Comparison of setline and trawl survey catch rates in different areas

William G. Clark

Abstract

There are no consistent and significant differences among areas in the ratio of trawl survey CPUE to setline survey CPUE. There may nevertheless be a difference in setline survey catchability among areas, but if so it is obscured by the large variance of the trawl data and the differences in the survey trawls used in different areas.

Background

In the 2006 assessment (Clark and Hare 2007) the staff estimated coastwide abundance by fitting the standard assessment model to a coastwide data set, and then estimated exploitable biomass in each regulatory area by apportioning the total in proportion to an estimate of stock distribution derived from the setline survey. Specifically, an index of abundance in each area was calculated by multiplying setline CPUE (running 3-year average) by total bottom area between 0 and 300 fm. The logic of this index is that survey CPUE can be regarded as an index of density, so multiplying it by bottom area gives a quantity proportional to total abundance. The estimated proportion in each area is then the index value for that area divided by the sum of the index values.

This procedure assumes that survey catchability (the constant of proportionality between CPUE and the density of halibut on the bottom) is the same in all areas. The survey is highly standardized so as to have the same fishing power in all areas and all years, but there may be differences among areas in halibut behavior or environmental conditions that result in differences in setline survey catchability.

In principle the assumption can be checked by comparing setline and trawl survey catch rates in different areas. Because the trawl is an active gear, it is at least plausible that trawl survey catchability is the same everywhere. If setline survey catchability is also the same everywhere, then the ratio of the two should be the same everywhere. If not, differences in the ratio can be regarded as evidence of differences in setline survey catchability.

Available trawl survey data

NMFS conducts trawl surveys on the eastern Bering Sea shelf using a flatfish trawl (Lauth and Acuna 2007), and in the Gulf of Alaska using a high-opening roller trawl (Britt and Martin 2001). DFO conducts trawl surveys off British Columbia using a flatfish trawl (Stanley et al. 2007). The Bering Sea survey is done every year, but not the others. Some features of the various surveys are shown in Table 1.

For the purpose of making the comparisons reported here, the data were grouped by regions smaller than IPHC regulatory areas, the aim being to filter out some of the variance due to geographic differences in halibut density. In British Columbia surveys have been conducted at various times in three regions: West Coast Vancouver Island, Queen Charlotte Sound, and Hecate Strait. Gulf of Alaska trawl survey data were grouped by INPFC region (Yakutat,

Kodiak, Chirikof, Shumagin). Data from Southeast Alaska and the western Aleutians were not included because of the prevalence of very rough ground in those regions. The years and regions for which both trawl and setline survey data are available are shown in Table 2. Only hauls and sets made on the continental shelf (inside 100 fm) were included because data of both types were sparse at greater depths.

Trawl/setline comparisons

Because of the differences in size selectivity between trawl and setline gear, the comparisons were done separately for fish in four length intervals: 70-80 cm, 80-90 cm, 90-100 cm, and 100+ cm. For example, Figure 1a shows trawl survey catch rates (fish/hectare) plotted against setline survey catch rates (fish/skate) of fish in the 70-80 cm length interval. The ratio of the catch rates is estimated by fitting a regression through the origin. Separate regressions are fitted for each of three super-regions to test for differences: British Columbia, Yakutat/Kodiak (IPHC Area 3A), and Chirikof/Shumagin (Area 3B plus most of Area 4A). The single point from the Bering Sea (2006) is also plotted, but no regression. Trawl catch rates were treated as the dependent variable in the regressions because they have a much larger sampling variance than the mean setline catch rates. When the regressions were fitted, the data points were weighted inversely to their variances.

If trawl survey catchability were equal in all areas, differences in the slopes of the fitted lines among areas would indicate differences in setline survey catchability. The unit of the slope is skates/hectare; it is an estimate of how many skates of gear have to be fished in order to catch as many fish as are caught by sweeping one hectare with a trawl. A lower slope therefore indicates a higher setline survey catchability. British Columbia has the lowest slope in all the plots, and Yakutat/Kodiak the highest in all but one, with Chirikof/Shumagin intermediate. If the line corresponding to the single Bering Sea point were shown, it would have the highest slope in every plot.

Most of the slope estimates are very imprecise, as shown by the approximate 95% confidence interval around the predicted mean value at the right end of each fitted line. This is because the trawl data are so noisy. Only for the Chirikof/Shumagin super-region is the slope reasonably well estimated.

Discussion

The data do not show any differences among super-regions that are both consistent and significant. And even if they did show a difference between British Columbia and the Gulf of Alaska, it could be due to a difference in trawl catchability between the DFO and NMFS survey nets rather to a difference in setline survey catchability between regions.

The comparison is more straightforward for the eastern and western Gulf of Alaska where the same survey trawl is used. The slopes for those two super-regions are quite similar for two out of the four length intervals, and they differ in opposite directions for the other two. This confirms the results of previous analysis showing no difference in which the data were grouped by IPHC regulatory area.

References

Britt, L.L., and Martin, M.H. 2001. Data report: 1999 Gulf of Alaska bottom trawl survey. NOAA Technical Memorandum NMFS-AFSC-121.

Clark, W.G., and Hare, S.R. 2007. Assessment of the Pacific halibut stock at the end of 2006. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2006:97-128.

Lauth, R.R., and Acuna, E. 2007. Results of the 2006 Eastern Bering Sea continental shelf bottom trawl survey of groundfish and invertebrate resources. NOAA Technical Memorandum NMFS-AFSC-176.

Stanley, R.D., Olsen, N., Workman, G., Cleary, J., and de la Mare, W. 2007. A review of the Queen Charlotte Sound groundfish bottom trawl survey (2003-2005). Canadian Technical Report of Fisheries and Aquatic Sciences 2709.

Table 1. Characteristics of trawl surveys conducted in British Columbia and Alaska.

Region	British Columbia	Gulf of Alaska	Eastern Bering Sea
Agency	DFO	NMFS	NMFS
Net	Atlantic Western IIA	90-105 Nor'eastern	83-112 Eastern
Wingspread	13 m	16 m	17 m
Vertical opening	2 m	7 m	2.5 m
Towing speed	3 kt	3 kt	3 kt
Tow duration	20 min	15 min	30 min

Table 2. Regions and years with both trawl and setline survey data.

Region	1993	1996	1999	2001	2003	2004	2005	2006	2007
West Coast Vancouver Island						X		X	
Queen Charlotte Sound					X	X	X		
Hecate Strait							X		X
Yakutat		X	X		X		X		X
Kodiak	X	X	X	X	X		X		X
Chirikof		X	X	X	X		X		X
Shumagin		X	X	X	X		X		X
Bering Sea								X	

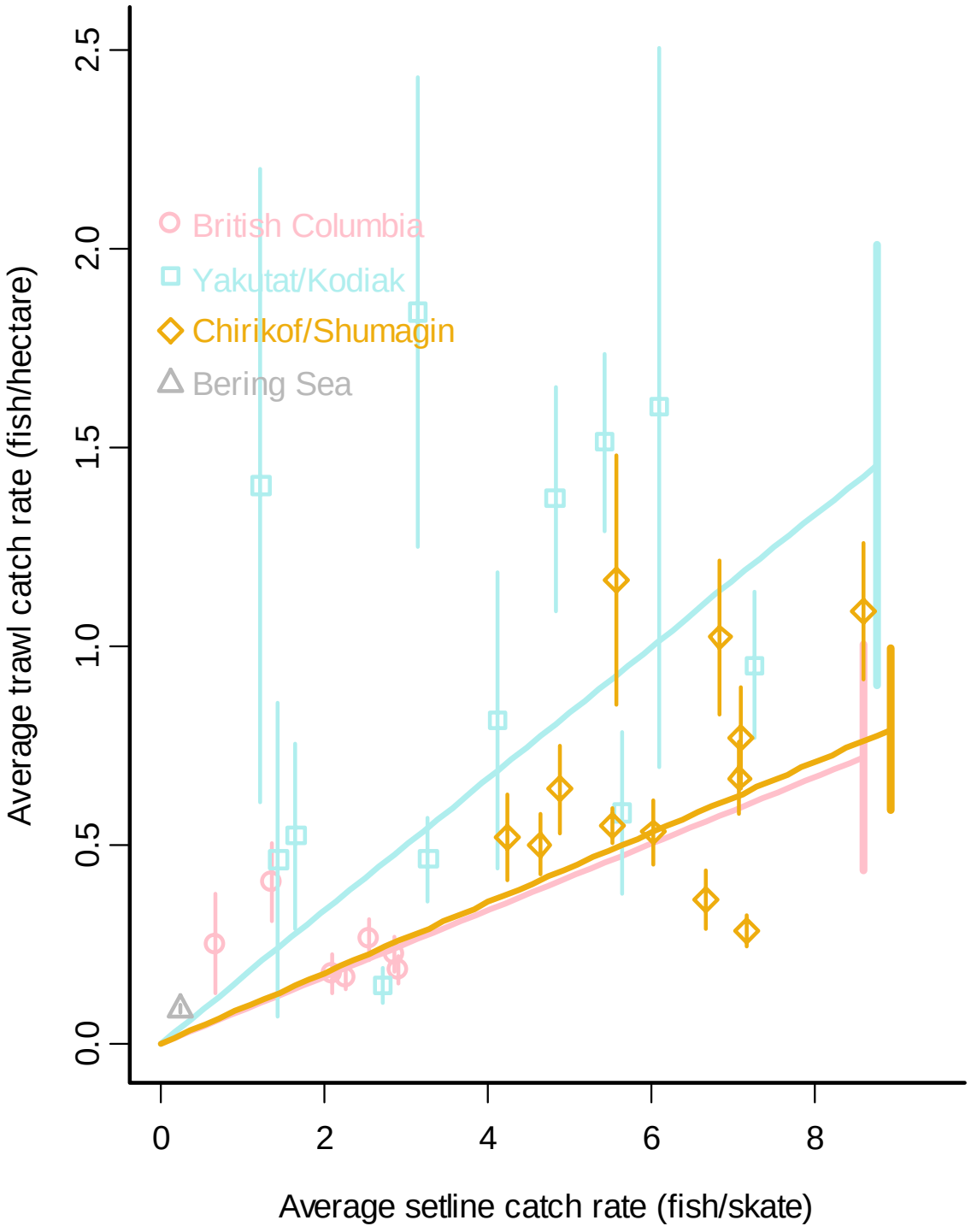

Figure 1a. Trawl survey catch rates of 70-80 cm fish regressed on setline survey catch rates. Each point represents one region/year. The vertical bars on the data points are ± 1 standard error of the mean trawl catch rate. The vertical bars at the end of each regression line are ± 2 standard deviations of the predicted value.

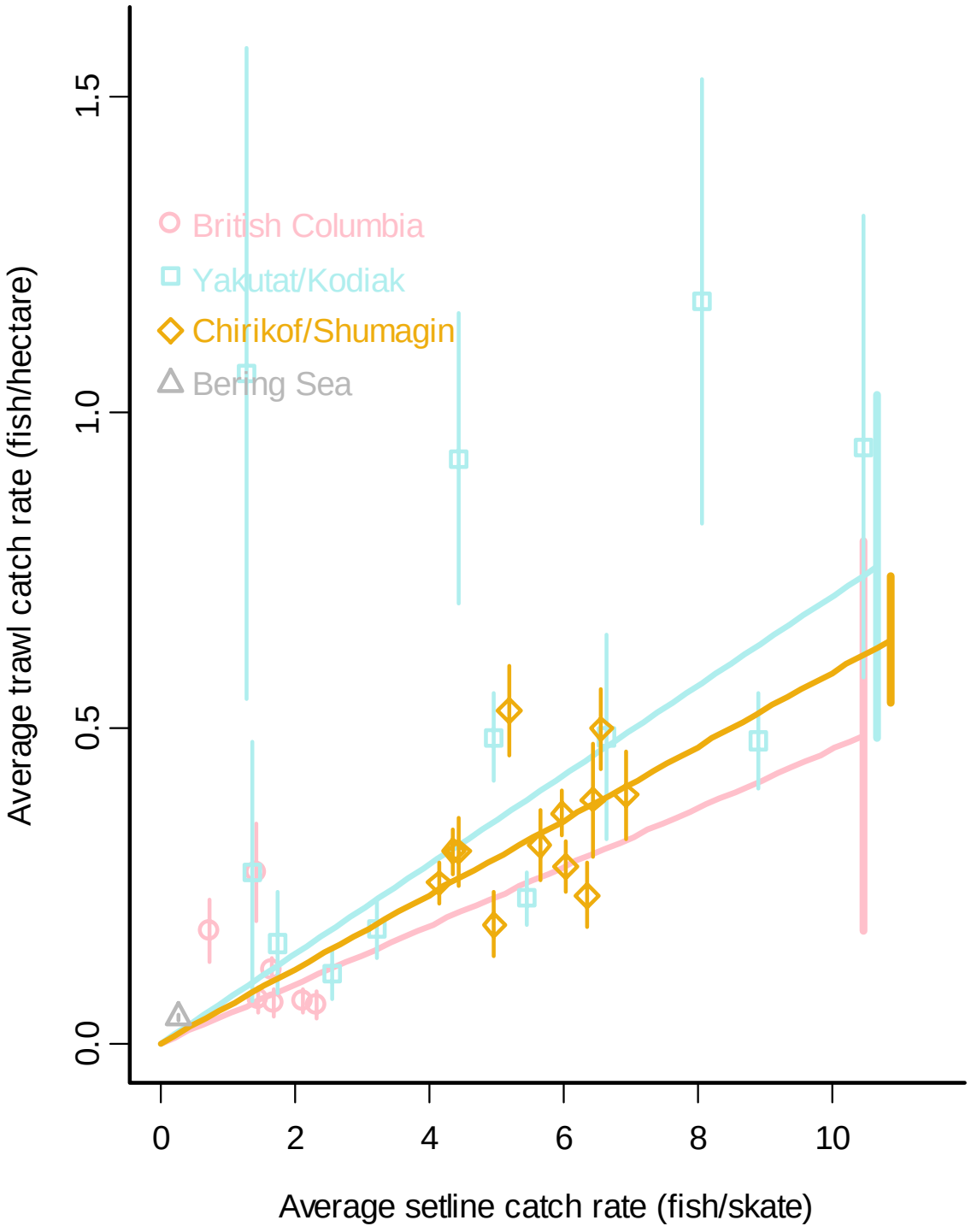

Figure 1b. Same as Figure 1a, but for 80-90 cm fish.

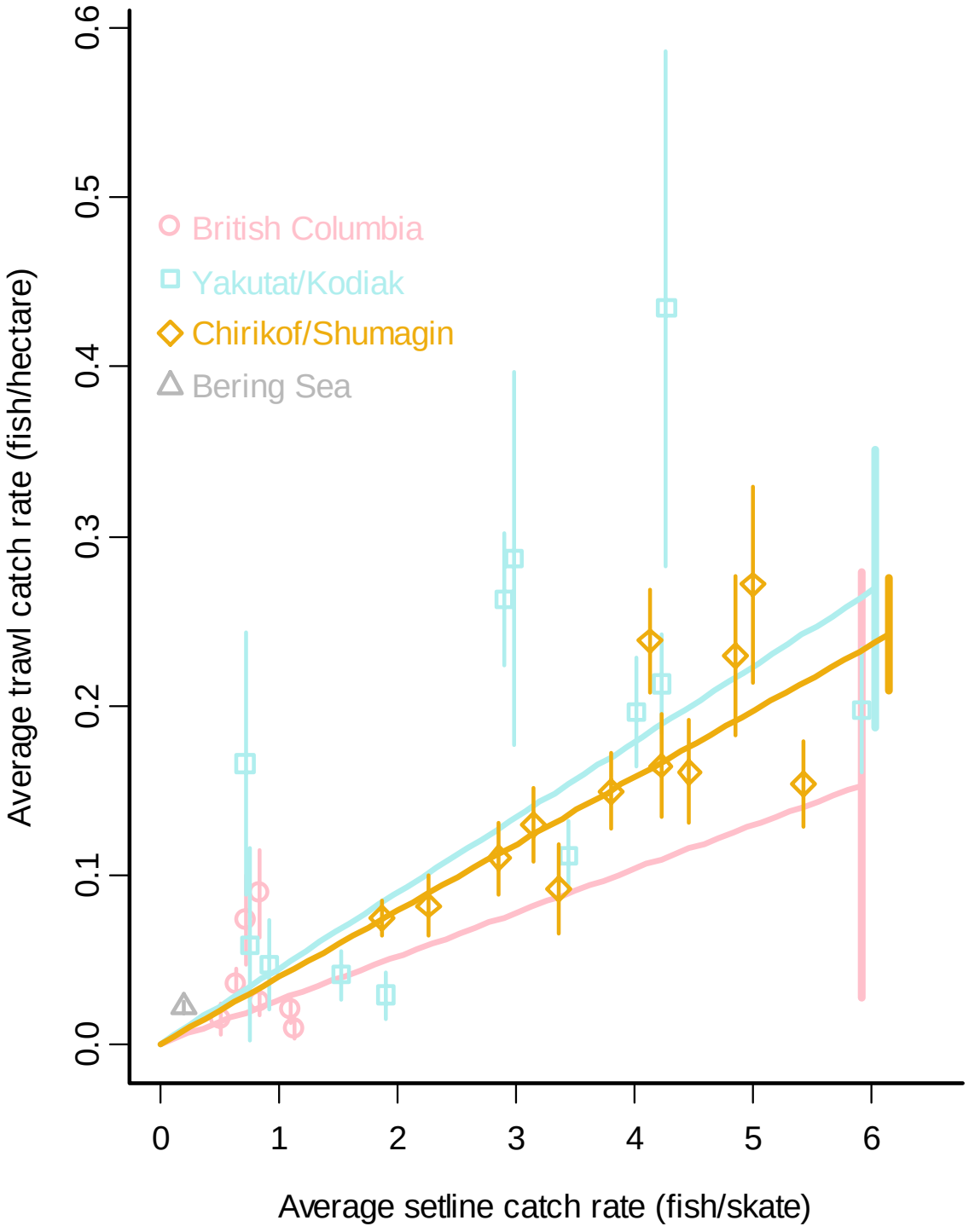

Figure 1c. Same as Figure 1a, but for 90-100 cm fish.

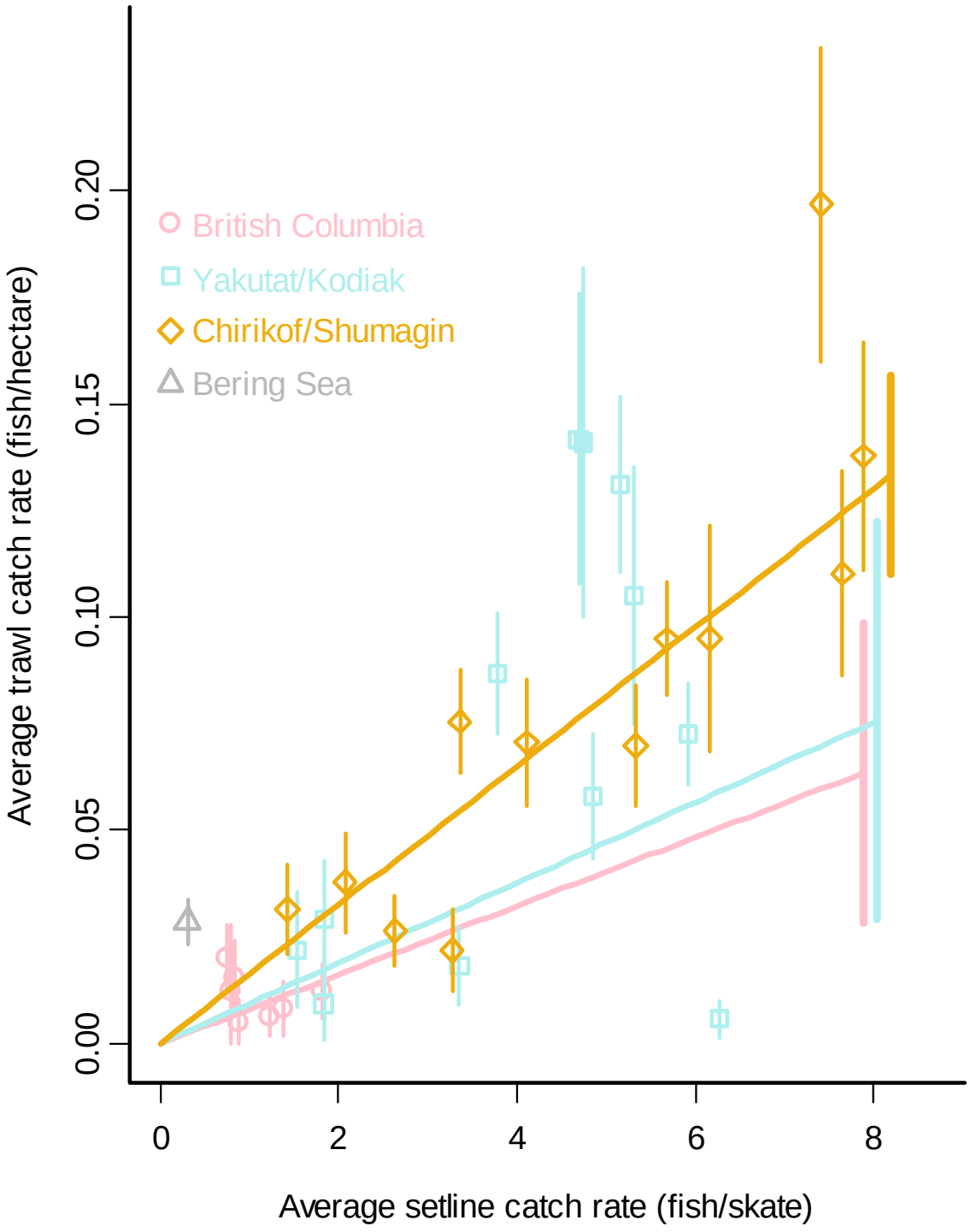

Figure 1d. Same as Figure 1a, but for 100+ cm fish.