

# Report cards summarizing results from alternative widget runs during and after BAW II

## Introduction

This document summarizes results for scenarios that were presented or that were prepared after being suggested during the IPHC Biomass Apportionment Workshop II (BAW II) held in Seattle, April 29-30 2009. The results were obtained by simulation modeling with a graphical tool (“the widget”). A widget installer, related documentation, and presentations can be accessed via the following link:

[https://tundra.iphc.washington.edu/iphc/blog/?page\\_id=12&cpage=4#comment-55](https://tundra.iphc.washington.edu/iphc/blog/?page_id=12&cpage=4#comment-55)

Documentation for an earlier version of the widget is available in the 2008 RARA (Valero and Hare 2009a) and the 2009 Annual Meeting Blue Book (Valero and Hare, 2009b). The widget version used to develop the report cards presented in this document has the same basic dynamics as the earlier widget. One of the main differences of the new version is the use of a fully specified migration matrix between all areas following PIT tag model estimates derived from Webster and Clark (2007) and Webster (2009). Specific documentation for the latest widget version will be included in this year’s RARA. Key changes to this widget version were discussed during BAW II in the following presentation:

[http://www.iphc.washington.edu/halcom/meetings/workshop2009/presentations/MigFish\\_BAWI\\_I\\_web.pdf](http://www.iphc.washington.edu/halcom/meetings/workshop2009/presentations/MigFish_BAWI_I_web.pdf)

The results of the simulation runs are summarized in report cards whose basic structure is similar to a decision table (Table 1). The report cards can be interpreted from the vertical or horizontal axis. The vertical axis contains alternatives over which we have no control (i.e., different states of nature, in this case possible recruitment scenarios). The horizontal axis contains alternatives that we can control (in this case, alternative apportionment methods). The tables can be read in different ways, for example we can see the results of a particular apportionment method (e.g., survey based) under one possible state of nature (recruitment distribution based on Closed-area estimates of recruitment). Results for that combination of state of nature and management alternative can be read on the left-uppermost corner of the table (See Table 1). Summarized results in Table 1 include performance metrics of interest (to be explained further down the text) for each IPHC regulatory area included in the widget (4A to 2A) and for the coastwide case (“ALL”). Other ways of reading the table are to horizontally compare a particular management decision (say, survey-based apportionment) across different states of nature (different types of recruitment distribution), or to vertically compare two alternative apportionment methods under a particular recruitment scenario.

## Performance metrics of interest

The following are performance metrics of interest used to summarize results of simulations for each scenario:

**SB/SB0:** relative Spawning Biomass level at the end of the simulation compared to the same scenario without fishing (HR=0).

**HR:** realized harvest rate at the end of the simulation (the widget allows a max HR of 0.9)

**CHCS:** Percentage change from historical catch shares (15 year, 1993 to 2007, average share of total removals).

Yield: Percentage change in yield from an alternative method to the Survey based apportionment method

Age Composition

%<11: % of female fish younger than 11 years of age

%11-16: % of female fish between 11 and 16 years of age

%>16: % of female fish older than 16 years of age

%>20: % of female fish older than 20 years of age

Avg: Average age of females

The above described metrics are arranged in two separate report cards: Report Card I (SB/SB0, HR, CHCS, Yield) and Report Card II (%<11, %11-16, %>11, %>20, Avg). Elements of Report Card I are color coded (**Red/Yellow/Green**) to improve readability. Color coding for SB/SB0 is shown in Figure 1 and follows SBio threshold and SBio limit reference levels. Color coding for HR is shown in Figure 2. Color coding for CHCS and Yield follow a **Red/Black** color system, where black characters represent a positive change and red characters represent a negative change on the metric.

## Scenarios compared

All runs were done with version 2 of the widget assuming the same size at age for all areas. Initial conditions are in the absence of fishing and results shown are end points at equilibrium results. Figures 3 and 4 illustrate the time trajectories of a widget run assuming survey-based apportionment (balanced harvest rates at HR = 0.2), migration following PIT tag matrix, same growth pattern in all areas, and recruitment distribution as estimated by recent surveys.

The report cards compare the following apportionment methods (suggested by the industry or other interested parties) to the survey-based method (supported by staff):

- 1) Historical catch shares, based on 15-year average (1993-2007) total removals.
- 2) Blending of survey (fixed survey based apportionment shares as of the 2009 Annual meeting) and historical shares (2:1 ratio) as fixed shares.
- 3) Blending of survey (dynamic during widget run) and historical shares (2:1 ratio).

Report cards for these scenarios are presented in Tables 2 to 8. Additional results and alternative graphical presentation of results can be obtained by running the scenario of interest with the widget.

## References

- Valero, J. L. and Hare S. R. 2009a. Exploring effects of fishing and migration on the distribution of Pacific halibut. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2008:265-298.
- Valero, J. L. and Hare S. R. 2009b. Exploring effects of fishing and migration on the distribution of Pacific halibut. Int. Pac. Halibut Comm. 2009 Annual Meeting Blue Book 37-50.
- Webster, R. A. and Clark W. G. 2007. Analysis of PIT tag recoveries through 2006. Int. Pac. Halibut Comm. Report on Assessment and Research Activities 2006: 129-138.
- Webster, R. A. Analysis of PIT tag recoveries through 2008. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2008:213-220.



Table 2. Report Card I comparing survey based apportionment with historical catch shares (1993-2007 average share of total removals)

APPORTIONMENT METHOD		RECRUITMENT SCENARIO											
		CA Estimates (1996-2005)				Survey (1998-2004)				Juvenile movement			
		Area	SB/SB0	HR	CHCS <sup>1</sup>	SB/SB0	HR	CHCS <sup>1</sup>	Yield <sup>2</sup>	SB/SB0	HR	CHCS <sup>1</sup>	Yield <sup>2</sup>
Survey	ALL	33%	0.20		33%	0.20			33%	0.20			
	4A	41%	0.20	-72%	54%	0.20	-18%		48%	0.20	-46%		
	3B	33%	0.20	15%	36%	0.20	34%		29%	0.20	-29%		
	3A	34%	0.20	25%	32%	0.20	6%		34%	0.20	-5%		
	2C	38%	0.20	-51%	38%	0.20	-49%		39%	0.20	-40%		
	2B	29%	0.20	4%	29%	0.20	4%		32%	0.20	83%		
	2A	33%	0.20	-25%	33%	0.20	-32%		33%	0.20	102%		
Historical shares <sup>3</sup>	ALL	35%	0.19		34%	0.20		0%	34%	0.20		1%	
	4A	19%	0.90	-36%	48%	0.27	1%	23%	32%	0.54	0%	87%	
	3B	40%	0.15	4%	45%	0.12	1%	-25%	13%	0.57	0%	41%	
	3A	42%	0.14	4%	36%	0.17	1%	-5%	25%	0.28	0%	5%	
	2C	14%	0.90	-7%	14%	0.90	-4%	89%	21%	0.59	0%	67%	
	2B	21%	0.26	4%	22%	0.24	1%	-3%	51%	0.07	0%	-45%	
	2A	9%	0.85	4%	9%	0.90	-6%	39%	69%	0.05	0%	-50%	

<sup>1</sup> % Change from Historical Catch Shares (15 yr: 1993-2007 average proportion of total removals)

<sup>2</sup> % change in Yield from Method A

<sup>3</sup> Apportionment based on Historical Catch Shares (15 yr: 1993-2007 average proportion of total removals)

Table 3. Report Card I comparing survey based apportionment with a fixed blending of 2009 survey apportionment shares and 1993-2007 average total removals shares (2 to 1 proportions)

		RECRUITMENT SCENARIO												
		CA Estimates (1996-2005)				Survey (1998-2004)				Juvenile movement				
APPORTIONMENT METHOD	Survey	Area	SB/SB0	HR	CHCS <sup>1</sup>	SB/SB0	HR	CHCS <sup>1</sup>	SB/SB0	HR	CHCS <sup>1</sup>			
		ALL	33%	0.20		33%	0.20		33%	0.20				
		4A	41%	0.20	-72%	54%	0.20	-18%	48%	0.20	-46%			
		3B	33%	0.20	15%	36%	0.20	34%	29%	0.20	-29%			
		3A	34%	0.20	25%	32%	0.20	6%	34%	0.20	-5%			
		2C	38%	0.20	-51%	38%	0.20	-49%	39%	0.20	-40%			
		2B	29%	0.20	4%	29%	0.20	4%	32%	0.20	83%			
	2A	33%	0.20	-25%	33%	0.20	-32%	33%	0.20	102%				
	Survey:HCS (2:1) <sup>3</sup>	Area	SB/SB0	HR	CHCS <sup>1</sup>	Yield <sup>2</sup>	SB/SB0	HR	CHCS <sup>1</sup>	Yield <sup>2</sup>	SB/SB0	HR	CHCS <sup>1</sup>	Yield <sup>2</sup>
		ALL	34%	0.20		0%	33%	0.20		0%	34%	0.20		0%
		4A	19%	0.90	-34%	134%	49%	0.27	1%	23%	32%	0.54	3%	91%
		3B	33%	0.20	14%	-1%	38%	0.16	11%	-17%	8%	0.90	1%	42%
		3A	35%	0.19	21%	-3%	28%	0.25	18%	11%	16%	0.50	21%	26%
		2C	22%	0.52	-22%	58%	24%	0.44	-24%	49%	32%	0.31	-22%	29%
2B		38%	0.11	-26%	-29%	39%	0.10	-28%	-31%	62%	0.04	-26%	-60%	
2A	40%	0.15	-31%	-9%	33%	0.20	-33%	0%	79%	0.03	-31%	-66%		

<sup>1</sup> % Change from Historical Catch Shares (15 yr: 1993-2007 average proportion of total removals)

<sup>2</sup> % change in Yield from Method A

<sup>3</sup> Apportionment based on blending 2 parts Survey proportions (fixed as of 2009), and 1 part 15 yr (1993-2007) average proportion of total removals

Table 4. Report Card I comparing a blending of dynamic survey based apportionment and 1993-2007 average total removals shares (2 to 1 proportions)

APPORTIONMENT METHOD		RECRUITMENT SCENARIO											
		CA Estimates (1996-2005)				Survey (1998-2004)				Juvenile movement			
		Area	SB/SB0	HR	CHCS <sup>1</sup>	SB/SB0	HR	CHCS <sup>1</sup>	SB/SB0	HR	CHCS <sup>1</sup>	SB/SB0	HR
Survey	ALL	33%	0.20		33%	0.20		33%	0.20		33%	0.20	
	4A	41%	0.20	-72%	54%	0.20	-18%	48%	0.20	-46%	48%	0.20	-46%
	3B	33%	0.20	15%	36%	0.20	34%	29%	0.20	-29%	29%	0.20	-29%
	3A	34%	0.20	25%	32%	0.20	6%	34%	0.20	-5%	34%	0.20	-5%
	2C	38%	0.20	-51%	38%	0.20	-49%	39%	0.20	-40%	39%	0.20	-40%
	2B	29%	0.20	4%	29%	0.20	4%	32%	0.20	83%	32%	0.20	83%
	2A	33%	0.20	-25%	33%	0.20	-32%	33%	0.20	102%	33%	0.20	102%
	dSurvey:HCS (2:1) <sup>3</sup>	ALL	33%	0.20		33%	0.20	0%	33%	0.20		33%	0.20
4A		28%	0.47	-53%	52%	0.22	-13%	43%	0.27	-34%	43%	0.27	-34%
3B		34%	0.19	13%	37%	0.18	27%	27%	0.24	-23%	27%	0.24	-23%
3A		36%	0.19	20%	33%	0.20	6%	33%	0.21	-5%	33%	0.21	-5%
2C		30%	0.30	-40%	31%	0.29	-38%	34%	0.26	-31%	34%	0.26	-31%
2B		28%	0.20	1%	28%	0.20	1%	35%	0.17	68%	35%	0.17	68%
2A		30%	0.23	-21%	28%	0.25	-28%	39%	0.16	87%	39%	0.16	87%
				5%			7%			-7%			

<sup>1</sup> % Change from Historical Catch Shares (15 yr: 1993-2007 average proportion of total removals)

<sup>2</sup> % change in Yield from Method A

<sup>3</sup> Apportionment based on blending 2 parts Survey proportions (dynamic), and 1 part 15 yr (1993-2007) average proportion of total removals

Table 5. Report Card II comparing survey based apportionment with historical catch shares (1993-2007 average share of total removals)

APPORTIONMENT METHOD		RECRUITMENT SCENARIO															
		CA Estimates (1996-2005)					Survey (1998-2004)					Juvenile movement					
		Area	%<11	%11-16	%>16	%>20	Avg	%<11	%11-16	%>16	% >20	Avg	%<11	%11-16	%>16	% >20	Avg
Survey	ALL	37%	52%	12%	3%	12.3	36%	52%	12%	3%	12.3	36%	52%	12%	3%	12.3	
	4A	49%	44%	7%	2%	11.4	56%	41%	4%	1%	10.8	53%	42%	5%	1%	11.0	
	3B	35%	53%	12%	3%	12.4	40%	50%	10%	2%	12.0	28%	57%	16%	4%	13.0	
	3A	38%	51%	11%	3%	12.2	33%	54%	13%	3%	12.5	38%	51%	11%	3%	12.2	
	2C	42%	49%	9%	2%	11.8	41%	50%	9%	2%	11.9	42%	49%	9%	2%	11.8	
	2B	32%	54%	15%	4%	12.7	31%	54%	15%	4%	12.8	35%	53%	13%	3%	12.5	
	2A	37%	52%	12%	3%	12.3	37%	52%	12%	3%	12.3	37%	52%	12%	3%	12.3	
	Historical shares <sup>3</sup>	ALL	35%	50%	15%	4%	12.6	36%	51%	14%	4%	12.5	35%	48%	17%	6%	12.9
		4A	69%	30%	2%	1%	10.1	58%	39%	3%	1%	10.6	64%	33%	3%	1%	10.3
		3B	32%	52%	17%	5%	12.9	35%	50%	15%	4%	12.6	42%	54%	4%	1%	11.4
		3A	34%	51%	16%	5%	12.7	31%	53%	16%	4%	12.9	44%	50%	6%	1%	11.5
		2C	66%	32%	2%	0%	10.1	65%	33%	2%	0%	10.2	57%	40%	3%	1%	10.6
		2B	37%	53%	9%	2%	12.0	35%	54%	11%	2%	12.2	27%	49%	24%	9%	13.9
		2A	66%	34%	0%	0%	10.0	68%	32%	0%	0%	9.9	25%	46%	29%	13%	14.6

NOTE: All values correspond to Females on the survey

**Table 6. Report Card I comparing survey based apportionment with a fixed blending of 2009 survey apportionment shares and 1993-2007 average total removals shares (2 to 1 proportions)**

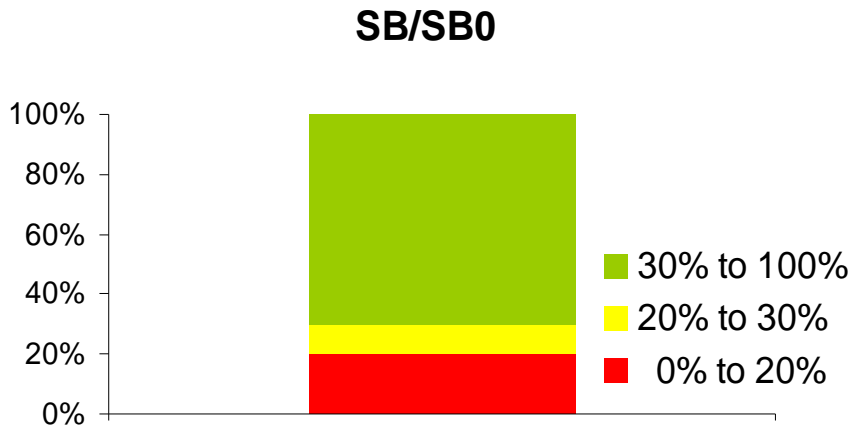
APPORTIONMENT METHOD		RECRUITMENT SCENARIO														
		CA Estimates (1996-2005)					Survey (1998-2004)					Juvenile movement				
		Area	%<11	%11-16	%>16	%>20	Avg	%<11	%11-16	%>16	% >20	Avg	%<11	%11-16	%>16	% >20
Survey	ALL	37%	52%	12%	3%	12.3	36%	52%	12%	3%	12.3	36%	52%	12%	3%	12.3
	4A	49%	44%	7%	2%	11.4	56%	41%	4%	1%	10.8	53%	42%	5%	1%	11.0
	3B	35%	53%	12%	3%	12.4	40%	50%	10%	2%	12.0	28%	57%	16%	4%	13.0
	3A	38%	51%	11%	3%	12.2	33%	54%	13%	3%	12.5	38%	51%	11%	3%	12.2
	2C	42%	49%	9%	2%	11.8	41%	50%	9%	2%	11.9	42%	49%	9%	2%	11.8
	2B	32%	54%	15%	4%	12.7	31%	54%	15%	4%	12.8	35%	53%	13%	3%	12.5
	2A	37%	52%	12%	3%	12.3	37%	52%	12%	3%	12.3	37%	52%	12%	3%	12.3
Survey:HCS (2:1) <sup>3</sup>	ALL	36%	51%	13%	4%	12.5	36%	51%	13%	4%	12.4	33%	46%	21%	9%	13.5
	4A	68%	30%	3%	1%	10.1	58%	39%	3%	1%	10.6	64%	33%	3%	1%	10.4
	3B	35%	53%	12%	3%	12.4	38%	51%	11%	3%	12.2	55%	45%	1%	0%	10.5
	3A	37%	51%	11%	3%	12.2	36%	54%	11%	2%	12.2	54%	45%	2%	0%	10.7
	2C	55%	42%	3%	1%	10.8	51%	45%	4%	1%	11.0	47%	46%	7%	2%	11.5
	2B	28%	51%	21%	7%	13.5	26%	52%	23%	8%	13.8	24%	47%	29%	13%	14.6
	2A	33%	51%	16%	5%	12.8	37%	52%	12%	3%	12.3	23%	44%	33%	16%	15.2

NOTE: All values correspond to Females on the survey

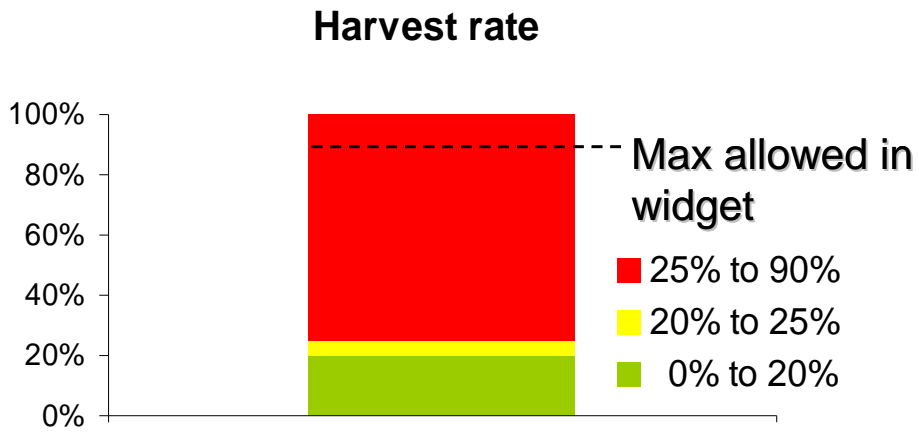
**Table 7. Report Card I comparing a blending of dynamic survey based apportionment and 1993-2007 average total removals shares (2 to 1 proportions)**

APPORTIONMENT METHOD		RECRUITMENT SCENARIO														
		CA Estimates (1996-2005)					Survey (1998-2004)					Juvenile movement				
		Area	%<11	%11-16	%>16	%>20	Avg	%<11	%11-16	%>16	% >20	Avg	%<11	%11-16	%>16	% >20
Survey	ALL	37%	52%	12%	3%	12.3	36%	52%	12%	3%	12.3	36%	52%	12%	3%	12.3
	4A	49%	44%	7%	2%	11.4	56%	41%	4%	1%	10.8	53%	42%	5%	1%	11.0
	3B	35%	53%	12%	3%	12.4	40%	50%	10%	2%	12.0	28%	57%	16%	4%	13.0
	3A	38%	51%	11%	3%	12.2	33%	54%	13%	3%	12.5	38%	51%	11%	3%	12.2
	2C	42%	49%	9%	2%	11.8	41%	50%	9%	2%	11.9	42%	49%	9%	2%	11.8
	2B	32%	54%	15%	4%	12.7	31%	54%	15%	4%	12.8	35%	53%	13%	3%	12.5
	2A	37%	52%	12%	3%	12.3	37%	52%	12%	3%	12.3	37%	52%	12%	3%	12.3
	dSurvey:HCS (2:1) <sup>3</sup>	ALL	36%	52%	12%	3%	12.3	36%	52%	12%	3%	12.3	36%	52%	12%	3%
4A	58%	39%	3%	1%	10.7	56%	40%	4%	1%	10.7	56%	40%	4%	1%	10.8	
3B	34%	53%	13%	3%	12.5	39%	50%	11%	3%	12.1	29%	57%	14%	3%	12.7	
3A	37%	51%	12%	3%	12.3	33%	54%	14%	3%	12.6	38%	51%	11%	2%	12.1	
2C	47%	47%	6%	1%	11.4	45%	48%	6%	1%	11.4	45%	48%	7%	1%	11.5	
2B	32%	54%	14%	3%	12.6	31%	54%	15%	4%	12.8	33%	52%	15%	4%	12.7	
2A	39%	52%	10%	2%	12.0	40%	52%	9%	2%	11.9	34%	51%	15%	4%	12.7	

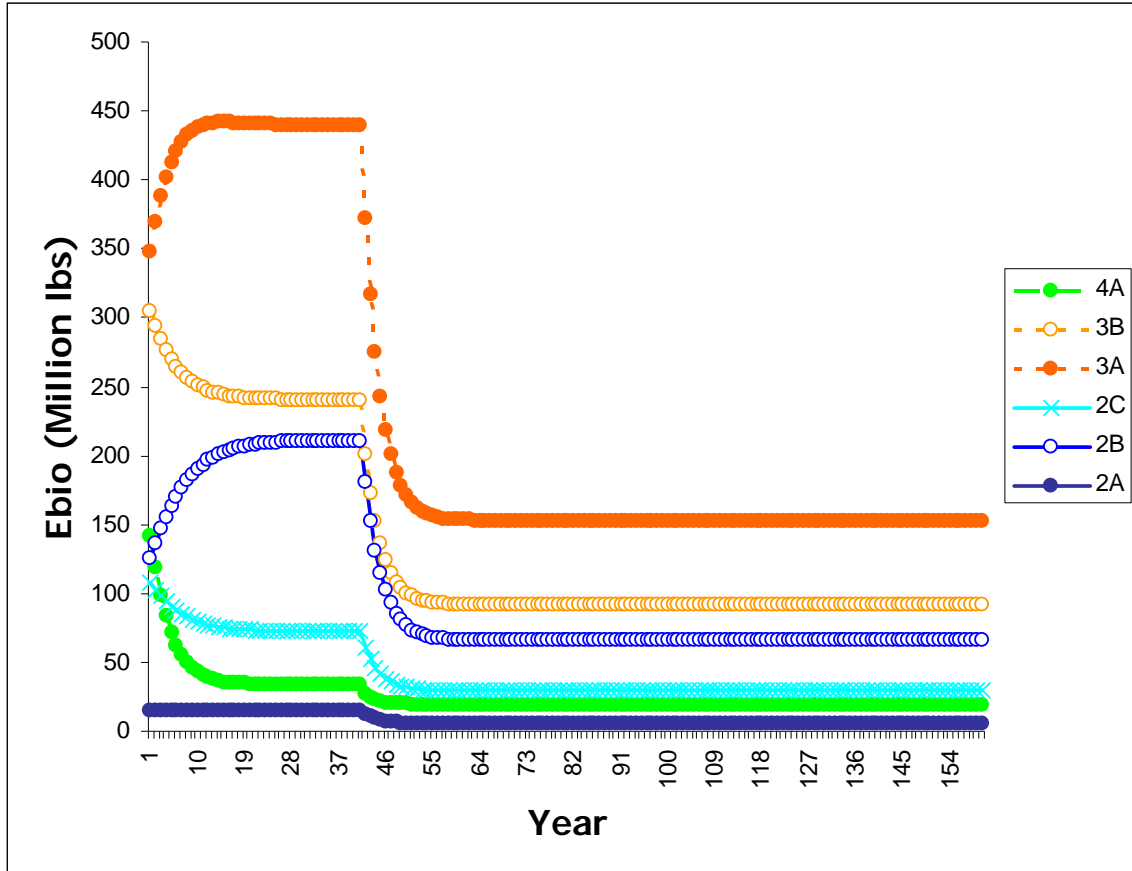
NOTE: All values correspond to Females on the survey



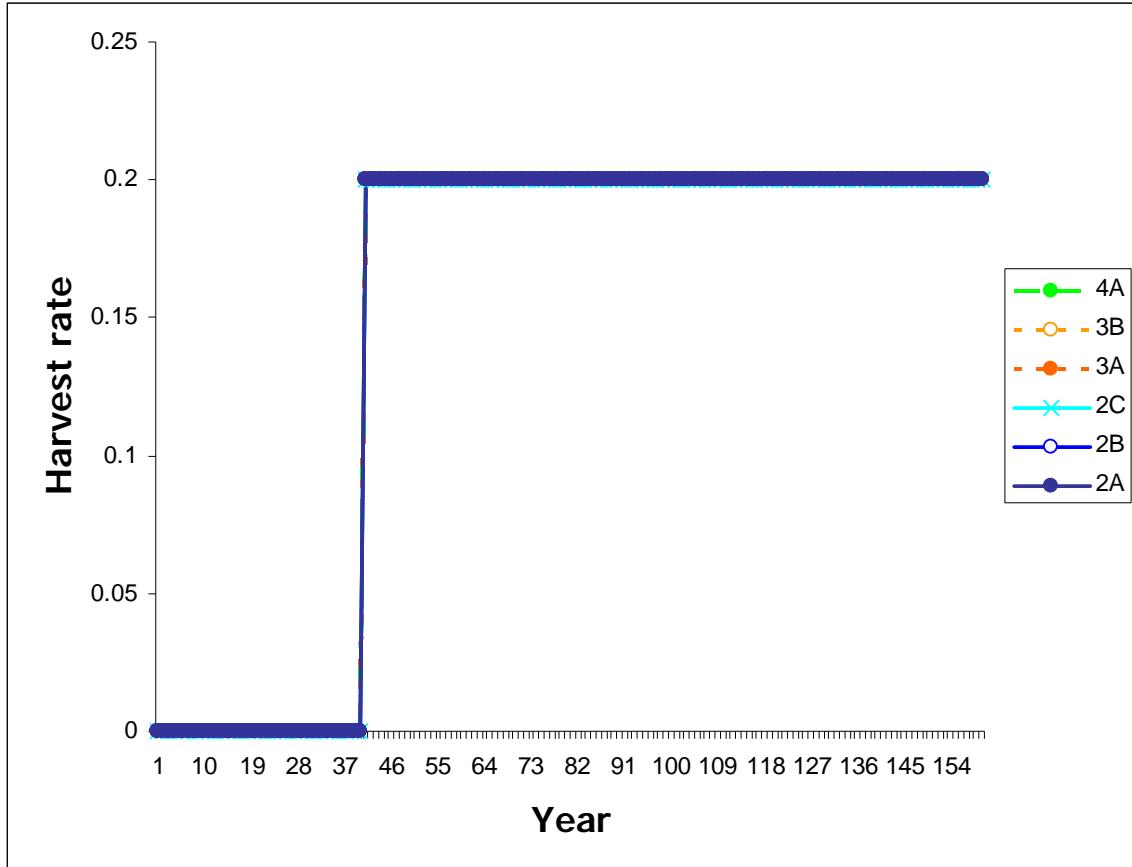
**Figure 1. Color coding used for the relative Spawning Biomass level at the end of the simulation compared to the same scenario without fishing (SB/SB0), based on Spawning Biomass threshold and limit reference levels.**



**Figure 2. Color coding used for realized harvest rates at the end of widget simulations. The dynamics of the widget have a maximum harvest rate of 0.9.**



**Figure 3. Time trajectory of exploitable biomass (Ebio) of a scenario with balanced harvest rates (HR= 0.2 for all areas after year 40 of the simulation), migration following PIT tag matrix, same growth pattern on all areas and recruitment distribution as estimated by recent surveys. The first 40 years represent a transition from initial age distributions without migration to equilibrium age distributions with migration added to the population dynamics.**



**Figure 4. Time trajectory of harvest rates of a scenario with balanced harvest rates (HR= 0.2 for all areas after year 40 of the simulation), migration following PIT tag matrix, same growth pattern on all areas and recruitment distribution as estimated by recent surveys.**