Chapter 9: Assessment of Pacific ocean perch in the Gulf of Alaska (Executive Summary)

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Introduction

Rockfish are assessed on a biennial stock assessment schedule to coincide with new survey data. We use a separable age-structured model as the primary assessment tool for Gulf of Alaska Pacific ocean perch. This consists of an assessment model, which uses survey and fishery data to generate a historical time series of population estimates and a projection model, which uses results from the assessment model to predict future population estimates and recommended harvest levels. For Gulf of Alaska rockfish in alternate (even) years, we present an executive summary to recommend harvest levels for the next (odd) year. For this off-cycle year, we only updated the 2007 projection model estimates with revised catch data for 2007 and a new catch estimate for 2008. For further information regarding the assessment model, please refer to last year's full stock assessment, which is available online (Hanselman et al. 2007, www.afsc.noaa.gov/REFM/docs/2007/GOApop.pdf). A full stock assessment document with updated results for the assessment and projection model will be presented in next year's SAFE report.

Updated ABC, OFL, Catch and Projection

New information for this year's projection is updated 2007 catch at 12,954 t and the best estimate of the 2008 catch at 12,258 t. Catch estimates used in last year's model were 12,410 t and 13,500 t for 2007 and 2008, respectively. For the 2009 fishery, we recommend the maximum allowable ABC of 15,111 t from the updated projection. This ABC is very similar to last year's ABC of 14,999 t. The corresponding reference values for Pacific ocean perch are summarized in the following table, with the recommended ABC and OFL values in bold. The stock is not overfished, nor is it approaching overfishing status.

Summary	2007 projection: Not Updated		2007 projection: Updated catch*	
Projection Year	2008	2009	**2009**	2010
Tier 3a				
Total Biomass (Age 2+)	317,511	317,615	318,336	318,965
Female Spawning Biomass (t)	90,898	94,149	94,538	97,091
$B_{0\%}$ (t, female spawning biomass)	222,987	--	--	--
$B_{40\%}$ (t, female spawning biomass)	89,195	--	--	--
$B_{35\%}$ (t, female spawning biomass)	78,045	--	--	--
M	0.060	0.060	0.060	0.060
F_{ABC} (maximum allowable = $F_{40\%}$)	0.061	0.061	0.061	0.061
F_{OFL}	0.073	0.073	0.073	0.073
ABC (t, maximum allowable)	14,999	15,072	**15,111**	15,098
OFL (t)	17,807	17,893	**17,940**	17,925

*Projected ABCs and OFLs for 2010 are derived using an expected catch value of 12,356 t for 2009 based on recent ratios of catch to ABC. This calculation is in response to management requests to obtain a more accurate one-year projection.

Area Apportionment

The apportionment percentages are identical to last year, because there is no new survey information. The following table shows the recommended apportionment for 2009.

	Western	Central	Eastern	Total
Area Apportionment	25%	55%	20%	100%
Area ABC (t)	**3,713**	**8,246**	**3,152**	**15,111**
Area OFL (t)	4,409	9,790	3,741	**17,940**

Amendment 41 prohibited trawling in the Eastern area east of 140° W longitude. The ratio of biomass still obtainable in the W. Yakutat area (between 147° W and 140° W) is the same as last year at 0.35. This results in the following apportionment of the Eastern Gulf area:

	W. Yakutat	E. Yakutat/Southeast
Area ABC (t)	1,108	2,044

Responses to Council, SSC, and Plan Team Comments

The SSC December 2007 minutes included the following comments concerning all stock assessments:

"The SSC notes that the approach for calculating ABC and other biological reference points is not fully described in the SAFE's. It would be desirable to have a general description in the introduction of the SAFE. In each SAFE chapter, specific details could be provided, if the calculation is done differently. For example, the range of years that is used to calculate average recruitment for converting SPR to B_{40} should be given."

We continue to assume that the equilibrium level of recruitment is equal to the average of age 2 recruits from 1979-2005 (year classes between 1977 and 2003) for Pacific ocean perch as detailed in the *Amendment 56 Reference Points* section of the *Projections and Harvest Alternatives* of last year's full stock assessment.

The SSC December 2007 minutes included the following comments concerning all rockfish:

"For all of the rockfish assessments, the SSC recognizes the efforts of the stock assessment authors to respond fully to the 2006 CIE review comments. The SSC requests that the draft response to the CIE review be finalized and made available."

The response to the 2006 CIE rockfish review is available online at the following web address: ftp://ftp.afsc.noaa.gov/afsc/public/rockfish/RWG%20response%20to%20CIE%20review.pdf

The GOA Plan Team 2007 minutes included the following comments concerning all rockfish:

"Area apportionments for rockfish ABC are a weighted average of previous years' percent exploitable biomass distributions. The Plan Team discussed the merit of exploring the difference that weighting the apportionments by biomass rather than percentages could have on the resultant apportionments. Assessment authors agreed to compare the approaches under different scenarios of biomass distribution."

Please see Appendix A for a comparison of the effects of weighting proportion or biomass by survey year for determining area apportionment. Simple scenarios assuming no survey error and how that affects bias between the two methods are first presented. This is followed by simulations exploring varying levels of survey error and results on stability.

The SSC December 2007 minutes included the following comments concerning Pacific ocean perch:

"The SSC requests that the authors include plots of the spatial distribution of the catch in future assessments. The SSC also requests that the tables of commercial catch should include estimates of discard as well as retained catch."

Historical maps of Pacific ocean perch observed catch (kg) for all gear types are provided from 1993 through 2007 (Figures 9.1 – 9.5). Data are available online from Fisheries Monitoring and Analysis Division (FMA, Observer program) at www.afsc.noaa.gov/FMA/spatial_data.htm. Catches are aggregated in 10 km x 10 km (100 km^2) cell blocks and cells representing less than three vessels for a given gear type and year are not provided due to confidentiality issues. Description and appropriate usage of data are available on the webpage given above. Spatial distribution of Pacific ocean perch catch expanded in the mid to late 1990s, contracted to the central GOA region in early 2000s and has become more evenly distributed since 2002, with the possible exception of 2004. In 2007, substantial catches were observed in the central GOA near the Portlock Bank region.

Gulfwide discard rates (% discarded) are provided in a separate table embedded in the main text of the stock assessment (please see *Discards* of the *Fishery* section in the *Introduction* of last year's full stock assessment, www.afsc.noaa.gov/REFM/docs/2007/GOApop.pdf). We intend to also include these estimates of discard rate in the catch table for the full assessment next year.

Research Priorities

It is critically important to rockfish stock assessments that the GOA trawl surveys continue and that they extend into deeper waters (>300m) in order to cover the range of primary habitat for rockfish. There is little information on larval, post-larval, or early juvenile stages of rockfish. Habitat requirements for these stages are mostly unknown. Research on early life history parameters and essential habitat for these early life stages is vital to effective management of rockfish.

Summaries for Plan Team

Species	Year	Biomass[1]	OFL	ABC	TAC	Catch
Pacific ocean perch	2007	315,521	17,157	14,636	14,635	12,954
	2008	317,511	17,807	14,999	14,999	12,258
	2009	318,336	17,940	15,111		
	2010	318,965	17,925	15,098		

[1]Total biomass from the age-structured model

Stock/ Assemblage	Area	2008 OFL	ABC	TAC	Catch[2]	2009 OFL	ABC	2010 OFL	ABC
Pacific ocean perch	W	4,376	3,686	3,686	3,653	4,409	3,713	4,405	3,710
	C	9,717	8,185	8,185	7,505	9,790	8,246	9,782	8,239
	WYAK		1,100	1,100	1,100		1,108		1,107
	SEO		2,028	2,028	0		2,044		2,042
	E	3,714	3,128	3,128	1,100	3,741		3,738	
	Total	17,807	14,999	14,999	12,258	17,940	15,111	17,925	15,098

[2]Current as of October 14, 2008 (http://www.fakr.noaa.gov)

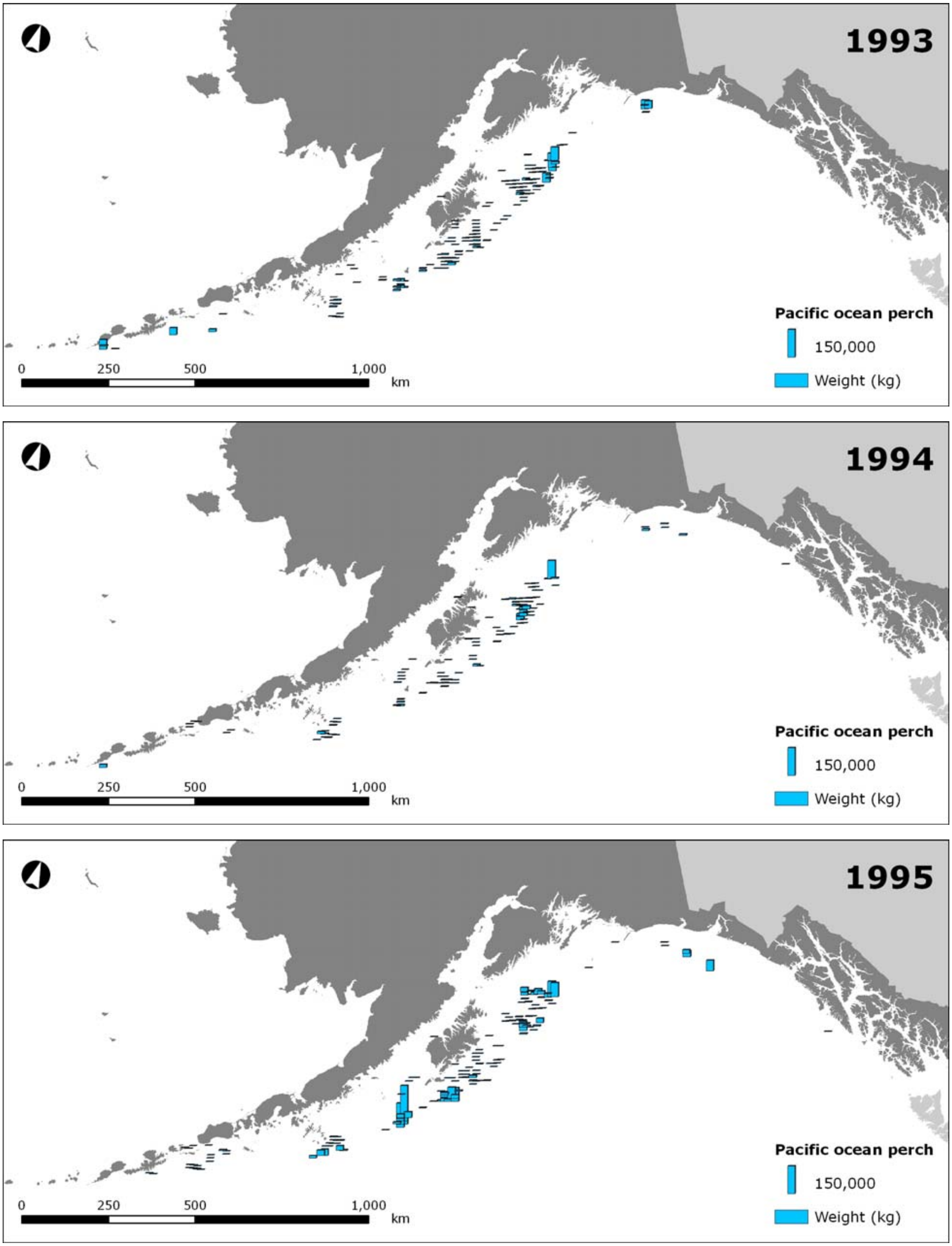

Figure 9.1: Maps of fishery catch based on observer data by 100 km^2 blocks for Pacific ocean perch from 1993-1995.

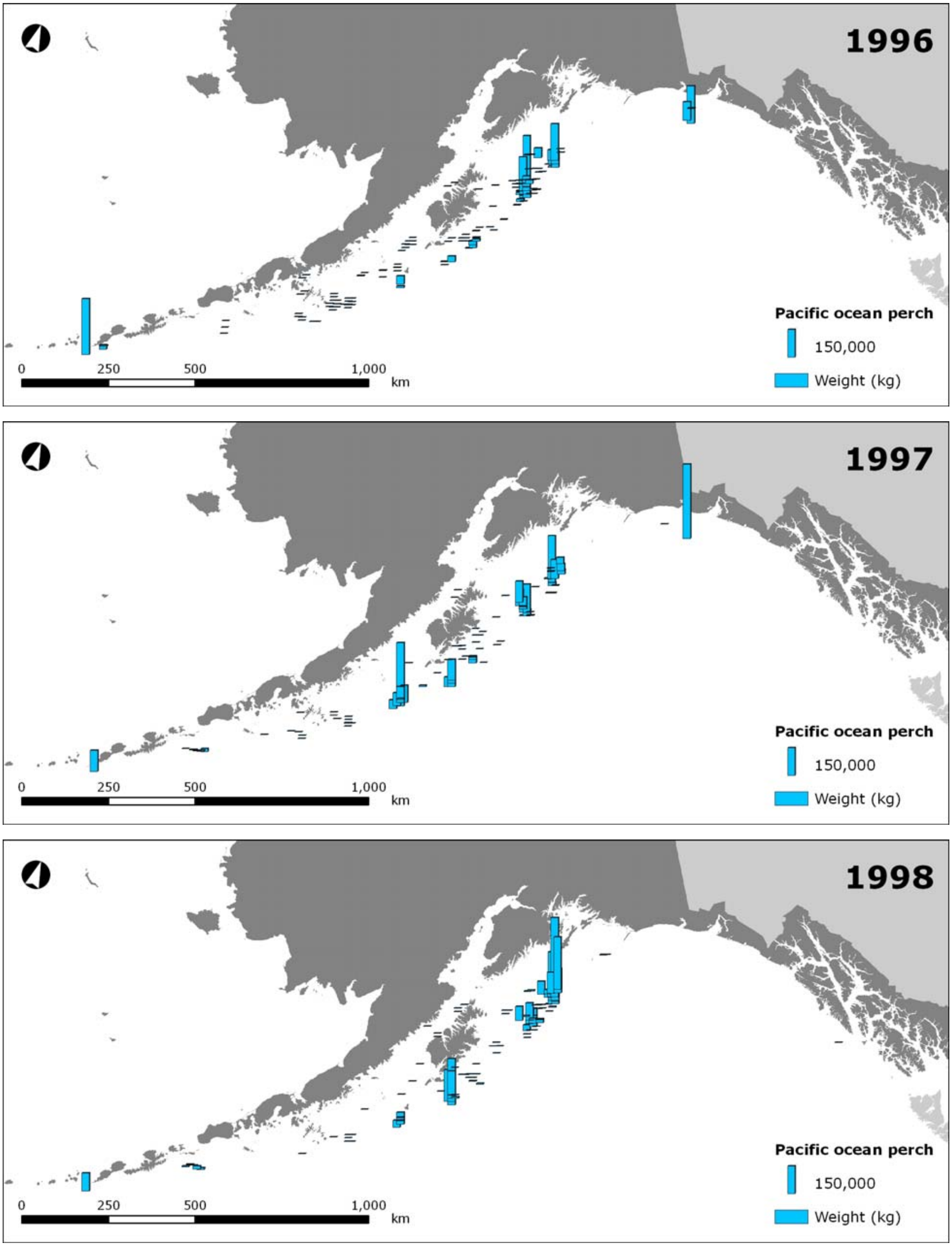

Figure 9.2: Maps of fishery catch based on observer data by 100 km^2 blocks for Pacific ocean perch from 1996-1998.

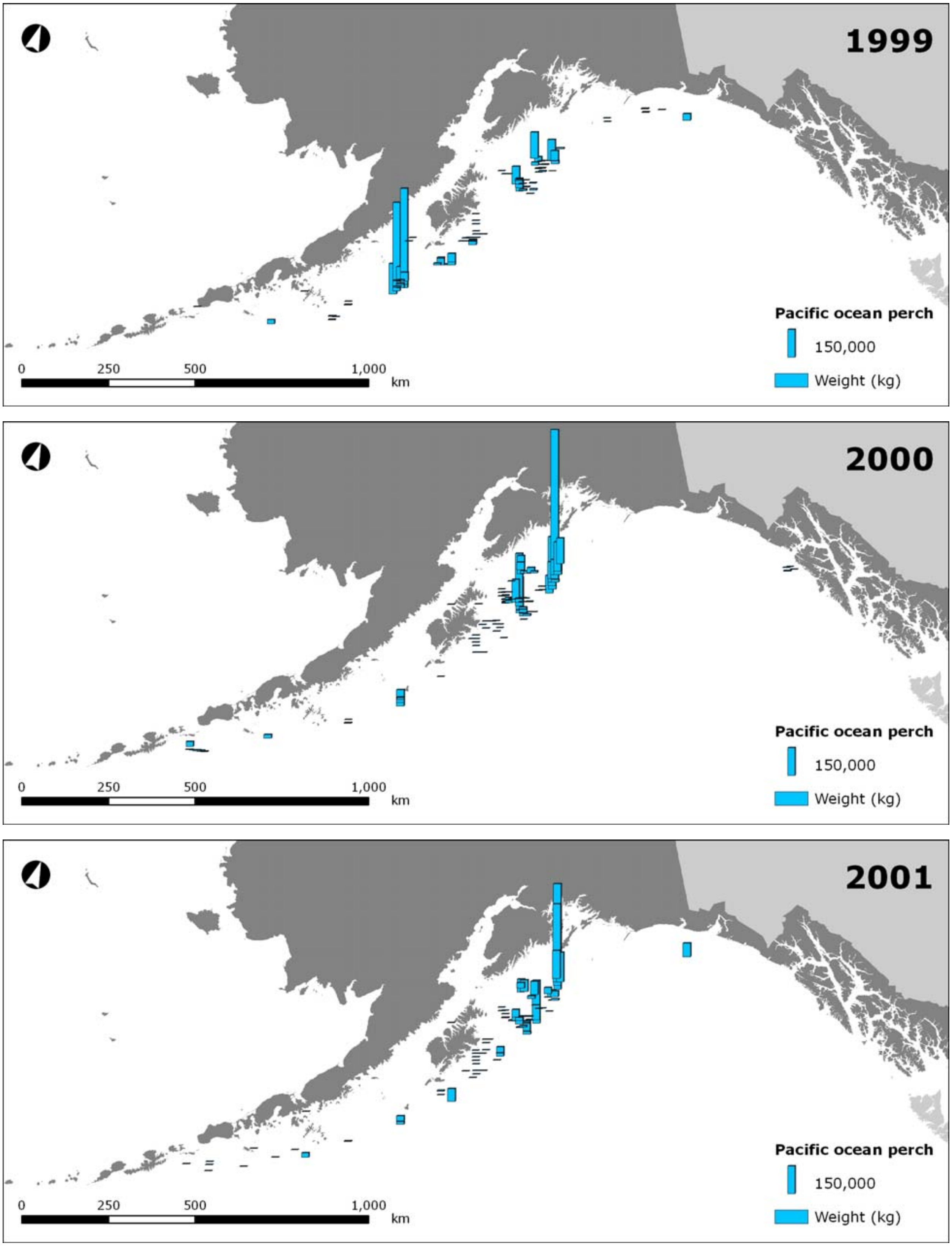

Figure 9.3: Maps of fishery catch based on observer data by 100 km^2 blocks for Pacific ocean perch from 1999-2001.

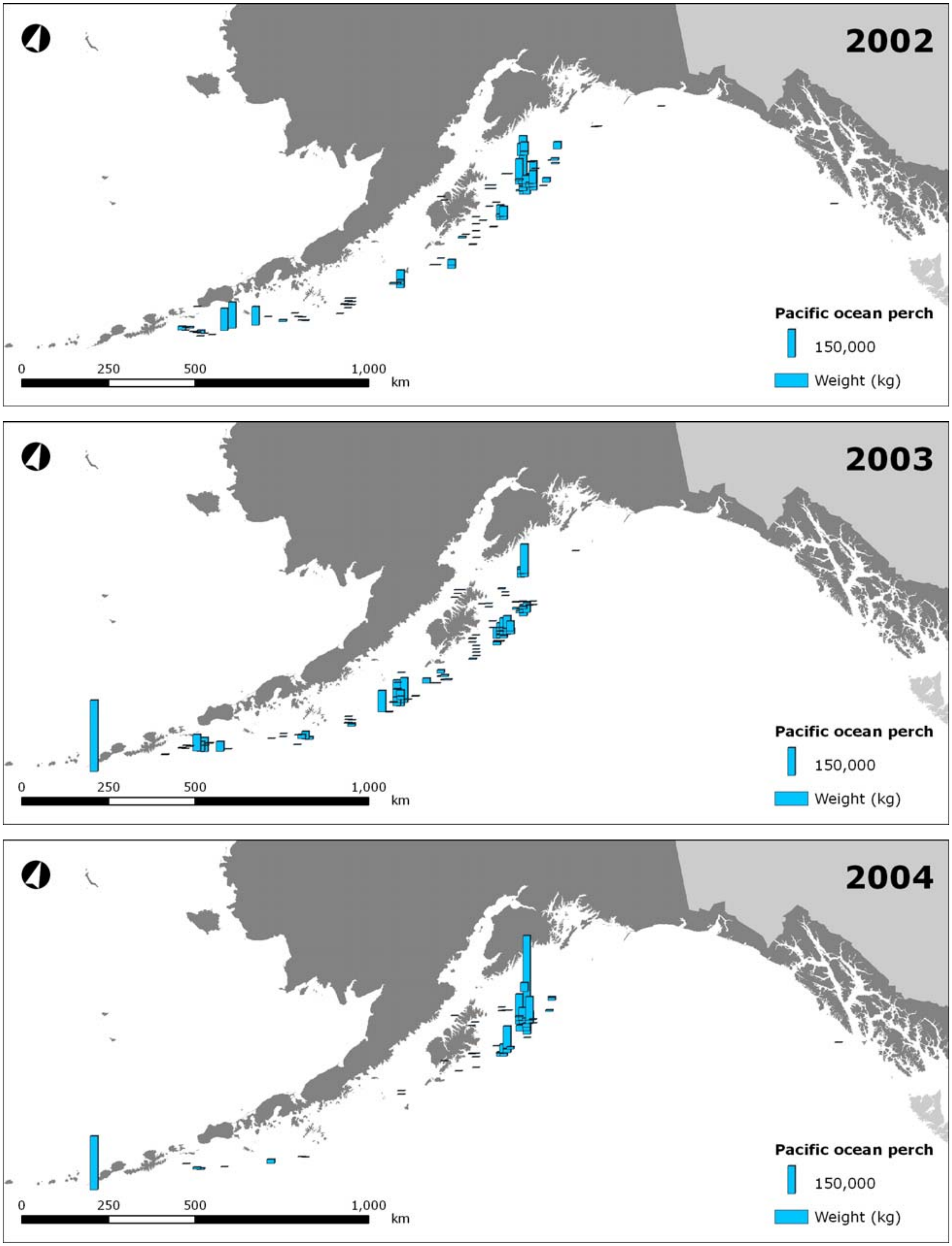

Figure 9.4: Maps of fishery catch based on observer data by 100 km^2 blocks for Pacific ocean perch from 2002-2004.

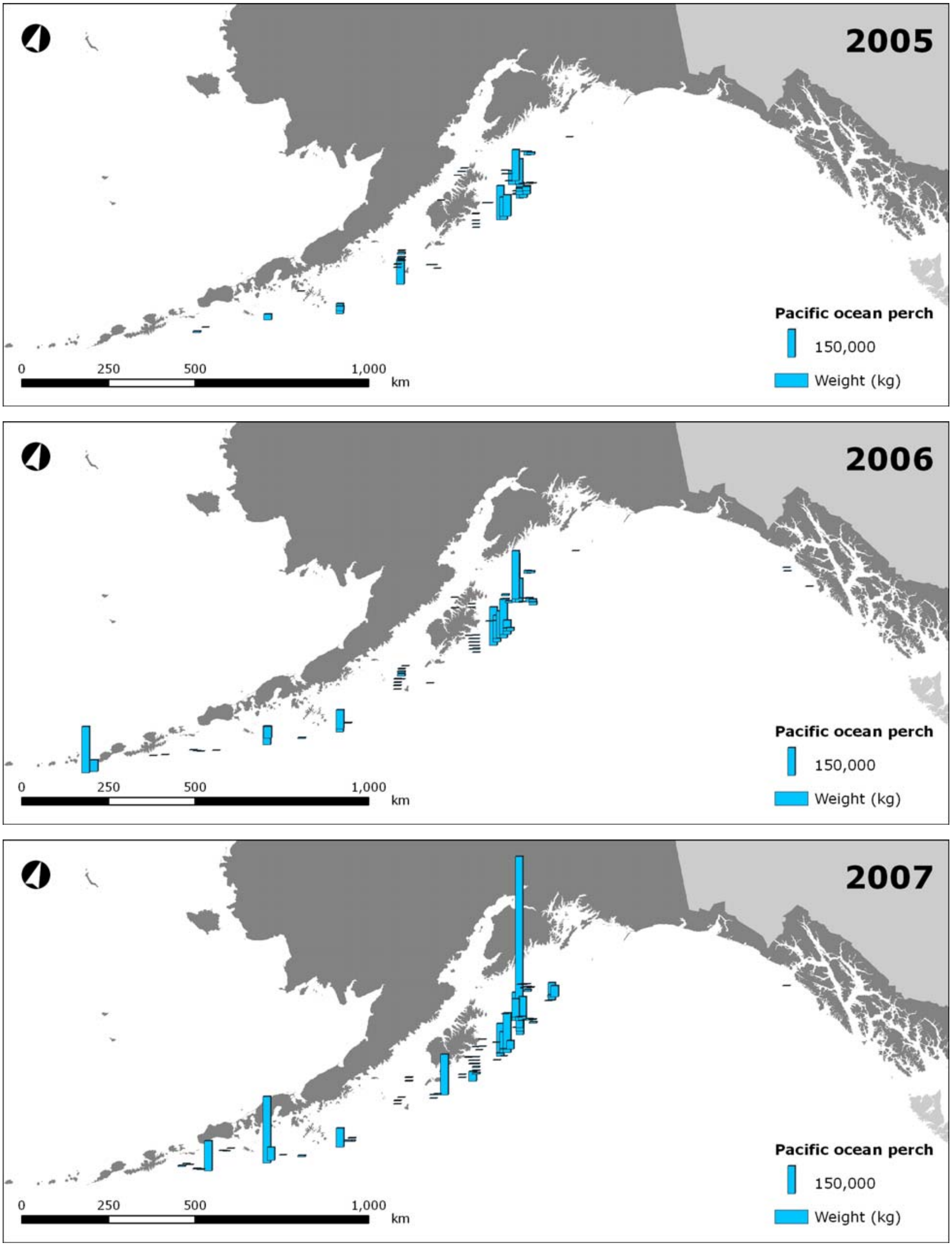

Figure 9.5: Maps of fishery catch based on observer data by 100 km^2 blocks for Pacific ocean perch from 2005-2007.

Appendix 9A: Comparison of the effects of weighting biomass or proportions when apportioning biomass for rockfish

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Introduction

During the GOA Groundfish Plan Team meeting in November 2007, the optimal strategy for the apportionment of future catches by a moving average of survey biomass estimates was discussed. The current framework from the 2007 Gulf of Alaska POP framework is explained as follows:

"Prior to the 1996 fishery, the apportionment of ABC among areas was determined from distribution of biomass based on the average proportion of exploitable biomass by area in the most recent three triennial trawl surveys. For the 1996 fishery, an alternative method of apportionment was recommended by the Plan Team and accepted by the Council. Recognizing the uncertainty in estimation of biomass yet wanting to adapt to current information, the Plan Team chose to employ a method of weighting prior surveys based on the relative proportion of variability attributed to survey error. Assuming that survey error contributes 2/3 of the total variability in predicting the distribution of biomass (a reasonable assumption), the weight of a prior survey should be 2/3 the weight of the preceding survey. These results in weights of 4:6:9 for the 2003, 2005, and 2007 surveys…"

The question raised was whether the best method was to use the proportion by survey year or to use the biomass by survey year in the moving average. We briefly show some simple scenarios to look at bias assuming that the surveys are correct. We then show some simulation results to look at precision (or stability) in the resultant apportionments when there is error in the survey.

Methods and Results

Many possible scenarios could be proposed, but we explore what we expect to be the most common. In both the deterministic results (Table 9A.1) and the simulation results (Table 9A.2) we construct a simple population consisting of three areas and three survey years, analogous to the three areas in the Gulf of Alaska. This population is divided into these areas in a 3:6:1 ratio. We describe the scenarios and the results in the next two subsections.

Deterministic scenarios and results (bias)

- **(A)** No change in population over time or area. These methods are identical in this case.
- **(B)** The area with the lowest biomass is decreasing while the others remain stable. This gives a small, similar bias (1-2%) for each method.
- **(C)** The area with the largest biomass is decreasing while the others remain stable. This results in much larger bias, with the largest bias in the biomass method overestimating biomass for the decreasing area error and underestimating the stable areas.
- **(D)** The area with the smallest biomass is increasing while the others remain stable. This results in small biases across all areas.
- **(E)** The area with the largest biomass is increasing while the others remain stable. This results in larger biases, with the largest bias in the proportion method underestimating biomass for the increasing area and overestimating the stable areas.

Stochastic scenarios and results (stability)

In this section, we introduce survey error to area biomass estimates to determine the stability of the two types of apportionment estimates. We use the same population ratio of 3:6:1 and simulate 100,000 lognormal biomass estimates per area with increasing amounts of survey variability. Here we only show four scenarios in Table 9A.2.

- **(A)** The underlying biomass is stable with a survey CV of 5%. This results in small variability in the apportionment results; this apportionment variability is smaller than that of the underlying biomass estimates. Both methods are nearly identical.
- **(B)** The underlying biomass is stable, survey CV of 20%. Results are similar to (A) with proportionally more variability in apportionment.
- **(C)** The underlying biomass is stable with a survey CV of 40%. Again there is higher apportionment variability then **(B)**, but no difference between the two methods.
- **(D)** An underlying movement of fish from west to east (Area 1 toward Area 3) at a rate of 20% per survey, with a survey CV of 20%. This basically spreads the apportionment variability more evenly across the three areas. In this case the proportion-based estimate performs slightly better in terms of stability.

Discussion

Under most circumstances, the two methods perform similarly and proficiently at dampening survey variability when translated to the apportionment. For different fisheries, each method might be preferred based on the goals of management. If we wanted to ensure that we are maximizing harvest of surplus production in an area where the population is increasing, you would choose the biomass-based averaging because it leads to a less negatively biased estimate of the increasing area (see Table 9A.1.E). However, modern fisheries management is usually more concerned with not overharvesting an area that is decreasing. In this case, managers would prefer the proportion-based method because it has the least positive bias on the area that has decreased (see Table 9A.1.C).

Table 9A.1. Comparison of apportionment scheme used for rockfish assuming no survey error.

		Weighted Biomass Method			Weighted Proportion Method		
(A)	Weight	Area 1	Area 2	Area 3	Area 1	Area 2	Area 3
	4	60	120	20	30%	60%	10%
	6	60	120	20	30%	60%	10%
	9	60	120	20	30%	60%	10%
	19	60	120	20	30%	60%	10%
Apportionment		30%	60%	10%	30%	60%	10%
True		30%	60%	10%	30%	60%	10%
Bias		0%	0%	0%	0%	0%	0%
(B)							
	4	60	120	20	30%	60%	10%
	6	60	120	10	32%	63%	5%
	9	60	120	5	32%	65%	3%
	19	60	120	9.736842	32%	63%	5%
Apportionment		32%	63%	5%	32%	63%	5%
True		32%	65%	3%	32%	65%	3%
Bias		**-1%**	**-2%**	**2%**	**-1%**	**-2%**	**2%**
(C)							
	4	60	120	20	30%	60%	10%
	6	60	60	20	43%	43%	14%
	9	60	30	20	55%	27%	18%
	19	60	58.4	20	46%	39%	15%
Apportionment		43%	42%	14%	46%	39%	15%
True		55%	27%	18%	55%	27%	18%
Bias		**-11%**	**15%**	**-4%**	**-9%**	**12%**	**-3%**
(D)							
	4	60	120	5	32%	65%	3%
	6	60	120	10	32%	63%	5%
	9	60	120	20	30%	60%	10%
	19	60	120	13.7	31%	62%	7%
Apportionment		31%	62%	7%	31%	62%	7%
True		30%	60%	10%	30%	60%	10%
Bias		**1%**	**2%**	**-3%**	**1%**	**2%**	**-3%**
(E)							
	4	60	30	20	55%	27%	18%
	6	60	60	20	43%	43%	14%
	9	60	120	20	30%	60%	10%
	19	60	82.1	20	39%	48%	13%
Apportionment		37%	51%	12%	39%	48%	13%
True		30%	60%	10%	30%	60%	10%
Bias		**7%**	**-9%**	**2%**	**9%**	**-12%**	**3%**

Table 9A.2. Introducing survey error into calculations effect on precision (stability) of apportionment estimates.

	Weighted Biomass Method				Weighted Proportion Method			
	Area 1	Area 2	Area 3	Survey CV	Area 1	Area 2	Area 3	Survey CV
(A)	3%	2%	3%	5%	3%	2%	3%	5%
(B)	11%	6%	14%	20%	11%	6%	14%	20%
(C)	21%	12%	27%	40%	22%	12%	28%	40%
(D)	11%	8%	10%	20%	12%	8%	13%	20%