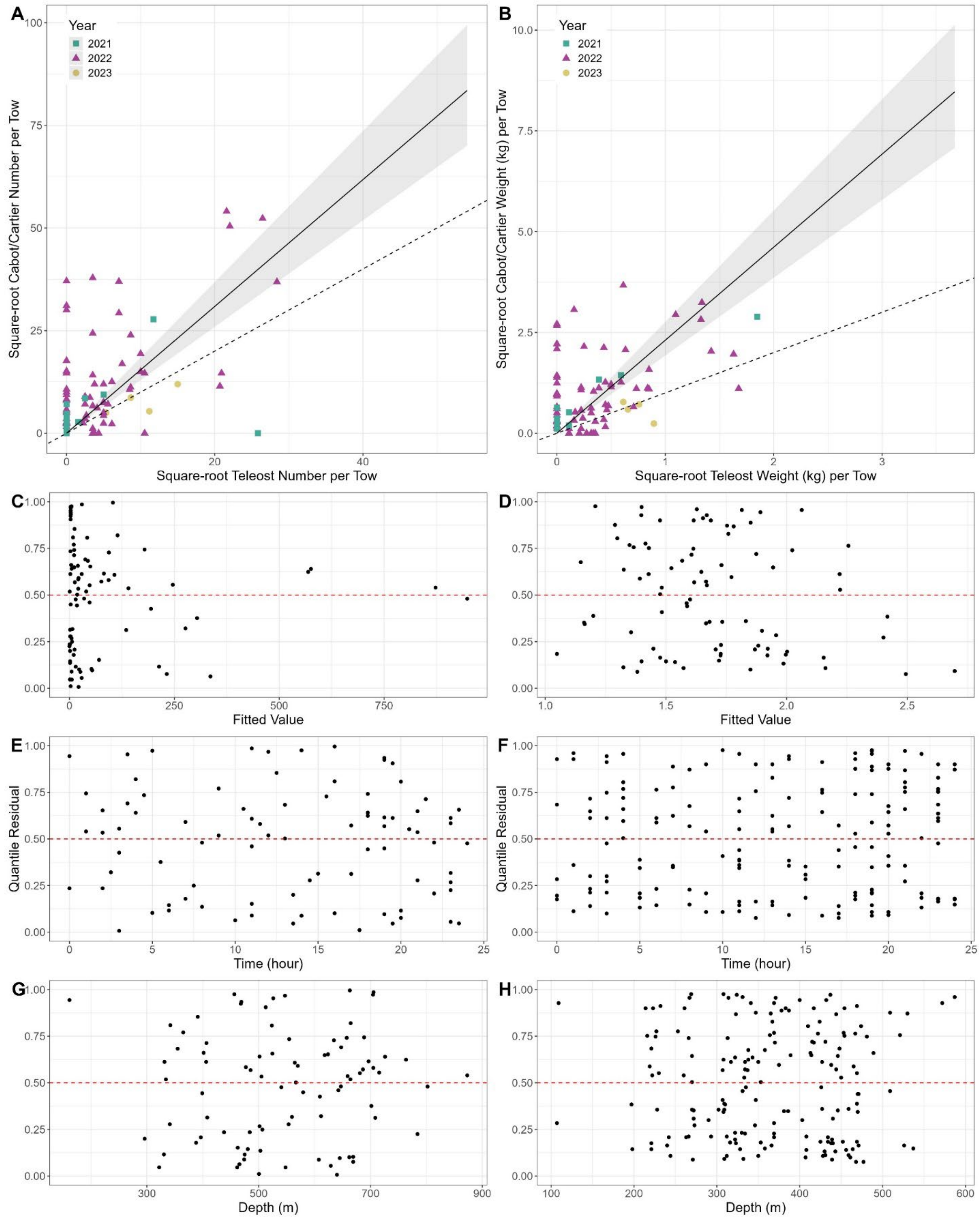


Figure 64. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of Common Mud Star (*Ctenodiscus crispatus*), fall NAFO Divisions 2HJ3K + 3L deep.*

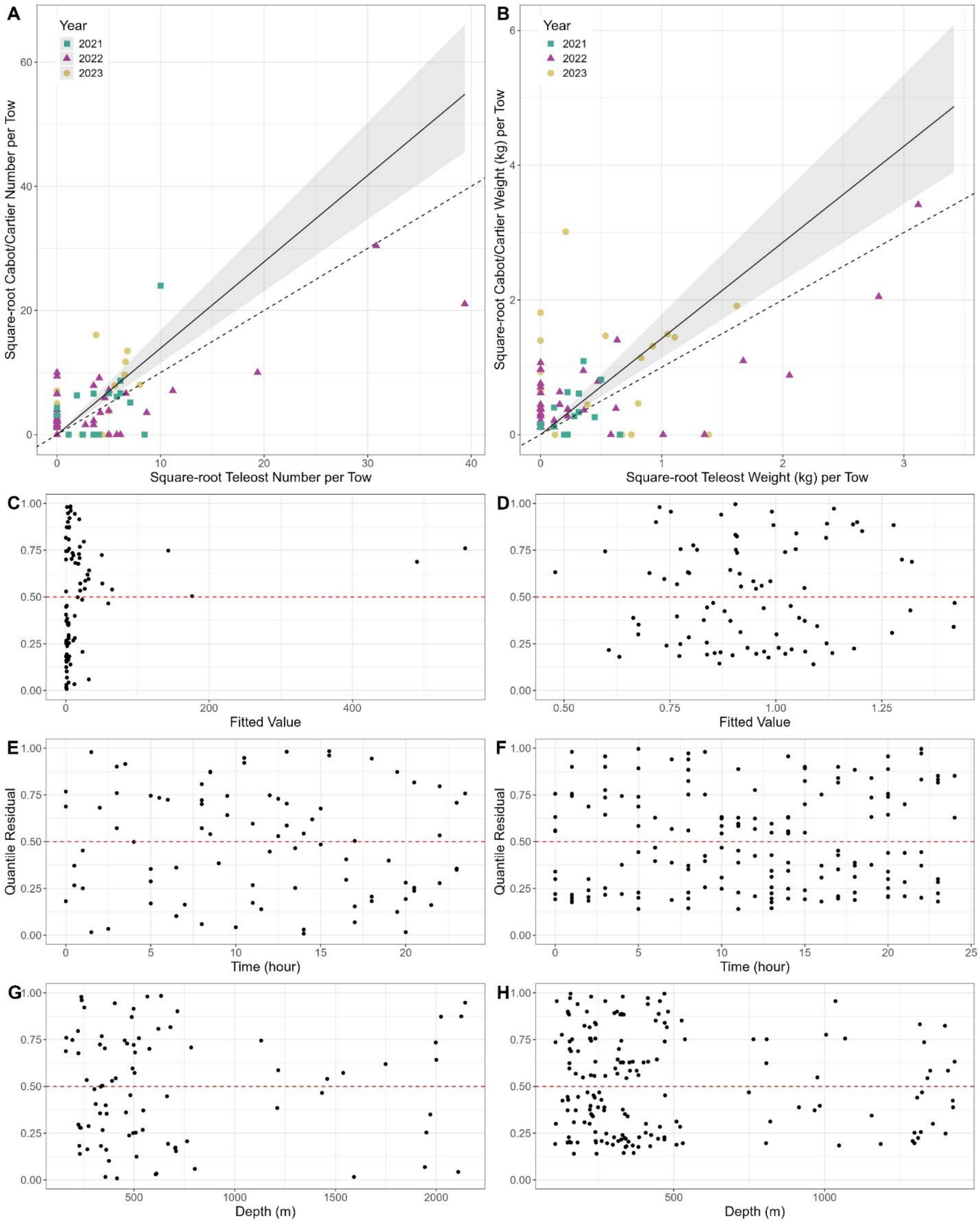


Figure 65. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of sea urchins (*Strongylocentrotus *sp.,* Brisaster *sp.,* Phormosoma *sp.), fall NAFO Divisions 2HJ3K + 3L deep.*

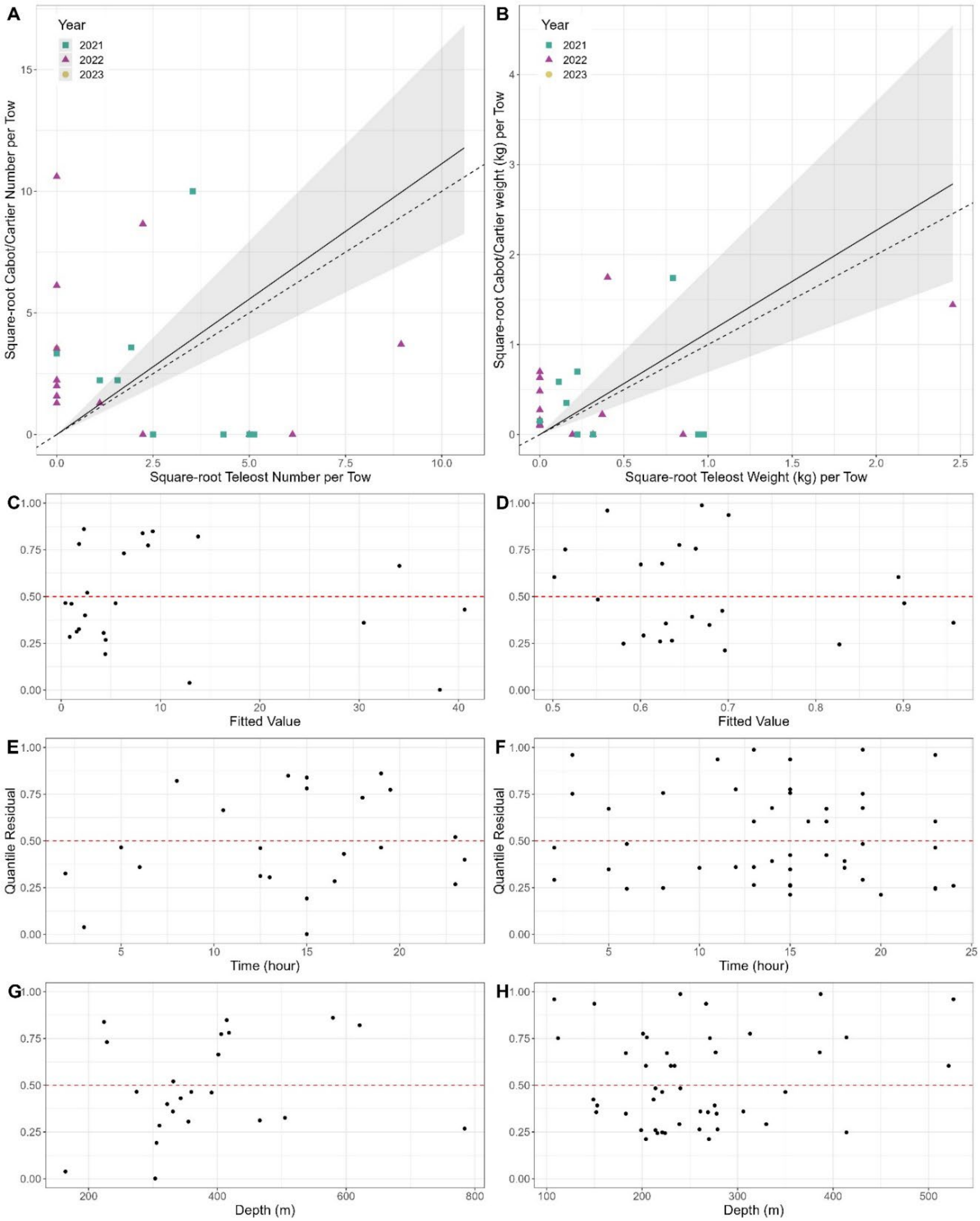


Figure 66. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of sea cucumbers (Holothuroidea), fall NAFO Divisions 2HJ3K + 3L deep.*

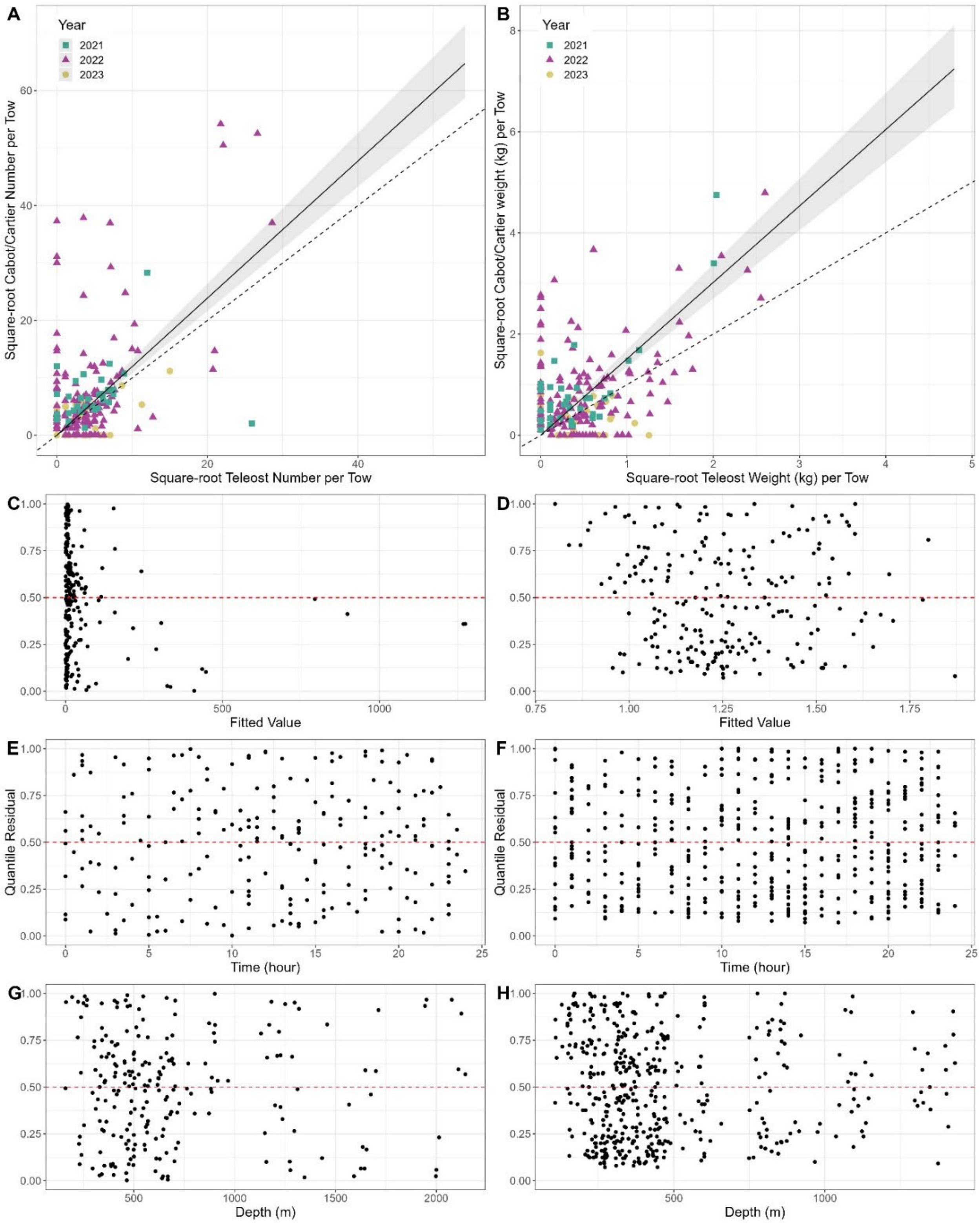


Figure 67. Results of size-aggregated analysis for the CCGS Teleost *and CCGS* Capt Jacques Cartier/John Cabot *for catch of sea stars, all grouped (Asteroidea), fall NAFO Divisions 2HJ3K + 3L deep.*

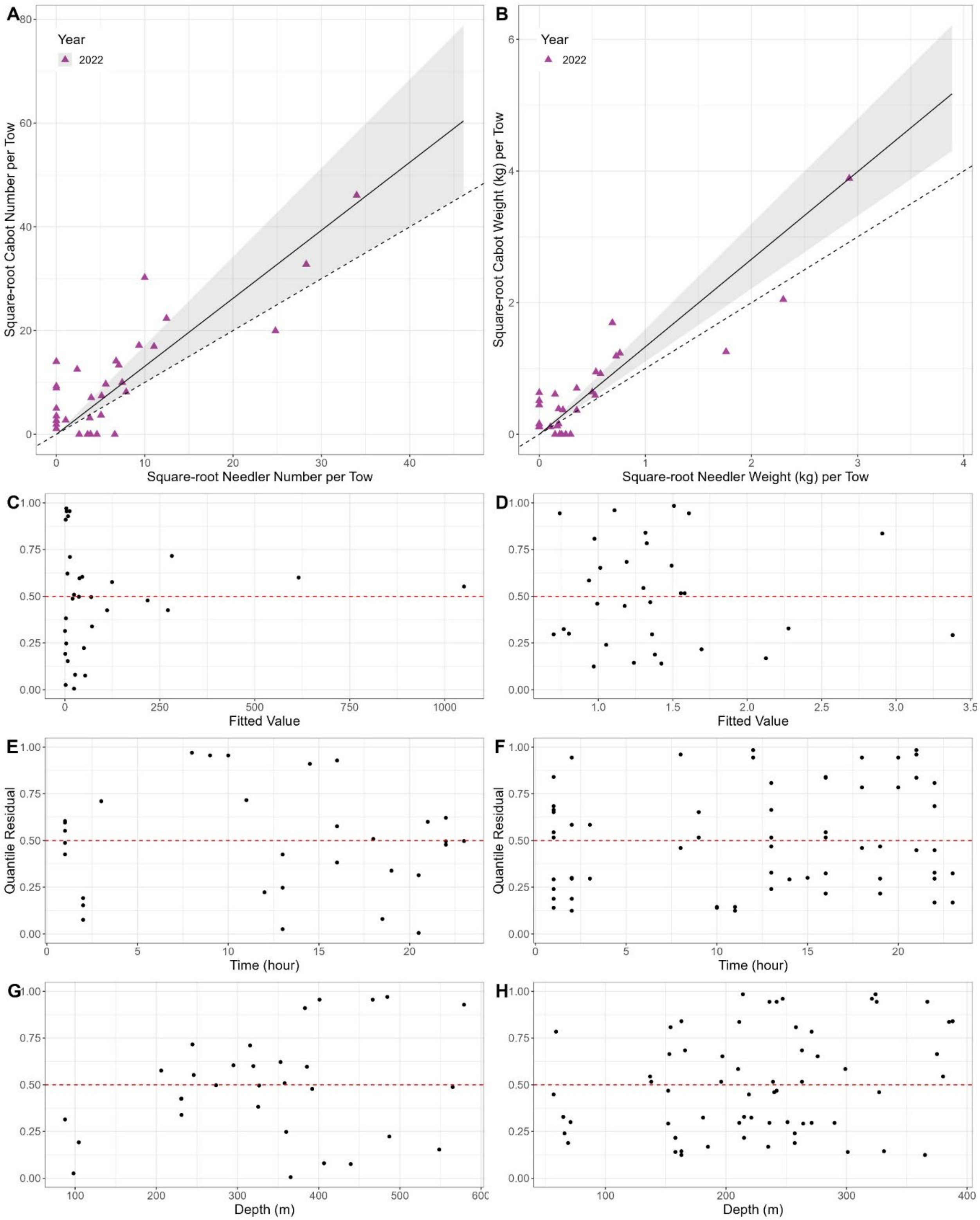


Figure 68. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of benthic shrimp (*Eualus belcheri*,* Sclerocrangon *sp.,* Sabinea septemcarinata*,* Sabinea sarsi*,* Argis *sp.), fall NAFO Division 3KL.*

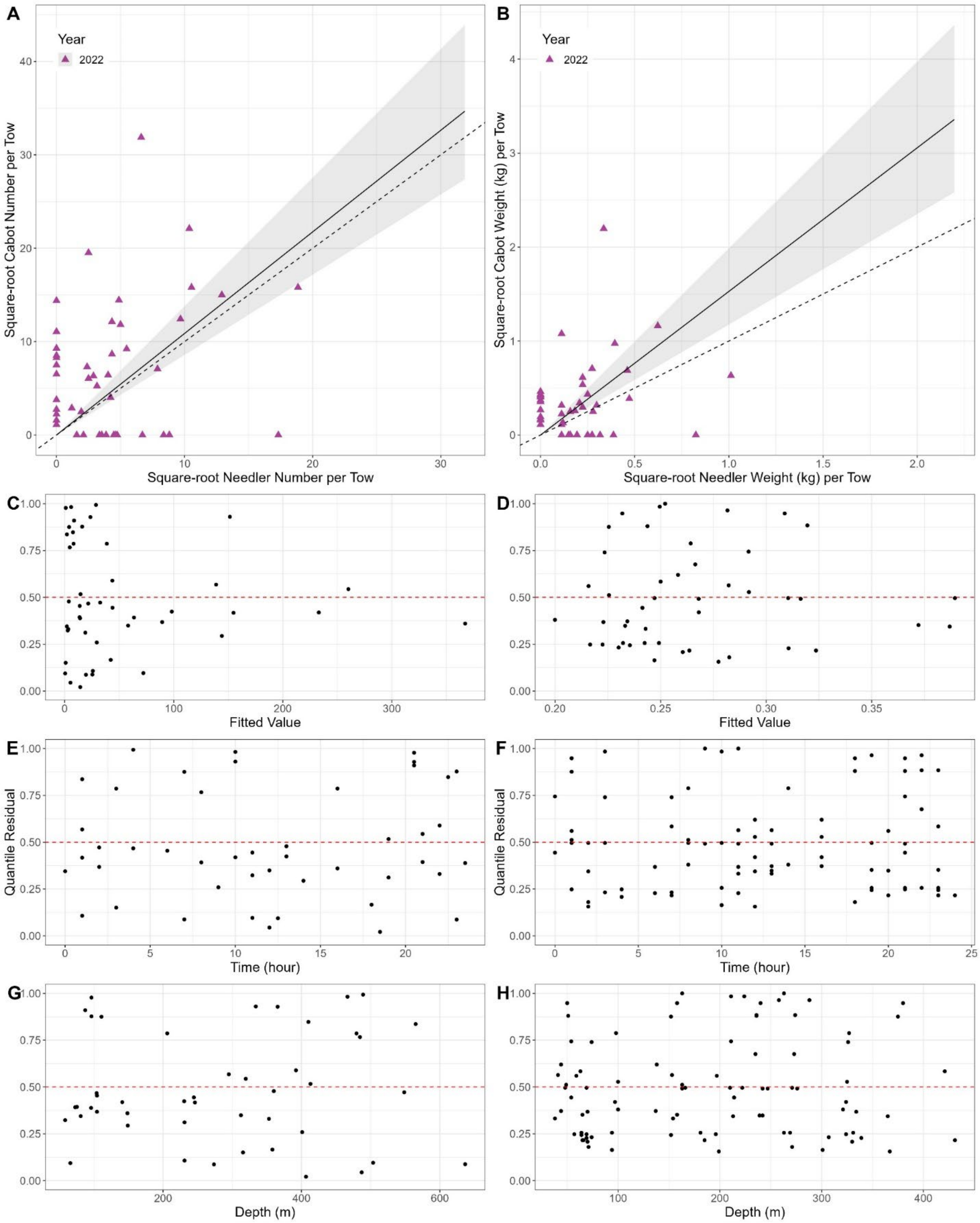


Figure 69. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of benthopelagic shrimp (*Benthesicymus *sp.,* Aristeus *sp.,* Eualus *sp.,* Spirontocaris *sp.,* Lebbeus *sp.,* Dichelopandalus *sp.,* Atlantopandalus *sp.,* Sabinea hystrix*,* Pontophilus *sp.), fall NAFO Divisions 3KL.*

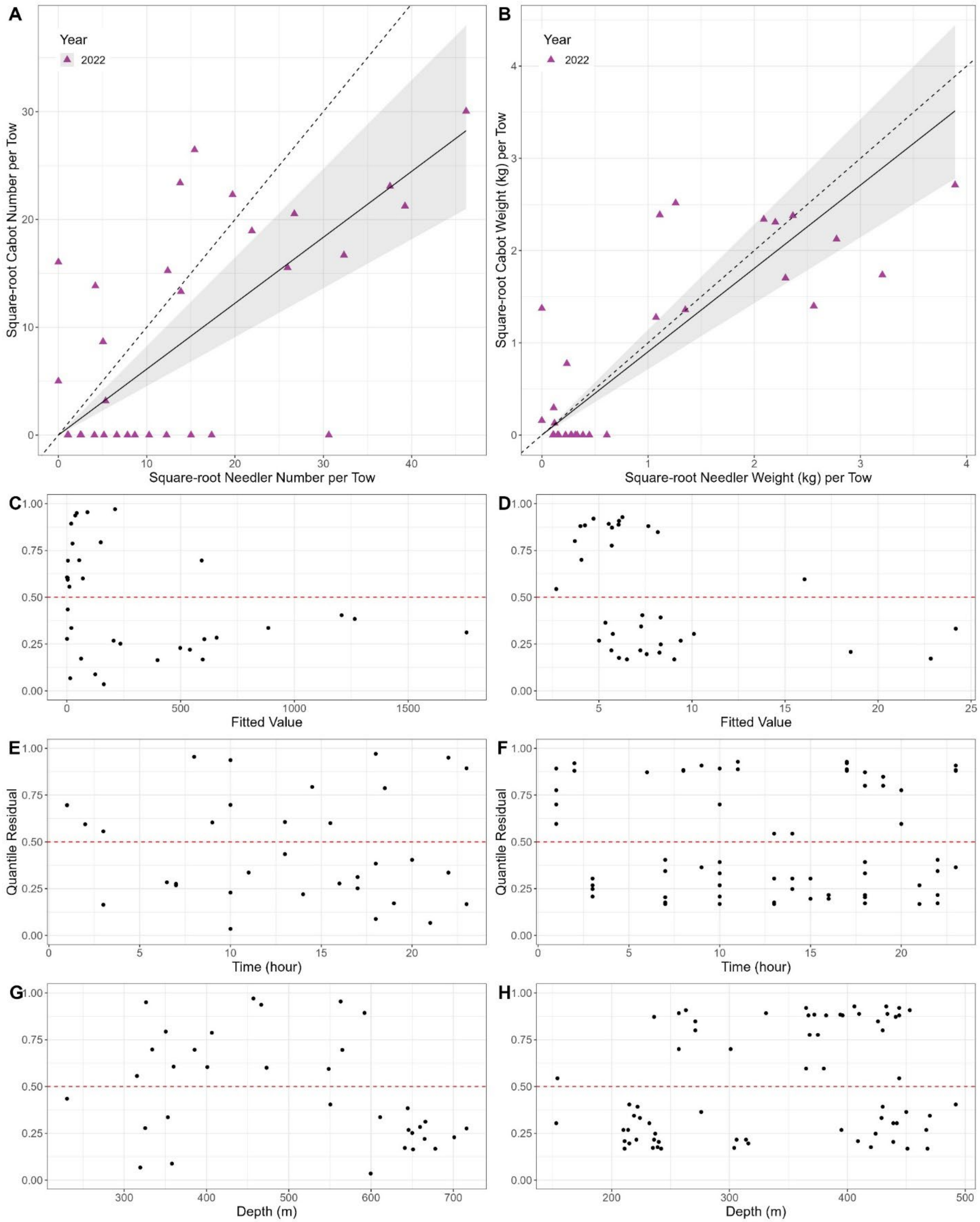


Figure 70. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of pelagic shrimp (*Aristaeopsis *sp.,* Gennadas *sp.,* Sergestes *sp.,* Sergia *sp.,* Acanthephyra *sp.,* Pasiphaea *sp.,* Parapasiphae *sp.), fall NAFO Divisions 3KL.*

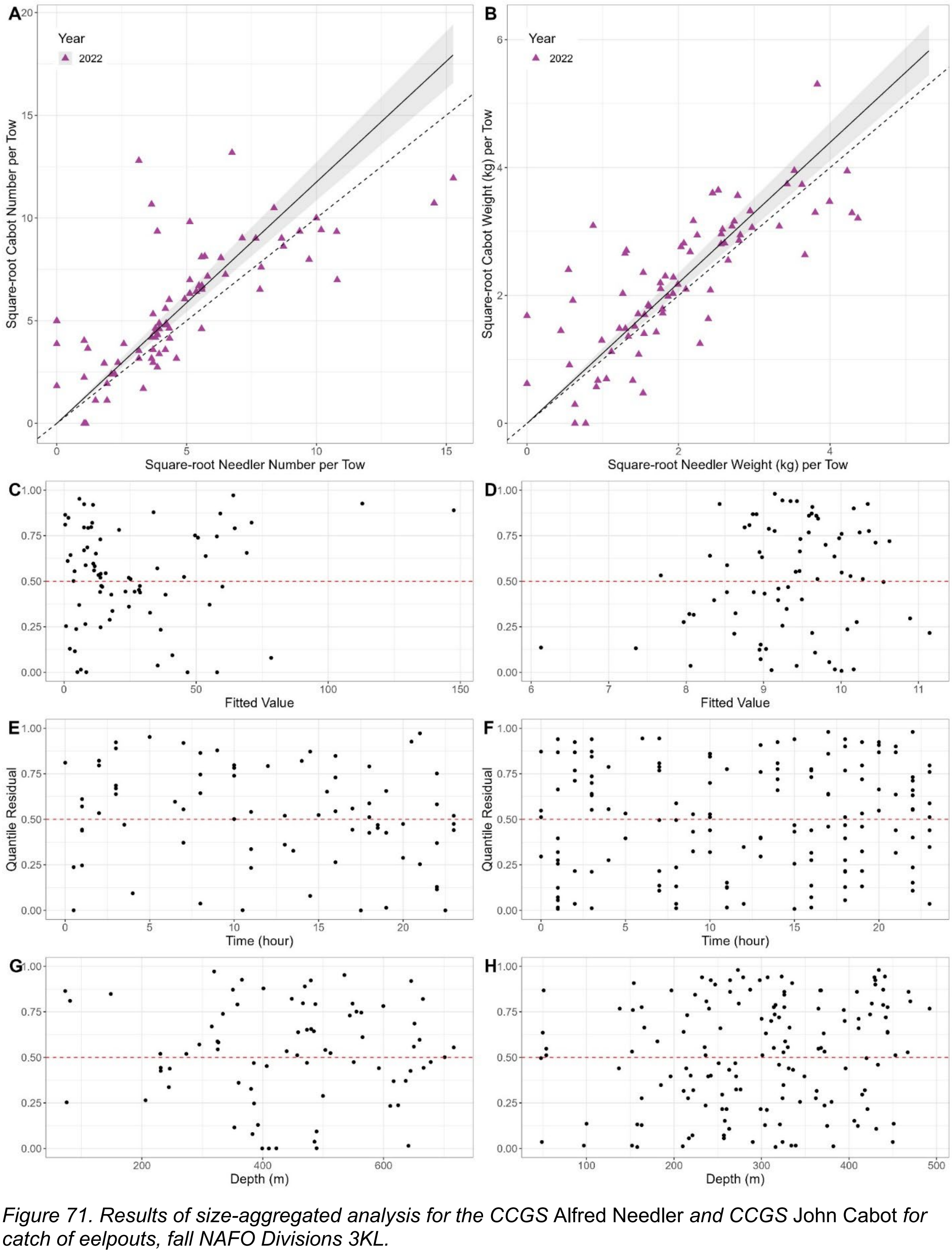


Figure 71. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of eelpouts, fall NAFO Divisions 3KL.*

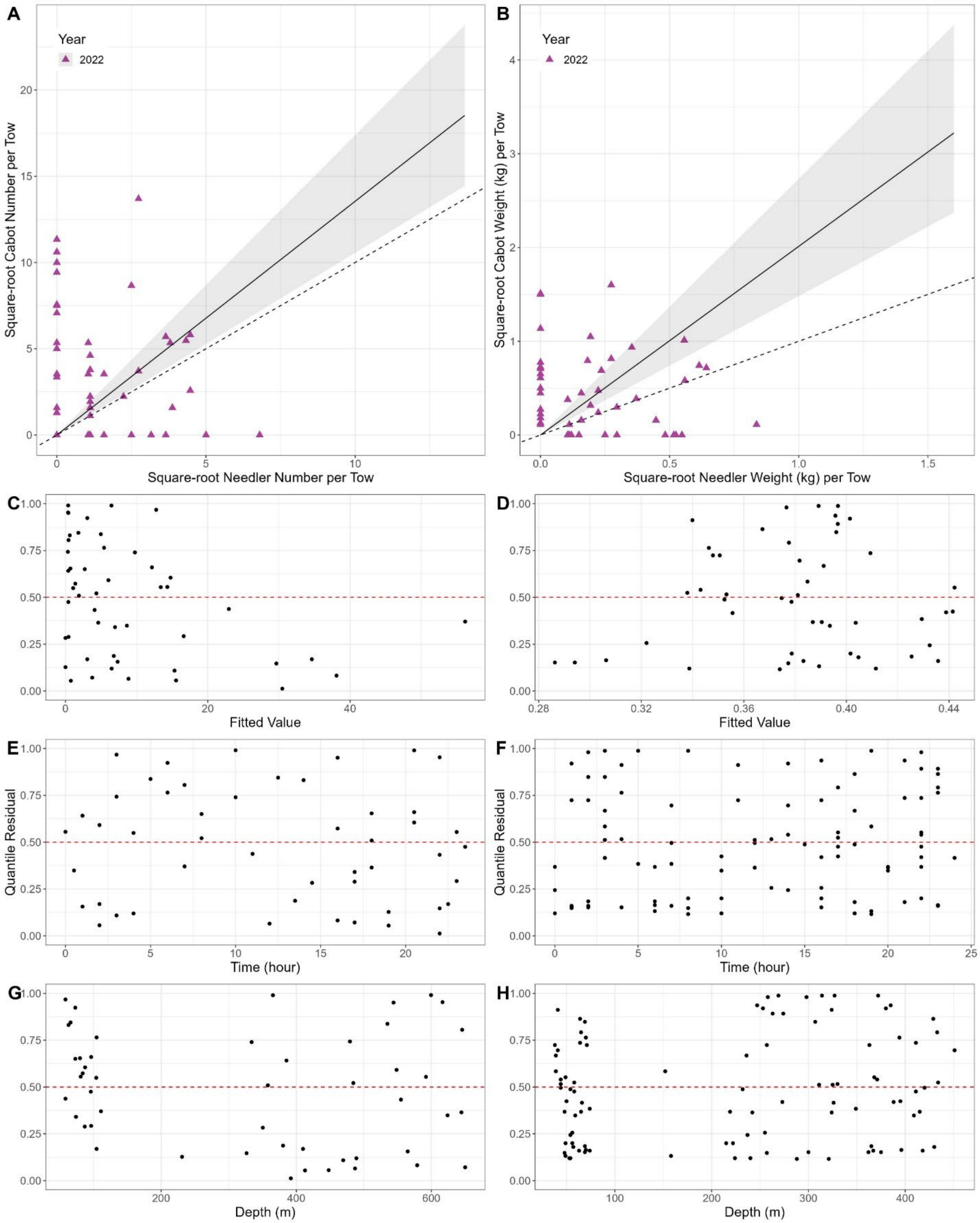


Figure 72. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of gastropods (Gastropoda, excluding Nudibranchia), fall NAFO Divisions 3KL.*

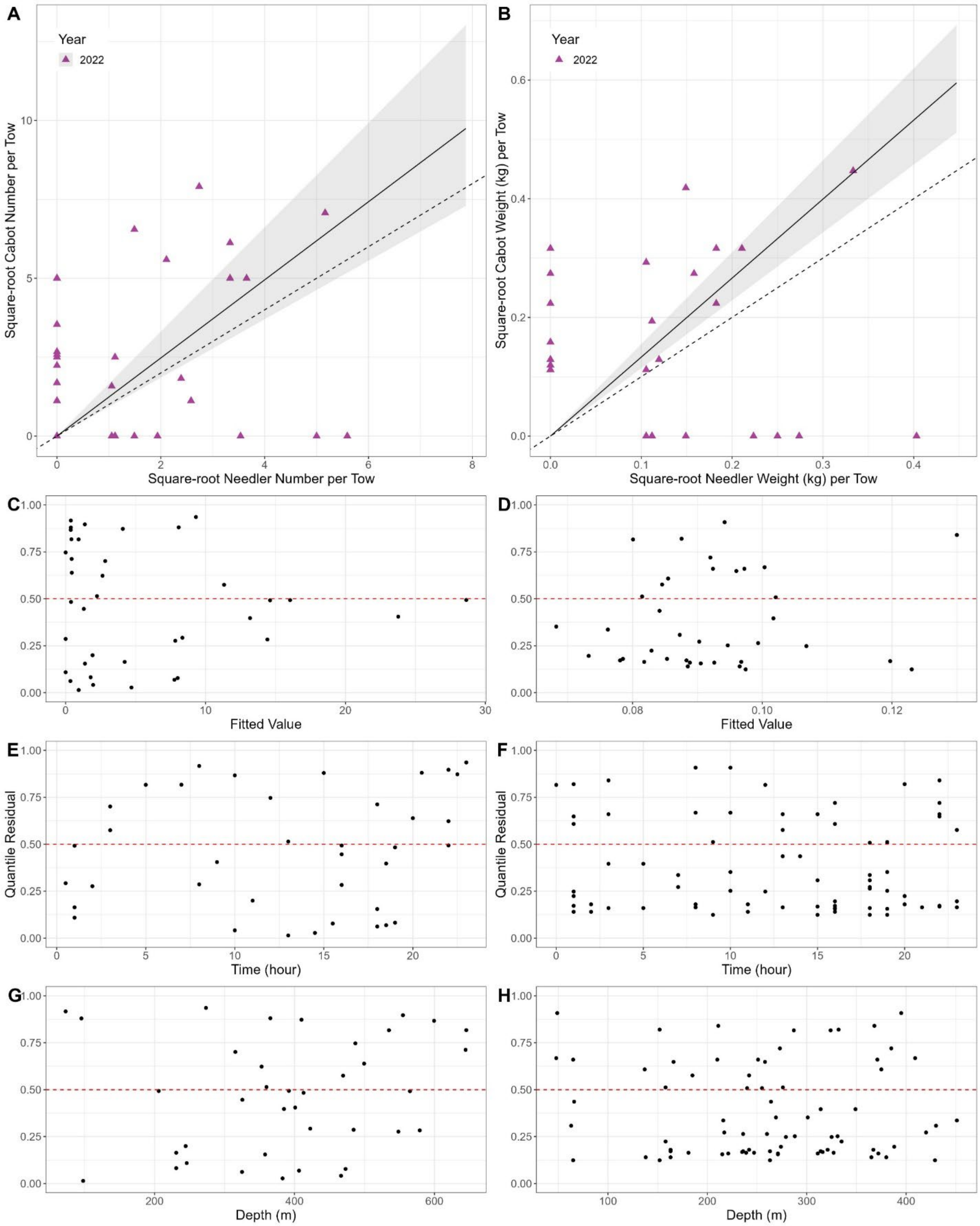


Figure 73. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of Henricia sea stars (*Henricia *sp.), fall NAFO Divisions 3KL.*

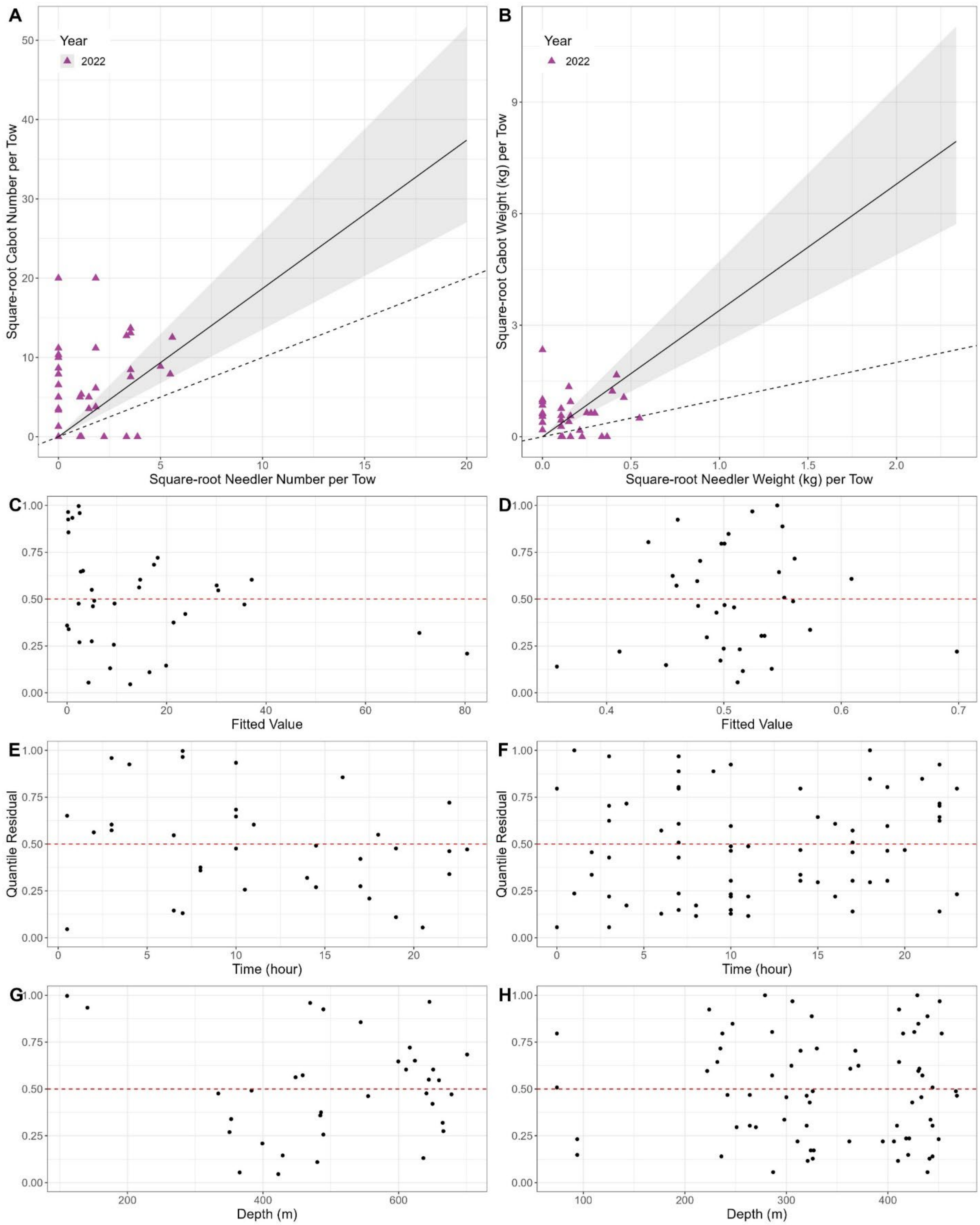


Figure 74. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of Common Mud Star (*Ctenodiscus crispatus*), fall NAFO Divisions 3KL.*

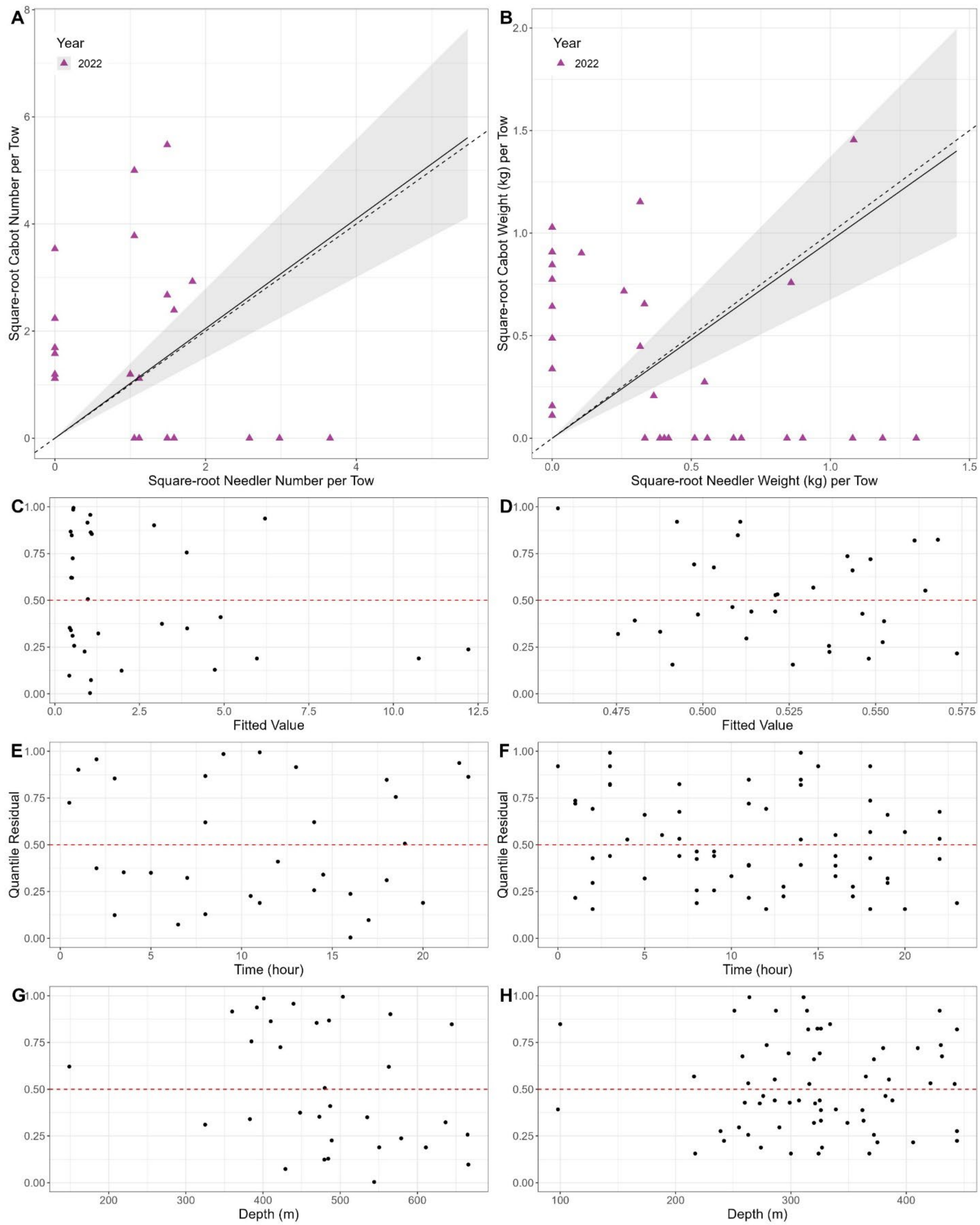


Figure 75. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of Rigid Cushion Star (*Hippasteria phrygiana*), fall NAFO Divisions 3KL.*

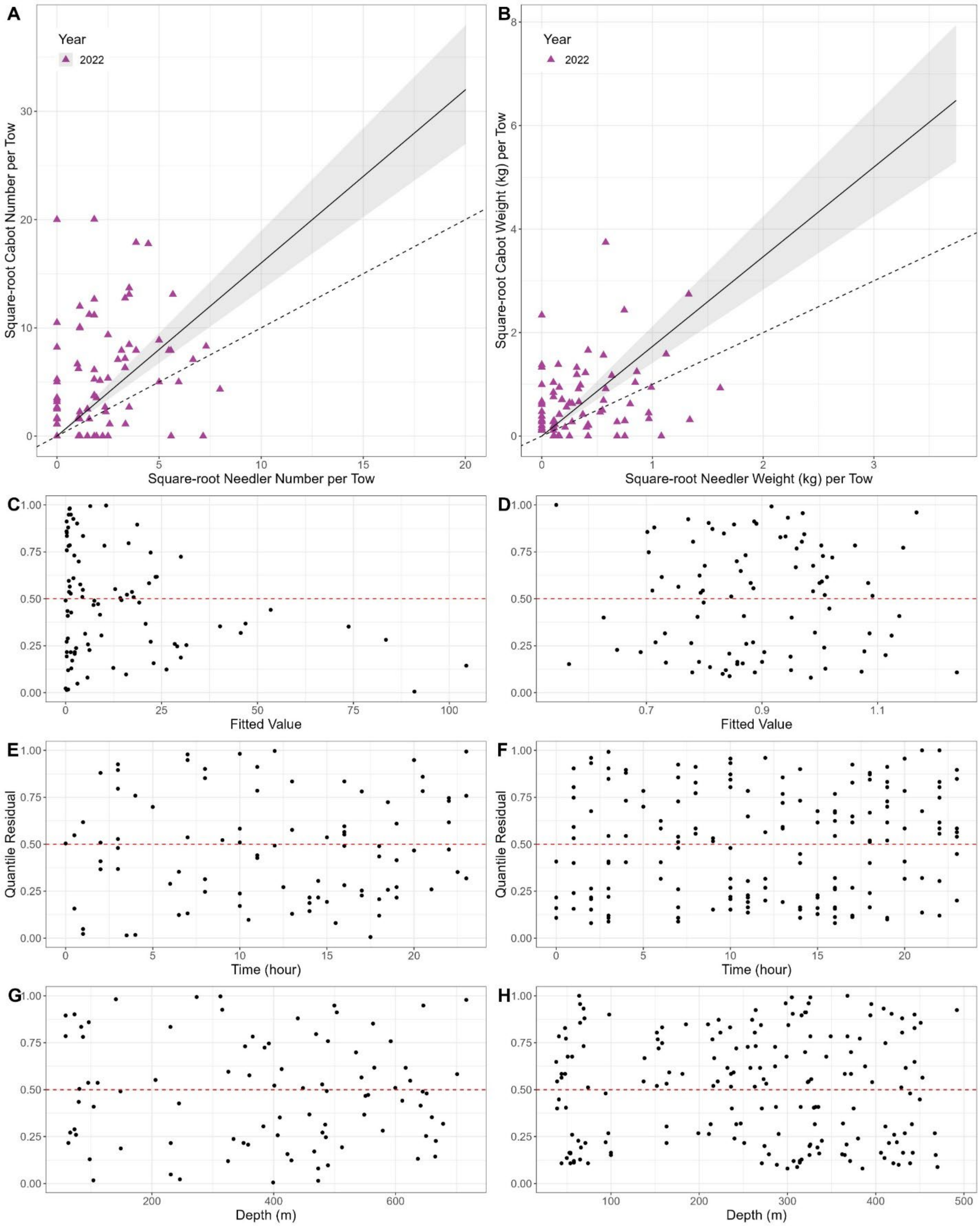


Figure 76. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of sea stars, all grouped (Asteroidea), fall NAFO Divisions 3KL.*

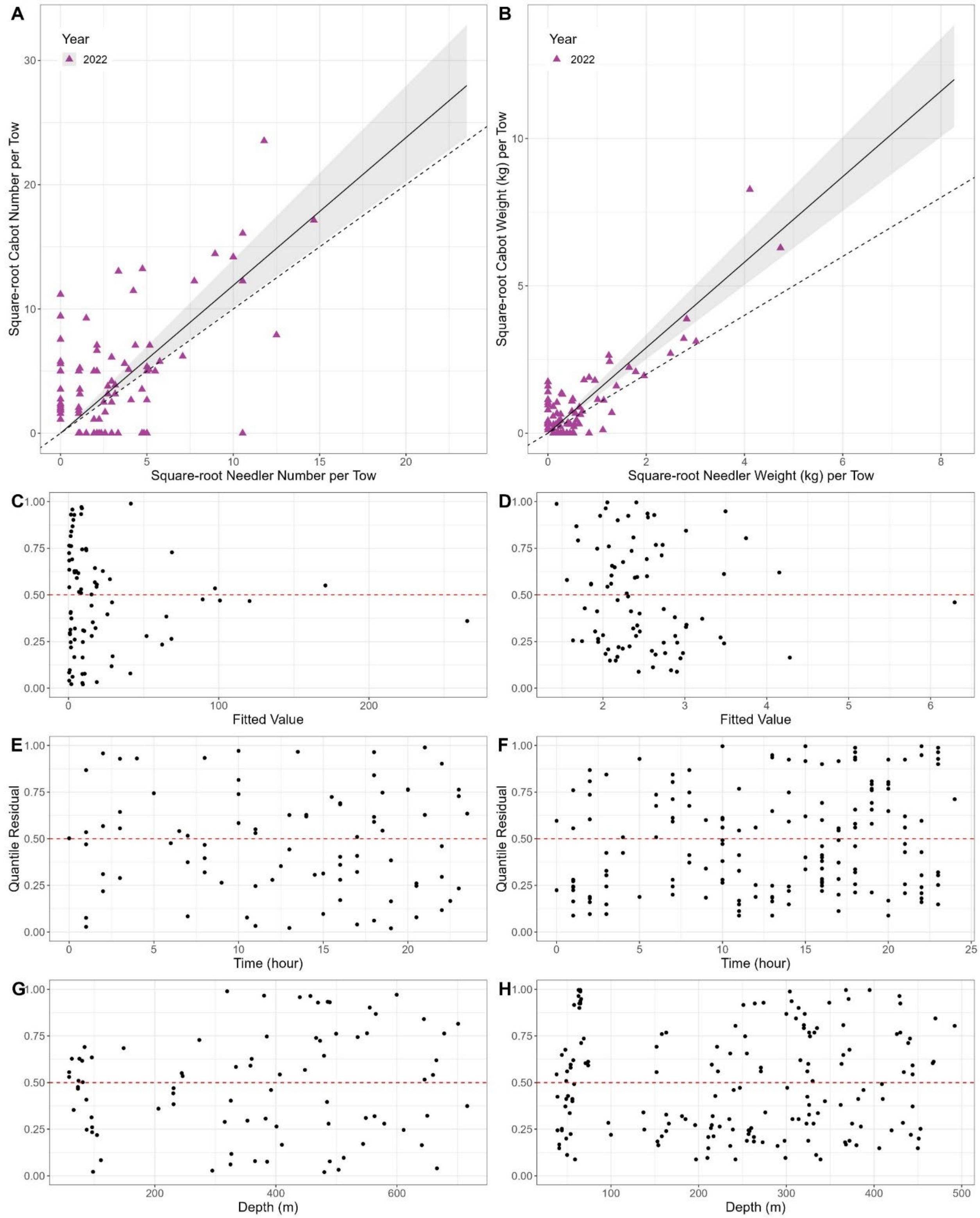


Figure 77. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of sculpins (*Artediellus *sp.,* Triglops *sp.,* Gymnocanthu *sp.,* Cottunculus *sp.,* Icelus *sp.,* Myoxocephalus *sp.,* Hemitripterus americanus*), fall NAFO Divisions 3KL.*

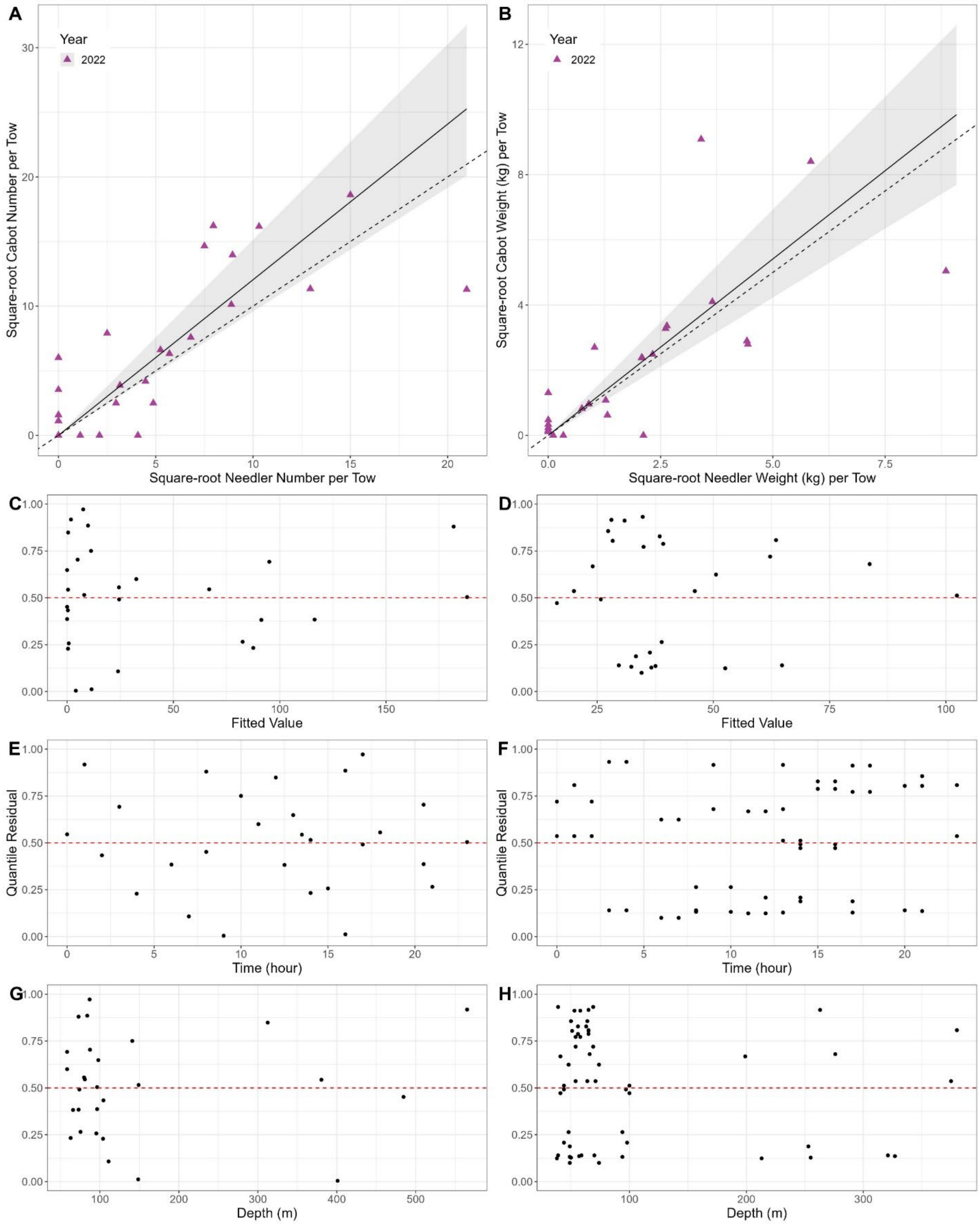


Figure 78. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of sea cucumbers (Holothuroidea), fall NAFO Divisions 3KL*

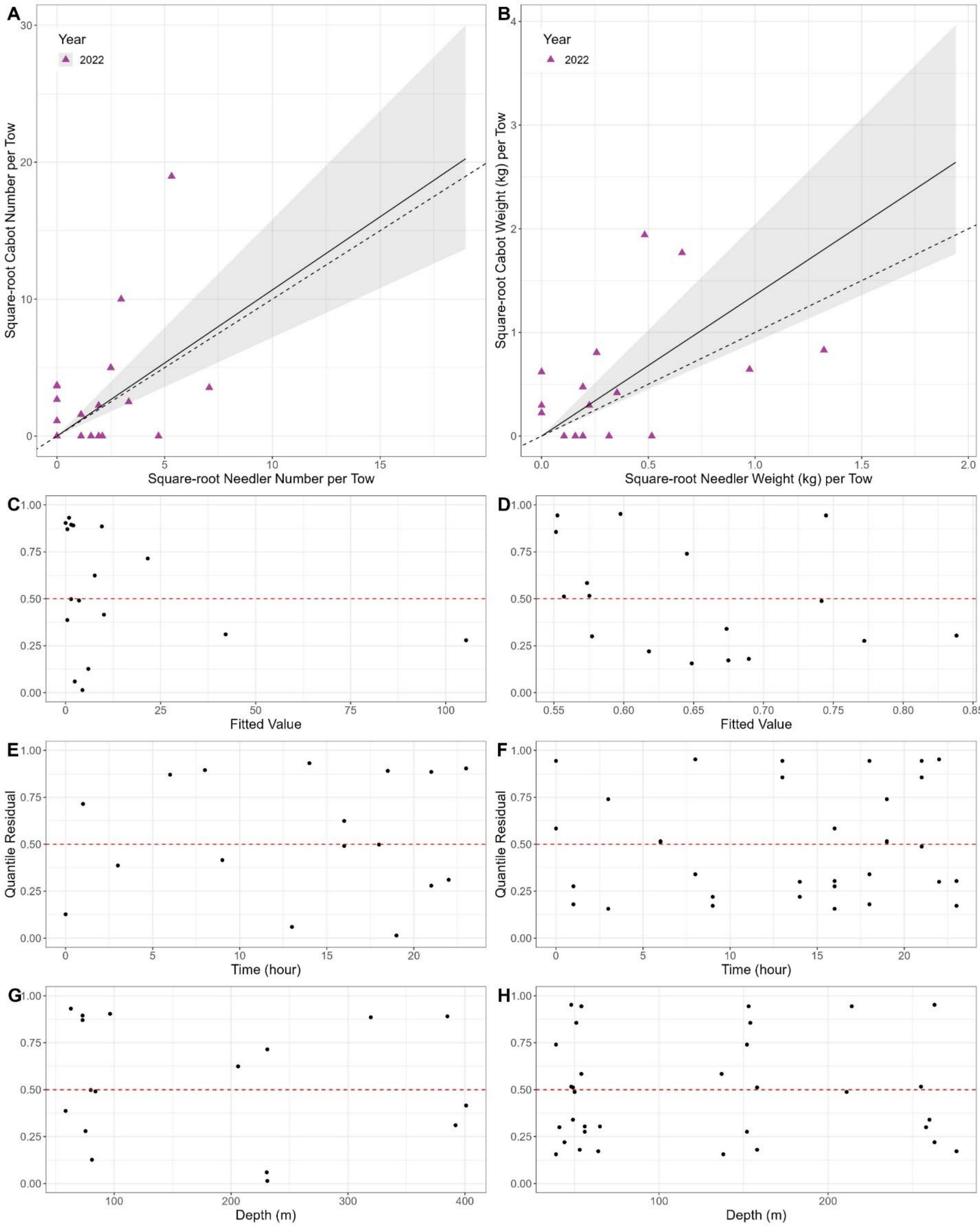


Figure 79. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of sea urchins (*Strongylocentrotus *sp.,* Brisaster *sp.,* Phormosoma *sp.), fall NAFO Divisions 3KL.*

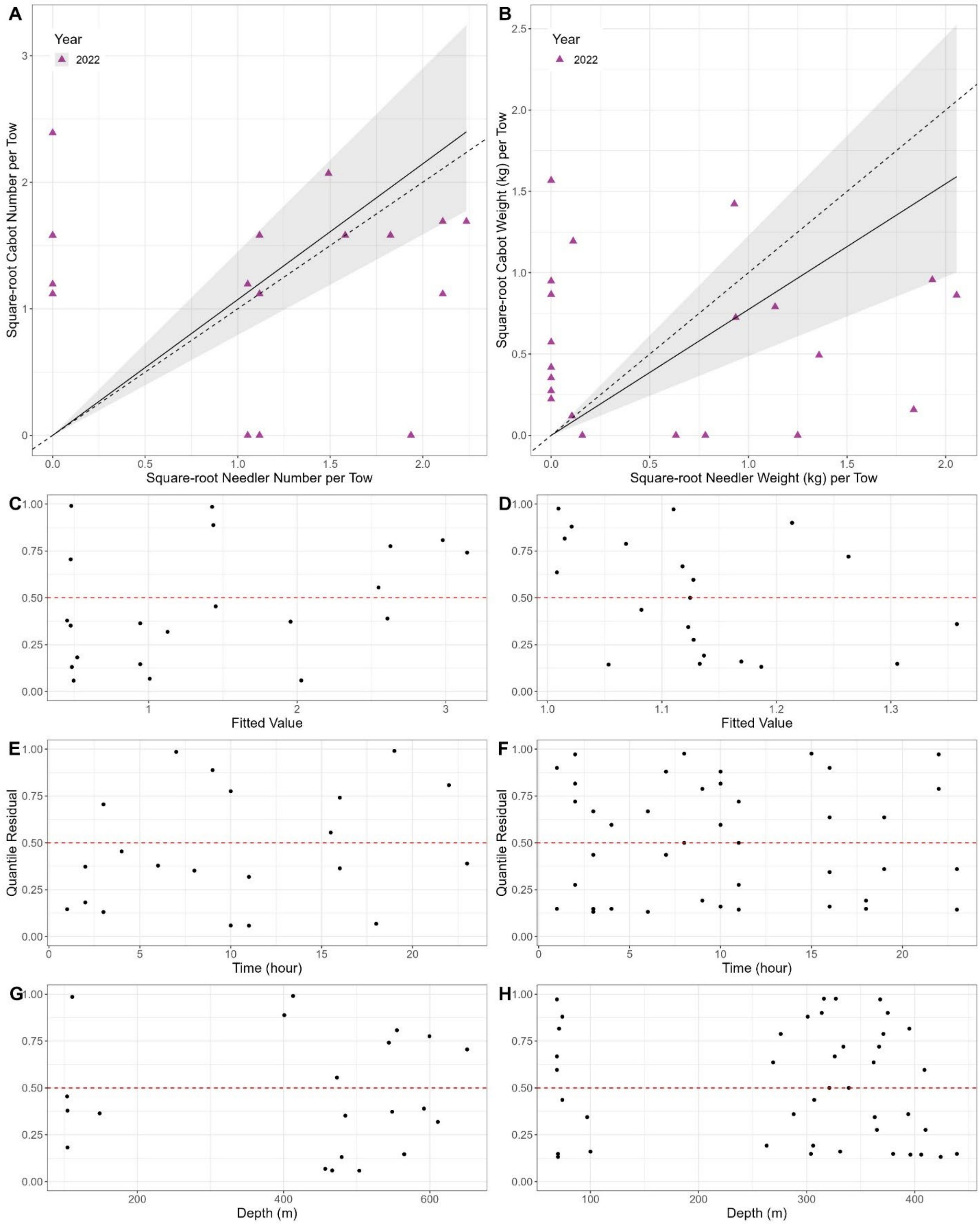


Figure 80. Results of size-aggregated analysis for the CCGS Alfred Needler *and CCGS* John Cabot *for catch of Smooth Skate, fall NAFO Divisions 3KL.*