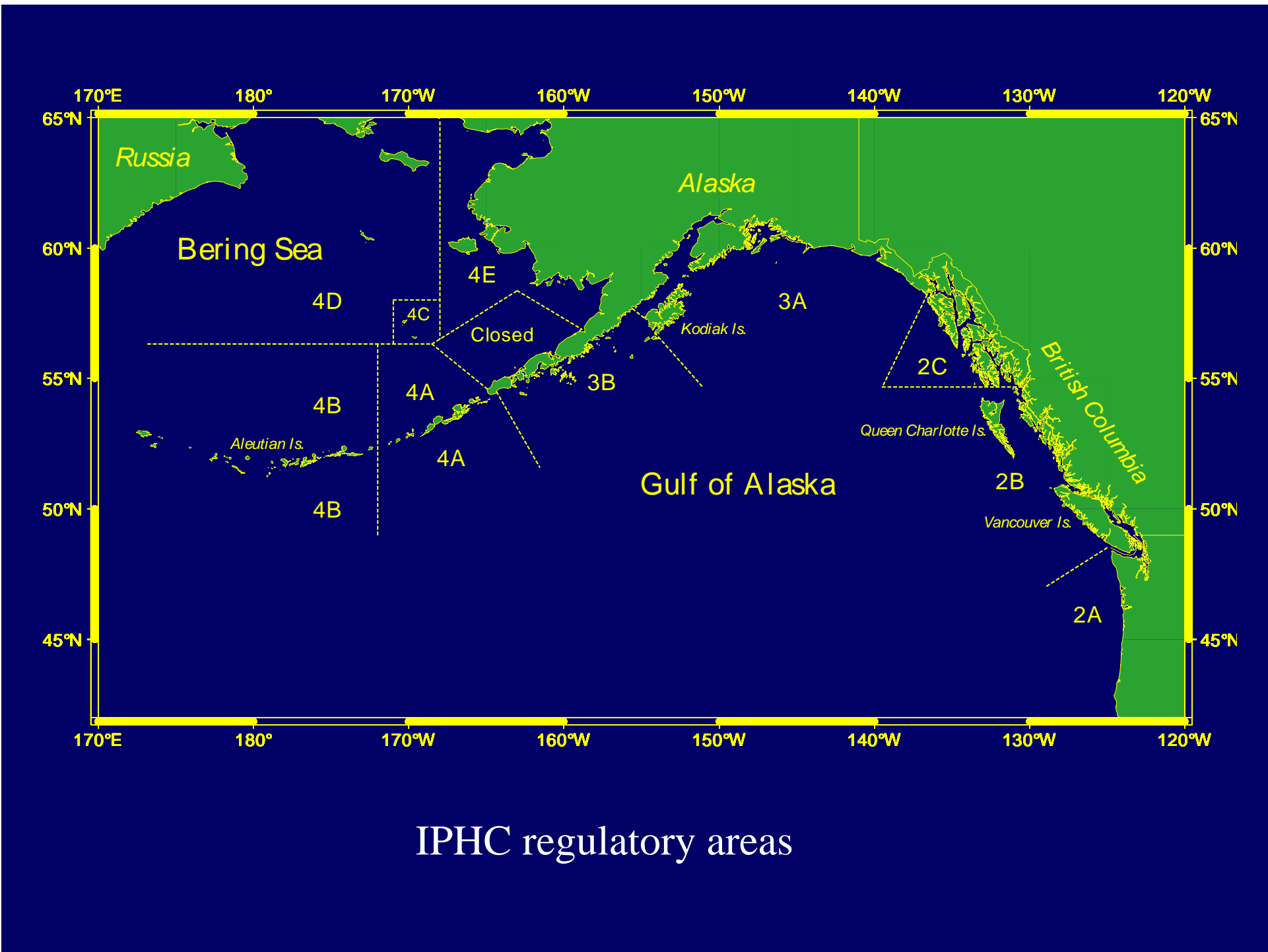
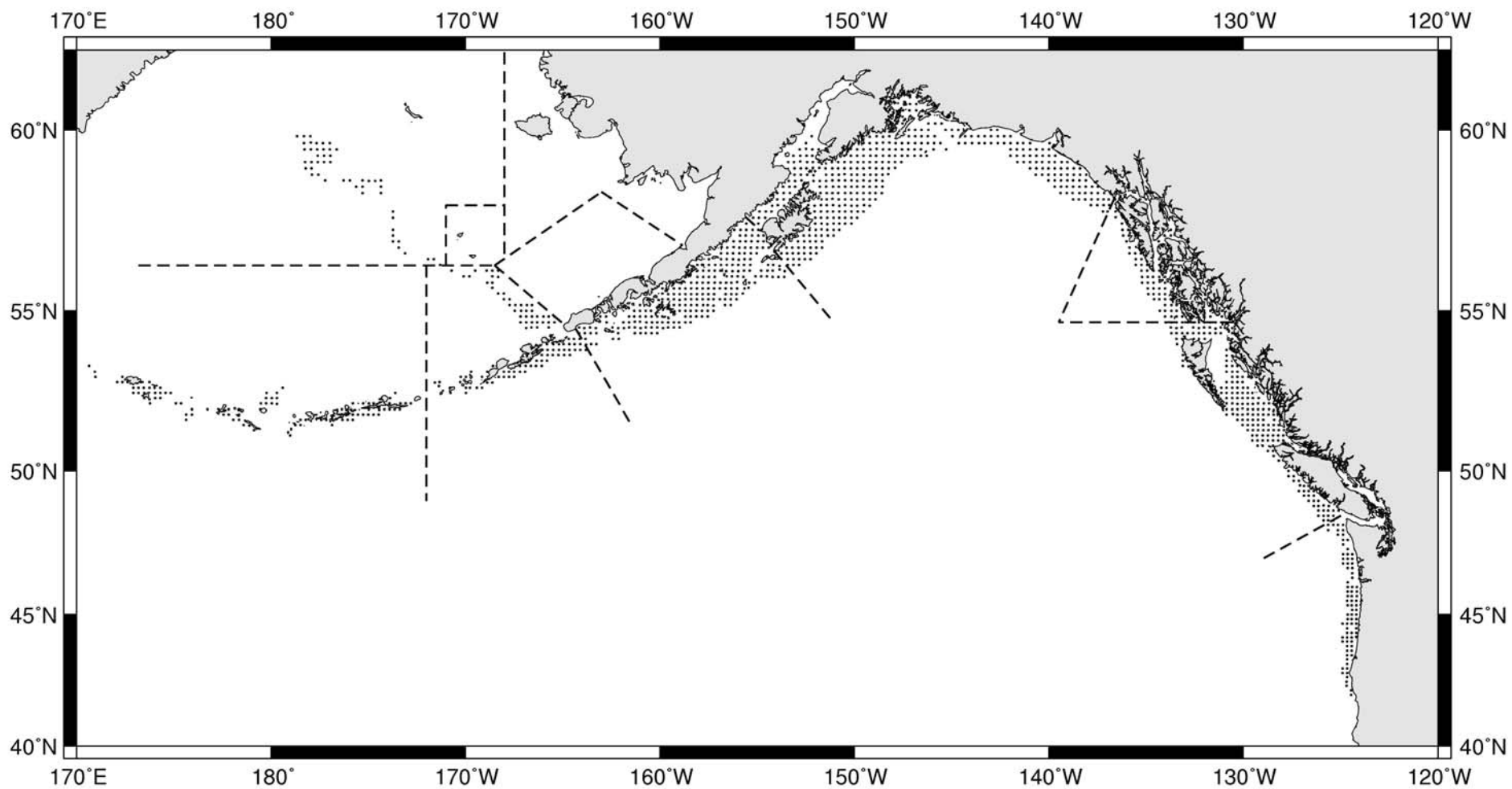


Area apportionment

William G. Clark



IPHC regulatory areas

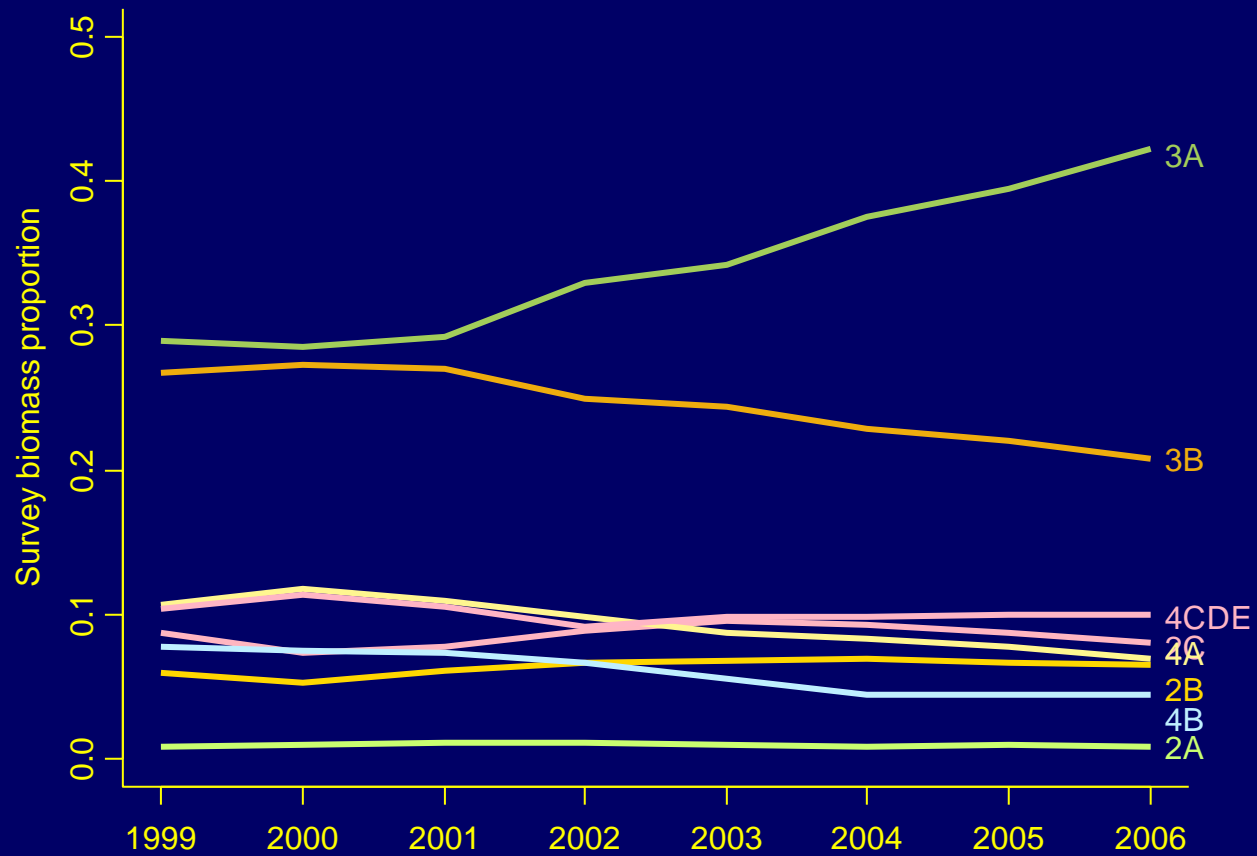


IPHC setline survey stations (10 nmi grid, 20-275 fm)

Survey apportionment

- Total biomass = density \times (bottom area)
- (Biomass index) = (survey CPUE) \times (bottom area)
- (Area proportion) = (area index) / (sum of indices)

- CPUE = 3-year running average.
- Bottom area = 0-300 fm.



Recent shares of total survey biomass
(index = survey CPUE x bottom area)

Shares in each area by various measures

	2A	2B	2C	3A	3B	4A	4B	4C DE
Closed-area assess.	.01	.09	.14	.45	.13	.04	.02	.12
Survey index	.01	.07	.08	.42	.21	.07	.05	.10
Share of removals 1997-2006	.02	.15	.13	.34	.17	.07	.04	.09
Share of recruitment 1996-2005	.02	.11	.10	.46	.20	.04	.01	.06?

Is setline survey catchability equal in all areas?

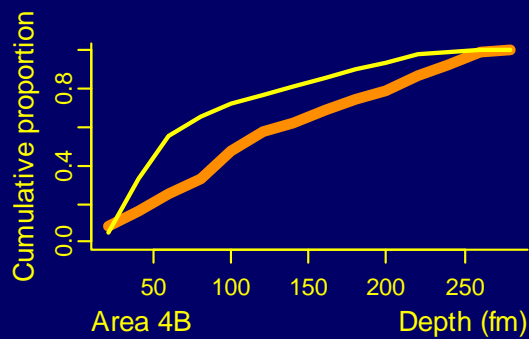
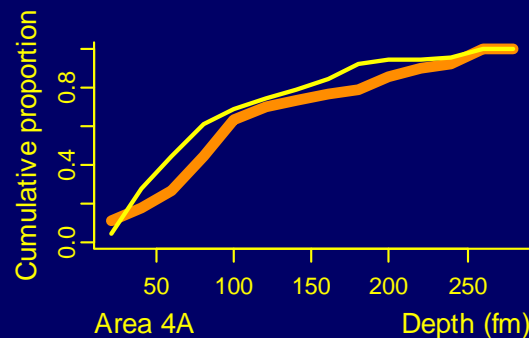
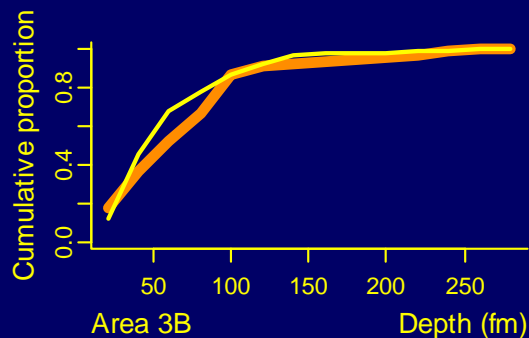
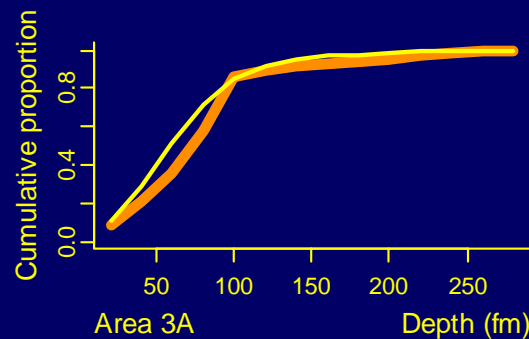
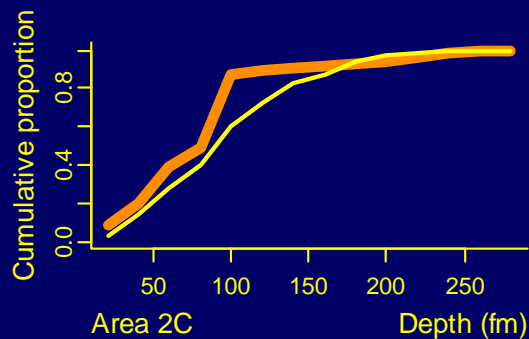
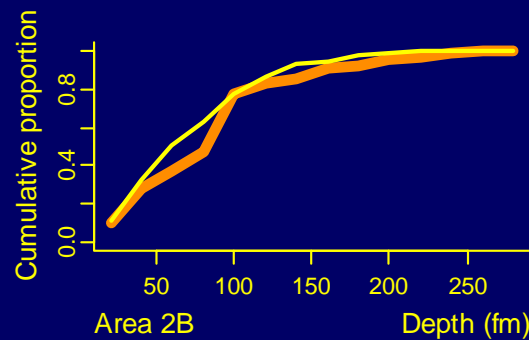
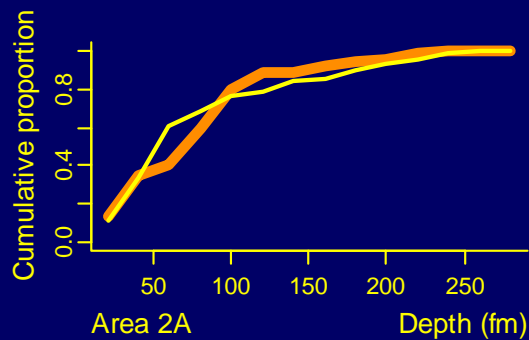
- Trawl and setline survey data produce very similar estimates of relative abundance in trawlable areas (2A, 3A, 3B, 4A).
- PIT tag recoveries per 10,000 fish scanned have been quite similar in Area 2B-3B:

Area 2B	Area 2C	Area 3A	Area 3B
3.2±0.3	6.0±0.4	3.4±0.2	3.3±0.2

Does the IPHC survey accurately reflect the effect of depth on CPUE in each area?

- Stations are set on a regular 10 mile grid, so they should have approximately the same distribution as the bottom as regards depth, substrate type, temperature, density of halibut, etc.

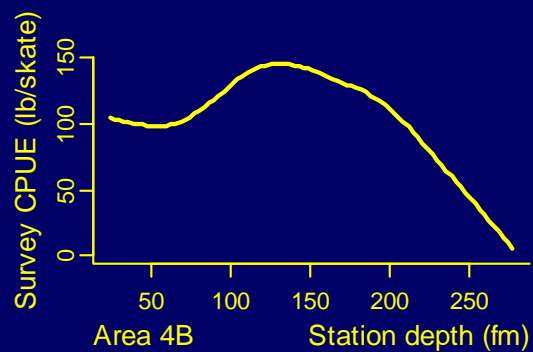
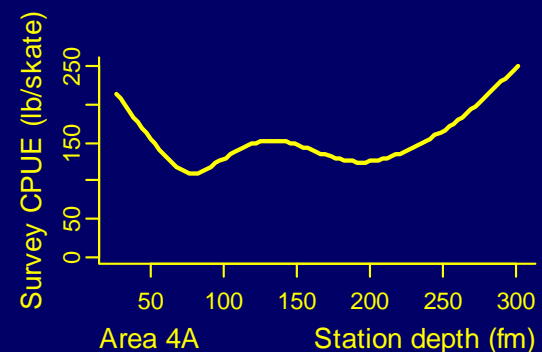
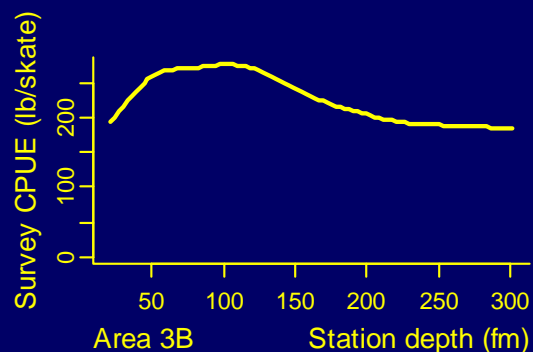
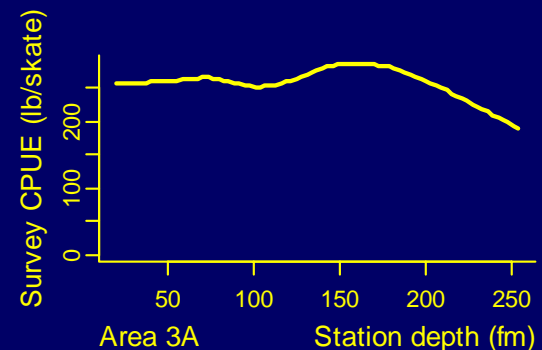
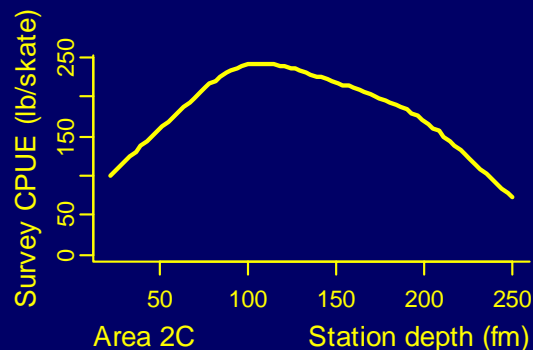
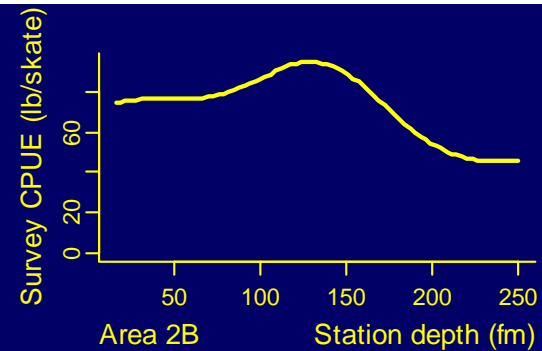
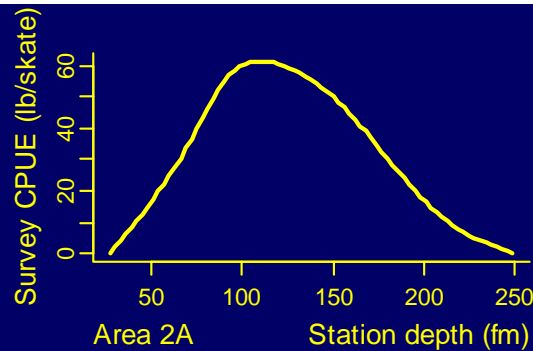
Depth distribution of bottom and IPHC setline survey stations.



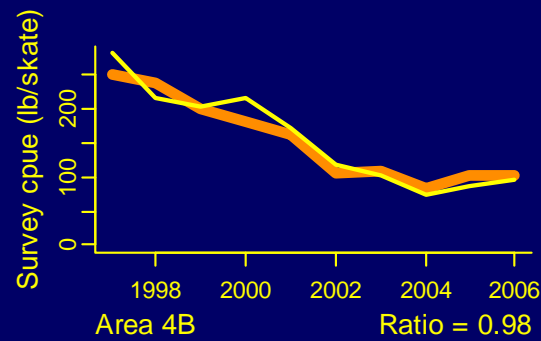
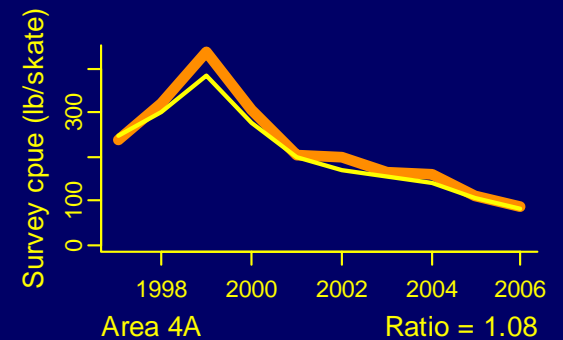
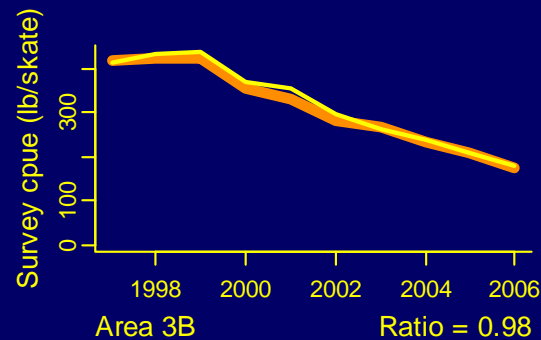
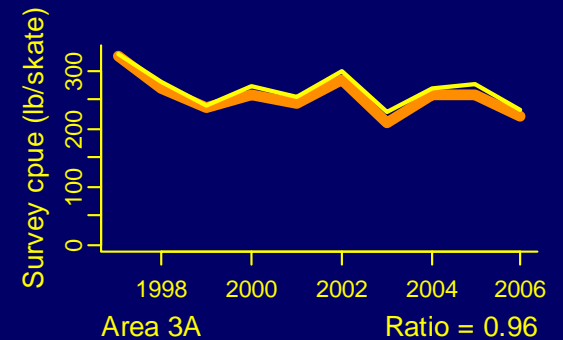
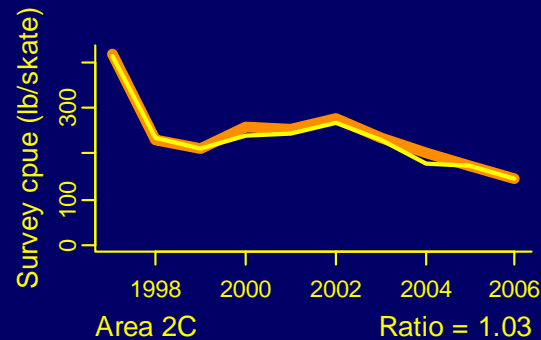
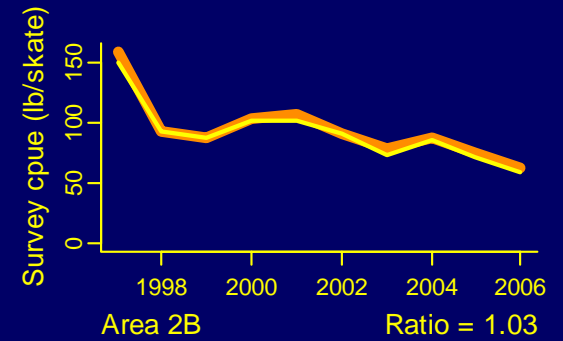
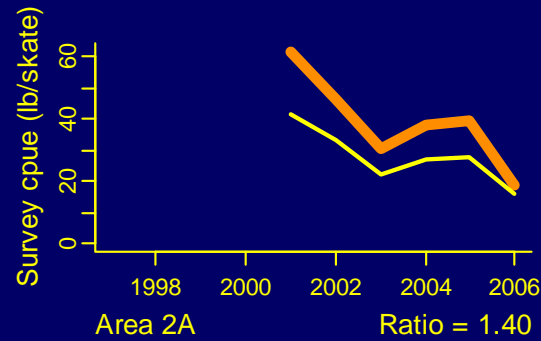
Depth distributions by area

- Bottom depth distribution
- Station depth distribution

GAM estimates of the effect of depth on survey CPUE.



Unweighted and depth-weighted CPUE.

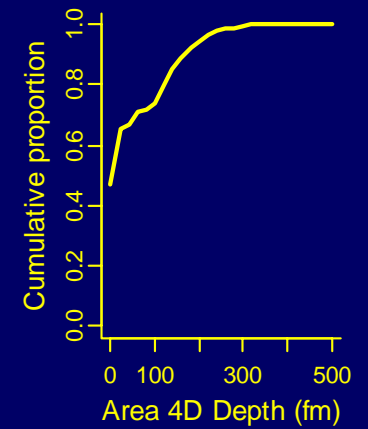
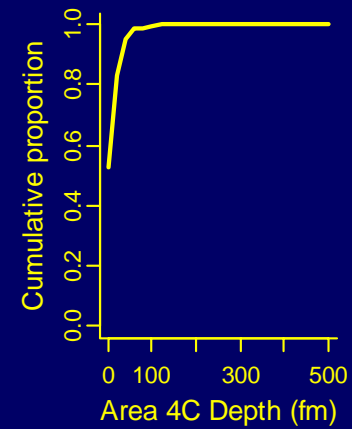
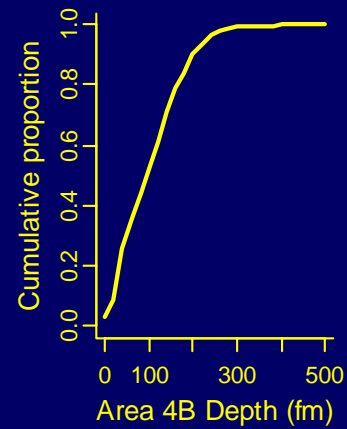
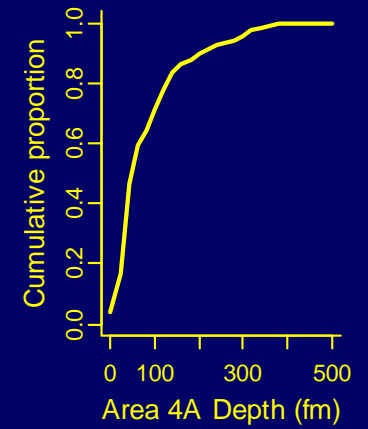
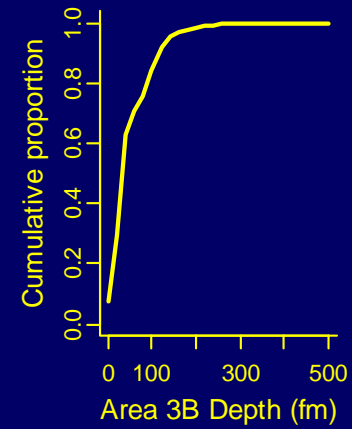
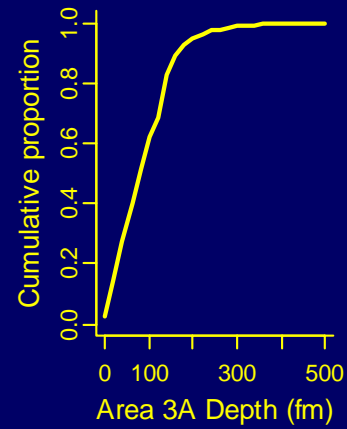
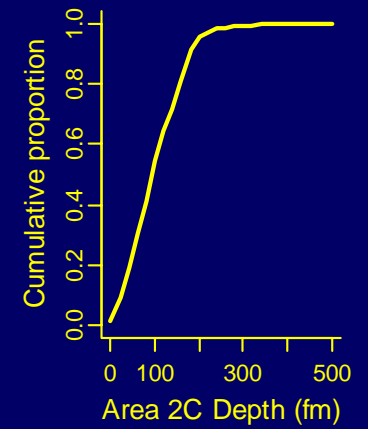
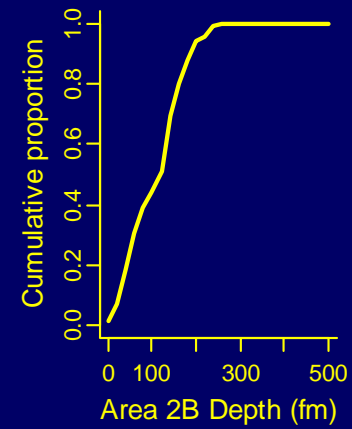
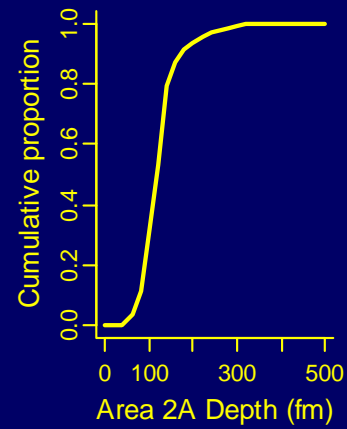


Unweighted and depth-weighted CPUE

— Simple CPUE (the usual)

— Depth-weighted CPUE

Depth distribution of commercial catches.



Does the effect of hook competition on survey CPUE differ among areas?

- Do dogfish depress survey CPUE in Area 2B?
- Do cod depress survey CPUE in Area 4?

The catch equation for baits

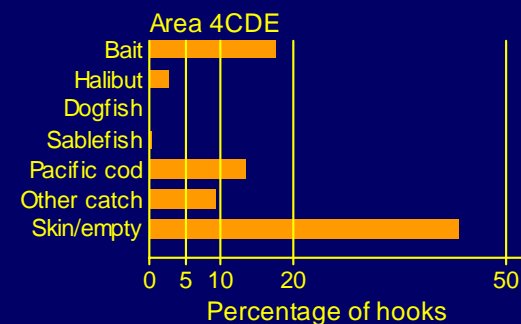
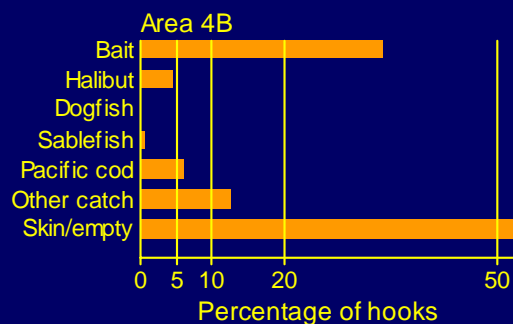
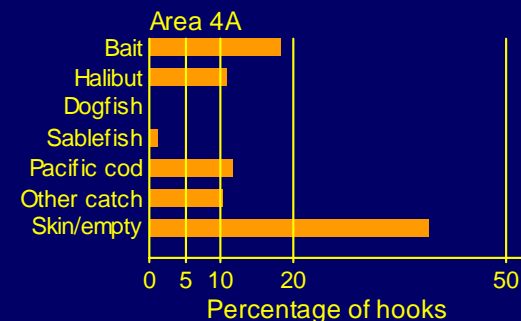
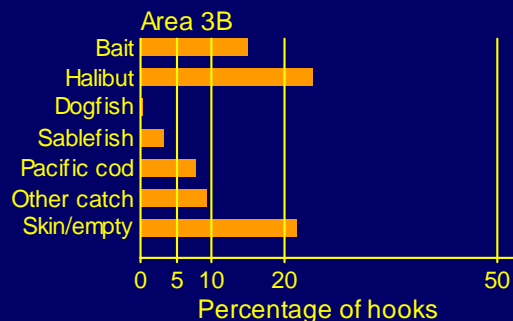
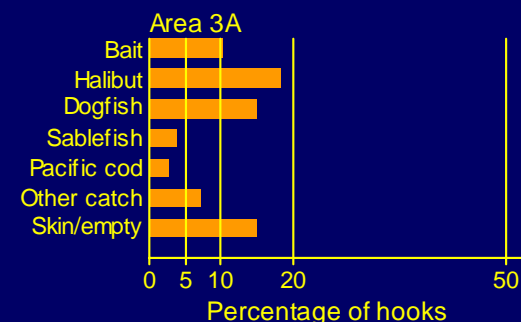
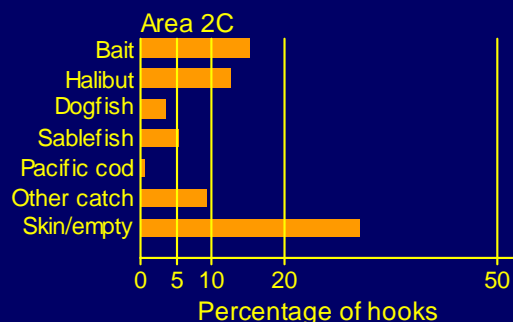
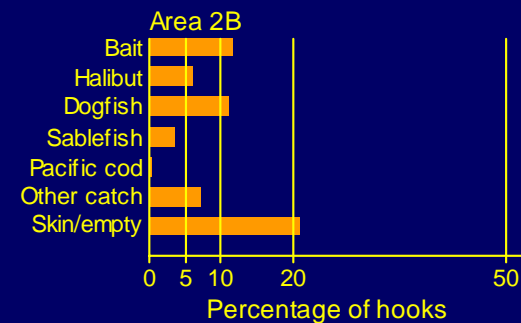
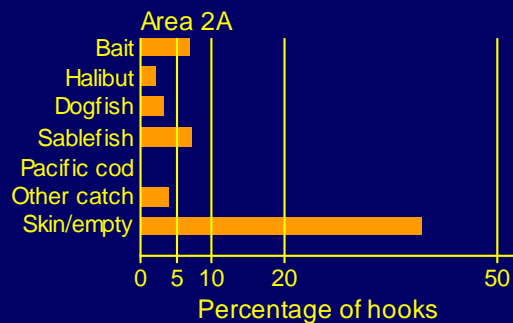
Given an initial number of baits B_0 the number of baits B_i taken by consumer i is well described by the standard catch equation:

$$B_i = F_i \cdot B_0 \cdot (1 - e^{-Z}) / Z$$

$$\text{where } Z = \sum_i F_i$$

Survey CPUE will be a consistent index of abundance among areas if the total attack rate Z is the same or equivalently if the proportion of bait recovered ($=e^{-Z}$) is the same.

Survey hook contents by area, 2001-2006 data combined.



Fraction of bait recovered and correction factor that would standardize survey CPUE among areas.

Area	Fraction recovered	Correction factor	Standard deviation
2A	0.07	1.25	0.05
2B	0.12	1.07	0.02
2C	0.15	0.97	0.02
3A	0.10	1.12	0.02
3B	0.15	0.98	0.02
4A	0.18	0.91	0.01
4B	0.34	0.72	0.01
4D	0.34	0.71	0.01

Conclusions

- Setline survey CPUE appears to be a consistent index of density in Areas 2B, 2C, 3A, 3B, and 4A.
- A case can be made for scaling survey CPUE upward in Area 2A and downward in Areas 4B and 4D, but it would be difficult to pick scalers in a precise and objective way.