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Statistically Assessing the Precision of Self-reported VTR Fishing Locations

US DEPARTMENT OF COMMERCE
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Editorial Treatment: To distribute this report quickly, it has not undergone the normal technical and copy editing by the Northeast Fisheries Science Center's (NEFSC's) Editorial Office as have most other issues in the NOAA Technical Memorandum NMFS-NE series. Other than the four covers and first two preliminary pages, all writing and editing have been performed by – and all credit for such writing and editing rightfully belongs to – those so listed on the title page.

TABLE OF CONTENTS

ABSTRACT

The precision of self-reported VTR points often comes into question, despite its importance in both fisheries management and stock assessment. This manuscript uses a novel statistical approach to assess the spatial precision of these points in order to generate a better understanding of how the data can best be used.

INTRODUCTION

By merging Vessel Trip Reports (VTR) with Northeast Fisheries Observer Program data at the trip level, statistical models can be developed to rigorously assess the spatial precision of VTR through the comparison of VTR self-reported fishing locations with observed haul locations. Furthermore, we parameterize and estimate cumulative distribution functions for the distance between VTR points and observed sets/hauls by using only variables reported directly on the VTR. This method allows a flexible framework from which to generate out-of-sample predictions for the spatial footprint of fishing, covering the universe of VTR data available and filling a hole in the current understanding of the spatial precision of the data in question. This approach also allows precision to be assessed for periods in which a Vessel Monitoring System (VMS) does not exist.

The precision issue associated with VTR is inherent in the attempt to represent the entirety of a trip's effort by a single set of latitude and longitudinal points for each gear and statistical area fished, regardless of the length of that trip. The problem is further compounded by issues such as an underreporting bias associated with the number of gear and statistical areas fished (Palmer and Wigley 2007, 2009).

Traditionally, studies utilizing VTR fall back on 1 of 2 approaches to the spatial data: either using the raw latitude and longitude (lat-lon) points, or spatially joining the data to predetermined grids, often composed of 10 min squares. Both of these approaches rely on a priori assumptions regarding VTR spatial precision. However, the VTR instructions state that fishermen must "Enter a single set of latitude [longitude] bearings (degree and minutes) where most of your effort occurred," which provides no obvious guidance for the precision of self-reported fishing location (Northeast Regional Office 2014). There have been some important strides in utilizing secondary data sources to more rigorously account for fishing location in the last decade (Palmer and Wigley 2007, 2009; Records and Demarest 2014). However, these tend to rely on VMS data, which only cover a subset of vessels for which a realistic spatial footprint might be of interest.

DATA AND METHODS

Data Sources

This study used 13 years of observations (2000 – 2012). A dataset including permit, vessel hull number, date sailed, date landed, area fished, gear code, latitude, and longitude was compiled from the VTR database's trip and gear tables, for the years of interest. This dataset was processed to remove records for which missing values of latitude, longitude, or hull number existed and to generate a variable for trip length, in days, by differencing the date landed and date sailed variables and the rounding up. A second dataset comprising link1, link3, hull number (hullnum1), date sailed, area fished, date landed, and haul beginning and endpoints (lat-lon) was generated for the relevant years by querying the haul and trip tables of the Observer database. The 2 datasets were then joined through a hierarchical matching algorithm. Table 1 outlines the variables used to match VTR and observed haul records in each round of the algorithm. The algorithm resulted in 488,251 hauls in the OBDBS being matched to 27,358 VTR records. The matched observations represent 87.5% of all hauls with either a beginning or end point of a haul recorded. Distance between haul beginning and end points were calculated by using a haversine function, and the top 1% of the distribution was dropped to remove hauls whose length indicated data errors in the observer dataset.

The joined VTR-Observer dataset was then exported into ArcGIS. For hauls with both beginning and endpoints, the haul path was imputed by using a straight line between these 2 points. Minimum distances between the VTR position and either the haul path, or haul beginning and end points if only 1 was recorded, was then calculated in nautical miles. These data were then exported into Stata for the statistical model estimation. In order to allow for out of sample predictions, 10% of the hauls were randomly selected and held back from the modeling endeavor.

Tables 2 – 4 present descriptions of variables from the VTRs within the matched dataset which are of interest in the current study. Bottom trawl and scallop dredge trips make up the vast majority of observed trips within the dataset, as evident in Table 2. Some of the gear categories contain too few observations to use in the model. The purse seine observations were therefore folded into the bottom trawl gear category, and the other dredge recoded as scallop dredge for modeling purposes, while the 5 observations with either unknown or harpoon gear classifications were dropped.[1] Table 3 details the diversity of trip lengths within the dataset, with only 34% of the observations occurring on trips reported to be less than 7 days long. Table 4 details the areas of the ocean in which fishing on these observed trips was reported within the VTR, with the majority coming from southern New England and the Mid-Atlantic Bight. In the next section we detail how this information will be used to model the distance between observed hauls and self-reported fishing location.

Statistical Model and Estimation

The final dataset can be understood as a repeated measure of the distance on a single trip between observed hauls and the self-reported location of fishing. As such, it is analogous to what is known as either duration or survival modeling in economics, in which the researcher models the amount of time until an event occurs. Duration models are often employed in order to assess the conditional time until an event occurs. By recasting these models from time into distance, a realistic spatial footprint can be assessed as a function of trip characteristics likely to affect precision of reported fishing locations. Formally, we are interested in estimating the cumulative distribution function (CDF) for the distance between the self-reported centroid of fishing and observed hauls, conditional on observed characteristics of that trip. With censoring of observations not an issue, this can be represented mathematically as:

(1) $$Pr(D \leq d) = F(d) \equiv \int_0^d f(x)dx,$$

[1] Although other gear types are fished in a manner more similar to purse seine, the same does not necessarily hold for the manner in which reporting occurs. The conservative decision was therefore made to combine purse seine with bottom trawl, the gear representing the largest spatial footprint.

where F(·) represents a generic CDF, f(·) is the corresponding probability density function, d is a given distance, and Pr(·) is the probability of a haul occurring within distance d from the reported centroid of fishing. Although the final form depends on the parametric distribution, the CDF can be estimated through maximum likelihood, or equivalently maximizing the log-likelihood $lnL(\theta) = \sum_{i=1}^{n} lnf(d_i|\theta)$. In this log-likelihood, θ represents a vector of parameters to be estimated, and n is the number of observations. The choice of distribution is not trivial, as different distributions will impose substantially different restrictions on the dependence between the rate of haul occurrence and the distance from the self-reported fishing location. See, for example Van den Berg (2000), Kiefer (1988), or chapter 22 in Greene (2003). For the purposes of this paper, the 3-parameter (shape, scale, and location) generalized gamma distribution is adopted. The gamma distribution is a flexible functional form, with the log-normal, exponential, and Weibull distributions as special cases, which provides appeal. However, criteria such as Akaiki's Information Criterion (AIC) or Bayesian Information Criterion can be used to assess the appropriateness of different distributional assumptions. The location is parameterized such that $\mu_i = X_i\beta$, with X_i being a vector of observed characteristics on trip i, and β representing a parameter vector to be estimated, while the shape κ and scale σ are estimated as free parameters. Following the notation used in StataCorp (2011), the exact specification of the 3-parameter gamma distribution depends on the value of the shape parameter:

$$(2) \qquad f(d) = \begin{cases} \frac{\gamma^\gamma}{\sigma d\sqrt{\gamma}\Gamma(\gamma)} \exp(z\sqrt{\gamma} - u) & if \kappa \neq 0 \\ \frac{1}{\sigma d\sqrt{2\pi}} \exp\left(-\frac{z^2}{2}\right) & if \kappa = 0 \end{cases}$$

where:

$$(3) \qquad \gamma = |\kappa|^{-2},$$

$$(4) \qquad z = sign(\kappa)(\ln(d) - X\beta)/\sigma,$$

$$(5) \qquad u = \gamma \exp\ (|\kappa| z).$$

Here $\Gamma(\cdot)$ is the gamma function, u is the standardized distance, and all other arguments are as previously defined. Note that if $\kappa = 0$, the log-normal distribution results.

By parameterizing the model as a function of observed trip characteristics, the model can control for variability between trips that would theoretically be expected to impact the precision of the self-reported fishing locations. For purposes of this paper, we parameterize the CDF as a function of characteristics solely reported on the VTR and likely to explain a substantial amount of variance in precision across trips. These trip characteristics include gear employed, trip length (coded as a discrete categorical variable), and subarea fished.[2] Gears are fished in different manners, and a highly mobile gear such as bottom trawls chasing mobile fish are likely to cover more ground on a fishing trip than a gear such as scallop dredge which harvests sessile organisms highly concentrated in known beds. Furthermore, hauls on a 7 day trip would be expected to be more diffuse than those of a 1 day trip. Even with trips using a single gear and

[2] Additional variables including month, season, and year indicators, as well as vessel length and horsepower, proved to be insignificant in alternate specifications.

fully encompassed within a single statistical area, a longer trip would be expected to cover more area of the ocean than a shorter trip, all else equal.

Estimation results can be found in Table 5. All variables are binary indicators, with a 1 day bottom trawl trip to southern New England/Mid-Atlantic forming the baseline for both model specifications. The majority of the parameter estimates from the full model specification are significant at the .01 level. The exceptions are the indicator for a pot trip, the Area 521 and Gulf of Maine indicators, and the estimate for the shape parameter, κ.[3] The Wald test for the null hypothesis that κ = 0 is rejected at the .1 significance level (p-value = 0.083). This test suggests that the gamma distribution fits the model better than the log-normal. An additional Wald test was conducted to test the null hypothesis that κ = 1, which was also rejected at the .1 significance level (p-value = 0.0000).[4]

Wald tests were performed on the full model specification in order to better understand the parameter estimates. The null hypothesis that the parameter estimates associated with the Area 521, Georges Bank, and Gulf of Maine were equivalent could not be rejected at any conventional level (p-value = 0.8192). Likewise, the null hypothesis of equality between the parameter estimates for 4 – 6 day trips (p-value = 0.9964), 9 – 10 day trips (p-value = 0.7691), 13 – 14 day trips (p-value = 0.8942), and 11 – 14 day trips (p-value = 0.6484) could not be rejected at conventional levels. The variables were therefore collapsed in the parsimonious specification, in order to facilitate the further investigation of the distances between observed hauls and self-reported fishing location. Further investigation is particularly important given that the marginal effects in the gamma distribution are not linear, and the magnitude and sign of parameter estimates do not lend themselves readily to interpretation.

The Cox-Snell residuals are used to assess goodness of fit for duration models. These residuals are defined as follows:

$$(6) \qquad \hat{r}_j = -\ln\left(\hat{S}_j(d_j)\right),$$

in which $\hat{S}_j(d_j) = 1 - \hat{F}_j(d_j)$ is the estimated survival function and is calculated from the estimated model and observed trip characteristics. Cox and Snell (1968) determine that a correctly specified model leads to these residuals following an exponential distribution, with a mean of 1. The fit of the model can then be assessed visually by graphing the Nelson-Aalen empirical estimator of the residual's cumulative hazard function against the Cox-Snell residuals. Again following the notation in StataCorp (2011), the Nelson-Aalen estimator is defined as:

$$(7) \qquad \widehat{H}_j(\hat{r}_j) = \sum_{j|\hat{r}_j<r} \frac{y_j}{n_j},$$

[3] Area 521, off the eastern coast of Cape Cod, was pulled out separately because it is treated differently by different stock assessments. For example, winter flounder from 521 is attributed to the southern New England/Mid-Atlantic Bight Stock, while yellowtail flounder from this same area is attributed to the Cape Cod/Gulf of Maine stock. This area was thus delineated as a separate area of interest because of the potential for differing fishing practices from a mix of Southern New England and Gulf of Maine stocks and species.

[4] These assertions are reinforced by the AIC for the two models, which suggests that the generalized gamma distribution fits the data better than the Weibull, exponential, and log-normal distributions. The log-normal scored closest to the generalized gamma distribution, although the AIC difference between the two models was still 80 points.

with y_j representing a binary variable equal to 1 if a haul occurred and 0 otherwise, n_j the total number of trips for which a haul could have occurred, and $\hat{r}_j$ as defined in equation 6. See, for example, Stata's reference manual for Survival Analysis and Epidemiological Tables (StataCorp 2011) for a more thorough discussion on the topic. A correctly specified model's residuals will fall along a 45° line on the graph.

Figure 1 graphs the Nelson-Aalen estimator versus the Cox-Snell residuals, along with a histogram of the Nelson-Aalen results. Although there is deviation within the right tail of the distribution, the vast majority of the estimates fall very near the 45° line. The substantial length of the tail, as illustrated in Figure 2, is likely symptomatic of problems in parametrically fitting the longest distances between observed hauls and reported fishing location. Regardless, 95% of the observations diverge from the 45° line by no more than 3%. Overall, the tight alignment of the majority of the points along the 45° suggests that the model is correctly specified.

Figure 2 compares the modeled survival function (1-CDF) versus the empirical distribution of the 10% of hauls reserved for out-of-sample validation of the model. The modeled survival function was estimated by using each variable's mean value as calculated from the in-sample observations. As Figure 2 illustrates, the predicted outcome very closely matches the empirical distribution, aside from some deviation indicating differences in density in the 30 – 60 nautical mile range.

In order to better understand the correlation between trip characteristics and spatial precision, confidence intervals conditioned on observable characteristics of trips can be generated. Substituting equations 3 and 4 into 5 and solving for the distance d leads to the following:

$$(7)\ d = \exp\left(\frac{\ln\left(\frac{u}{\gamma}\right)\sigma}{\kappa} + X\beta\right).$$

An inverse gamma function can be used to estimate the standardized distance, u, for each probability band of interest. The conditional distance can then be calculated from equation 7. For the purposes of this paper, the distance defining the 25, 50, 75, 90, and 95 percentiles were calculated for each combination of gear, area, and trip length. The results of these estimates, for observed combinations, are presented in Figures 3 – 8. The trip length and gear effects dominate the distance associated with any particular confidence level. This is intuitive, given the theoretical reasoning that longer trips submitting a single VTR are likely to be less precise in location than shorter trips, and that mobile gear is likely to cover more ground than static gear.

In essence, the distance estimated can be interpreted as a radius of a circle centered around the self-reported fishing location within which there is a certain confidence of all a trip's hauls falling. As an example, a 1 day trip employing scallop dredge in the Mid-Atlantic has a 25% confidence interval extending .43 nautical miles from the self-reported centroid of the circle. This means that on average we would expect 25% of a 1 day scallop dredge trip's hauls to fall within .43 nautical miles of a self-reported fishing location. Looking again at Figures 3 – 8, it becomes evident that the ability of a 10 minute square to effectively represent the spatial footprint of a fishing trip depends greatly on the length and type of gear employed on the trip in question. For example, a 1 day scallop dredge trip in the Mid-Atlantic has a 90% confidence interval extending 5.87 nautical miles from a VTR point, a distance for which a 10 min square might be a realistic representation of effort for that trip. However, a 2 day bottom trawl trip in the same region has a 90% confidence interval of 19.01 nautical miles, a footprint much less likely to be represented effectively by a 10 min square. Given the distribution of distances presented in Table 3, the results are not promising for the ability of 10 min squares to reflect fishing locations across all trips of interest.

CONCLUSION

This paper suggests a statistical approach that can be used to ascertain the precision of self-reported VTR fishing location. Modeling results indicate that the gear employed and length of a fishing trip greatly impact the spatial precision of self-reported fishing locations from VTR. These results suggest that more care in the selection of spatial aggregation is likely warranted, and a trip’s spatial resolution depends on the gear and type of trip being investigated. Future work will look at the ability of this statistical approach to replicate the distribution of effort on observed hauls, with a comparison to raw VTR points and aggregations to the 10 min square, currently 2 common treatments of this spatial data.

REFERENCES CITED

Cox DR, Snell EJ. 1968. A general definition of residuals. Journal of the Royal Statistical Society, Series B (Methodological), 30(2): 248 – 275.

Greene WH. 2003. Econometric analysis (5th ed.). Upper Saddle River, NJ: Prentice Hall.

Kiefer NM. 1988. Economic duration data and hazard functions. Journal of Economic Literature, 26(2): 646-679.

Northeast Regional Office. 2014. Fishing Vessel Trip Report (VTR) Reporting Instructions. Gloucester, MA:NOAA National Northeast Regional Office. http://www.nero.noaa.gov/ro/fso/vtr_inst.pdf (Accessed May 8, 2014).

Palmer MC, Wigley SE. 2007. Validating the stock apportionment of commercial fisheries landings using positional data from vessel monitoring systems. U.S. Department of Commerce Northeast Fisheries Science Center Reference Document 07-22, 44 p.

Palmer MC, Wigley SE. 2009. Using positional data from vessel monitoring systems to validate the logbook-reported area fished and the stock allocation of commercial fisheries landings. North American Journal of Fisheries Management, 29(4), p. 928 – 942.

Records D, Demarest C. 2014. Producing high resolution spatial estimates of fishing effort using a VMS-based statistical model. Mimeo. Woods Hole, MA:NOAA Northeast Fisheries Science Center.

StataCorp. 2011. Stata: Release 12. Statistical Sofware. College Station, TX: StataCorp LP.

Van den Berg GJ. 2000. Duration models: Specification, identification, and multiple durations. Munich Personal RePEc Archive Paper No. 9446, 106 p.

Table 1. Hierarchical matching between Vessel Trip Report and Observer datasets

Match Round	Variables matched	Hauls Matched
1	Hull number, date sailed, date landed, area	351,481
2	Hull number, date landed, area	22,408
3	Hull number, date sailed, area	93,189
4	Hull number, date sailed, date landed	11,599
5	Hull number, date landed	6,035
6	Hull number, date sailed	3,533

Table 2. Gear representation in dataset

Gear	Observations	Cum. %	Northeast Gear Codes
Bottom Trawl	129,150	27.7	050, 051, 052, 053, 056, 058, 059, 350, 360, 054, 057
Drift Gillnet	1,271	28.1	100, 105, 117
Harpoon	2	28.1	030, 031
Longline	4,233	29.0	010, 020, 021
Midwater Trawl	3,626	29.8	170, 370
Other Dredge	790	27.8	381, 386, 400
Pot	1,235	30.1	181, 183, 186, 200, 300
Purse Seine	42	30.1	120, 121
Scallop Dredge	290,928	92.8	132
Sink Gillnet	34,462	100	100, 105, 117
Unknown	3	100	
Total	465,742		

Table 3. Trip length within dataset

Trip Length	Observations	Cum. %
1	48,676	10.5
2	14,091	13.5
3	10,376	15.7
4	12,620	18.4
5	17,281	22.1
6	22,698	27
7	31,520	33.8
8	41,463	42.7
9	47,314	52.8
10	47,946	63.1
11	42,895	72.3
12	32,062	79.2
13	28,218	85.3
14	23,411	90.3
15	24,208	95.5
16	11,560	98
17 plus	9,403	100
Total	465,742	

Table 4. Areas fished within the Northeast Fisheries Science Center (NEFSC) dataset

Areas	Observations	Cum. %	NEFSC Statistical Areas
Stat Area 521	41,765	9	521
Georges Bank	120,883	35	522, 525, 542, 543, 561, 562
Gulf of Maine	34,007	42.3	511 – 515
Southern New England/Mid-Atlantic Bight	268,195	100	526, 534, 537 – 539, 541, 611 – 616, 621 – 629, 631 – 639
Total	464,850		

Table 5. Regression of distance between observed hauls and self-reported centroid of fishing reported on Vessel Trip Reports, as a function of observed trip characteristics

Variables	Full	Parsimonious	All Observations
Drift Gillnet	-0.509***	-0.521***	-0.529***
	(0.119)	(0.118)	(0.119)
Longline	-0.658***	-0.663***	-0.666***
	(0.0964)	(0.0950)	(0.0941)
Midwater Trawl	-0.332***	-0.333***	-0.327***
	(0.0892)	(0.0886)	(0.0865)
Pot	0.263		
	(0.258)		
Scallop Dredge	-0.870***	-0.870***	-0.871***
	(0.0418)	(0.0415)	(0.0415)
Sink Gillnet	-0.383***	-0.382***	-0.378***
	(0.0530)	(0.0526)	(0.0526)
2 day trip	0.312***	0.304***	0.304***
	(0.0522)	(0.0519)	(0.0511)
3 day trip	0.723***	0.717***	0.722***
	(0.0571)	(0.0562)	(0.0561)
4 day trip	1.014***		
	(0.0582)		
5 day trip	1.015***		
	(0.0628)		
6 day trip	1.018***		
	(0.0613)		
4-6 day trip		1.008***	1.013***
		(0.0495)	(0.0492)
7 day trip	1.139***		
	(0.0646)		
8 day trip	1.214***		
	(0.0608)		
7-8 day trip		1.171***	1.175***
		(0.0522)	(0.0519)
9 day trip	1.372***		
	(0.0653)		
10 day trip	1.389***		
	(0.0685)		
9-10 day trip		1.370***	1.375***
		(0.0569)	(0.0566)
11 day trip	1.581***		
	(0.0706)		
12 day trip	1.676***		
	(0.0766)		
13 day trip	1.625***		
	(0.0948)		
14 day trip	1.610***		

Table 6, continued. Regression of distance between observed hauls and self-reported centroid of fishing reported on Vessel Trip Reports, as a function of observed trip characteristics

Variables	Full	Parsimonious	All Observations
	(0.103)		
11-14 day trip		1.609***	1.611***
		(0.0602)	(0.0598)
15 day trip	1.709***		
	(0.115)		
16 day trip	1.723***		
	(0.140)		
15-16 day trip		1.702***	1.704***
		(0.0954)	(0.0951)
17 + day trip	1.898***	1.887***	1.891***
	(0.128)	(0.127)	(0.126)
Area 521	-0.127**		
	(0.0539)		
Georges Bank	-0.125***		
	(0.0383)		
Gulf of Maine	-0.0964**		
	(0.0479)		
Non - S. NE/Mid-Atlantic		-0.124***	-0.125***
		(0.0343)	(0.0344)
Constant	0.894***	0.906***	0.902***
	(0.0502)	(0.0492)	(0.0488)
ln(sigma)	0.286***	0.287***	0.287***
	(0.00624)	(0.00625)	(0.00625)
kappa	-0.0368*	-0.0371*	-0.0375*
	(0.0214)	(0.0214)	(0.0213)
Observations	417,535	417,535	463,943

Robust standard errors in parentheses, clustered at the permit level to account for correlation in disturbances across observations of single permit holder's trips

*** p<0.01, ** p<0.05, * p<0.1

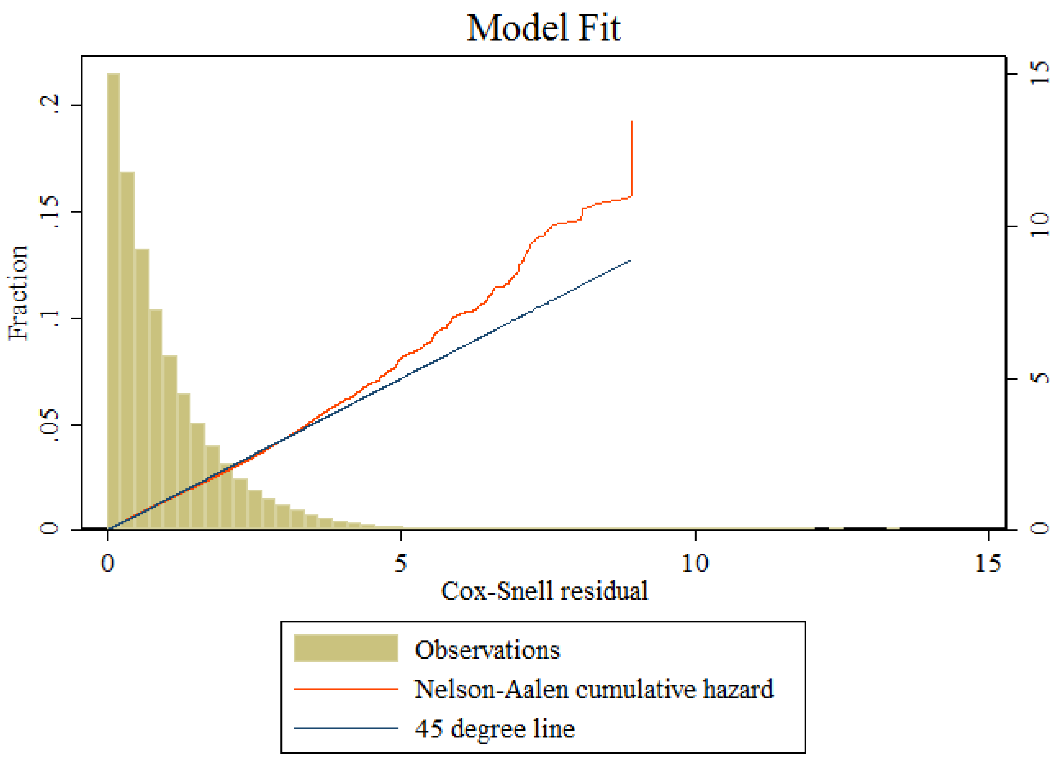

Figure 1. Histogram of observations and line graph illustrating the Nelson-Aalen empirical cumulative hazard function's divergence from the Cox-Snell residual.

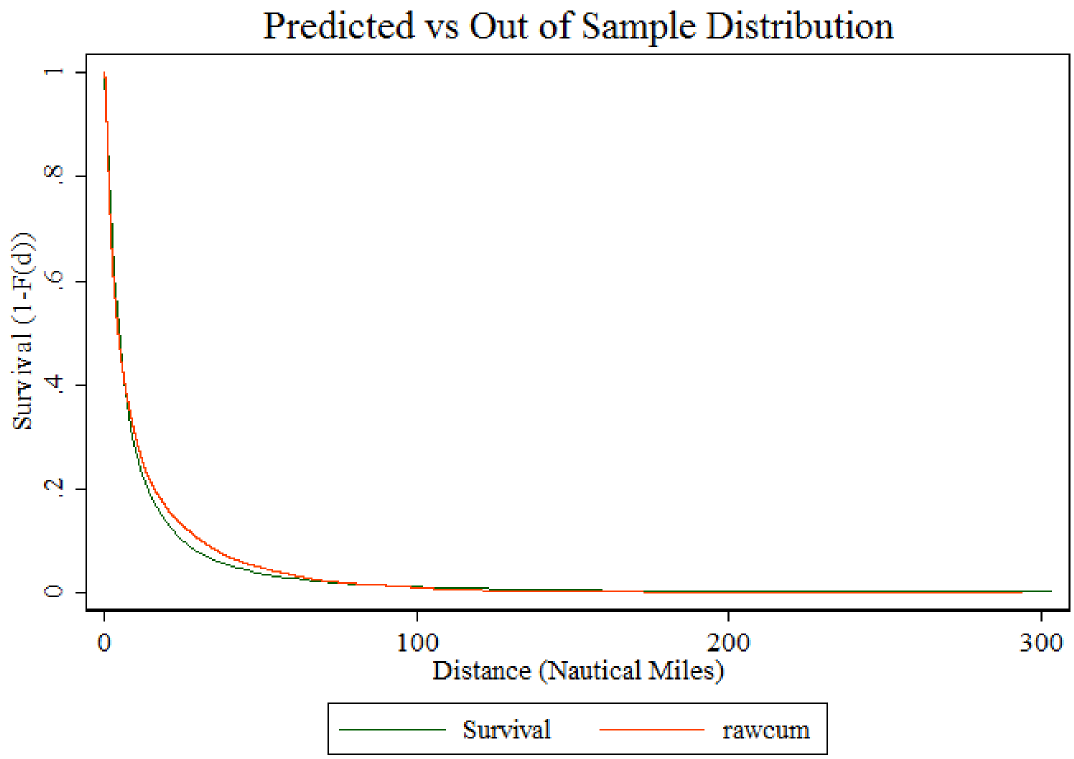

Figure 2. Comparison of the model distribution predicted from variable mean values compared to the out of sample empirical distribution of haul distance from Vessel Trip Report centroids.

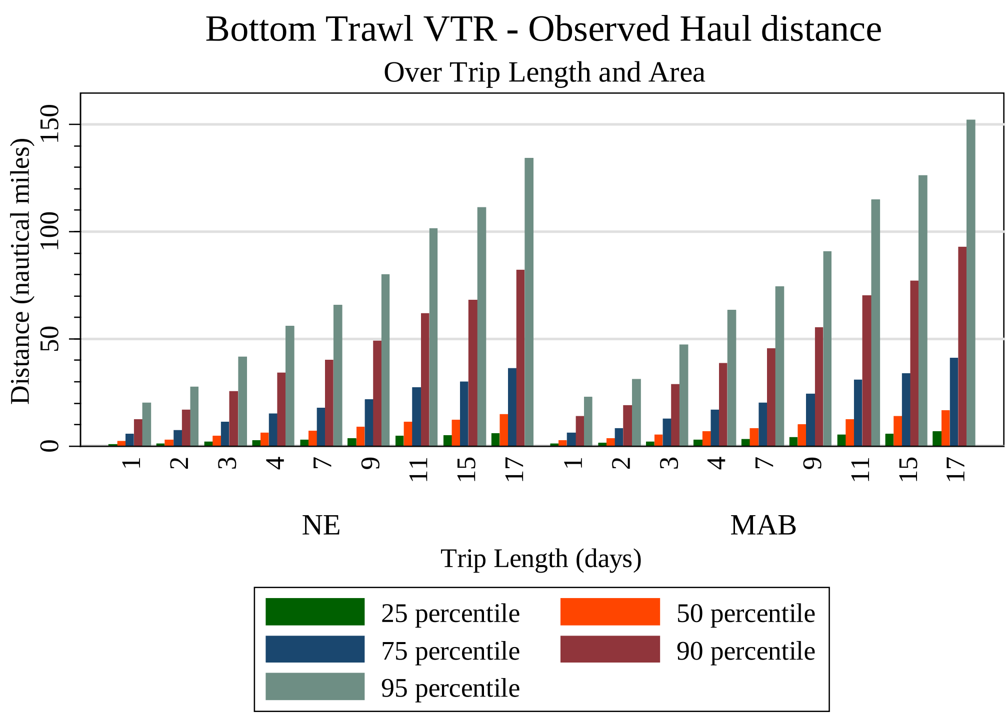

Figure 3. Confidence intervals for bottom trawl hauls, as distance from self-reported Vessel Trip Report fishing location. Confidence intervals conditioned on area and trip length.

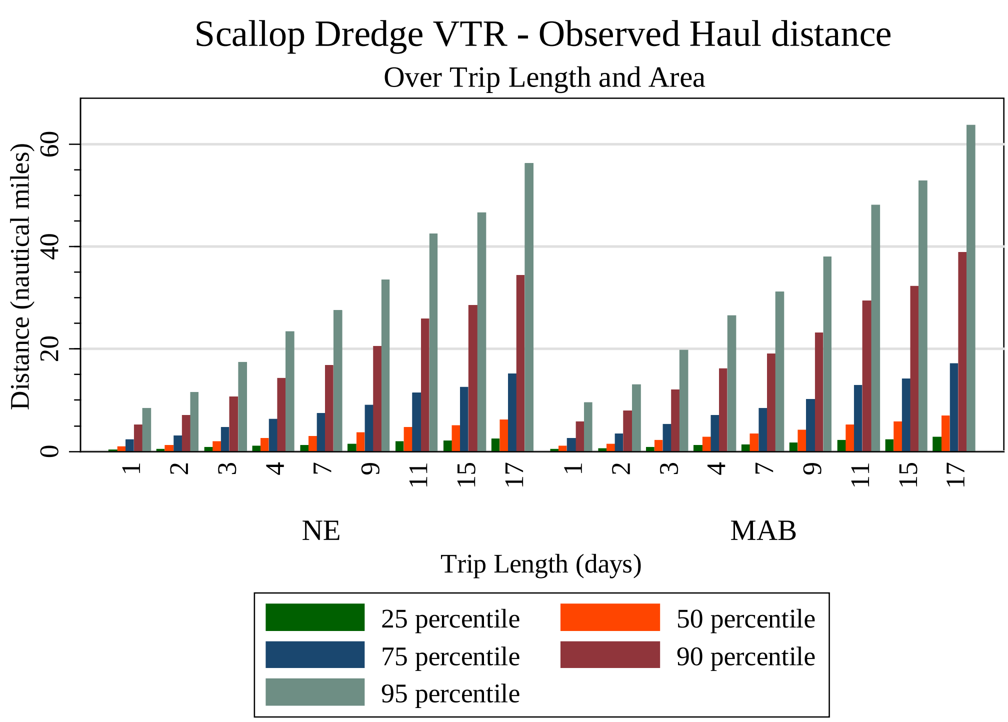

Figure 4. Confidence intervals for scallop dredge hauls, as distance from self-reported Vessel Trip Report fishing location. Confidence intervals conditioned on area and trip length.

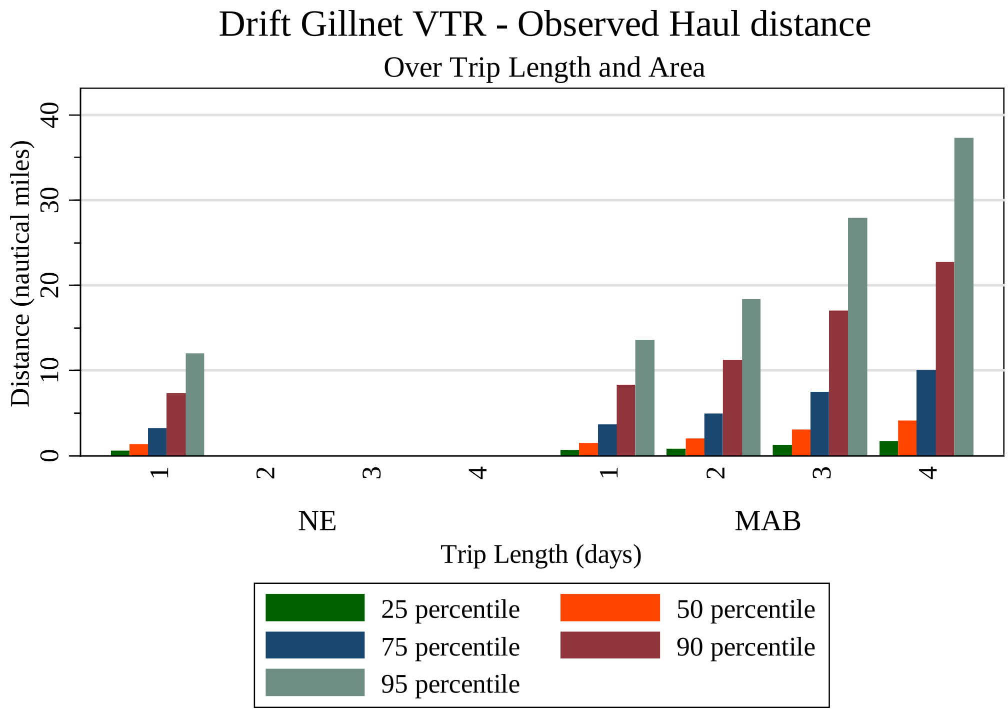

Figure 5. Confidence intervals for drift gillnet hauls, as distance from self-reported Vessel Trip Report fishing location. Confidence intervals conditioned on area and trip length.

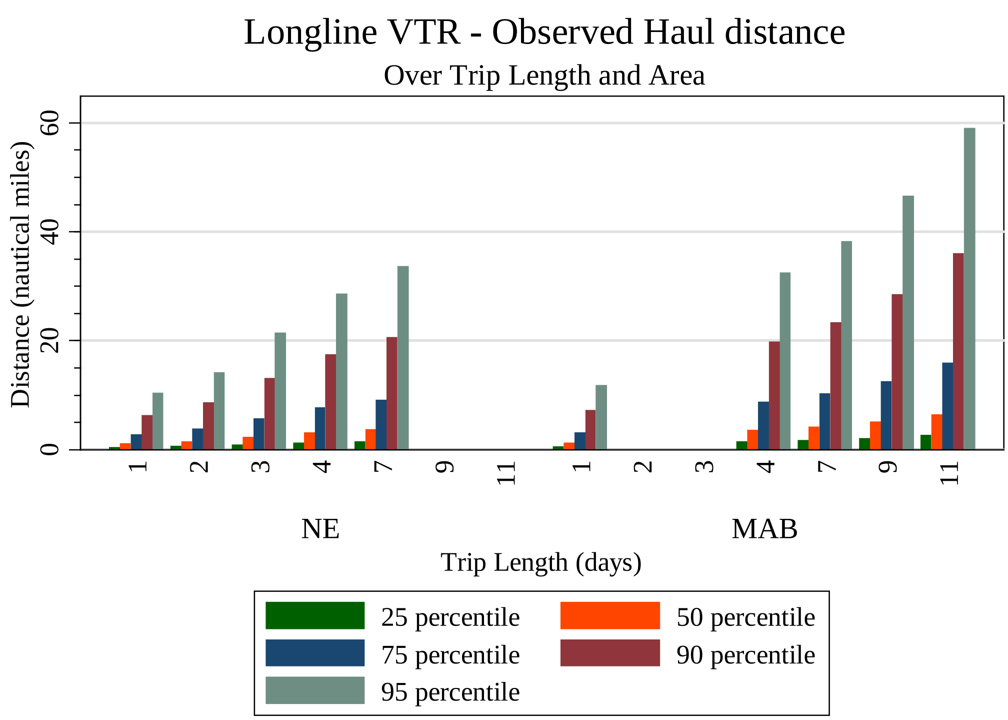

Figure 6. Confidence intervals for longline hauls, as distance from self-reported Vessel Trip Report fishing location. Confidence intervals conditioned on area and trip length.

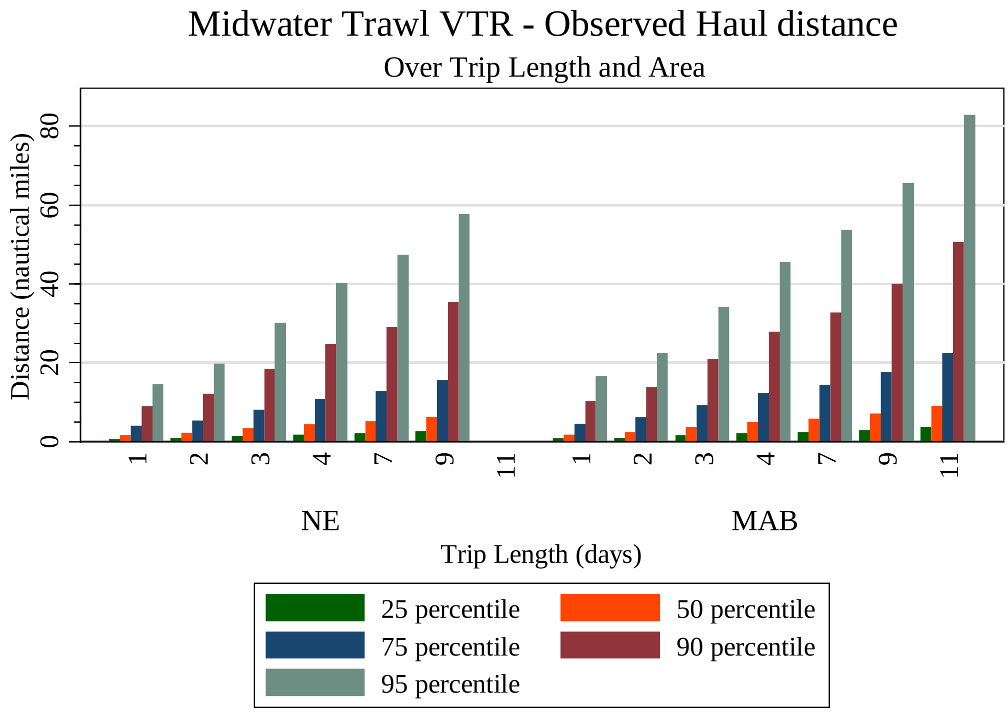

Figure 7. Confidence intervals for midwater trawl hauls, as distance from self-reported Vessel Trip Report fishing location. Confidence intervals conditioned on area and trip length.

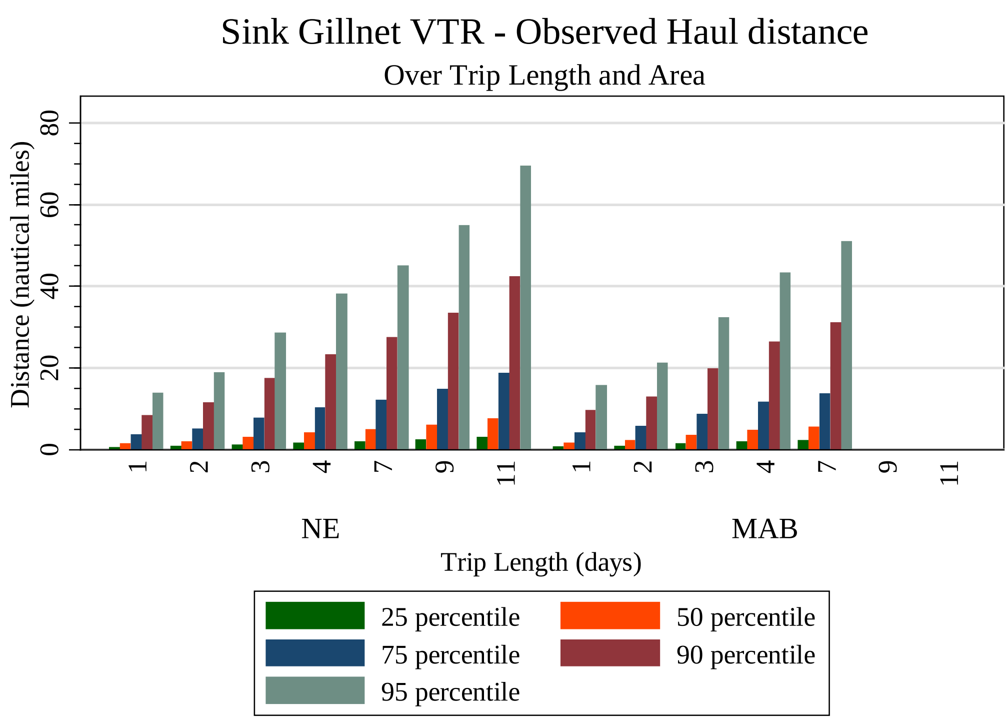

Figure 8. Confidence intervals for Sink Gillnet hauls, as distance from self-reported Vessel Trip Report fishing location. Confidence intervals conditioned on area and trip length.

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