AGENDA C-2
OCTOBER 2012

MEMORANDUM

TO: Council, SSC, and AP Members

FROM: Chris Oliver
Executive Director

ESTIMATED TIME
4 HOURS
ALL C-2 ITEMS

DATE: September 19, 2012

SUBJECT: 2013/2014 BSAI and GOA Proposed Annual Harvest Specifications

ACTION REQUIRED

(a) Receive Groundfish Plan Team Reports
(b) Adopt proposed groundfish harvest specifications for 2013/2014

BACKGROUND

(a) Plan Team Reports

During their meetings on September 11-14, 2012, the BSAI and GOA Groundfish Plan Teams recommended proposed groundfish harvest specifications for 2013 and 2014 and Pacific halibut discard mortality rates (DMRs) for all groundfish fisheries for 2013-2015. The Teams also considered numerous informational reports, including a revised process for developing 5-year research priorities each year. Team recommendations for the next two fishing years are based on rollovers of the published 2013 final harvest specifications, which were adopted by the Council in December 2011. The reports from the meetings of the Joint BSAI/GOA Groundfish Plan Team, BSAI Groundfish Plan Team (page 31), and GOA Groundfish Plan Team (page 43) are attached under **Item C-2(a)**.

(b) Proposed Harvest Specifications

The Council is scheduled at this meeting to recommend proposed BSAI and GOA groundfish harvest specifications for the next two-year period *for the sole purpose of notifying the public of likely outcomes for Council action to set final harvest specifications in December 2012.* Following this practice, 2013 harvest specifications were published in the *Federal Register* in March 2012 and will start the groundfish fisheries in January 2013. Proposed harvest specifications for 2014 will be adopted at this meeting and are set equal to the 2013 harvest specifications. Any proposed Prohibited Species Catch (PSC) limits for halibut, red king crab, Tanner crab, *opilio* crab, and herring and their gear type and target fishery apportionments, should be adopted by the Council at this meeting so that the final rule, based on final harvest specifications from December 2012, is a logical outgrowth of the proposed rule. Final harvest specifications will be based on stock assessments included in the respective Stock Assessment and Fishery Evaluation Reports for the BSAI and GOA, which will be released in late November 2012.

Bering Sea/Aleutian Islands The BSAI Plan Team recommendations for proposed 2013/2014 BSAI groundfish harvest specifications are attached under **Item C-2(b)**. Final BSAI harvest specifications include PSC limits for halibut, red king crab, Tanner crab, opilio crab, and herring and their gear type and target fishery apportionments, which are set in federal regulations. NMFS staff will be available to assist the Council in adopting proposed PSC limits for 2013/2014.

TABLE 8a-FINAL 2012 AND 2013 APPORTIONMENT OF PROHIBITED SPECIES CATCH ALLOWANCES TO NON-TRAWL GEAR, THE CDQ PROGRAM, AMENDMENT 80, AND THE BSAI TRAWL LIMITED ACCESS SECTORS

PSC species	Total non-trawl PSC	Non-trawl PSC remaining after CDQ PSQ[1]	Total trawl PSC	Trawl PSC remaining after CDQ PSQ[1]	CDQ PSQ reserve[1]	Amendment 80 sector[2]	BSAI trawl limited access fishery
Halibut mortality (mt) BSAI	900	832	3,675	3,349	393	2,325	875
Herring (mt) BSAI	n/a	n/a	2,094	n/a	n/a	n/a	n/a
Red king crab (animals) Zone 1[1]	n/a	n/a	97,000	86,621	10,379	43,293	26,489
C. opilio (animals) COBLZ[2]	n/a	n/a	7,029,520	6,277,361	752,159	3,085,323	2,017,544
C. bairdi crab (animals) Zone 1[2]	n/a	n/a	980,000	875,140	104,860	368,521	411,228
C. bairdi crab (animals) Zone 2	n/a	n/a	2,970,000	2,652,210	317,790	627,778	1,241,500

[1]Section 679.21(e)(3)(i)(A)(2) allocates 326 mt of the trawl halibut mortality limit and § 679.21(e)(4)(i)(A) allocates 7.5 percent, or 67 mt, of the non-trawl halibut mortality limit as the PSQ reserve for use by the groundfish CDQ program. The PSQ reserve for crab species is 10.7 percent of each crab PSC limit.

[2] The Amendment 80 program reduced apportionment of the trawl PSC limits by 150 mt for halibut mortality and 20 percent for crab. These reductions are not apportioned to other gear types or sectors.

Note: Refer to § 679.2 for definitions of zones.

Note: Sector apportionments may not total precisely due to rounding.

TABLE 8b-FINAL 2012 AND 2013 HERRING AND RED KING CRAB SAVINGS SUBAREA PROHIBITED SPECIES CATCH ALLOWANCES FOR ALL TRAWL SECTORS

Fishery Categories	Herring (mt) BSAI	Red king crab (animals) Zone 1
Yellowfin sole	179	n/a
Rock sole/flathead sole/other flatfish [1]	31	n/a
Turbot/arrowtooth/sablefish[2]	15	n/a
Rockfish	11	n/a
Pacific cod	31	n/a
Midwater trawl pollock	1,600	n/a
Pollock/Atka mackerel/other species[3,4]	227	n/a
Red king crab savings subarea non-pelagic trawl gear[5]	n/a	24,250
Total trawl PSC	2,094	97,000

[1]"Other flatfish" for PSC monitoring includes all flatfish species, except for halibut (a prohibited species), arrowtooth flounder, flathead sole, Greenland turbot, Kamchatka flounder, rock sole, and yellowfin sole.

[2]"Arrowtooth flounder" for PSC monitoring includes Kamchatka flounder.

[3]Pollock other than pelagic trawl pollock, Atka mackerel, and "other species" fishery category.

[4]"Other species" for PSC monitoring includes sculpins, sharks, skates, and octopuses.

[5]In December 2011 the Council recommended that the red king crab bycatch limit for non-pelagic trawl fisheries within the RKCSS be limited to 25 percent of the red king crab PSC allowance (see § 679.21(e)(3)(ii)(B)(2)).

Note: Species apportionments may not total precisely due to rounding.

TABLE 8c–FINAL 2012 AND 2013 PROHIBITED SPECIES BYCATCH ALLOWANCES FOR THE BSAI TRAWL LIMITED ACCESS SECTOR

BSAI trawl limited access fisheries	Prohibited species and area[1]				
	Halibut mortality (mt) BSAI	Red king crab (animals) Zone 1	C. opilio (animals) COBLZ	C. bairdi (animals)	
				Zone 1	Zone 2
Yellowfin sole	167	23,338	1,901,193	346,228	1,185,500
Rock sole/flathead sole/other flatfish[2]	0	0	0	0	0
Turbot/arrowtooth/sablefish[3]	0	0	0	0	0
Rockfish April 15 - December 31	5	0	3,232	0	1,000
Pacific cod	453	2,954	80,799	60,000	50,000
Pollock/Atka mackerel/other species[4]	250	197	32,320	5,000	5,000
Total BSAI trawl limited access PSC	875	26,489	2,017,544	411,228	1,241,500

[1] Refer to § 679.2 for definitions of areas.

[2] "Other flatfish" for PSC monitoring includes all flatfish species, except for halibut (a prohibited species), flathead sole, Greenland turbot, rock sole, yellowfin sole, Kamchatka flounder, and arrowtooth flounder.

[3] Arrowtooth flounder for PSC monitoring includes Kamchatka flounder.

[4] "Other species" for PSC monitoring includes sculpins, sharks, skates, and octopuses.

Note: Seasonal or sector apportionments may not total precisely due to rounding.

TABLE 8d–FINAL 2012 AND 2013 PROHIBITED SPECIES BYCATCH ALLOWANCES FOR NON-TRAWL FISHERIES

Non-trawl fisheries	Catcher/processor	Catcher vessel
Pacific cod-Total	760	15
January 1 - June 10	455	10
June 10 - August 15	190	3
August 15 - December 31	115	2
Other non-trawl-Total		58
May 1 - December 31		58
Groundfish pot and jig		Exempt
Sablefish hook-and-line		Exempt
Total non-trawl PSC		833

Note: Seasonal or sector apportionments may not total precisely due to rounding.

Gulf of Alaska The GOA Plan Team recommendations for proposed 2013/2014 GOA groundfish harvest specifications are attached under **Item C-2(b)(2)**. Since 1997, the Council has reduced the GOA Pacific cod TAC to account for removals of not more than 25 percent of the Federal Pacific cod TAC from the State Guideline Harvest Level fisheries. Using the area apportionments of the proposed 2013 Pacific cod ABC that was recommended by the Plan Team, the 2013/2014 Federal TACs for Pacific cod would be adjusted as listed below. The halibut PSC apportionments recommended based upon the 2012 apportionments for the Gulf of Alaska groundfish fisheries are shown below. The 2,000 mt halibut PSC limit is reduced by 27 mt reduction per Rockfish Program GOA. Salmon PSC limits are set in regulation.

Proposed 2013/2014 Gulf of Alaska Pacific cod ABCs, TACs and State Guideline Harvest Levels (GHLs) (mt).

Specifications	Western	Central	Eastern	Total
ABC	29,120	59,150	2,730	91,000
State GHL	7,280	14,787	683	22,750
(%)	25	25	25	25
Federal TAC	21,840	44,363	2,047	68,250

GOA Pacific halibut PSC Limits

2013-2014 Trawl		2013-2013 Hook and Line		
Jan 20 - Apr 1	550 t	1st trimester	Jan 1 - Jun 10	250 t
Apr 1 - Jul 1	400 t	2nd trimester	Jun 10 - Sep 1	5 t
Jul 1 - Sep 1	600 t	3rd trimester	Sept 1 - Dec 31	35 t
Sept 1 - Oct 1	150 t			
Oct 1 - Dec 31	300 t	DSR	Jan 1 - Dec 31	10 t
TOTAL	2,000 t			300 t

Trawl fishery categories

Season	Shallow Water	Deep Water	Total
Jan 1 - Apr1	450 t	100 t	550 t
Apr 1 - Jul 1	100 t	300 t	400 t
Jul 1 - Sep 1	200 t	400 t	600 t
Sep 1 - Oct 1	150 t	any rollover	150 t
Oct 1 - Dec 31	*no apportionment*		300 t
TOTAL	900 t	800 t	2,000 t

Proposed 2013 and 2014 halibut PSC limits, allowances, and apportionments.

Trawl gear			Hook-and-line gear				
			Other than DSR			DSR	
Season	Percent	Amount	Season	Percent	Amount	Season	Amount
January 20 - April 1	27.5%	543	January 1 - June 10	86%	250	January 1 - December 31	10
April 1 - July 1	20%	395	June 10 - September 1	2%	5		
July 1 - September 1	30%	592	September 1 - December 31	12%	35		
September 1 - October 1	7.5%	148					
October 1 - December 31	15%	296					
Total		1,973			290		10

Note: The trawl PSC limit is reduced by 27 mt to 1,973 mt from 2,000 mt per Rockfish Program regulatory revisions in 2011.

Proposed 2013 and 2014 apportionment of halibut PSC trawl limits between the trawl gear deep-water species fishery and the shallow-water species fishery.

Season	Shallow-water	Deep-water[1]	Total
January 20 - April 1	444	99	543
April 1 - July 1	99	296	395
July 1 - September 1	197	395	592
September 1 - October 1	148	Any remainder	148
Subtotal January 20 - October 1	888	789	1,677
October 1 - December 31[2]	n/a	n/a	296
Total	n/a	n/a	1,973

[1] The third season deep-water apportionment of 395 mt is reduced by 191.4 mt for the Rockfish Program Halibut PSC allocation.

Apportionment of the "Other Hook-and-line fisheries" proposed 2013 and 2014 halibut PSC allowance between the hook-and-line catcher vessel and catcher/processor sectors

HAL gear (other than DSR) annual PSC amount	Sector	Percent of Annual limit [1]	Annual Amount	Season	Seasonal Percentage	Seasonal Amount
290	CV	59.7%	173	A	86%	149
				B	2%	3
				C	12%	21
	CP	40.3%	117	A	86%	101
				B	2%	2
				C	12%	14

[1] The basis calculations for these percentages incorporate the 2013 WGOA and CGOA cod TACs.

Pacific Halibut Discard Mortality Rates Halibut discard mortality rates (DMRs) are set by the Council on a 3-year cycle based on recommendations by International Pacific Halibut Commission staff **[Item C-2(b)(3)]** and the Groundfish Plan Teams. The recommended rates are based on an average of annual DMRs from the previous 10 years. Current rates will expire at the end of 2012; new rates are needed for 2013 - 2015. This procedure will be repeated in 2015 for 2016-2018. The teams endorsed IPHC staff recommendations for DMRs for the BSAI and GOA groundfish fisheries for 2013 - 2015.

Table 8. Recommended Pacific halibut discard mortality rates (DMRs) for 2013-2015 CDQ and non-CDQ groundfish fisheries off Alaska.

I. Non-CDQ

Bering Sea/Aleutians			Gulf of Alaska		
Gear/Target	Used in 2010-2012	2013-2015 Recommendation	Gear/Target	Used in 2010-2012	2013-2015 Recommendation
Trawl			*Trawl*		
Atka mack	76	77	Bottom poll	59	60
Bottom poll	73	77	Pacific cod	62	62
Pacific cod	71	71	Dpwtr flats	48	43
Other Flats	72	71	Shallwtr flats	71	67
Rockfish	81	79	Rockfish	67	66
Flathead sole	74	73	Flathead sole	65	65
Midwtr poll	89	88	Midwtr poll	76	71
Rock sole	82	85	Sablefish	65	71
Sablefish	75	75	Arr. fldr	72	73
Turbot	67	64	Rex sole	64	69
Arr. fldr	76	76			
YF sole	81	83			
Pot			*Pot*		
Pacific cod	8	8	Pacific cod	17	17
Longline			*Longline*		
Pacific cod	10	9	Pacific cod	12	11
Rockfish	9	4	Rockfish	9	9
Turbot	11	13			

Continued next page

II. Bering Sea/Aleutians CDQ

Gear/Target	Used in 2010-2012	2013-2015 Recommendation
Trawl		
Atka mackerel	85	86
Bottom pollock	85	83
Pacific cod	90	90
Rockfish	84	80
Flathead sole	84	79
Midwtr pollock	90	90
Rock sole	87	88
Turbot	88	89
Yellowfin sole	85	86
Pot		
Sablefish	32	34
Longline		
Pacific cod	10	10
Turbot	4	4

Minutes of the Joint Plan Teams for the Groundfish Fisheries of the Gulf of Alaska (GOA) and Bering Sea Aleutian Islands (BSAI)

September 11 - 14, 2012
North Pacific Fishery Management Council
605 W 4th Avenue, Suite 306
Anchorage, AK 99501

BSAI Team		GOA Team	
Mike Sigler	AFSC (BSAI co-chair)	Jim Ianelli	AFSC REFM (GOA co-chair)
Grant Thompson	AFSC REFM (BSAI co-chair)	Diana Stram	NPFMC (GOA co-chair)
Kerim Aydin	AFSC REFM	Sandra Lowe	AFSC REFM
Lowell Fritz	AFSC NMML	Chris Lunsford	AFSC ABL*
David Carlile	ADF&G	Jon Heifetz	AFSC ABL
Alan Haynie	AFSC REFM	Mike Dalton	AFSC REFM
Jane DiCosimo	NPFMC (Coordinator)	Kristen Green	ADF&G
Bill Clark	IPHC (retired)	Tom Pearson	NMFS AKRO Kodiak
Brenda Norcross	UAF	Mark Stichert	ADF&G**
Mary Furuness	NMFS AKRO Juneau	Paul Spencer	AFSC REFM
David Barnard	ADF&G	Nancy Friday	AFSC NMML
Leslie Slater*	USFWS	Leslie Slater*	USFWS
Dana Hanselman	AFSC ABL	Craig Faunce	AFSC FMA
Vacant	WDFW	Vacant	WDFW
		Elisa Russ	ADF&G**

* absent
** nominated

Introduction

The Joint meeting of the Gulf of Alaska (GOA) and Bering Sea Aleutian Islands (BSAI) Groundfish Plan Teams convened Tuesday, September 11, 2012 at 9:00 am at the Alaska Fisheries Science Center in Seattle, Washington. Introductions were made. New GOA Team members Mark Stichert and Elisa Russ were welcomed. It was noted that WDFW representative Henry Cheng, who is now on the SSC, will not be replaced on either team this year. Dave Carlile is retiring this fall and ADF&G will nominate his replacement after his position is filled; Dave's supervisor Chris Siddon will assist the BSAI Team in November.

Agenda

The Joint Groundfish Plan Teams adopted a revised agenda (attached).

Council actions

The Teams received updates on the following Council actions:

- NMFS will accept written comments from the public until October 15, 2012 to determine the issues of concern for the Steller Sea Lion (SSL) EIS; the appropriate range of management alternatives; and the direct, indirect, and cumulative impacts. A scoping meeting will be held October 2, 2012, at 5:30 to 7:30 at the Anchorage Council meeting. A report from NMFS to the Council on the scoping comments is scheduled for November 19, 2012. Information on the EIS, CIE review, and litigation is at http://www.alaskafisheries.noaa.gov/protectedresources/stellers/.
- NMFS and the Council are preparing a Supplementary Information Report to evaluate the 2004 Programmatic Supplemental Environmental Impact Statement (SEIS) for the BSAI and GOA groundfish fisheries and will present it to the Council at a future meeting.
- NMFS implemented a final rule for the GOA Chinook salmon Prohibited Species Catch (PSC) limits starting with the 2012 pollock C and D seasons.
- The Council final action in June 2012 resulted in reductions of the GOA halibut PSC limit for hook-and-line catcher/processor by 7% in year 1 and hook-and-line catcher vessel and trawl fisheries by 7%, 5%, and 3% for a total reduction of 15% over three years. Implementation is planned for 2014, at the earliest.
- Initial review of analysis to revise Bering Sea Chum salmon PSC limits in the pollock fishery is scheduled in December 2012 and final action possibly in April 2013.
- The Council is preparing discussion papers on GOA Chum salmon PSC limits and full retention in all non-pollock fisheries, with initial review tentatively scheduled for December 2012.
- NMFS is preparing a housekeeping amendment to the GOA Groundfish FMP to remove the pelagic shelf rockfish complex from the FMP to be consistent with GOA harvest specifications starting in 2012.
- NMFS is preparing an analysis to include grenadiers in the BSAI and GOA Groundfish FMPs. In June 2012 the Council adopted a purpose and need statement and alternatives for analysis. Alternatives include adding grenadiers 1) in the fishery, 2) in the ecosystem component (EC) category, or 3) in the fishery in the GOA and the EC in the BSAI. Initial review is scheduled tentatively for February 2013. Implementation likely would occur for the 2015 season, at the earliest.
- The Council prepared a discussion paper in June 2012 on Bering Sea flatfish TAC flexibility for yellowfin sole, rock sole, and flathead sole for Amendment 80 cooperatives and CDQ groups; initial review is scheduled for February 2013.
- The Council prepared a discussion paper in June 2012 on BS and AI Greenland turbot allocations by sectors; the Council adopted a problem statement and alternatives for analysis but encouraged the freezer longline and Amendment 80 sectors to identify a non-regulatory solution.
- NMFS and the Councils are convening the third Managing Our Nation's Fisheries conference in May 7-9, 2013, Washington, D.C., www.managingfisheries.org/.
- The Council produced a Fishing Fleet Profile report in April 2012; copies will be mailed to the team members.

NMFS groundfish stock assessment update

Rick Methot (F/ST) addressed the Teams regarding several issues related to groundfish stock assessments.

NS1 ANPR: NMFS is looking to revise the National Standard 1 guidelines through an advance notice of proposed rulemaking. This could be a lengthy process. However, Rick felt that some issues might be able to be resolved in a Q&A within the context of the current guidelines. The main idea for now is to have a thorough scoping prior to the "Managing Our Nation's Fisheries III" (MONFIII) conference in May, 2013 (Washington, D.C.). One item to be pursued is increased use of complexes in other regions, as is done in the North Pacific. Rick drew a distinction between complexes and multi-stock fisheries (complexes are groups of stocks with status determined on the basis of one or more indicator stocks; multi-stock fisheries have several individually assessed stocks that are harvested together). He posed the question of how do we deal with assessments of individual species versus assessments of managed complexes, particularly complexes with fluid compositions?

NAS study on rebuilding stocks: Pat Sullivan and Ana Parma are chairing a National Academy Study on rebuilding stocks. Three workshops are scheduled in various locations around the country; anticipated completion date prior to May 2013 MONFIII. Rebuilding also will likely be a subject for any NS1 guidelines revision.

Assessment prioritization: Another iteration of this document was presented to the NMFS Science Board last month. This activity was initially requested by Office of Management and Budget. The mechanism for obtaining feedback from Councils is yet to be determined, but specification of such a mechanism will obviously be necessary. Emphasis is on providing a standardized set of information for use in prioritization. NMFS staff are looking to identify a triage approach, ranging from well-assessed stocks to those about which we know very little. For those that have been assessed, the focus is on identifying how good each assessment needs to be (e.g., which ones *need* to have age data, which ones *need* to have a fishery-independent survey, etc.), and how frequently each assessment needs to be updated in order to provide adequate information for management. This would not prohibit assessments from being done more often, but would address how limited assessment resources are allocated. Prioritization is to occur *within* regions, not *between* regions. One of the objectives is to give regions a defense against being pressured to do additional assessments that provide very little value added, as opposed to assessments that are truly needed. The Science Board will be making decisions about where new investments are needed.

NSAW: There is a fair prospect of having a national stock assessment workshop next year, probably on a smaller scale than previous workshops (less symposium-like and more topic-focused, perhaps resulting in some sort of "best practices" report).

World Conference on Stock Assessment Methods: The conference will be held in Boston in July, 2013. Simulated data sets (6-7) will be provided for participants to test their respective methods. Questions to be addressed will include: What types of models perform best in various types of situations? What is needed in order for age-structured models to work well? A formal conference announcement is forthcoming.

Assessment methods: NMFS has hired a national scientific programmer, working out of NMFS SEFSC. He is used to working with biologists on large projects. He will be working with the ADMB (automatic differentiation model builder) Project. A Request for Proposals will be out soon (on the order of a few hundred thousand dollars) for development and testing of models. A workshop on selectivity is scheduled for March, 2013 at SWFSC-IATTC (time-varying versus constant, asymptotic versus domed, parametric versus non-parametric, etc.). The long-awaited Stock Synthesis website should be up soon (on Google Sites).

Assessment accomplishments: There are now 478 stocks managed under FMPs (down from the previous total, in part due to increased use of complexes and the ecosystem component category). Of these, 230 are included in the Fish Stock Sustainability Index (FSSI), which contribute about 90% of the total catch from all stocks; 133 of which have "full" assessments (i.e., assessments that are capable of making status determinations with respect to "overfished" and "overfishing" and are recently updated); 83 have "partial" assessment information; and 14 have never been assessed. About 100 non-FSSI stocks have no recorded catch.

Status of assessed stocks: Rick showed both national and NPFMC "Kobe" plots (fishing mortality and biomass time series relative to MSY reference points). These "report cards" indicate that NPFMC stocks are well managed.

National assessment issues:

1. Retrospective bias: Rick is not keen on this term because we *expect* things to change when a new datum is added. If selectivity is assumed to be constant, but it is actually changing, we will tend to see a retrospective pattern. This is a big issue in the northeast. What to do when a retrospective pattern exists is unclear.
2. Rejected assessments: This has been a big issue in the northeast and southeast. The bar keeps getting raised. What is the fallback position when a new model is rejected? We should not default to saying that we know nothing or cannot provide management advice.
3. Quantifying uncertainty: How uncertain is a data-poor assessment? We need a proxy level when we cannot measure uncertainty.
4. Assessment protocols and best practices: How do assessment "terms of reference" compare across regions?
5. Getting economics into control rules (MEY, MSE, trade-off analysis): We have not tackled this head-on. The guidelines say that this sort of analysis needs to be done for OY, but do not say how to do it. People are working individually, but we have not compared notes. Under what conditions (if any) is it appropriate to talk about a single-stock OY?

ACL II discussion paper

While the Groundfish FMPs already comply with the MSA, trailing FMP amendments could augment precautionary management of groundfish stocks. Grant Thompson presented an ACL discussion paper that the SSC reviewed in June 2011 and was scheduled for GPT review in September 2011, but was rescheduled for this meeting. The paper focused on three items: 1) changing the role of scientific uncertainty in ACL and OFL, 2) lack of a numeric value for the minimum stock size threshold (MSST), and 3) which removals need to be applied in computation of reference points and which removals are counted against harvest specifications. The Teams had greater discussion of the third topic (summarized below under the report of the working group on total catch accounting), and deferred additional consideration of the first two topics until September 2013.

In Issue #1, Grant excerpted the National Standard 1 (NS1) guidelines that state that ABC is a level of a stock or stock complex's catch which accounts for scientific uncertainty in OFL and other scientific uncertainty. The guidelines basically prescribe the P* approach. The 1997 FMP amendments established the Tier 1 buffer, based on a decision-theoretic (DT) approach that accounted for uncertainty directly, while Tiers 2-6 used "fixed" buffers. This was the first use of a probability-based buffer between OFL and ABC. In 1999, FMP amendments implemented changes to comply with the MSA, in order to treat MSY as a limit rather than a target. The 2010 ACL amendments adopted the new terminology of the 2009 NS1 Guidelines. No additional action is *required* since the Groundfish FMPs have already been determined to comply with the MSA.

The current maxABC rule is based on the DT approach: risk is minimized when the stock is fished at the rate that maximizes the geometric mean of stationary yield. Under certain conditions, this fishing mortality rate turns out to be the harmonic mean of F_{MSY}. The OFL rule, however, is not the risk-neutral optimum; instead, it uses the arithmetic mean of F_{MSY}, which ensures a buffer that increases with uncertainty. Grant's discussion paper considers the alternative of setting F_{OFL} at the risk-neutral optimum. For some crab stocks, Andre Punt pointed out that sometimes with large uncertainty, the risk-averse and risk neutral optima were very close. Grant showed how this result is theoretically possible in special cases, which is disconcerting for those who believe that the buffer should always vary directly with the amount of uncertainty. However, the P* approach has problems, too; chief among which is that it does not correspond to any kind of optimization (i.e., it does not consider what is gained or lost by achieving a buffer defined by particular value of P*).

The SSC requested an economic analysis, which Mike Dalton provided in an appendix to the paper and summarized for the GPTs. This was an effort to evaluate MSY alongside maximum economic yield (MEY). In the static case, a larger biomass is obtained at MEY, because, if costs vary directly with effort, effort at MEY will be less than at MSY. This is known as the Gordon-Schaefer inequality. Jim Ianelli asked about the cost function, and what happens when it is asymptotic or when it does not start at the origin (fixed costs). Mike replied that realistic features such as rising or fixed costs do not affect the Gordon-Schaefer inequality. A weakness of the Gordon-Schaefer bioeconomic model is the restrictive assumption of scalar population dynamics based on logistic growth.

Mike presented an alternative framework that uses an age- or size-structured population dynamics model, and a "Bioeconomic Rational Expectations" model. The objective in that model is to maximize the expected net present value of the fishery subject to population dynamics. The Gordon-Schaefer inequality does not necessarily hold in this dynamic (non-static) model. Results from the bioeconomic rational expectations model are contrary to some other publications (e.g., Grafton et al. 2007), which found the Gordon-Schaefer inequality holds for some stocks with dynamic MEY. Their results were seen as a win-win for environmental and economic outcomes, and as a potential justification for ACLs. However, the bioeconomic rational expectations model makes sharp predictions about the validity of the Gordon-Schaefer inequality at MEY. In particular, if costs are a large fraction of ex-vessel price, then the Gordon-Schaefer inequality holds (win-win). However, if costs are a small fraction of price, then constraining OFL by MSY is necessary, because market forces will otherwise cause the stock to become depleted. Therefore, expecting the win-win result to obtain in general when managing for MEY is a dubious claim, and is very situation specific.

Mike's part of the ACL presentation concluded with a static 2-stock example to demonstrate how multi-stock bioeconomic models could be used to analyze ACLs in the presence of fishery-wide constraints such as an OY cap. If the objective is to minimize total harvest costs subject to an OY cap, and per unit harvest costs are similar across species, then the cost-minimizing solution has (roughly) proportional reductions in yield below the OFL for each stock. In this case, ex-vessel prices do not affect the cost-minimizing solution. Alternatively, if the objective is to maximize ex-vessel profits subject to an OY cap, then the profit-maximizing level of effort shifts toward the higher valued species and away from the lower valued species.

Mike Sigler asked more about the linear nature of the cost curve. Linear variable cost curves were used to simplify figures in the presentation. In addition to linear variable costs, the bioeconomic rational expectations model represents three types of non-linear variable costs, including decreasing returns to scale for fixed-capacity fishing vessels, dynamic adjustment costs for changes in production levels over time, and a dynamic stock externality that affects harvest costs via search and travel. In addition, fixed costs can be included but these do not affect cost-minimizing or profit-maximizing solutions. Ed Richardson talked about how the industry generally goes through the same rationalization calculations, as evidenced by the fact that some catches are close to TAC and others are not; so results that were presented for these bioeconomic models are confirmation of what the industry is already doing.

Grant discussed the alternatives of moving forward with uncertainty changes. The P* approach complies with the NS1 guidelines but is not optimal. The DT approach does not comply with the NS1 guidelines but is more optimal. The minimum of the two approaches could be applied, which would be compliant but not always optimal (and would be more complicated than either approach individually). Mike Sigler asked how the economic analysis related to these options. Mike D. thought that the DT approach was already close and could include MEY easily. Alan said that there are a lot of cost data on crab, which could be used as an example, and that we should to look at the empirical data we have first. Jim asked whether there was much guidance on moving assessments toward being more risk neutral. Grant said that assessments and OFLs (in contrast to ACLs) are supposed to be risk-neutral, but aren't always. Alan asked what the path is, which Grant said is being discussed, but there is no specific timeline. There will be further discussion of the future path after the rest of the NS1 discussion. Anne Hollowed said that there is a post-doc working on this and any guidance on things to explore would be helpful.

Issue #2 is whether/how to determine a numeric MSST. The NS1 guidelines define MSST as either 0.5 MSY or the point at which the stock is no longer expected to rebuild to B_{MSY} in 10 years when fished at F_{OFL}, whichever is greater. The SSC concluded in 1998 that the added complexity of MSST was unnecessary in our system, so the 1998 amendments did not specify an MSST. Because the FMPs did not specify an MSST, NMFS assumed that the definition in the guidelines would apply, with the understanding that $B_{35\%}$ would be the B_{MSY} proxy for stocks managed under Tier 3. Simulation is used to determine whether a given stock is expected to be above B_{MSY} 10 years into the future when fished at F_{OFL}. The ACL amendments finally formalized this approach in the FMPs. There are at least two problems with this approach: 1) It is difficult to tell how close a stock is to being overfished and to compare performance to other U.S. fisheries; and 2) having to explain our unique system has resulted in annual struggles.

Grant conducted an analysis that showed that stocks with low natural mortality were unlikely to rebuild in 10 years, even if they started at a biomass level somewhat greater than ½ $B_{35\%}$, depending on current age structure. One option would be to use the maximum of ½ B_{MSY} or the smallest equilibrium stock size that would be expected to rebuild to B_{MSY} in 10 years (simple, but could result in a stock being declared overfished even though it would be expected to rebuild in 10 years). Another option would be to use the maximum of ½ B_{MSY} or smallest *dis*equilibrium stock size for rebuilding (more complicated, and could result in a stock being declared *not* overfished even though it would *not* be expected to rebuild in 10 years). The SSC suggested a third option based on determining the stock size at which rebuilding would be expected to occur in 10 years if the population proportions at age were equal to those estimated in the current assessment (somewhat complicated, and the MSST would change every time the current proportions at age changed).

National Standard 1 guidelines ANPR

This topic was for information only. Grant Thompson reported that a SSC/GPT/Council Staff work group reviewed the Advance Notice of Proposed Rulemaking on the NS1 guidelines, which was published May 3, 2012. The public comment period was subsequently extended to September 15 (and again to October 15). The Council will forward work group comments on the following 11 issues:

1. Stocks in a fishery--should clarify
2. OFL Impacts
3. ACL and OY--need additional guidance
4. Mixed stock fisheries
5. Scientific uncertainty and management -- clarification of risk
6. Data poor stocks--not all data poor stocks require federal management

7. ABC Control rules--P* should not be required
8. Total Catch Accounting (TCA)--flexibility
9. ACM -- clarify measures related to ACL
10. ACL Exceptions
11. Rebuilding progress

Working group reports

I. Total catch accounting

The Total Catch Accounting (TCA) Work Group report overlaps with Issue #3 of the ACL discussion paper agenda item and will be addressed jointly here. The 2010 ACL FMP amendments set the Council's policy for TCA for accounting for all removals by incorporating all removals as an input to the assessment models; however this has yet to be implemented in practice as the full data set is still in development. NMFS RO/AKFIN annually prepares estimates of removals for use by authors, although these do not always include all sources of removal. Currently these estimates of removals are supposed to be accounted for in an appendix table to each assessment.

The FMP states, "*To the extent practicable, each chapter contains estimates of all annual harvest specifications except TAC, all reference points needed to compute such estimates, and all information needed to make annual status determinations with respect to "overfishing" and "overfished." In providing this information, the SAFE report uses the official time series of historic catch for each stock or stock complex. This time series, which is provided by the NMFS Alaska Region, includes estimates of retained and discarded catch taken in the groundfish fisheries; bycatch taken in other fisheries; state commercial, recreational, and subsistence fisheries; catches taken during scientific research; and catches taken during the prosecution of exempted fisheries.*"

In 2011 the GPTs recommended the following:

- Authors were asked to report available "other" catch information in addition to the existing Catch Accounting System estimates as appendices to each stock assessment in the November 2011 SAFEs
- "Other" catches were to be reported only, but not used as input to stock assessment models
- Research, sport, recreational, subsistence, personal use, exempted fishing permits, etc. catches for 2010 were to be provided by AKRO as "other" removals
- Time series of Halibut Fishery Incidental Catch (HFICE) for 2001-2010 were also to be listed in the appendix
- "Other" removals were not to be used by GPTs for determining OFLs and ABCs for 2012/2013

The GPTs formed the Work Group to address how to reach full compliance for TCA requirements under the MSA. A summary of the written report of the TCA Working Group was presented by Sandra Lowe. The WG addressed several issues. One issue is a lack of consistency in the accounting of removals in the stock assessments.

- Sources for time series of catch removals (other than CAS) have not always been available, used inconsistently, and not routinely updated
- Data sets (which may cover only part of the actual time series) have been created to help account for other sources of removals including, but not limited to:
  - Research catches
  - Halibut fishery incidental catches
  - Recreational sport fishery harvests
  - Pacific cod bait catches in the crab fisheries

Remaining TCA issues:

- No associated size/age composition information (sometimes)
- Incomplete or inaccurate time series (but still best available)
- Incorporating these data for in-season management (to avoid overharvesting) is problematic
- Challenge to develop a single catch time series incorporating all data components for stock assessment use
- Advance notice of proposed rulemaking (ANPR) to potentially revise the NS 1 Guidelines (last updated 2009)

Working group recommendations:

- Authors continue to include "other" removals in appendix for 2013 but not apply those removals in the models
- "Other" removals data set continue to be compiled
- HFICE estimates not be continued
- SSC/GPT workshop to occur when NS1 guidance is provided on:
- Determination of how to use "other" removals in computation of reference fishing mortality rates and reference harvest amounts (ABC/OFL)
- How to include other catches in the "total" catch used to manage harvest specifications
- Whether to distinguish "other" removals by source such as research catches vs. fishery catches
- Development of methods for the incorporation of "other" removals for all Tier levels in the event they are used in determining reference harvest amounts

Plan Team discussion:

If possible, the GPTs would like to move in the direction of accounting for research catches differently from other removals, so that research catches would not count against the ABC. For example, perhaps research catches could be counted as a removal in the assessment but not counted against the ABC, so that they would affect the *determination* of ABC, but would not reduce TAC *from* the ABC. (As a shorthand method of approximating the likely impact of deducting research catches from the beginning biomass, an estimate of the coming year's research catches could be multiplied by the ABC exploitation rate. It may be that the impact is smaller than the rounding error typically associated with ABC recommendations. The sensitivity of this approximation could be tested by modeling the research catches as occurring at different times during the year, instead of assuming that they all occurred at the beginning of the year).

Plan Team recommendations:

- **The Teams recommend that authors continue to include other removals in an appendix for 2013. Authors may apply those removals in estimating ABC and OFL; however, if this is done, results based on the approach used in the previous assessment must also be presented.**
- **The Teams recommend that the "other" removals data set continue to be compiled, and expanded to include all sources of removal.**
- **The Teams recommend that computation of new HFICE estimates not be continued during the coming year. Once a sufficient amount of observer data are available to compare with HFICE, the time series could be filled out retroactively if comparison suggests this is appropriate. In the meantime, if individual authors want to continue the time series on their own, the code will be made available.**
- **The Teams recommend that a joint SSC/GPT workshop on TCA be held once NS1 guidance is provided. The Teams recommend that NMFS AKRO include a discussion of NEFMC and MAFMC research set-asides in its upcoming discussion paper on accounting for Scientific**

Research Permits/Exempted Fishing Permit removals (scheduled for review in December 2012).

II. Retrospective analysis

Mike Sigler presented a report on the retrospective analysis working group. A retrospective pattern is a systematic inconsistency among a series of estimates of population size, or related assessment variables, based on increasing periods of data (Mohn 1999). The primary goal of the group was to assess the value of conducting retrospective analyses, and to recommend a protocol for application to Alaska stocks. The group benefited from a workshop held in Woods Hole in 2008, and many of the conclusions and recommendations stem from this previous workshop.

The focus of the group was 'within-model' retrospective analysis, in which a single model and data set are used and successive model runs are conducted by dropping recent years of data. Inconsistencies in estimated biomass between these successive runs are an indication that the data are not entirely consistent with the assumed population dynamics, which could result from some combination of unusual input data and erroneous model specification. Many things could result in a retrospective pattern, and some inconsistencies between models and data may not be revealed from the retrospective analysis. General recommendations are to check the retrospective patterns, explore the potential underlying causes of any inconsistencies, and communicate the uncertainty in estimated abundance that results from the retrospective pattern. There is not a clearly defined level at which the retrospective pattern would warrant rejecting the assessment model. The retrospective pattern should be considered in the context of overall uncertainty, as some patterns that look problematic may be within the uncertainty bounds. Example retrospective patterns were shown for Gulf of Alaska POP and northern rockfish, and sablefish.

For the November 2012 SAFE report, the Teams recommend that authors conduct a retrospective analysis back 10 years (thus, back to 2002 for the 2012 assessments), and show the patterns for spawning biomass (both the time series of estimates and the time series of proportional changes relative to the 2012 run). This is consistent with a December 2011 NPFMC SSC request for stock assessment authors to conduct a retrospective analysis. The base model used for the retrospective analysis should be the author's recommended model, even if it differs from the accepted model from previous years.

The Plan Teams will assess the range of severity and recommend potential future steps. Experience with Pacific halibut assessments indicates that it may be difficult to diagnose the causes of retrospective patterns.

Spawning biomass was chosen as the estimated quantity for analysis of retrospective patterns because of its management importance, although input data on spawning biomass are rarely available. For time series that do have input data, it is important to examine correlation in residual patterns and how they are related to the retrospective patterns.

III. Methods for averaging surveys

Jim Ianelli presented the report from the working group (Jon Heifetz, Jim Ianelli, Paul Spencer, Grant Thompson) tasked with addressing issues related to averaging survey biomass estimates. Specific topics addressed by the working group included: 1) methods for using time series data to produce 'reliable' estimates of biomass for Tier 5 stocks; 2) methods for using survey time series to apportion ABC among areas; and 3) methods to fill in time series gaps for unsurveyed areas. The working group primarily focused on topics 1 and 2. Work on topic 3 initiated as an extension of topic 1.

Topic 1 - Biomass estimates: Two single-area simulation models were developed for generating survey biomass data using POP and pollock life histories. Models included parameters for survey CV, natural mortality, recruitment variability, survey frequency, and trends in fishing rate/biomass. The inventory of methods used to average survey estimates included: 1) most recent survey; 2) simple recent survey average; 3) weighted average of recent surveys; and 4) Kalman filter (a random effects method, similar to the Kalman filter, was also added late in the working group's research).

Topic 2 - Area proportions: The single-area model was expanded to a three-area model. Adults were allowed to move between areas in the model and estimates of survey biomass were generated for each subarea.

Working Group Recommendations: Weighted average and Kalman Filter methods both performed well for estimating current survey biomass (Topic 1). Variability was higher for some weighted average methods, so the Kalman filter method was preferred overall.

Most methods worked well for determining area apportionments (Topic 2), but the working group felt that this was likely due to insufficient variability among the simulated proportions over time. Further work incorporating spatial variability in biomass proportions is needed to better evaluate methods for area apportionment.

Vector autoregressive models also appeared promising in general, but need more work.

Dana Hanselman noted that there appears to be positive bias in mean relative biomass error and suggested using median values.

The Plan Teams recommend that assessment authors retain status quo assessment approaches for the November 2012 SAFE report but also apply the Kalman filter or random effects survey averaging methods for Tier 5 stocks and summarize the analytical results for comparison purposes only. ADMB code for implementing the random effects method will be made available.

IV. Recruitment

Grant Thompson presented a status update on the work of the recruitment workgroup. An SSC workshop was held in February 2012, followed by an April workshop which focused on three major themes: 1) identification of regime shifts; 2) estimation of parameters (i.e., average recruitment, stock-recruitment parameters, recruitment variability); and 3) forecasting environmental variability. Within these themes, a total of 10 topics were considered:

A. Identification of regime shifts, either for an ecosystem or some subunit thereof

- A1. Current policy on identification of regime shifts
- A2. Possible improvements to current policy, including consideration of risk

B. Estimation of parameters (average recruitment, stock-recruitment relationships, σ_R)

- B1. Establishing criteria for excluding individual within-regime year classes from estimates
- B2. Use of "conditioned" stock-recruitment parameters (e.g., $F_{MSY}=F_{35\%}$, $B_{MSY}=B_{35\%}$)
- B3. Specification of priors, including hierarchical Bayes and other meta-analytic approaches
- B4. Alternatives for setting/estimating σ_R
- B5. Determining "reliability" of the F_{MSY} pdf
- B6. Other issues involving the stock-recruitment relationship

C. Forecasting environmental variability

- C1. Best practices for incorporating environmental forcing in stock assessments
- C2. How knowledge of environmental forcing changes perceptions of reference points

Four topics were addressed initially for the May meeting of the Crab Plan Team (A1, A2, B1, and C2), and the remaining set of 6 topics will be evaluated in the next year with more analysis. For topics A1 and A2, the provisional recommendation is to condition estimation of the scale parameter of a two-parameter stock recruitment curve on F_{MSY} proxies consistent with FMP control rule, and estimate the breakpoints between regimes with AIC, likelihood ratio tests, or other appropriate statistical criteria. For topic B1 (criteria for excluding within regime year classes from estimates), the provisional recommendation was to exclude recent year classes based on a formula that reflects natural mortality and age selectivity to the survey. For topic C2 (how knowledge of environmental forcing affects perceptions of reference points), the provisional recommendation is to acknowledge that the current knowledge of environmental forcing is not sufficient to quantitatively alter perceptions of reference points.

For topic C1 (best practices for including environmental forcing in assessments), the provisional recommendation specifies the use of log-linear models because: 1) this is a mathematically convenient functional form; 2) this is the functional form that is typically used in such analyses; and 3) the "true" functional forms underlying the relationships between environmental variables and recruitment have not been identified for any BSAI or GOA groundfish stocks. One Team member suggested modifying this alternative, or adding a new alternative, in which the assessment authors first attempt to determine the "true" functional forms, then use log-linear only in those cases where the attempt is unsuccessful.

BSIERP/BEST FEAST model for the Bering Sea

Kerim Aydin summarized the FEAST (Forage, Euphausiid, Abundance in Space & Time) model. FEAST is a complex higher trophic model focused on Pacific cod, arrowtooth flounder, walleye pollock, and their prey. Data collection is coordinated with BSIERP and tied to integrated modeling. A series of workshops/conference calls were held with field researchers for model validation during January to March 2012. The modelers have devoted much time to simulating ice melt and links with Bering Sea water temperature. One model component represents crab species, but predictions will be limited by lack of biological detail in this model component. The model is run using three climate sets: CORE (1970-2005), CFSR (2003-2009) and IPCC forecast scenarios (2005-2040). The model shows fishable biomass of pollock and the scale of fishing operations. The model predicts different spatial distributions by age class that correspond with survey data, resulting from modeled fish moving towards areas of best conditions and small fish avoiding large fish (predators) spatially. Current analysis is focusing on predictors of recruitment. For example, the highest fall plankton concentration (predicted by the model) shows correspondence with highest abundance years for age zero pollock. Following the presentation, Kerim noted that actual data on the magnitude and timing of fall blooms are scarce.

The BSIERP management strategy evaluation (MSE) uses FEAST as an operating ("truth") model, and evaluates single species assessment models (SSMs), multispecies statistical models (MSMs), and Ecosim assessments with different inputs for recruitment, predation mortality, predation/growth, and fisheries selectivity. The model is forecast with various temperature predictions.

An October 2011 workshop on MSE developed a set of control rules to test with a range of management strategies. The following is a subset of these control rules: 1) Individual stocks fished to 40% of multispecies B_0 (calculated by simulation), conditioned such that all component stocks never drop below respective $B_{35\%}$ during predator/prey oscillations; 2) Calculate $F_{40\%}$ from M as calculated at multispecies B_0 for each stock. 3) Fish such that that the sum of all target biomass levels for the stocks is 40% of the sum of B_0s; 4) Solve for system-wide estimated B_{MSY} (key species) - both unconstrained or constrained such that none fall below $B_{35\%}$.

So far, control rule (1), above, has been simulated. For this simulation, the $B_{40\%}$ and B_0 set by single species models is higher than the same as set by MSM (because in the MSM B_0 scenario, predators of pollock increase in the no-fishing scenario). The results also illustrate how outcomes for pollock are affected by arrowtooth flounder and Pacific cod.

The modelers expect to complete forecasts, publications, and results of hindcasts for FEAST over the next year. An MSE workshop for discussing implications of these results with GPTs, SSC, and Council is anticipated for February-April 2013.

GOA Integrated Ecosystem Research Project (GOAIERP)

Olav Ormseth presented an update on the GOAIERP. The structure of the project has four components: upper, mid, and lower trophic level groups plus a modeling group. The project duration is 2010-15 with the main field years of 2011 and 2013. Some limited fieldwork was completed in 2010 and 2012. Olav presented some but not all of the preliminary results.

The spatial scale is east versus west and inshore versus offshore in terms of fish catch and oceanography. The eastern section consists primarily of SE Alaska, and the western section consists primarily of CGOA.

Waite and Mueter are conducting retrospective analyses on fish distribution through analysis of groundfish abundance (CPUE) and species diversity. Their results indicate a breakpoint in the middle of the Gulf (148° W long) where the eastern side has higher diversity and lower abundance, and the western side has the opposite – lower diversity and higher abundance.

Waite and Mueter are also conducting cluster analysis of common patterns of chlorophyll variability through satellite data. Their results show a seasonal trend for 4 areas with the western shelf being most productive, followed by eastern, then central, and the western off-shelf being the least productive. All areas show a spring bloom and a smaller fall bloom. This is the first time that the data have been analyzed in this way. Although the results are not surprising for the most part, one interesting result is a large negative anomaly in 2011 (also seen to a lesser extent in 2003-05). In 2011, there was a late bloom, lower chlorophyll, low fish catches in the offshore area, and low seabird productivity.

Kalei Shotwell, Zimmermann, Reid, and Golden are working on habitat mapping. They are digitizing the original survey charts ("smooth sheets") from the 1920s-30s, resulting in exceptionally detailed maps. Nearly linear features trending NE/SW were identified (likely earthquake faults), as well as some interesting curvilinear deposits--some small and diffuse, some large and pronounced. Finer-scale habitat mapping and some ground trothing also are occurring for some nearshore areas. The goal is to produce predictive models of, for example, flatfish distribution.

Ladd and Hermann performed a pattern analysis of historical data to identify climate regimes that could be used to identify hindcast years for the GOAIERP modeling efforts. The results suggest that El Nino is a major contributor to GOA environmental variability; positive ENSO results in stronger NE wind stress, stronger Alaska gyre circulation, high coastal sea surface height anomalies, warmer SST, and a deeper coastal mixed layer. From 2010-12, the ENSO index has been negative, which is consistent with field observations in 2011.

In 2011, Strom studied total chlorophyll versus size of plankton cells, showing that the expected diatom bloom conditions (high chlorophyll, large cell size) occurred late and in some areas, but not in all. Stabeno and others studied the Alaska Coastal Current (ACC) in 2011 through ARGOS-tracked drifters. Their results showed discontinuous flow of ACC with continuity breaks at Cross Sound and Kayak Island, and greater wandering on and off the SE shelf. Hopcroft observed an abundant biomass of salps (*Cyclosalpa bakeri, Salpa fusiformis*). The meaning of this event is unclear, but it is a remarkable occurrence.

Doyle, Matarese, and Napp looked at 2011 GOA larval sablefish distribution through a survey with a neuston net conducted May 3-17 in SE; high larval numbers that appear higher than WGOA and size range comparable to WGOA in May. Moss and Ormseth studied 2011 GOA young of the year (YOY) rockfish in summer and fall. Not a lot of rockfish were caught in offshore areas and also no YOY pollock or Pacific cod were caught offshore. There were fewer fish overall in fall, but they were more evenly distributed. Smaller YOY rockfish were found on the west side, but this could be a species effect. Rockfish were not identified to species, but Olav hopes that this will eventually be included in project scope. DeRobertis and Ormseth conducted an acoustic survey in Kiliuda Bay (eastern side of Kodiak) in fall 2011, and showed pollock and herring distribution.

In summary, 2011 seems to have been anomalous, with a late bloom, low fish abundance (especially offshore), and low seabird productivity. An east-versus-west difference is present. Preliminary data indicate more fish offshore in 2012 (Pacific cod, pollock, rockfish YOY). The team is gearing up for 2013.

Halibut discard mortality rates and IPHC performance review

Gregg Williams from the IPHC staff reported the estimates of halibut discard mortality rates (DMRs) by region, species, and fishery to be applied in 2013-2015. Following a long-established standard procedure, the estimates are calculated by averaging the annual rates based on the last ten years of observer data, in this case 2002-2011. There is little change from the rates used in 2010-2012. The Plan Teams endorse the updated rates. The present procedure for computing rates should be reevaluated when data from the restructured observer program (beginning with 2013 data) become available. Some alternative methods of estimation, including weighting the annual values by sample size or filtering, should be considered at that time.

Gregg also reported on the performance review of the IPHC that was requested by the governments, conducted by a consulting firm, and presented last spring. The review produced twelve major recommendations dealing with transparency of the Commission process, communication with stakeholders, conduct and review of IPHC science, and Commission membership among other things. The Commission is considering alternatives for strengthening the routine review of its stock assessment and research, such as an annual scientific meeting or a standing scientific committee. For this year, a group of scientists appointed by the governments will conduct a closed review of the stock assessment in October and make recommendations. The new IPHC senior assessment scientist, Ian Stewart, stated that the 2012 assessment would report halibut abundance estimates obtained with the existing model and probably one or more alternatives.

Discard mortality

Liz Conners provided an overview of two on-going projects to estimate discard mortality rates (DMRs) for octopus per request by the Council. There are no new data from these projects at this stage but work continues to estimate appropriate mortality rates for octopus.

Jon Heifetz presented an overview of issues relative to DMRs for sablefish per request by the Council to provide a white paper on this topic. Jon noted that DMR issues are not unique to sablefish and a group comprised of Council, RO, and AFSC staff broadened the discussion to groundfish. The default assumption is 100% for all species outside of halibut PSC for management purposes. Lowering DMRs from this estimate may reduce the probability of exceeding TACs; furthermore, observer restructuring may provide better estimates of discards in the future.

Biological challenges behind setting DMRs are related to differences amongst species, regions, fisheries, and gears. Furthermore, to set DMRs similar to halibut PSC, some estimate of viability is also necessary. There are some management considerations regarding the process of setting DMRs in regulation. An example analysis for sablefish was provided based on tag releases and data on returns based on a range of injuries and mortality estimates. Some management issues in setting DMRs include how DMRs are specified in regulation and the process by which they are reviewed annually during the harvest; whether regulations must specify that discards be returned to the sea immediately, with a minimum of injury, regardless of their condition; and whether the amount of discards is sufficient to warrant species-specific DMRs.

Some species where discards are likely a large proportion of mortality include sharks and skates. Suggestions from Team members include a more formal list of those species which are most likely to have less than 100% mortality. Julie Bonney noted that DMRs would serve several management purposes; for example, for sablefish it's an economic issue with respect to discards, while for octopus this could be more of a conservation issue as--absent DMRs--some species could exceed the OFL and close fisheries.

NMFS RO staff noted concerns with establishing regulations based on the presumption of careful release and the burden of proof to verify that. One way to go forward would be to look first at those species with lower estimated handling mortality as well as those for which management would benefit from the use of DMRs. Glenn Merrill noted that significant analyses would be necessary to implement DMRs.

The Plan Teams recommend establishing a list of species which are most likely to have rates less than 100%. The RO staff could then provide input on the level of discard by species while the assessment scientists could provide an overview of viability estimates. How the prioritization is established would depend on a number of factors and would likely involve the Council as well.

Viability, amount of discarded and retained catch, and discard rate for 2011 groundfish fisheries are shown in the table below. Viability is a subjective evaluation of the potential for survival of a carefully discarded fish. The viability estimates shown in the table were prepared by Jon Heifetz at the request of the Teams.

Gulf of Alaska	Viability	Discarded (t)	Retained (t)	Percent discarded
Atka mackerel	High	172	1,027	14.3%
Arrowtooth flounder	Medium	7,144	23,747	23.1%
Big skate	Medium	428	1,834	18.9%
Demersal shelf rockfish	Low	0	82	0.0%
Deep water flatfish	Medium	233	231	50.2%
Flathead sole	Medium	96	2,633	3.5%
Longnose skate	Medium	348	631	35.5%
Northern rockfish	Low	131	3,309	3.8%
Octopus	High	524	388	57.5%
Pacific cod	Medium	1,753	60,722	2.8%
Pelagic shelf rockfish	Low	71	2,405	2.9%
Walleye pollock	Medium	1,948	77,832	2.4%
Pacific ocean perch	Low	923	12,059	7.1%
Rex sole	Medium	93	2,783	3.2%
Rougheye rockfish	Low	77	451	14.6%
Other rockfish	Low	358	359	49.9%
Sablefish	High	525	10,620	4.7%
Sculpin	High	612	74	89.2%
Shallow water flatfish	Medium	191	3,783	4.8%
Squid	Low	52	177	22.7%
Shortraker rockfish	Low	109	427	20.3%
Thornyhead rockfish	High	82	528	13.4%
Other skates	Medium	964	225	81.1%
Sharks	High	538	11	98.0%

BSAI				
Alaska plaice	Medium	7,197	16,460	30.4%
Atka mackerel	High	1,775	50,044	3.4%
Arrowtooth flounder	Medium	4,009	16,606	19.4%
Other flatfish	Medium	2,097	1,080	66.0%
Flathead sole	Medium	1,827	11,728	13.5%
Greenland turbot	Medium	83	3,554	2.3%
Kamchatka flounder	Medium	365	9,570	3.7%
Northern rockfish	Low	154	2,608	5.6%
Octopus	High	545	32	94.5%
Pacific cod	Medium	2,453	217,466	1.1%
Walleye pollock	Medium	4,877	1,195,578	0.4%
Pacific ocean perch	Low	732	23,268	3.1%
Rougheye rockfish	Low	25	141	15.1%
Other rockfish	Low	192	747	20.4%
Rock sole	Medium	4,526	56,105	7.5%
Sablefish	High	24	1,690	1.4%
Sculpin	High	5,069	291	94.6%
Squid	Low	192	144	57.1%
Shortraker rockfish	Low	39	293	11.7%
Skates	Medium	17,431	5,562	75.8%
Sharks	High	164	6	96.5%
Yellowfin sole	Medium	4,750	146,414	3.1%

Stock structure template

GOA POP

Dana Hanselman presented a discussion of POP--one of only a few species in the GOA that has OFLs specified by area. The recent overages in the Western Gulf have prompted interest in reviewing the utility of area-specific OFLs. This stock has an abundance of stock structure data.

Harvest and trends: GOA-wide, harvests are well below ABC but in the smaller management areas (WGOA) there have been some overages. Their abundance is concentrated east of Kodiak Island, along the 200 m line. Most fishery catches coincide with the trawl survey except for the Eastern Gulf, which is closed to trawling. A 2007 study examined localized depletion and found that, while infrequent, areas are depleted in some years; in the following year the catch rates return to pre-depletion level, which indicates that movement replenishes areas.

Barriers and phenotypic characters: Generation time 27 years. Morphometrics indicate V-shaped cline from west to east, probably related to latitude. Growth in length: Not much difference between areas; although significantly different due to large sample size, possibly not biologically important. Weight-at-age: fish in eastern Gulf grow larger. Year classes develop in the eastern and central GOA. Appear first in eastern and later in western. Strong year classes not consistently found in all areas; could be localized spawning.

Behavior and movement: Spawning site fidelity unknown because it is difficult to tag POP and there are no known natural tags.

Genetics: Isolation by distance significant, with dispersal of ~70-140 km per generation, which is smaller than current management areas.

Author's summary and conclusions: There appears to be stock structure that is supported by genetics data. Genetics imply that current management areas are too large. Infrequent overharvest by area may not be a problem. The author's recommendation was to use smaller areas for ABCs (perhaps smaller than those currently used), but set OFLs for larger areas. For OFLs, the areas open to trawling (Western, Central, and West Yakutat areas) could be combined while having the areas closed to trawling (East Yakutat and Southeast Outside) separate.

Plan Team discussion: The Teams asked whether it is possible to have OFLs by area that are different from an aggregate OFL. The logic is that acknowledging estimation and stock structure uncertainty could result in area-specific values that sum to a higher value than the overall (all-region) OFL. This could provide a buffer for management, which could manage slightly higher levels by area while still ensuring that the overall catches remain within the region-wide OFL. This option effectively would likely fall somewhere between using area-specific OFLs and a single, region-wide OFL. NMFS Regional Office staff noted that this would be difficult to implement and discouraged this approach. Setting separate ABCs by region appears to provide some within-region precaution.

BSAI northern rockfish

Paul Spencer presented the template organization, management implications, and recommendations.

Harvest and trends: Paul showed the trends of exploitation rate by year for each area. Harvests in the eastern Aleutians have increased recently. Surveys don't really vary substantially in terms of biomass proportion by area. Paul also examined bycatch rate by area and by comparing catch rates of northern rockfish per ton of Atka mackerel caught in the Atka mackerel fishery. These catch rates do not quite follow the distribution of survey biomass and proportionally more northern rockfish are harvested in the eastern Aleutians.

Barriers and phenotypic characters: Several passes reach about1000 m in depth. Adults might not cross these passes since they prefer <200 m depths. There are significant differences in growth by area. Fish grow larger in the west than in the east. There is no consistent pattern between years in age composition across AI areas.

Genetics: There are significant pair-wise genetic differences between EBS and AI stocks and a significant relationship in isolation by distance. Dispersal distance is ~12-120 km, ~190-211 based on auxiliary movement information, similar to other rockfish species.

Author's summary and recommendations: Paul recommended that northern rockfish ABCs should be specified by BS and AI subareas to prevent disproportionate harvest and to be consistent with available stock structure information. Area-specific ABCs should have minimal impact on bycatch fisheries and would be consistent with previous Plan Team actions.

BSAI rougheye/blackspotted update

Paul suggested that the BSAI Team reexamine rougheye and blackspotted rockfish due to exploitation rates in the Western AI. Survey data show only about 10% of the biomass occurring in Western AI, but the catch is relatively high in this area. However, the variability in trawl survey biomass estimates makes it difficult to tell if there is a trend by area. In terms of exploitation rates, much higher values are seen in the west, above 0.75M. When the Western AI is combined with the Central AI (low catch/high survey), the pattern in the west (high catch, low survey) is swamped.

Paul recommended subarea ABCs in the BSAI. His rationale was that this approach would provide more effective monitoring, consistency with spatial structure, minimal impact for bycatch fisheries, and consistency with previous recommendations.

Plan Team discussion: The Plan Teams discussed several points: 1) Whether we should consider splitting ABC by area now or in November. 2) There should be an examination of similarity between species stock structures to develop overarching guidelines for all stock structure-related decisions. Stock structure templates have not been completed for many GOA and BSAI stocks. 3) The inconsistency of typically dividing the GOA into smaller areas for ABC management than the AI. 4) Splitting ABCs by area can increase mandatory discards.

Julie Bonney recommended that, prior to implementing spatial TACs, the Plan Teams investigate the management implications.

BSAI yellowfin sole

Tom Wilderbuer presented the stock structure template for this BSAI yellowfin sole. A 1989 study indicated different spawning areas, which may indicate stock structure. Tom's presentation focused on comparing the NW and SE EBS.

Harvest and population trends: Larger biomass and catch in SE compared to NW. Exploitation rates fairly small in both areas and are similar in both the NW and SE. CV of survey biomass is larger in NW than SE.

Barriers and phenotypic characters: Generation time is 14 years. No obvious physical barriers to movement. For both sexes, there are significant differences in length-weight relationship and NW weights are slightly larger for both sexes. However, this difference is not biologically significant. There are some differences in age composition between NW and SE, with larger differences since 2009.

Genetics: No current information

Behavior and movement: Essentially unknown

Author's recommendations: Tom stated that his analysis does not support splitting the allocation of ABC and OFL between the NW and SE regions. **Plan Team discussion:** The Plan Teams inquired about the apparent lack of larger fish in the NW BS. Tom answered that there may be oceanographic differences between the two regions which may result in different growth rates. **The Plan Teams recommend that a genetic study be conducted to estimate isolation by distance in yellowfin sole.**

BSAI skates

Olav Ormseth presented the stock structure template for BSAI skates. This template was different from the others in that several species were presented together.

Harvest and abundance: Alaska skate is a Tier 3 species and the others are Tier 5 species. Directed fishing for Alaska skate is not allowed, but incidental catches of Alaska skate can be retained. Alaska skate is widely distributed in the GOA and BSAI. Other species' distributions vary by region and depth. In BSAI, 82% of skate biomass is found on the shelf and is dominated by Alaska skate. The largest diversity in skate species is found on the EBS slope and in the AI. There are large differences in species composition by depth. Skates have been identified to species by fisheries observers only since 2005; thus, it is difficult to analyze harvest trends by species. In the bottom trawl surveys, reliable differentiation of species has occurred only since 1999. With the available data, the exploitation rate of the skate complex is larger in the EBS than the AI, and is less than M, ranging around 0.35 to 0.45 of M since 2003. The spatial distribution of catch tends to reflect the survey abundance distribution.

Barriers and phenotypic characters: Some phenotypic variations. No physical barriers to movement except in the AI.

Behavior and movement: Tagging study currently underway. In GOA, large scale movements of big skates occur.

Genetics: No data available

Author's recommendations and conclusions: Olav pointed out that data limitations make it difficult to reach conclusions. The available data suggest low potential for localized depletion and that the current management approach is satisfactory. However, the , composition of the BSAI skate complex should be reviewed periodically.

Plan Team discussion: The Plan Teams recommended adding error bars to the abundance plots to show uncertainty in the observations.

GOA walleye pollock

Martin Dorn presented the stock structure template for GOA pollock.

Harvest and abundance trends: Pollock are fully exploited in the GOA and F~0.12. Mean CPUE in the bottom trawl survey is larger in Central and Western GOA, lowest in Yakutat, slightly larger in SE and is concentrated in the Shumagin, Chirikof, and Kodiak areas. Overall abundance decreased through 2000 and then increased after 2000.

Barriers and phenotypic characters: In the GOA gyre, transport is counter-clockwise. No physical barriers exist that would lead to stock structure. Spawning occurs in locations that are advantageous for retaining larvae. There seem to be a lot of spawning locations for pollock, which could possibly create stock structure. On average, Shelikof Strait has 52% of the spawning biomass. There is not a lot of information on spawning locations of pollock in SE Alaska. Growth rates exhibit strong cline, with much larger fish in

Central and Western GOA for both males and females and smaller asymptotic length in SE. Growth seems to become different among areas at around age 4. Average age is lowest in SE. There seems to be structure in age composition by area, but young fish do occur in all areas, with differences manifesting themselves at older ages.

Genetics: Genetic structure is not strong, no suitable studies in GOA to determine isolation by distance. Pair-wise differences have been found between Shelikof Strait and Middleton Island.

Behavior and movement: Information not available.

Author's recommendations: Martin recommended keeping the current methods of allocating ABC and OFL. The ABC is set for management areas in the Central and Western GOA due to Sea lion protection measures. If stock structure is present, current management measures ensure that disproportionate harvest does not occur.

Plan Team discussion: A Plan Team member asked whether the present areal management would be too conservative if Steller sea lions were not threatened. Martin answered that possibly this is overly conservative and is not due to biological information on stock structure. The Plan Teams noted that isolation by distance does seem to be useful; it has helped with rockfish to understand dispersal, so additional genetic studies or analyses of existing data for pollock may be useful.

BSAI and GOA sharks

Cindy Tribuzio presented the stock structure template for sharks.

There are three primary species in Alaska: spiny dogfish, Pacific sleeper shark, and salmon shark.

Harvest trends and abundance: Harvest rates are generally uncertain due to lack of reliable catch data. Population trends are stable for dogfish, decreasing for sleepers and unknown for salmon sharks. Most of dogfish catch is taken around Kodiak. Their spatial distribution based on survey data indicates a significant portion of the biomass occurs in SE Alaska, but there is a lack of catch data in SE. Sleeper shark abundance data and catch overlap spatially. Salmon shark cannot be evaluated due to lack of survey and catch data. Based on halibut longline survey data, dogfish catch rates are stable. Sleeper shark catch rates are declining in both the GOA and BSAI. Salmon shark catch rates in the GOA are highly variable and none are caught in BSAI surveys.

Barriers and phenotypic characters: No differences in growth and no physical barriers to movement have been found.

Behavior and movement: Unknown spawning site fidelity. Tagging studies for dogfish are underway. Preliminary data indicate long-range movements for dogfish. Short-range movements have been studied for sleeper sharks, all for immature animals. Salmon sharks are highly migratory.

Genetics: Largely unknown,. Genetic studies did differentiate between Atlantic and Pacific dogfish, which are now considered separate species.

Author's summary and recommendations: No known differences spatially. Cindy concluded that the data do not support area-specific ABC/OFL.

Plan Team discussion: The Plan Teams recommend continuation of FMP-wide harvest specifications for sharks.

GOA Atka mackerel

Sandra Lowe presented a brief overview of the stock structure template for GOA Atka mackerel. This stock is an extension of the AI population. They are caught only in fisheries in the Western GOA near the Shumagin Islands. There are few age data to perform growth/age structure analysis. Currently, the TAC is around 2,000 t and is caught incidentally in other target fisheries. Sandra concluded that the current method of setting GOA wide ABC/OFL seems appropriate.

General discussion

Team members discussed a wide variety of possible next steps, some of which are listed below:

Team members noted that if we are uncertain about stock structure, our policy (adopted in September, 2010) has been to be precautionary in case stock structure actually does exist.

Alaska groundfish have many different life history strategies. Our procedure has been to keep chipping away and getting more stock structure templates completed. These templates provide information, for example, on isolation by distance by species and life history strategy. Having more templates completed will help to determine whether to split or lump ABC or OFL and to be consistent in doing so. We need to put things in context; just because we see higher exploitation in one area does not mean we are going to split the area.

The template lays out a two-step process, the first of which is assessment of the biological data, and the second of which is consideration of the management implications. We need to work more on the second step with fishery managers. Improving the process to provide additional sub-stock protection without just creating more discards would be desirable. Splitting the ABC but not the OFL can promote discards and have costly implications in the BSAI because of the 2 million t OY cap. Julie Bonney: There is a need to add in a discussion of fishery characteristics (MRA, TAC below ABC). Industry may be able to come up with creative solutions to lessen the impact of splitting ABC/OFL. The Plan Teams can identify concerns (if any), then industry can be innovative on how to deal with these.

The Plan Teams recommend that: 1) the separate Teams identify the next set of stocks for application of the stock structure template, to be completed by the September 2013 meeting; 2) metrics be developed (perhaps by a yet-to-be-established Plan Team working group) to help decide when to lump or split areal ABCs and OFLs; and 3) stock structure concerns and management implications (e.g., effects of splitting on discards) be included in these metrics.

Because there may be difficulty with interpretation of areal overages without the context of areal biomass, the Plan Teams also recommend that a detailed discussion of this subject occur next September and that, in the interim, biomass be included as part of the next set of stock structure analyses, similar to what Paul Spencer provided this year for RE/BS and northern rockfish.

Sablefish update

Dana Hanselman gave a 2012 longline survey update. The sablefish recruitment pulse observed in 2010 and 2011 continued in 2012, but the catch rates of larger fish are down for some reason in 2012. This same pattern holds for female and males, but is less pronounced in males. The preliminary 2012 RPNs for CGOA, EY/SE, WY, and WGOA were all down from 2011, while the AI RPN was up from 2010. RE/BS rockfish RPNs were all down with the exception of WY. In general, the deep non-sablefish species RPNs were all down.

Dana gave an update on the ABL tagging program and sablefish movement model. The movement model included sablefish from SE Alaska ADFG state waters (Clarence and Chatham). Tag recoveries occur throughout the northeast Pacific Ocean and southeastern Bering Sea and some occur off the West Coast.

There was a strong relationship between mean distance moved and lat/long of initial tag location (more distance moved for fish initially tagged farther west). Archival tag records indicate that, in December-March, fish often are deeper, which is probably related to spawning; whereas they are shallower in July-August. In addition, some fish show a deep-night, shallow-day depth pattern.

Absolute annual movement rate probabilities have increased between the earlier movement study (Heifetz and Fujioka 1991) and the updated study. Small/medium fish move east more frequently than previously observed. WGOA fish have the highest annual probability of moving, while Chatham/Clarence fish have the lowest. The original paradigm of counter-clockwise movement with ageism more ambiguous than originally thought with the addition of new data.

Authors are trying to get a better handle on depredation and effects on survey estimates. They want a global model to account for whale depredation if possible, which is challenging for computational reasons.

Killer whales are mainly an issue out west. It is obvious when killer whales have depredated longline gear because all the fish are removed from the line. Winbugs (software for doing Bayesian models) was chosen for the modeling exercise rather than R because R was difficult to run the model with. For sperm whales, depredation effect is subtle but estimable. The question is how should we use the estimates (e.g., inflate survey estimates by a scalar)? For killer whales, we can estimate the effect, but should we add this effect to the survey estimates? Depredation location may be non-random. Should those stations with killer whale depredation just continue to be thrown out?

Other updates: For the November stock assessment, authors may use a new age error matrix. For 2013, the authors plan to examine new survey and fisheries indices, juvenile sablefish diets, apportionment, MSY, and MEY. A CIE review is anticipated in 2014.

Observer program restructuring

Craig Faunce (NMFS/AFSC/FMA) presented a draft methods document detailing the 2013 Annual Deployment Plan (ADP). This ADP was created from the advice and input provided by an Observer Restructure Analysis Group. Only a draft is available at this time because cost estimates for an observer day and electronic monitoring are not yet available but are expected by the end of September. Craig provided a schematic of the hierarchy of the observer sampling design.

The lowest level is TISSUES (age, length, maturity). The next level is INDIVIDUAL SPECIMEN from which the tissues are taken. Next level is HAULS from which specimens are taken. Next level up is TRIPS and highest level is SECTOR/FISHERY. Observer restructure only affects the top two levels, which are TRIPS and SECTOR/FISHERY.

In 2010, the Council designated two classes of vessels that fall within the restructured observer program: 1) catcher-processors (CP) and motherships (M), which will be under a pay-as-you-go funding program and will have complete coverage of trips; and 2) catcher vessels (CV), which will be assessed a landings tax of 1.25% (to fund future years) and will have partial coverage of trips at a rate based on available funds (the first year of the program is paid for by Federal funds).

Two CV partial coverage deployment methods are included:

1) A vessel selection stratum for vessels 0-57.5' LOA. All trips in a quarter will be observed for selected vessels in this stratum. Vessels <40' in this stratum have no probability of being selected in 2013.

2) A trip selection stratum for vessels>57.5' LOA. Each trip will be logged into an Observer Declare and Deploy System (ODDS) and is given a probability of being selected for an observer.

3) The number of estimation strata changes from three to four under the restructure. From 1990-2012 the 3 categories were:

1. Zero
2. Partial
3. Full coverage

For 2013 and forward the categories are:

1. Zero
2. Partial (trip-selection)
3. Partial (vessel-selection)
4. Full Coverage

The above pertains to at-sea deployment. Currently, AFA pollock offloads carry a 100% observer coverage requirement that is funded from industry, and this observer requirement and payment method will not change in the restructured program. In comparison, non-AFA deliveries of pollock will be fully monitored (i.e., carry 100% coverage) as well; however, these observers will be paid for with restructure funds. Summary of changes for 2013:

- All CP vessels become fully observed regardless of size. (Two minor exceptions were mentioned.)
- In the CV sector, the deployment of observers is randomized and at-sea deployment will be based on trip units and vessel units--not on days or pots per quarter.
- Dockside deployments will be used to monitor salmon bycatch (2013) and will not be based on metric tons processed.

Evaluation analyses were conducted. First, how much coverage can be afforded in the CV fleet? Analysts simulated total program costs (with many realizations) using 2011 as the base year of effort, and calculate the rate that resulted in 90% of the simulated values being less than or equal to the program funds (=$4.2M). The methodology was established and documented in the ADP.

Second, how would coverage be distributed within the 2013 CV fleet? This was determined by simulating at-sea deployment for the 2011 year using two rates: 1) the rate that actually occurred, and 2) the rate that would be expected under the ADP. An example chart (heat map) illustrating actual 2011 trips observed by FMP/Gear/Target/Week was presented. Heat maps and histograms depicting magnitude of differences among weeks will be in the final ADP.

The third analysis examined changes to the number of lengths and specimens collected. These were determined using existing biological specimen collection rates (FMP/Target) projected onto simulated observed trips from the second evaluation analysis. This was done for length measurements, age structures, maturity stages, and stomachs from CP/M, CV, and dockside samples for each species. It was noted that the numbers of lengths and tissues expected from dockside sources were set equal to those collected from all non-AFA pollock offloads in 2011 (since AFA offloads would be paid for by industry).

Fourth, what is the cost of dockside deployment? The number of observers per day needed will be determined and translated into costs using contract pay rates.

Finally, what are the differences between what actually occurred in 2011 and what would have occurred under the restructured program, with respect to number of vessels, number of trip days, and total catch?

Electronic monitoring (EM) is to be incorporated into the 2013 ADP. Camera systems will be used to monitor compliance with the full retention requirement for demersal shelf rockfish within the IFQ hook-and-line fleet out of selected SE Alaska ports during the halibut and sablefish season.

Expectations for ADP vs. status quo:

Final evaluation analyses are pending, but it is expected that observer coverage under a randomized deployment will be more representative of the fleet because:

- Decreased ability and incentive to introduce bias (observer effect)
- Distribution of observed trips should be proportional to fishing effort

Craig asked the Plan Teams to consider how to improve this ADP. For example:

In preparation of the 2013 ADP, 2011 was used as a proxy for effort expected in 2013 (this in turn determines costs). For 2014 ADP they would like to improve on this assumption. They considered using 1) an average of prior years, 2) predicting future year based on trend in past years, and 3) a model that incorporates other factors (e.g., TAC). The Plan Teams' suggestion was to use a model to predict future effort, with some members suggesting that interannual variability in effort be evaluated. The Plan Teams did not have additional advice or criticism relative to the ADP.

NMML report

Lowell Fritz (NMML) gave an update on the western Distinct Population Segment (DPS) of Steller sea lions in Alaska. In 2012, only the Western Aleutians were surveyed due to bad weather. As a result, an update on overall trend in the western DPS is not available. However, it is possible to update regional trends within the western DPS.

Aleutian Islands trends: Steller sea lion populations in all areas west of 177°W in the Aleutian Islands are declining. The Western AI continued declining for both pups (-10% per year) and non-pups (-7% per year); Buldir no longer functions as a rookery and Cape Wrangell on Attu likely will not produce any pups within the next 5 years. No data were collected for Kiska through Amchitka in 2012; pups and non-pups declined through 2009, but this area had less steep declines since 1990 than in Western AI. The Delarof Islands continued to show a decline in both pups (-4% per year) and non-pups (-2% per year), but this area is declining at slower rates than the Kiska-Amchitka area.

Lowell gave an overview of planned 2012-13 NMML SSL research:

- Oct. 2012 – Foraging ecology and condition studies. Capture and tag adult females in the Central and Western Aleutians.
- June-July 2013 – Population trend studies with aerial surveys. Use manned aircraft to survey pups and non-pups in southeast Alaska through Eastern Aleutians. Attempt use of an unmanned aircraft to survey pups and non-pups in the Central and Western Aleutians. Summarize the 2008-2012 surveys with a NOAA Technical Memorandum report. Conduct vital rate studies with pup branding and resighting efforts. Vital rate studies to be conducted at field camps at Marmot and Ugamak Islands. Two planned cruises in the Aleutians and Gulf of Alaska. Pup branding will take place in the Aleutians. Complete paper summarizing survival rates through age 11 in the Eastern Aleutians through the Eastern Gulf of Alaska. Condition studies will be conducted on pups at rookeries.
- Oct. 2013- Foraging ecology and condition studies. Capture and tag adult females in the Central and Western Aleutians.

Lowell also responded to several "SSL Myths:"

"Killer whale predation is impeding recovery." NMML studies and examination of survival data show juvenile and young adult survival has rebounded. Steller sea lions are increasing fastest in regions with the most transient killer whales (Eastern Aleutian Islands and Southeast Alaska).

"Steller sea lions are near-shore foragers." This "myth" stemmed from studies based solely on foraging distributions of juveniles, the majority of which were not weaned and therefore limited in foraging distances. Other data show that adult females regularly forage outside of critical habitat (>20nm from haulout).

"Steller sea lions are shallow divers." This misperception stems from a bias related to definition and location of dives. Data show dives were shallower off shelf and deeper on shelf. Steller sea lions regularly dive to depths >100 m.

"Steller sea lions only eat small, young fish." This bias is related to the use of scats to describe diet. Big fish are under-represented in hard part remains in scats. Large bones and other hard parts are not passed and often regurgitated. In June 2012, a stranded recently deceased juvenile sea lion on Agattu Island was found. Its stomach contained two 1+ m cod and five 40+ cm Atka mackerel. Steller sea lions in the eastern DPS routinely feed on spawning sturgeon in the lower Columbia River.

"Juvenile Steller sea lions cannot survive on a gadid-rich diet (regime shift-"junk" food hypothesis)." A study was conducted on 15 free-ranging juveniles (1 to 2 yrs old), which were held captive for 54 days. 7 sea lions were fed a diet of 100% pollock, and 8 were fed a mixed diet of non-gadid fish and cephalopods (averaged 92% herring). All animals increased mass on both diets. The pollock diet group showed a significant increase in mean body fat (8.2%; $p=0.023$). There was no significant difference in mass change between diet types ($p=0.287$). There were no negative consequences noted in blood chemistry or body condition in sea lions consuming only pollock. The authors (Atkinson et al., in prep.) conjectured that negative health effects outlined in previous studies were artifacts of the permanent captivity of the test sea lions. Lowell emphasized that there is no "junk" food. Prey species with low energy density are just as healthy for sea lions as those with high energy density.

FOCI program report

Jeff Napp presented information for a number of projects which the Fisheries and Oceanography Coordinated Investigations (FOCI) group (RACE and PMEL) is conducting, many in collaboration with the Ecosystem Modeling and Assessment (EMA) group at Auke Bay. FOCI is an observation-based program collecting data through vessel surveys and moorings in the Gulf of Alaska, Bering Sea, and Chukchi Sea. FOCI projects follow cohorts of fish and shellfish through the end of their first year and attempt to understand the physical and biological mechanisms affecting the early life history stages and how environmental influences change the key stages.

A study in the Bering Sea described how pollock recruitment increases as their total energy before their first winter increases. Franz Mueter has hypothesized that there is an optimum environmental temperature for pollock recruitment which is not too warm or too cold. A study in the Gulf of Alaska is examining whether there are sufficient surveys and in the correct areas to predict recruitment. FOCI and EMA's survey schedule is changing to an alternating schedule switching between the Bering Sea and Gulf of Alaska. Other FOCI projects include studying rock sole in the Bering Sea, examining whether species with similar life histories respond similarly to environmental forcing, and studying the larval transport of snow crab. A study in the Bering Sea has found that biomass of large crustacean zooplankton changes significantly between warm and cold years. FOCI researchers are working on back-calculating the spawning stock size from the number of larvae. Finally, FOCI researchers have found that the addition of environmental data to simple models does improve recruitment predictions.

Anne Hollowed mentioned that PMEL atmospheric scientists have created models for short-term climate predictions on the WA coast and queried whether it is possible to create similar models for the Bering Sea to predict warm/cold years. A question was also raised about whether forage models could be used to predict how much food is available for pollock in the short term. Exercising models may improve understanding of why some cold years are bad and some are good. Jeff queried the Plan Team about what kind of process-related research is needed to assist in understanding variation in fish abundance.

Ecosystem chapter

Stephani Zador presented the compilations to date and highlights of the draft Ecosystems Considerations chapter of the SAFE Report for 2013. She informed the Teams that EBS and AI Report Cards and assessments will be presented in November. Development of a GOA report card and assessment was postponed until 2013 due to staff loss.

There is a new Arctic Ecosystem (AE) preliminary assessment in this version of the document. Stephani explained that, rather than a full assessment, this preliminary assessment represents an ecosystem overview that should provide the basis for future indicator-based ecosystem assessments for the Arctic. It was decided that this AE assessment should include the Northern Bering Sea (NBS), since biological and oceanographic differences support this breakout from surrounding waters. The southern boundary of the NBS was based on traditional boundaries of the groundfish surveys. The document lists potential indices related to climate, sea ice, and primary production. *Of special note is the historical low for Arctic sea ice just reached in 2012.* Also of note is decreased abundance in the lower trophic levels in 2011, particularly in the GOA.

The North Pacific Climate Overview: 2011-12 reflected a combination of responses to La Niña and intrinsic variability. The eastern North Pacific (NP) showed cooler than normal upper ocean temperatures, and ENSO forecasts indicate a near-neutral or weak-to-moderate cooling El Niño state. There was suppressed storminess in winter, a typical La Niña in spring with a cold and wet Pacific northwest, and typical weak winds in summer.

Climate indices indicate a La Niña during 4 of the last 5 years. The NP gyre oscillation (NPGO) relates to the GOA and CalCOFI area; a positive trend in the recent four-year period indicates strong flows in AK and CA currents. Future projections of SST in the coupled atmosphere-ocean forecast system indicates a development then waning of a weak El Niño. SST projections and other climate patterns indicate a likely warming of AK waters in the next 2-3 seasons.

Eddies in the GOA were very low in 2009, which resulted in phytoplankton biomass confined to the shelf, and little cross-shelf transport. There was high activity in the SW Kodiak area in 2010 and 2012, compared to an average eddy kinetic energy in 2012 in the northern GOA area.

In the Aleutian Islands, eddy kinetic energy was low from spring 2010 to early 2012. A strong eddy developed in April resulting in higher than average energy through Amutka Pass during the summer of 2012.

The 2011/2012 simulated ocean drifter (starting at Ocean Station Papa—50°N, 145°W) moved in a typical NE direction. However, the trajectory resulted in the northernmost endpoint and largest inter-annual change (in latitude of the endpoint) since 1994. This indicates a return of surface drift conditions similar to those that existed prior to the 1977 regime shift (since mid-2000 there had been a southerly flow, following 20+ previous years of northerly flow).

Habitat: The area disturbed by trawl gear increased in 2011 following declines in 2008-2010. The cause of the increase is currently unknown.

New item: Trends in surface carbon uptake by phytoplankton during the late summer and early fall in the EBS are included in this version of the assessment because uptake is related to energy flow to higher trophic levels. Uptake in 2011 was similar to 2006-2010, with the exception of 2007, which had very low uptake by comparison.

Long-term zooplankton trends in Icy Strait, SE AK. Negative anomalies during 1997-2005 switched to positive during 2006-2009, followed by rapid annual reversals in direction. The authors point out that, except for 2010, values were dominated by calanoid copepods.

Continuous plankton recorder data from the NE Pacific suggest that biomass on the Alaskan shelf and southern Bering Sea was low in 2011, but plankton were of average size, thus indicating no shift in zooplankton community composition, just lower densities. In British Columbia, densities were average in 2011 compared to a record minimum in 2010.

Jellyfish biomass in the EBS has receded from a large spike in 2010. However, for the first time, biomass was higher in the north than the south.

Forage fish and pink shrimp CPUE in the GOA remains below average. Eulachon density was also down in 2011, following several large positive anomalies in recent years.

Alaska Salmon trends- ADFG is forecasting a continued decrease in commercial catch due to fewer pinks. Marine survival in 2010 from Prince William Sound hatchery fish was highest since 1977. Survival was apparently not influenced by the 1988/89 or 1998/99 regime shifts. The forecast of SEAK pink salmon in 2012 is 18.8 M. The 2011 juvenile CPUE in SEAK is the second lowest on record.

New item: GOA ichthyoplankton abundance- Annual sampling is now biennial. Cod, pollock, and northern rock sole show a high degree of synchrony during 1990s and 1995+ years. This is evidence of similar responses to environment among species with similar early life histories and environmental exposure.

EBS pollock recruitment- The average energy content of YOY pollock during fall 2003-2010 accounted for nearly 80% of the variation in the number of age-1 recruits per spawner. Pre- and post-winter temperature change index predictions of age-3 pollock point to a below-average 2012 year class, an above-average 2013 year class, and a below-average 2014 year class.

New item: Spatial variability in crab catches- From historical catch data during 1960s-2000s there were 12 stocks that had collapsed and all of them had increasing variability compared to two stocks in the opposite condition that exhibited no or decreasing variability. Spatial variability in catches seems to be related to collapse risk. Of 5 current crab fisheries investigated, only Kodiak Tanner crab shows a significantly increase in variability. However, this is likely due to an expansion of the fishery into low-catch areas.

ADF&G GOA trawl survey- There has been a decrease in the overall biomass with no change in the dominant species composition. In 2011 there were positive anomalies for skates, tanner crabs and cod compared to negative anomalies for arrowtooth flounder and flathead sole.

Time trends in groundfish discards continue downward since the early 1990s in the EBS, since 2002 in the AI, and since 2009 in the GOA (interpreted as due to improved IR/IU regulations).

Trends in non-target catch have been downward since the 1990s in the EBS. The spike in eulachon seen during 2006-2007 was not present in recent years. Minimal trends were evident in the AI. In the GOA no spikes in non-target catch have been observed in the most recent three years.

Fish Stock Sustainability Index- No groundfish stocks are overfished or subject to overfishing. The time series of FSSI scores shows a peak in 2010 with declines in 2011 and 2012. Pribilof Island blue king crab and BSAI Tanner crab are overfished while the BS snow crab is considered rebuilt.

Groundfish fleet composition- The number of vessels in the fleet increased in 2011 which halted the decline experienced during 1994-2007. Trawl and pot vessels have remained largely unchanged since 2004. The increase in 2011 was due to new jig vessels targeting Pacific cod.

Change in procedure for Plan Team meetings- Stephani discussed how best to present this information to the Plan Teams in November. It was proposed that shorter presentations be made to each Plan Team separately in November instead of a joint presentation so that each Plan Team hears only relevant information specific to each region. There would still be a joint presentation in September. For reference, in November there are a lot of updates and the sum of the assessments is used to produce the total picture of the stocks. Oceanographic information would be presented to both Plan Teams at the November meeting. Decisions as to what gets presented to each Plan Team will be up to the presenters. This approach adds work for the ecosystem presenters, but instead of an hour in joint session, two half hour presentations will be made. After discussion, the Plan Teams decided to adopt this plan.

Integrated ecosystem assessments (IEAs)- Kerim Aydin presented an overview. IEAs are a nationwide program to develop processes for bringing ecosystem-based fishery management into overall marine ecosystem management, not just fisheries. It is run at the HQ level. IEA as a framework will encompass what has been done in AK for some time, including ecosystem indicators, specific goals, risk analysis, ecosystem status, and management strategy evaluations. Alaska's funding for this work is limited. The funded work will maintain modeling capabilities and field/model links, extracting and processing climate data and models, and travel. Contacts are Kerim Aydin, Phyllis Stabeno, and Mike Sigler.

CIE flatfish review

General

Tom Wilderbuer summarized a 2012 CIE review of selected flatfish stock assessments (GOA Dover sole, GOA rex sole, GOA northern and southern rock sole, and BSAI yellowfin sole), which was requested by the AFSC. The CIE review was held at the AFSC Seattle lab, 11-13 June 2012. The CIE reviewers were: Dr. Yan Jiao, Department of Fisheries and Wildlife Science, Virginia Tech, Blacksburg, VA, 24061-0321; Dr. Sven Kupschus, Centre for Fisheries and Aquaculture Science, Lowestoft Laboratory, Pakefield Road, Lowestoft Suffolk NR33 0HT UK; and Dr. Kevin Stokes (via webex only), 59 Jubilee Rd, Khandallah, Wellington 6035 NZ.

Overall, the CIE reviewers noted that, except for BSAI yellowfin sole, the time series of data were short and the stocks have not been heavily exploited. This leads to a lack of contrast in either spawning biomass or fishing mortality (F), making it difficult to scale the management quantities or reference points accurately. The difficulty of determining fishery selectivity accurately when there is relatively little variation in year-class strength and high ageing error suggests that uncertainty in fishery selectivity and F reference points are likely to remain high as long as the time-series remains relatively short.

The terms of reference (TOR) were laid out as questions that the authors designed for each species. Reviewers responded individually for each term, which made the reviews difficult to consolidate. The following are some of the reviewers' comments in response to the TOR.

GOA Dover sole

The GOA Dover sole TOR asked the CIE Reviewers to evaluate the current model assumptions and make recommendations for improvement, including: 1. age data – use of age composition data, appropriateness of age range and binning, estimation of the size-at-age relationship and variability (external vs. internal to model), and inclusion of ageing error; 2. size data – use of survey size composition data, and use of fishery size composition data; 3. the number and functional forms of estimated selectivity curves – fitting different selectivity functions to data from different survey years based on survey depth coverage, types of selectivity curves considered, use of age-based vs. size-based selectivity curves, allowing for annual variability in fishery selectivity, and use of size-based selectivity curves for survey data based on trawl net catchability experiments; 4. fixing (and updating) the natural mortality rate based on Hoenig, 1983; and 5. model convergence diagnostics.

The reviewers considered the Dover sole assessment to be preliminary and thought more model scenarios should be explored in the future before it could be used for providing management reference points for the following reasons: 1) The fundamental building blocks to enable reliable use of integrated statistical catch-age models seemed to be lacking. 2) There was a lack of reliable fishery size and age sampling and exploitation rates high enough to create signals in the data that can be interpreted in the context of natural variability and sampling errors. 3) This assessment suffers from a relatively short time series with little contrast in F and only slight indication of interannual cohort variation.

GOA rex sole

The GOA rex sole TOR requested that the CIE reviewers evaluate and recommend improvements for the current approach to determining stock status and future harvest reference points (ABC and OFL). The reviewers thought estimation uncertainty of the fishery selectivity parameters needs to be validated through simulation studies or data cloning (Lele et al. 2007, Lele 2010). Furthermore, given the many model/data uncertainties, one reviewer advised providing information on the basis of Tier 5, but unlike the assessment team's consensus view, not base the estimate of spawning biomass on the assessment, but rather on the survey or a form of survey-only analysis. Another reviewer found the notion of using the biomass estimate from the assessment, but not the F/selectivity information, problematic. Separating the uncertainty in the biomass trends from the uncertainty in the F trends within an age-structured assessment would be much more tenuous than is suggested by the MCMC marginal posterior distribution figure shown in the assessment. To quote one reviewer: "Given the difficulty of estimating $F_{35\%}$ and $F_{40\%}$, it would be natural to place rex sole in Tier 5 category on the basis that the assessment cannot provide a reliable estimate of these reference points. Note that the assessment, with such high weight placed on the survey, is effectively just a complicated smoother of the survey series; using the assessment-derived B (and $B_{40\%}$) point estimates would be little different to using the survey data directly and transparently."

GOA northern and southern rock sole

The GOA northern and southern rock sole TOR asked the reviewers to consider:

1. Evaluation, findings, and recommendations of the analytical approach (application of a statistical ADMB integrated catch-age model) used to assess stock status and estimation/presentation of uncertainty;
2. Evaluation, findings, and recommendations on quality of input data and methods used to process them for inclusion in the assessment (specifically fishery and survey data); and
3. Recommendations for further assessment improvements for management in both the long and short term.

In response to the GOA rock sole TOR, one reviewer thought that the two-species, sex-specific statistical model is valuable, but that the model exploration was very preliminary and further effort was needed on model development, comparison, and selection. Simulation studies were recommended to evaluate the robustness of the model, effect of age composition sample sizes, and selection of selectivity curves. Furthermore, one reviewer stated that the GOA northern and southern rock complex was the most complex to assess. It suffers from the same difficulties as the rex and Dover sole assessments of low data contrast, short time series, and the need to deal with variation in survey coverage, but additionally has to deal with the problem of two species which have only been separated since 1996. Additionally, parameter estimates are either hitting bounds or there is little or no information to estimate them, with the result that the model more or less comes up with the same answers irrespective of the sometimes substantial changes to its configuration. The suggestion was made to start with a much simpler model, then add different options as a more efficient approach in building a model. The reviewer said that as it stands, he found it difficult to support the model's current implementation. The summary was that it would make good modeling sense to consider simpler formulations of the model(s) before moving to the more complicated one used.

BSAI yellowfin sole

The reviewers were asked to address the following BSAI yellowfin sole TOR:

1. Evaluation of the analytical approach (application of a statistical ADMB integrated catch-age model) and model assumptions used to assess stock status and stock productivity;
2. Evaluation of the implications of using the Northern Bering Sea research results as an index of abundance if yellowfin sole increasingly occupy this area with changing climate; and
3. Determination of whether the assessment represents the best available science for the stock assessment of BSAI yellowfin sole, including considerations of fishery rationalization on timing and selectivity of fishery.

The assessment of BSAI yellowfin sole was considered to represent the best scientific information available for the stock assessment of this species although improvements or adjustments in model structure development are possible. The suggested improvements were: 1) to compare the performance of constant Q and temperature-dependent Q with other functional forms, and 2) to explore whether fishery selectivity needs to be time varying, since it accounts for 66% of the model parameters. A further computer-intensive simulation study could be conducted to evaluate whether surveys with and without the Northern Bering Sea area would result in the same abundance index after standardization. One reviewer noted that temperature-dependent Q is modeled as an exponential multiplier on Q, whereas the true form must inevitably be more complex. Moreover, Q is applied to all ages including those not taking part in the spawning migration, which is a substantial part of the survey biomass. The temperature dependence parameter ends up being a catch-all for residuals, reducing the information available to the assessment. The yellowfin sole assessment estimates the stock-recruit relationship internally and uses it to estimate a pdf of F_{MSY} and other quantities for use in Tier 1 management. While the reviewer commented that, on the surface, this is good, the way data are split on the basis of a known, but unexplained or "undocumented" regime shift is a concern. There are some minor discrepancies in the dates described at various places but the major concern must be the influence due to just a few estimated recruitment values in 1977-1980. The reviewer went on to question whether the currently accepted stock-recruitment curve is reliable.

Research priorities

Diana Stram provided an overview of progress toward revising the research priorities process following an SSC request in June 2012. The SSC specifically requested: 1) a more orderly process of submitting and prioritizing proposals for research priorities, and 2) a process of evaluating and organizing the list of proposed research priorities using an Excel file or relational database. A sub-group of SSC, PT, and Council staff met over the summer to begin to address these requests. Council staff and AKFIN staff developed a database to house the research priorities and better organize information related to each priority. Under the proposed process, the Plan Teams will break into assigned workgroups to provide revisions by category over the next several months. Assignments for workgroups and additional information on the developing database and report structure will be provided by Diana to the joint Teams following SSC review in October. The workgroups will meet independently to revise research priorities and submit their recommendations to the joint teams by mid-January. A teleconference will be scheduled for Plan Team review and final recommendations on the research priorities, to accommodate review of these by the SSC in February.

Minutes of the
Bering Sea Aleutian Islands Groundfish Plan Team

North Pacific Fishery Management Council
605 W 4th Avenue, Suite 306
Anchorage, AK 99501
September 14-15, 2012

Mike Sigler	AFSC (Co-chair)	Grant Thompson	AFSC REFM (Co-chair)
Jane DiCosimo	NPFMC (Coordinator)	Lowell Fritz	AFSC NMML
Kerim Aydin	AFSC REFM	Alan Haynie	AFSC REFM
David Carlile	ADF&G	Dana Hanselman	AFSC ABL
Brenda Norcross	UAF	Mary Furuness	NMFS AKRO
David Barnard	ADF&G	Nancy Friday	AFSC NMML
Leslie Slater*	USFWS	Vacant	WDFW
*absent		Bill Clark	IPHC

The BSAI Groundfish Plan Team convened on Thursday, September 14, 2012, at 1:45 pm.

Bottom trawl survey CIE review

Dave Somerton presented a summary of the recent Committee of Independent Experts (CIE) review of AFSC bottom trawl surveys. Dave stated that the approach was to explain how the surveys provide information for use in stock assessment models and then ask the reviewers to evaluate their success. The general evaluation by the CIE was that the biomass estimates are reasonable with low CVs except for Pribilof blue king crabs. Some of the CIE Panel's recommendations and AFSC responses are summarized below:

1) CIE recommendation: Reduce tow duration from 30 to 15 minutes to free time for more tows and reduce splitting and subsampling of large catches. Response: AFSC survey scientists have found that this change would not increase the number of tows per day, would increase variance of biomass estimates and may affect catchability of some species, in particular crab species.

2) CIE recommendation: Reduce the number of lengths collected. Response: This will be considered.

3) CIE recommendation: Change the fixed station survey design. The survey scientists could randomize the position of the first station to allow potential bias and variance estimation. Response: For some species of crab (the concentration of snow crab at station K-24) this is a challenge.

4) CIE recommendation: Re-examine the utility of high-density strata (e.g., around Pribilof Islands), hot-spot sampling (sample a few locations nearby high crab CPUE stations) and cold-year re-sampling. Response: The survey scientists have dropped the hot-spot sampling, and are considering the other two recommendations.

5) CIE recommendation: Use a model-based biomass estimator (e.g., GAM) to incorporate factors affecting catchability in place of the within-assessment-model approach currently taken for some

stocks. This approach typically is taken in ICES surveys because multiple vessels are used to complete these surveys.

6) CIE recommendation: Combine acoustic and bottom trawl estimates of pollock biomass. Response: The survey scientists continue to recommend not combining these estimates by adding them up and instead recommend staying with the current practice of incorporating the estimates independently in the stock assessment model. Stan Kotwicki is studying methods to combine these indices and understand fish behavior relative to the bottom trawl and acoustic survey methods.

Eastern Bering Sea shelf bottom trawl survey

Bob Lauth presented results of the 2012 eastern Bering Sea shelf trawl survey. Bottom trawl survey groups were involved in four major surveys this year in the eastern Bering Sea shelf, eastern Bering Sea slope, Aleutian Islands, and eastern Chukchi Sea. This shelf survey marked the seventh year of simultaneous acoustic measurements for pollock. The average surface and bottom temperatures were below average. Compared to last year, pollock biomass increased slightly, Pacific cod biomass was similar, and yellowfin sole dropped somewhat.

Bob also described a Pacific cod catchability study conducted this year. The study purpose was to measure the vertical distribution of Pacific cod and help understand the validity of estimates from archival tag data compiled by Dan Nichol. The latter estimate implies that the high-opening poly-Nor'Eastern net should catch about twice as much Pacific cod as the low-opening 83-112 net. Fifteen paired tows were conducted and six tows examined by DIDSON. The preliminary analysis found similar catches between the two nets and the DIDSON results indicate little diving within the DIDSON range of about 50 meters. Bob stressed that these results are preliminary.

Aleutian Islands bottom trawl survey

Wayne Palsson presented information on the Aleutian Islands trawl survey methodology. In 2012 the survey covered depths to 500 m, using 15 minute tows, a stratified random design, and two chartered fishing vessels. The Aleutian Islands are rocky and many areas are untrawlable and not surveyed. About 400 stations were sampled. Rockfish and Atka mackerel are the dominant species. Survey results will be available to authors in mid-September.

EBS pollock survey and assessment

This presentation was provided in two parts: the acoustic-trawl pollock survey and research combining acoustic data with bottom trawl surveys.

Taina Honkalehto presented results of the 2012 acoustic-trawl survey of the eastern Bering Sea shelf. The survey was conducted primarily during June and July. The survey included the Navarin area of Russia. Survey transects are oriented north-south and measurements with 5 acoustic frequencies are collected continuously. Pollock and euphausiid abundance estimates are derived from the survey data. Most pollock greater than 40 cm in length were found east of 170 degrees west longitude. Few age-1 pollock were found this year. The total U.S. waters estimate of pollock biomass dropped somewhat from the last survey estimate in 2010. The midwater pollock population was dominated by 23 cm, 30 cm (likely ages 2, 3) and 38 cm fish (likely age 4). The proportion of the shelf stock in the Navarin area was very high this year--23% of the eastern Bering Sea shelf total.

Taina also reported the results of the March 2012 acoustic-trawl survey of the Bogoslof Island area. Some transects were repeated and extended to check for concentrations of deepwater pollock (very little was found). The biomass estimate was 67,000 tons.

Lastly, Taina reported on results of experiments conducted by the acoustics group, including the acoustic vessel of opportunity index, the euphausiid index, the 83-112 net deployed in midwater, and acoustic sampling during southern and northern Bering Sea (BASIS) and Chukchi Sea surveys.

Stan Kotwicki reported on a new model-based estimate of the index of abundance that corrects for density-dependence of the bottom trawl survey. Survey bottom trawl efficiency decreases with increasing stock size. This method combines synchronously collected acoustic and bottom trawl data to estimate bottom trawl efficiency parameters. These parameters are then used to correct the bottom trawl abundance index. The results imply that the presently used abundance index is hyperstable and could lead to overestimation of spawning stock biomass in years of low abundance. The new index differs from the old index in the magnitude of abundance as well as the age structure of the surveyed population. The effect of the new model-based estimates on the assessment model's estimates of spawning stock biomass is anticipated to be on the order of 5%. Jim Ianelli noted that Stan's work had been tested within the assessment model and is being considered as a refinement to the bottom trawl survey index. The Team was encouraged by this work. **The Team recommends development of more complete documentation prior to accepting the model-based abundance indices as integral to the EBS pollock assessment.**

Disproportionate exploitation and genetic diversity

Ingrid Spies reported on simulations of a managed "stock" that in actuality consists of two biological stocks, as may well be the case for Pacific cod in the EBS and AI. In the simulations, the stocks have low rates of mixing and mutation, and the smaller stock (20,000 individuals) is subjected to much higher fishing mortality than the larger stock (80,000 individuals). In this situation, the smaller stock experiences a substantial loss of genetic diversity that is not recovered even if fishing mortality is reduced. The genetic diversity of the larger stock is hardly affected, even though it does sustain substantial fishing mortality. It was brought out in discussion that these effects are very unlikely in the case of BS/AI Pacific cod, where the population numbers are orders of magnitude larger and the exploitation rates, while different, are less different than those assumed in the simulation.

EBS Pacific cod

The model chosen for specifications in 2011 (then called Model 3b) had the following features:

- M = 0.34 (as before).
- Length-specific commercial selectivities for all fisheries, some forced to be asymptotic, estimated for blocks of years (as before).
- Age-specific survey selectivity with annually varying left limb (as before).
- Survey catchability fixed (as before) at the value obtained in the 2009 assessment (0.77), where it resulted in the product of catchability and selectivity at 60-80 cm equal (on average) to the desired value of 0.47 in the EBS. The desired value was based on a small number (11) of archival tags.
- A single growth schedule for all years (as before).
- Intercept and slope of age reading bias estimated internally (previously estimated manually as +0.4 y for all ages).
- Standard deviation of length at age estimated internally (previously external).
- Mean length at age data left out of the fit (previously in).
- All length composition data included in fit (previously only length composition data in cells lacking age composition data).

This model became the new base model, designated Model 1. In response to Team, SSC, and public comments received at meetings in November/December last year and May/June this year, the author developed a number of other models for consideration at this year's September/October meetings. Grant Thompson described the suite of models, listed below (from the assessment document):

Model	Description
1	Last year's accepted model (same as last year's Model 3b)
1.1	Same as Model 1, except survey catchability estimated internally
1.2	Same as Model 1, except ageing bias parameters fixed at GOA values
1.3	Same as Model 1, except with revised weight-length representation
2	Same as Model 1, except survey catchability re-tuned to match Nichol et al. (2007)
3	Same as Model 1, except new fishery selectivity period beginning in 2008
4	Same as Model 1, except no age data used (same as last year's Model 4)
Pre5.1	Same as Model 1.3, except for three minor changes to the data file
Pre5.2	Same as Model Pre5.1, except ages 1-10 in the initial vector estimated individually
Pre5.3	Same as Model Pre5.2, except Richards growth curve used
Pre5.4	Same as Model Pre5.3, except for recruitment *devs* estimated internally as a free parameter
Pre5.5	Same as Model Pre5.4, except survey selectivity modeled as a function of length
Pre5.6	Same as Model Pre5.5, except fisheries defined by season only (not season-and-gear)
5	Same as Model Pre5.6, except four quantities estimated iteratively

Models 1.1-1.3 were sensitivity tests of the base model to the features listed. Models 1.2 and 1.3 produced estimates very close to Model 1. Model 1.1 estimated survey catchability to be much higher than the tuned value (1.04 vs. 0.77) and therefore produced much lower estimates of abundance. Models 2-4 were requested by the Team and SSC.

Model 5 is a reworking of the "author's preferred model" that Grant presented a year ago (then called Model A). Last year, Model A differed from the base model in many respects and the Team had balked at making so many large changes, some of them not fully investigated. In response to those concerns, Grant had greatly simplified the model and brought it forward as Model 5. As presented, it differed from Model 1 in the following major ways

(i) All fisheries are combined into five seasons each year, with no separation of gears. (In Model 1 gear types are modeled separately.)

(ii) Fishery selectivity varies by season (as in Model 1) but not by year (vs. varying by time block in Model 1). One of the five seasons is forced to have asymptotic selectivity (vs. several gear/season fisheries in Model 1).

(iii) The improved length-weight model developed in the assessment document and tested in Model 1.3 was used.

(iv) Initial numbers at age are estimated for 10 ages (vs. 3 in Model 1).

(v) The four-parameter Richards growth equation is fitted (vs. the three-parameter von Bertalanffy in Model 1).

(vi) The log-scale standard deviation of recruitment ("sigma R") is estimated internally (at 0.83) rather than fixed at 0.57 as in Model 1.

(vii) Survey selectivity is estimated as a function of length (like fishery selectivity) rather than age as in Model 1.

To show the effect of the more important differences on the estimates, Grant fitted and reported the transitional Models Pre5.1-Pre5.6.

All of the primary models 1-5 produce very similar estimates of abundance and very similar (not very good) fits to the trawl survey abundance estimates. Grant stated that the persistently controversial features of this assessment were the mismatch between the input and output variances of the age compositions and the poor fits to the trawl survey. He regarded the former as not really serious because the mismatch depended on the assigned input variances, and he regarded the latter as hopeless, unless time-varying catchability is allowed.

Mike Sigler asked about the problems that Grant had encountered when running jitter tests on Model 5. Grant replied that he thought the problem lay with the tests rather than the model.

Bill Clark asked whether it was possible to entirely discount Model 1.1, which showed a higher survey catchability (1.04) and much lower estimated abundance. Grant replied that now, as before, the lower tuned value of survey catchability relied entirely on Nichol's estimate from archival tags. A member of the public questioned whether a trawl survey Q greater than 1 was realistic for cod.

In the assessment document, Grant had posed a number of specific questions about the models to the Team and/or SSC, and after some discussion the team provided the following answers:

1. *In view of the ratio between effective and input sample sizes in the fishery length data, is it necessary to incorporate time-varying selectivity?* Answer: No, we do not think it is necessary, nor would we forbid it.

2. *In Model 5, the Season 3 fishery is forced to be asymptotic, but it is small in terms of catch and length data, and so may not do much to stabilize the fit. Should another procedure be followed?* Answer: We think the present procedure is adequate.

3. *Should the assessment continue to rely on Nichol's value (0.47) for the product of survey selectivity and catchability at 60-80 cm?* Answer: For the time being we favor continuing to tune survey catchability in this fashion in order to limit the variability of abundance estimates. The risk is that by doing so we are overestimating abundance, as shown by Model 1.1. We also heard a report from Bob Lauth on two days of comparative tows with the low-opening EBS and high-opening GOA survey trawls which showed little difference in cod CPUE (although these results are preliminary). We have discussed this issue at length in the past and for now do not see a strong reason to abandon this tuning mechanism, which is extremely valuable for stabilizing the abundance estimates. We do intend to keep the issue under review.

4. *Last year the Team disparaged the practice of setting the penalty standard deviations of dev vectors by assigning them subjectively or estimating them iteratively, as is done in nearly all EBS and GOA assessments. Does the team still hold to this position?* Answer: No. As the author points out, while this is not a strictly correct method of dealing with random effects, it is reasonable and commonplace, and a strictly correct treatment in all assessments would be a large undertaking.

5. *In view of the great difficulty of fitting the trawl survey CPUE with a constant catchability, does the Team still oppose allowing survey catchability to vary over time?* Answer: Discussion revealed a range of views among team members. As was the case last year, some members felt that the survey CPUE should be heavily weighted, implying little or no variability in estimated survey catchability. Others were more sympathetic to the author's view that the data evidently contain substantial process error and that a due respect for the data implies allowing for that when fitting the model.

6. *Where is the breakpoint between acceptable and excessive variability in selectivity estimates?* Answer: The team is unable to give an answer.

7. [Moot question, as the team eventually endorsed Model 5 for inclusion in November.]

Regarding candidate models for November, the Plan Team recommends including Model 1 (because it is the currently accepted model, inclusion of Model 1 should be considered automatic), and also Model 5 because it is very parsimonious and includes a number of features that Grant showed to improve the fit. There was also a lot of interest in a model intermediate between Model 1 and Model 5, such as a version of Model 5 in which the commercial fishery data are still broken out by gear and season, with selectivity parameters estimated by time block. The Team recommends that the author investigate a model like that and bring it forward on his own if it looks worthwhile.

While they are not candidates for the specifications, we think that Models 1.1 and 4 provide a useful check on the candidate models and recommend that they be reported in November (and next September).

Aleutian Islands Pacific cod

Grant Thompson presented a preliminary assessment for Aleutian Islands Pacific cod. In general, the data are more variable and less informative for the Aleutian Islands than for the Bering Sea. Catches there have averaged about 20,000 t per year until dropping the last couple of years. Survey biomass estimates are about 100,000 t.

Grant presented two models. Model 1 was based on last year's eastern Bering Sea model with several simplifications (e.g., one season per year rather than five). In this model, Q is tuned to give a value of 0.92 for the average product of catchability and selectivity across the 60-81 cm range, rather than a value of 0.47, because the trawl survey net used in the Aleutian Islands survey differs from that used in the eastern Bering Sea shelf survey. Model 2 was like Model 1 except that growth was time varying. An analysis of sub-models of Model 2 was completed and Model 2B selected. The time series of estimates of total biomass had the same shape but differed in scale, with Model 1 values reaching a higher maximum than Model 2. In general, trends in time series of other estimates were similar with some differences in scale.

Model 2 implies that the population is close to $B_{40\%}$ whereas Model 1 implies the population is just above $B_{20\%}$. There appears to be some tradeoff in the model between recruitment and growth to explain the observations (the peak recruitments are larger in Model 1).

Model 2 had a much better fit than Model 1. Model 1 does not fit the early survey biomasses well. This fit may improve if the length sample sizes were decreased. **The Plan Team recommends trying a model with smaller average sample sizes for the length composition data.**

The Plan Team also recommends that the two models presented in the preliminary assessment be updated with the most recent data and presented at the November Plan Team meeting so as to continue progress on development of this assessment.

If the Council splits the OFL, ABC, and TACs and does not revise 50 CFR 679.20, NMFS will interpret that the sector allocations of the TACs will continue to apply at the BSAI-wide level. The BS and AI TACs will be combined in the harvest specifications to calculate the sector allocations. However, NMFS also will continue to manage the BS and AI subarea TACs and prohibit directed fishing in either subarea when its directed fishing allowance has been reached. The State sets its Aleutian Islands Guideline Harvest Level (GHL) fishery at 3% of the BSAI ABC. Assuming this continues, then the Council and NMFS will set the AI TAC accounting for this GHL. In 2012, the AI GHL was 9,420 t. It is possible that the available AI TAC may only allow for a small directed fishing allowance or no opening for directed fishing in the AI. Also, NMFS might need to complete housekeeping regulations before implementation of BS and AI splits. These include:

1. Regulatory authority to combine the BS and AI subarea TACs for sector allocation under 679.20 and to close all directed fishing based on the BS or AI subarea TAC.
2. Parallel fishery closures in 679.7, prohibitions.
3. Stand down requirements for trawl CV between BSAI and GOA under 679.23 seasons.
4. Observer coverage at plants reducing coverage if a Pacific cod directed fishery closes under 679.50.

Skates

Olav Ormseth revised the model for the Alaska skate in the BSAI. The model was changed because: 1) the old model did not do well at fitting length-at-age data, 2) the old model does not take advantage of new SS features (it is programmed in an old version of SS), and 3) the SSC requested it. The number of length-at-age data included in the model was reduced. Now only 2007 data are used, not 2003 or 2005. There was a big collection made in 2009. When all of those are aged, Olav plans to add them to the model.

The following features stayed the same in the new model: 3-year embryonic period, M of 0.13, fixed maturity, fixed fecundity, and fixed survey catchability of 1.0. In particular, there is good evidence, including lab confirmation, of an extended embryo period for Alaska skate (viz., they spend 3.5 years in skate egg cases before hatching out). This feature is modeled as skates being unavailable to the fishery until age 3.5.

The new model differs from the old in the following respects: (1) The new model uses an updated version of Stock Synthesis (version 3.23). (2) The 4-parameter Schnute growth function, which has more flexibility, was used to model growth, instead of the 3-parameter von Bertalanffy function. (3) The parameters of the growth model are estimated independently (i.e., outside of the assessment model) and fixed. It was suggested that the author estimate the growth curve from within the model, because, if selectivity is a function of length (as the author has assumed), estimates obtained outside the model will be biased by the effects of selectivity. (4) Selectivity functions for both fisheries (longline and trawl) and the survey are allowed to be dome-shaped rather than forced to be asymptotic, with the beginning of the peak region forced to equal 90 cm, 49 cm, and 49 cm for the longline fishery, trawl fishery, and survey, respectively. (5) A new survivorship-based function is used to model the stock-recruit relationship (Taylor et al., in press). (6) The maximum age was raised from 25 to 30 years because the 25+ group had too many fish in it. (7) The new model starts in 1980. There are no species-specific data for the 1980-1991 period, so annual catch is assumed to equal the 1992 value in each of these years, and the 1980 age structure is assumed to be in equilibrium under that level of catch. The new model results in biomass estimates that are a bit higher than in the old model, and it tracks the survey biomass data better. **The Plan Team recommends that the author include the following three models for November: 1) last year's model, 2) the new model with fixed growth parameters as proposed by the author, and 3) the new model with growth parameters estimated within the model. The Plan Team also recommends that the author try running the new model(s) with the beginning of the length+ group lowered to 110 cm (after trying this, the author can use his own judgment as to whether this change should be incorporated into the new models).**

Kamchatka Flounder

Tom Wilderbuer presented a provisional analysis to assess this stock in the BSAI using Tier 3 methodology. An age- and length- structured model was applied to survey data beginning in 1991, when Kamchatka flounder were first distinguished from arrowtooth flounder in the survey data, and fishery data beginning in 2007 when they were first identified in fishery catches. They comprise about 10% of the total arrowtooth-Kamchatka flounder catch on average. Length composition data used in the model come from the Bering Sea shelf and slope surveys and the Aleutian Islands survey; age data used are from the 2010 Aleutian Islands survey. The model is a sex-specific, length-based approach where survey and fishery length composition data are used to calculate estimates of population numbers-at-age using a length-age growth matrix. Initial estimates of area-specific catchability were assigned according to the proportion of the average biomass from the three survey time series: approximately 40% each for the Bering Sea shelf and slope populations and 20% for the Aleutian Islands population. Poor estimation of fishery selectivity was resolved by fixing the shape of the selectivity curve to be asymptotic. M was estimated initially as a free parameter. This estimate (0.13) was similar to the estimate obtained from likelihood profiling. In subsequent model runs, M was fixed at 0.13. Slope catchability was fixed at Q =

0.18 after examining results of likelihood profiling, while *Q*s for the shelf and AI surveys were estimated freely. Model results show total biomass steadily increasing to 160,000 t in 2009 and decreasing thereafter. Female spawning biomass follows a similar trend. Fits to the biomass estimates for the surveys were good. Model fits to the aggregate size composition data were good for the survey, but not so good for the fishery data (likely due to small sample sizes). According to the model, the fishing mortality rate in 2010 may have exceeded $F_{40\%}$, although by 2011 the fishing mortality was down to about 0.08.

The Plan Team feels that the model presented in the preliminary assessment is a good initial model, which increases understanding of the population. However, the Team recommends further sensitivity studies with alternative values of M (e.g., Hoenig estimate). Based on the results of this initial model, the Plan Team recommends that the November assessment include an alternative Tier 5 analysis using M = 0.13. The Team also recommends that the author provide an update on age-structured modeling of this stock next September.

Yellowfin sole area-specific exploitation

The Plan Team next discussed the results of the stock structure report presented earlier in the week with respect to whether to split the yellowfin sole TAC. The discussion centered around the Joint Team policy (adopted September 2010), which states, in effect, that in the absence of evidence not to split a stock, the stock should be split. Tom presented evidence indicating that the stock is well mixed and there is no conservation concern; therefore, a split in the ABC and OFL is not warranted. **The Plan Team supports the author's conclusion, and recommends not splitting the yellowfin sole ABC or OFL.**

Biennial cycle for certain flatfish

The Team discussed a proposal to assess selected BSAI stocks only in even years when Gulf of Alaska stocks are not being assessed. If there are large changes to the stock assessment data, model or fishery in the intervening years which present a concern, a full stock assessment would be compiled and presented. Three BSAI stocks were identified for conducting biennial assessments: Alaska plaice, arrowtooth flounder, and flathead sole. **The Team agreed that assessments of these stocks are not needed every year and recommends that the Science Center make the decision on which assessments to update each year.**

Greenland turbot

Steve Barbeaux reported on a preliminary assessment for 2012. The author developed alternative models and compared them to the original (reference) model. Attributes of the stock which present modeling challenges include sexual dimorphism, distribution straddling the U.S.-Russia border, and size separation by depth. One change in input data applied to all models consisted of lower estimated weights at length for both male and female Greenland turbot. This resulted in lower biomass estimates as well as differences in recruitment. For all models there were also minor differences in input catch values, beginning in 2004. Slope survey abundance indices prior to 2002 were excluded from the models due to inconsistencies in survey characteristics for that period. Fisheries length composition data were proportioned to catch by haul to improve the accuracy of catch composition estimates. The authors tuned input sample sizes to output ("effective") sample sizes.

The reference model with tuned composition data and seven other models - with alternative early recruitment, alternative selectivity curves, alternative catchability assumptions, and alternative assumptions about recruitment variability (Sigma R) - were evaluated. The author was requested to include a table in the preliminary assessment document that describes the distinguishing elements of the eight different model alternatives.

For the November meeting, the Team recommends that the author present two or possibly three models: 1) a reference model, which is the original 2011 model with updated and corrected data; 2)

an alternative model similar to the author's preferred model from the preliminary assessment with a few modifications (see below for details); and 3) a third model of the author's choosing, included at the author's discretion.

The author expressly sought suggestions from the Plan Team with respect to four elements of the model. These elements included the following:

1) Early recruitments.

Recruitment patterns for earlier years differed among models, with the reference model having a single large recruitment with little uncertainty and the alternative models having multiple recruitments with greater uncertainty. The author thinks the latter pattern is more appropriate considering the lack of data in the 1960s (e.g., large catches without accompanying age or size composition data). **Noting the potential influence of catches from earlier years (i.e., 1960s) on reference points, the Plan Team recommends further evaluation of that influence by starting the model at different points in time with single large catches, rather than a time series of catches, and including this change in Model 2 for November at the author's discretion and if the analysis can be completed in time. If this evaluation cannot be conducted in time for the November 2012 meeting, the Team recommends that it be completed for the September 2013 meeting.**

2) Selectivity patterns

The author presented models that differed with respect to selectivity for the Auke Bay longline survey, one with length composition data fit to a logistic curve (S1) and the other fit to a four node spline (S2). **The Plan Team recommends that only the logistic selectivity curve be used for the ABL longline survey in Model 2 for November. The Team also recommends that the author follow through with his plan to estimate separate selectivities for directed catch and bycatch in the trawl fishery in next year's assessment.** Improvements made in estimating sex specific selectivity in Stock Synthesis were also noted.

3) Models with fitted catchability

For November, the Plan Team recommends that the Model 2 estimate shelf survey catchability with as diffuse a prior as possible. The Team also recommends further exploration of alternative catchability assumptions for the September 2013 meeting.

4) Alternative values for Sigma R.

The relationship between the Sigma R recruitment parameter and recruitment autocorrelation, and their influence on recruitment estimates, were presented and discussed. **For November, the Team recommends fixing Sigma R at a value of 0.6 in Model 2, while allowing a small amount of autocorrelation.** Not allowing autocorrelation in the preliminary models resulted in a single large recruitment in the 1960s, a recruitment pattern that the author thought was less likely than multiple recruitments. **The Team also recommends additional exploration of Sigma R and recruitment autocorrelation for next year.**

The author emphasized that even for the reference model (i.e., the original 2011 model but with data corrections), estimates of total and spawning biomass and ABC will likely decline by at least 20% as a result of the data corrections and attendant changes in the weight-at-length relationships. Changes in selectivity also will likely contribute to biomass reductions.

Giant grenadier biomass and variance

Pete Hulson presented new methods for deriving biomass and variance estimates in the Aleutian Islands for giant grenadiers. This was different from previous attempts because it utilized the information from the Aleutian Island trawl survey to estimate biomass rather than using the GOA and EBS trawl surveys. Previously, the authors had used the ratio of sablefish biomasses from the Eastern AI to the Western AI to extrapolate grenadier biomass. Now they are using the ratio of grenadier biomasses instead. The new method uses the ratio of the trawl survey biomass to the longline survey RPWs in the same depth stratum, then applies this ratio to the longline survey total RPWs to estimate total AI biomass of giant grenadier. Estimates of variance for the new method were derived using the delta method. There were no comments from the Plan Team.

Northern rockfish and Pacific ocean perch

Paul Spencer presented updated information on maturity and ageing error for northern rockfish and Pacific ocean perch (POP).

Maturity: Shaw (2004 data) and TenBrink (2010 data) estimated new maturity curves for AI northern rockfish (the old curve was borrowed from the GOA assessment). A_{50} dropped by about 6 years in both the 2004 and 2010 data. The two new curves are very similar. Paul did not use the curve from the 2004 data when it first came out because it was so different from the GOA curve. Data for POP from the same two studies lowered A_{50} by about 1.5 years. As with northern rockfish, the two new data sets for POP gave very similar schedules.

New ageing error matrices have also been computed for both northern rockfish and POP.

Some effects of the new maturity curves and ageing error matrices are as follow (proceeding stepwise from the 2010 value, to the value that would have been obtained with the updated ageing error matrix, and finally to the value that would have been obtained with the updated ageing error matrix and the updated maturity curve): northern rockfish F_{ABC} goes from 0.058 to 0.063 to 0.090, POP F_{ABC} goes from 0.061 to 0.061 to 0.067, northern rockfish ABC goes from 8,669 t to 9,565 t to 13,568 t; POP ABC goes from 30,442 t to 29,811 t to 33,032 t.

For November, the Team recommends that the authors include two models (for both northern rockfish and POP): 1) the approved model from the most recent assessment; and 2) a revised model, with the ageing error matrix updated and the maturity curve weighted or constrained to pass through (or close to) the origin.

Paul indicated that he might pursue the following additional ideas for November:

1) evaluate choice of plus group

2) evaluate alternative selectivity curves (SSC request)

3) include retrospective analysis

The Team noted that authors are free to add whatever they wish in November, but the Team may be reluctant to accept a model with major changes that were not previewed in September. In addition, there is a proposed rockfish CIE review in 2013 that will likely suggest additional model revisions.

Stock structure (northern rockfish in particular, and policy in general)

Northern rockfish: Paul Spencer suggested that northern rockfish exhibit some degree of stock structure, as evidenced by genetic differences, dispersal distances on the order of 100 km, growth differences, differential bycatch rates in the Atka mackerel fishery, and differential catch/biomass ratios. Area exploitation rates often exceed M, occasionally $1.5 \times M$. Genetics (Gharrett et al. 2012) seem to show differences between WAI/CAI and EAI and also between the AI and the Pribilofs. There is a cline in length-at-age from WAI (lowest) to CAI to EAI (highest).

The Team talked about the possibility of Ingrid Spies applying her genetic individual-based model (currently configured for Pacific cod) to northern (or other) rockfish. Ingrid indicated that this would be a possibility, although computational constraints currently limit the population size to levels far below the population sizes that exist in nature.

Paul showed what the ABCs would be if split according to W/C/E/BS areas, and also W/C/(E+BS). "Current" (but hypothetical) area ABCs would have been exceeded retrospectively only rarely. The Team discussed whether setting area ABCs would be likely to change the amount actually caught. Mary Furuness said that it would not, but it would complicate management. She also suggested that there might be other ways to make area exploitation rates less disproportionate (e.g., getting industry to agree on voluntary measures).

The Team also noted that reference fishing mortality rates will likely increase in November, based on the new maturity schedule and the updated ageing error matrix. It was noted that the ratio of catch to model biomass in each area has been below the likely new F_{ABC} of about 0.09 in all areas and years since 2004 (however, this is not quite a valid comparison, because F_{ABC} is the full-selection F, not the ratio of catch to biomass).

The Team discussed ABC splits (but not OFL splits) apportioned as W/C/(E+BS) and (W+C)/(E+BS). The Team recalled the September 2010 policy that it adopted jointly with the GOA Team: "The Teams concurred with the Working Group's recommendation to divide quotas as a default measure in general but modified the recommendation as follows: 'allocate the Acceptable Biological Catch (ABC) across subsets of NMFS areas within the BSAI and GOA management areas as a precautionary measure to the extent practicable.'" The Team also recalled that the SSC had disagreed with this policy.

Economic losses, increased regulatory discards, and management difficulty were cited by some Team members as reasons not to split.

Conclusions: 1) We agree that there is evidence of stock structure, but we do not feel that there is an immediate conservation concern. 2) We feel that splitting ABC would not reduce mortality. 3) We are stepping back somewhat from the policy that we adopted together with the GOA Plan Team in September 2010, in part because there is now sufficient information for enough stocks that "default" measures no longer seem necessary; instead, we will proceed, at least for now, on a case-by-case basis, per SSC feedback on the 2010 policy. 4) We feel that recommendations regarding spatial allocation of harvest (either maintaining existing splits, creating new splits, or combining existing splits) should be undertaken in the context of a policy decision made in a larger forum (e.g., getting the SSC to re-engage with the stock structure working group, establishing a mechanism for Council/public involvement, etc.). 5) We would like to receive additional SSC feedback on these issues; in particular, a comparison of evidence and conclusions as they pertain to blackspotted/rougheye rockfish and northern rockfish, and a discussion of if/when it is appropriate to split when there is evidence of stock structure but no immediate conservation concern. 6) We would like to incorporate management considerations more explicitly in the process, to be able to weigh more effectively the costs and benefits of management outcomes.

Dana Hanselman constructed a spreadsheet to show what stocks have been evaluated so far under the stock structure template. In the BSAI, 10 stocks have been completed, with 17 remaining. The Team considered attempting to complete the template for all remaining stocks during the coming year, but determined that this would be impractical, because completing the template and providing appropriate review are both time-consuming.

The Team recommends that future stock structure presentations and discussions take place at the same time rather than on separate days like this year, and that the presentations be made to the respective Team rather than to the combined Teams.

For 2013, the Team recommends that the stock structure template be applied to the following 3 stocks:

1. **Aleutian Island pollock, as an example of a stock that is managed as an "AI only" stock, with a discussion of the rationale for this;**
2. **Shortraker rockfish, as an example of a long-lived Tier 5 stock that has moderate data availability; and**
3. **Flathead sole, as an example of a mixed-species stock complex that has both a dominant species and a much less abundant species (Bering flounder).**

Proposed specifications

The Team recommends adoption of the current 2013 OFLs and ABCs for BSAI groundfish as the proposed specifications for both 2013 and 2014, as no new information was received. Final harvest specifications will be based on the stock assessments in the 2012 SAFE Report.

Adjourn

The BSAI Team adjourned around 3 pm on Friday, September 15, 2012.

Minutes of the Gulf of Alaska Groundfish Plan Team

North Pacific Fishery Management Council
605 W 4th Avenue, Suite 306
Anchorage, AK 99501
September 14-15, 2012

James Ianelli	AFSC (Co-chair)	Diana Stram	NPFMC (Co-chair)
Paul Spencer	AFSC	Mark Stichert**	ADFG
Nancy Friday	AFSC	Michael Dalton	AFSC
Kristen Green	ADFG	Chris Lunsford*	AFSC
Sandra Lowe	AFSC	Tom Pearson*	NMFS AKRO
Elisa Russ	ADFG	Nancy Friday	AFSC
Craig Faunce	AFSC	Vacant	WDFW

* Absent
** Nominated

The GOA Groundfish Plan Team convened on Thursday, September 14, 2012, at 1:45 pm.

Pollock CIE review

Martin Dorn presented a summary of the CIE review for GOA pollock that occurred in summer 2012. The terms-of-reference covered topics related to data collection, procedures for developing inputs to the assessment model, model structure/assumptions, estimation procedures, characterization of uncertainty, appropriateness of $F_{35\%}$ as proxy for F_{msy}, $B_{35\%}$ for B_{msy}, etc.

Data used for the assessment

Regarding data used in the assessment, reviewers expressed concern about reliability of historical trawl data, and recommended removing these, or developing additional supporting documentation. In particular, NMFS bottom trawl surveys in 1984 and 1987 were judged to be incomparable to later surveys. A set of model runs were conducted that removed data for these two years and the results were not sensitive. Overall, timing and location of surveys has varied over time.

One reviewer was critical of how acoustic data are used with trawl data in the assessment to estimate the size/age composition of acoustic backscatter. For example, Shelikof Strait consists of a mix of juveniles and pre-spawning adults. The number of placement of tows should be adequate to assign backscatter to size classes. However, the relationship between the backscatter data and the individual tows is subjective. MACE acknowledges this issue, and will conduct a sensitivity analysis to evaluate its importance.

Assessment model

Reviewers agreed that the assessment model is based on standard methods, but were critical of the assumption of fixing the NMFS trawl survey catchability coefficient as a precautionary constraint on the biomass estimated by the model. In general, reviewers were concerned that accuracy of the assessment is compromised by the use of precautionary assumptions. Reviewers stressed the principle of developing a risk-neutral assessment, and the implementation of any precautionary adjustments in the harvest control rule. However, reviewers were supportive of a precautionary approach to management due to the importance of pollock in the GOA ecosystem, and recommended that structural modifications for a risk-neutral assessment model be accompanied by the development and application of a more conservative harvest control rule. In particular, the reviewers recommended estimating the catchability coefficient. Reviewers also commented on constraining selectivity for older fish, and incorporating ecosystem effects. To address the latter, Dr. Dorn proposed an approach based on time-varying natural mortality that would be estimated with an index of predation intensity.

The Team noted that while all issues identified in the CIE review reports are unlikely to be addressed in the November SAFE report, aspects that are easy to examine are encouraged.

Shelikof Survey

Mike Guttormsen presented an overview of the Shumagins and Shelikof acoustic-trawl surveys done for pollock during the winter of 2012. The Shumagins area abundance was the lowest in the time series and appeared to be missing juveniles. There was a strong age-2 pollock year class in Shelikof mixed in with older fish. Off of Chirikof Mike noted that most of the pollock were older (>10 years old).

Mike reported on some cooperative work with the skipper of the F/V Alaskan. The vessel ran the Marmot transect with a calibrated ES60 and found 23,000 t. Lai Guo calibrated the equipment, and MACE used observer length frequency data to convert S_a to biomass. Jay Stinson the skipper provided MACE with the raw data for free and MACE came up with the biomass estimates. The Team expressed concern that such voluntary survey efforts, while well-conducted and useful, may be ad-hoc and may appear to be a conflict of interest. The fact that this was the exact transect pattern and timing that MACE would have done was indicative that this was not ad-hoc. Any such future survey efforts should be similarly directed to avoid possible favoritism. The Team expressed appreciation for the time and effort donated by the skipper to contribute to the survey efforts.

An increased survey effort is planned for winter 2013 (including the Kenai Penisula and Prince William Sound) and an acoustic trawl survey is planned for summer of 2013. The Team inquired about the performance of the NOAA vessel and the response was that the Council letter seemed to help improve the sense of the mission's importance to management issues.

Prince William Sound GHL calculation

Elisa Russ provided an overview of how the GHL was established historically in PWS since 1995 and the associated harvest. The Team was presented with a proposal from ADFG to set the PWS GHL in future years as a fixed percentage of the W/C/WYAK ABC of 2.5%. Team members requested clarification of specifically how the 2.5% level was derived. That value is the midpoint between the 2001-2010 average of GHL % of GOA ABC (2.44%) and the 1996 and 2012 level (2.55%).

If the proposal is adopted, in November following deliberations on the recommended ABC, the Team would then deduct 2.5% of the W/C/WYAK as the PWS GHL, with the remaining as the combined ABC. The Team notes this could only be an issue for GHL setting in circumstances where the Team disagrees with the assessment author and/or the SSC recommends an ABC that differs from that of the Team in which case the percentage would be modified.

The Team notes that data is available to allocate resources in other portions of the GOA but expressed concern regarding the lack of a biomass-based allocation in PWS. The Team encourages the state to work with NMFS MACE for acoustic survey information and the assessment author in order to provide a biomass-based evaluation for PWS prior to fixing a percentage in regulation.

The Team discussed the potential to deduct the GHL from the ABC and report the resulting TAC as is done for GOA Pacific cod. However, while the team will discuss this further in November, the deduction for pollock is more complicated than for Pacific cod due to multiple seasons, areas and SSL measures.

Currently the deduction occurs from the W/C/WAYAK combined ABC prior to apportioning the ABC to individual areas. The PWS GHL is then noted in the introduction to the SAFE report and does not appear in any tables nor is reported elsewhere.

Historical PWS guideline harvest levels (GHLs) compared to ABC and assessment restuls.

Year	GOA ABC (W/C/WYK + PWS)	PWS GHL (t)	PWS GHL as % of ABC	Harvest (t)	Harvest as % of GOA ABC	GHL minus harvest (t)
1995[a]	65,360	950-2000		2,967	4.54%	
1996[b]	54,810	1,400	2.55%	1,675	3.06%	-275
1997[c]	79,980	1,800	2.25%	2,205	2.76%	-405
1998[d]	124,730	2,100	1.68%	2,107	1.69%	-7
1999	94,580	2,100	2.22%	2,342	2.48%	-242
2000[e]	94,960	1,420	1.50%	1,192	1.25%	228
2001	90,690	1,420	1.57%	1,592	1.76%	-172
2002[f]	53,490	1,720	3.22%	1,153	2.15%	567
2003[g]	49,590	1,720	3.47%	1,123	2.27%	597
2004	65,660	923	1.41%	1,057	1.61%	-134
2005	86,100	923	1.07%	905	1.05%	18
2006[h]	81,300	1,650	2.03%	1,582	1.95%	68
2007[i]	63,800	1,650	2.59%	1,179	1.85%	471
2008[j]	53,590	1,650	3.08%	633	1.18%	1,017
2009	43,270	1,650	3.81%	1,610	3.72%	40
2010	77,150	1,650	2.14%	1,803	2.34%	-153
2011	88,620	1,650	1.86%	1,686	1.90%	-36
2012[k]	108,437	2,770	2.55%	2,624	2.42%	146
		GHL % Avg All Years	*2.29%*	*Harvest % Avg All Years*	*2.08%*	
		Avg 2001-2010	*2.44%*	*Avg 2001-2010*	*1.99%*	
		Avg 2008-2012	*2.69%*	*Avg 2008-2012*	*2.31%*	
		Avg 2007-2011	*2.70%*	*Avg 2007-2011*	*2.20%*	

[a]For the 1995 fishery ADF&G set a guideline harvest range based on an exploitation rate of 10-20% of the 1989 ADF&G trawl survey biomass
[b]GHL derived from 1994 acoustic survey estimate, then adjusted to reflect changes in CGOA TAC
[c]GHL adjusted to reflect changes in CGOA TAC
[d]GHL calculated by applying 8–10% harvest rates to biomass estimates derived from ADF&G biennial summer trawl assessment surveys
[e]Starting in 2000, GHL set by applying Tier 5 approach using trawl survey estimate, natural mortality rate of 0.30, and precautionary factor of 0.75
PWS Pollock Pelagic Trawl Management Plan established to protect SSL:
Inside District split into 3 sections (Hinchinbrook, Knight Is, Bainbridge), 40% section harvest cap
Knight Island harvest level not achieved
[f]Knight Is & Bainbridge harvest levels not achieved
[g]5% bycatch cap implemented & species group caps, March 31 season closure in regulation, although season extended to April 15
[h]Hinchinbrook & Knight achieved, bycatch cap reached in Bainbridge
[i]Section harvest cap increased to 60%, but only taken in Hinchinbrook
[j]GHL remained static, trawl survey estimate not applied; rockfish bycatch caps reached and season closed; no test fishery
[k]GHL set using proportion of historical GHL to CGOA TAC; no test fishery (no bids)

GOA pollock salmon EFP discussion

As a follow up to the discussion held in conjunction with total catch accounting in the Joint Teams meeting, the GOA team reviewed the discussion regarding research removals and to what extent EFP catch may be accommodated in the assessment without a direct allocation needing to occur from the W/C

ABC for GOA pollock. The Joint Teams were supportive of catch being considered in the assessment itself. There is no national policy guidance on how to address EFP catch and regions vary in how they are considered. The RO indicated that accounting for the catch within the stock assessment process would be sufficient as an interim measure. This would have the net effect of reducing the ABC from that considered otherwise but on less of a magnitude than if it were directly allocated from the ABC prior to issuing TAC.

Martin provided an overview of how the 2,400 t could be accommodated in the forthcoming assessment. The projection model would be modified to accommodate this additional removal prior to consideration of the OFL and ABC calculation. The more conservative method to do this would be to accommodate this additional catch in the beginning of the year rather than approximating across multiple seasons. Alternatively the catch could be removed as projected catch within the current year which could lead to a more conservative estimate of the following year's ABC.

The Team and RO staff agrees that a more consistent approach is needed for evaluation of catch in anticipation of future EFPs. A request was made in the joint teams regarding the RO providing an overview of how research set-asides are established and managed in other regions (e.g., New England and Mid-Atlantic regions). More information on this is discussed in the Joint Plan Team report.

Pacific cod model

Teresa A'mar presented an updated SS3 application to GOA Pacific cod. Outline of presentation and document centered on SSC and Plan Team comments from the 2011 assessment. These comments centered around the following general model specifications:

- Last year's
- Retuned q
- Estimate q
- Reduced no of parameters

The base (last year's) model included (Model 1):

- Time-varying fishery selectivity-at-length for all gears and seasons;
- Two blocks for catchability for the 27plus survey, 1984 – 1993 and 1996 – 2011;
- Time-varying catchability for the Sub27 survey;
- Time-varying survey selectivity-at-age for the 27plus survey;
- Constant survey selectivity-at-age for the Sub27 survey; and
- Median recruitment before 1977 restricted to be less than the post-1976 median recruitment, as the pre-1977 recruitment deviation is restricted to be less than 0.0

During developments of these analyses, an option within SS called "Tail Compression" was invoked. It was recommended that this option be disabled and when that happened, the fits qualitatively improved as shown in the document. The tail compression option mainly affected recent recruitment whereas spawning biomass was about the same with and without that option selected. The recruitment index from the survey (so-called Sub27 index) fits better with the tail compression option on. However, the degradation of fits to length composition data was high in those cases. The main survey (so-called 27+) index had a poor residual pattern regardless of the model specifications.

Subsequent models included

<u>Model A</u>: Model 1 (the base model) with tail compression turned off
<u>Model AQ</u>: Model A with mean catchability for the 27plus survey tuned iteratively to 0.916

Followed by a sequence of models which reduced the number of parameters i.e., catchability estimated for the sub-27 each year to two-periods (with a break in 1996; Model B) and 2 blocks for 27+ index selectivity instead of 11 (Model D). Model C examined relaxing some upper bounds on early recruitments. Model E relaxed constraints on survey catchability (freely estimated).

Examining Table 1 in the document, the Team was concerned about the fact that Models B and C which had 8 fewer parameters had an improved total likelihood of nearly 40 ln-likelihood units relative to Model A. Normally more parameters should result in improvements to the total likelihood (for nested models as the case here) but rather the opposite occurred. This was very puzzling. The Teams therefore **recommended that this be examined more closely.** In particular, perhaps starting Model C with the converged parameters from Model A (except for the catchability values) might result in better performance and convergence and lead to an improved model. It appears Model C had a worse fit to the indices compared to Model A (as expected since fewer catchability parameters are involved) whereas the length and age composition data had a *far better* fit for Model C compared to Model A. Another suggestion for gleaning information on parameter behavior and potential confounding was to run some preliminary MCMC models and examine the how parameters are interacting.

The Team noted that the catchability for Model E was nearly double the experimental study results (but similar to the pre-1996 estimate) and discussed that the experimental work had a fair amount of uncertainty given the small sample size. Nonetheless, it seemed implausible that the value could be that different. It was noted that fitting to mean size at age is different than what is done for the EBS Pacific cod model. It was noted that conditional-age-at-length might be useful to help estimate age-error bias and that fixing the deviation for the 27plus index to 0.0 would be worth exploring.

Going forward the Team **recommended** that the author explore models with the following specifications:

Recommendation	Rationale	Notes
1) Fix q=1	Most of the tuned runs were close to 1.0	Request that the mean catchability for 60-81 cm be presented to contrast with experimental value of 0.916
2) Drop sub27 data	To evaluate effect on recruitment estimates and potential interaction with other data sources	Would remove many parameters from the base model related to sub27 catchability
3) Drop mean length-at-age	The lack of fit was quite high as indicated by the large contribution to the total likelihood.	Not used in the EBS model
4) Author's own	Provide flexibility to continue exploring alternative and possibly better model configurations	

DSR/Yelloweye rockfish

Age structured modeling

The revised age structured model was presented with new options requested by the Plan Team last year. This included using more ages (out to 97+, an alternative age error matrix, area specific models versus an aggregate, "super year" model). Although the current age group is 97+, the plus group could be moved out even farther since yelloweye are such long lived fish. Dave Carlile recommended going with the area specific model. Progress has been made and issues related to the treatment of the "plus group" have been investigated. The Team noted that this is a problem with some other stocks. Interestingly, of the three approaches the "single survey" (aggregated over areas and years tier 5 estimate) fell within the two modeling configurations (area aggregated versus area-specific models). The Team encouraged:

1) Maintaining the area-specific models but to investigate using the same selectivity relationships for all models.
2) Investigate possible synchrony in recruitment among the three areas.
3) Improving the ASA model and writing a complete stock assessment report in near future. Since the last submersible derived estimates of biomass occurred in 2005, 2007, and 2009, it would also be worthwhile to compare the a retrospective ASA model run from 2005, 2007, and 2009 to see how the area specific model biomass compares to the area specific submersible biomass estimates for a matching year.

ROV survey

Kristen Green presented a preliminary update on the 2012 GOA Demersal Shelf Rockfish ROV survey. In 2012 ADF&G initiated a ROV pilot study for DSR to replace the delta submersible survey that was discontinued in 2010 due to increasing funding costs. The 2012 pilot study repeated the 2007 Central Southeast Outside (CSEO) area submersible survey design. The ROV uses stereo cameras and obtains 3D point (x,y,z) data for each fish in an overlapping field of view, x value is perpendicular distance used to model probability detection function (PDF).

ROV pilot survey goals:
1. Test ROV capability in Southeast AK
2. Use 2012 data to evaluate if line transect assumptions are met
3. Collect DSR observations to model PDF
4. Evaluate utility of using the ROV and improve survey design for 2013

Preliminary results
1. *Capability* - Successfully completed 46 out of 60 transects with ROV – worked well – able to run transects for full distance – some limited capability compared to submersible in some locations due to sea state.
2. *Evaluate line transect assumptions* - Work in progress but ROV data promising
3. *Model PDFs* - Transect video data from 2012 will be reviewed fall/winter 2012
4. *ROV survey utility* – Work in progress based on 1-3 above

Pros: Cost effective/ logistically feasible / capable in DSR terrain / stereo cameras provide good length measurements / able to do more transects per day.

Cons: No human observer (reduced field of view) / less fish observed – may need expanded coverage / some technical aspects (video quality, umbilical cord management).

Question: Is ROV analogous to the submersible and is it possible for side by side comparisons?

- Side by side comparisons unlikely – submersible no longer available/cost effective.

Question: Given the efficiency of using the ROV has ADF&G considered expanding survey coverage rather than limiting transects to the defined submersible survey transects?

- Willing to consider – ROV funding available for the next 4-5 yrs. 2012 pilot data should help with prioritizing future sampling effort (concentrated versus broad survey design).

Recommendations:

- The Plan Team recommended that Kristen provide an expanded yelloweye executive summary at the November 2012 PT meeting which includes a summary of other yelloweye assessment work done by other agencies (DFO-Canada).
- The Plan Team also asked Kristen to develop a list of specific survey/assessment questions for an expanded yelloweye discussion at the November 2012 PT meeting.

Flatfish

Buck Stockhausen provided an overview of the development of GOA flatfish assessment models for rex sole, Dover sole and northern and southern rocksole. These stocks are lightly exploited and catch remains well below the TAC. The update for the Dover sole model is still in development and some technical issues with model results remain:

- Selectivity estimates for 2011 model different than 2009 version
- Biomass estimates vary widely

A new model aimed at resolving these issues include the following

- Size based selectivity
- A process for having time stanzas for arbitrary processes
- Allowance of multiple fisheries
- Include historic catch levels (i.e., before the model starts)
- Age compositions
- Environmental factors
- Aging errors

The Team requested to have a document of the proposed model and preliminary runs with the data for the November meeting and further SSC/Team review. The features presented are nearly complete (~90%) and are encouraged. The Team also **requests that a full assessment be provided for next September** at the latest.

The Team **recommends using survey averaging methods** from the workgroup (i.e., the Kalman filter) in the assessment this year for the Dover sole assessment.

Northern and Southern Rock Sole

Dr. Teresa A'mar presented current progress on Northern and Southern rock sole assessment models. Past plan team and SSC comments include: i) clarify model structure, ii) incorporating stock-recruit relationships, iii) perform age validation for the Northern and Southern components, and iv) consider spatial patterns in relative abundance to hindcast classification of historical Northern and Southern components. In addition, a recent CIE review also provided several comments: i) Examine survey data from 1996 onward to detect recruit patterns between Northern and Southern components, ii) start with single species model and build complexity from there, iii) go beyond sex-specific natural mortality to fit observed female fraction, iv) examine model fits with fewer survey blocks, v) explore differences in retained catch versus discards in fishery length composition data.

The current assessment models are based on 2011 data, including GOA rock sole survey biomass. The base model used for comparison is Model 1 from the 2011 assessment. The base model was compared to two other versions. Both versions included fishery selectivity and a restriction on early recruits that eliminated an anomalous spike in recruitments at the beginning of the model time period (1980) that was seen in Model 1. For the new versions, Model 2 is fit survey length composition data, and instead of length, Model 3 is fit to survey age composition data. In addition, model versions were tried with different sex-specific selectivity curves for the periods before 1990, the 1990s, and 2000 onwards.

The team discussed questions with respect to the current assessment. First, should likelihood components for fishery length composition and survey age and length compositions be weighted differently? Also, should biomass and length composition data from the ADFG shallow water survey be included in the assessment? This survey is patchy with respect to rock sole, but because it is a shallow water survey, it may provide useful information on rock sole recruitments. This survey is not sex specific and the summarized survey do not distinguish between Northern and Southern components, but species specific information are available in the underlying data for the recent period.

The Team concluded that Model 1 should be retired, and Model 3 (fit to the age composition data) was the most promising. A full assessment document for Model 3 was requested for the Team to review at the November 2012 meeting.

Shark model

Cindy Tribuzio and Pete Hulson presented an update on the development of a stock assessment model for spiny dogfish. A number of challenges exist in developing reliable input data. Spiny dogfish can occur above trawl nets and are patchily distributed, which can affect the variability in survey biomass estimates. The AFSC and IPHC longline surveys have length composition data for a limited number of years. A recent NPRB project has indicated that histological methods for aging vertebrae result reduces between-reader variability. Tagging studies have indicated that spiny dogfish are highly mobile. Spiny dogfish catch are reported in the HFICE estimates, but more information may be needed on the quality of these estimates, and the degree to which some catches are reported in both the HFICE and CAS estimates.

Information from a length-based model were presented. Historical estimates of catch form 1977-1989 were reconstructed from the fishery-specific ratios of groundfish catch to dogfish catch during recent years (2003-2011). The influence of the HFICE data was evaluated by running 2 models, one with and one without the HFICE data. There were not large differences between the models. Both models gave similar estimates of B40% and low exploitation rates, with the current stock size substantially above B40%. However, the HFICE data did make a difference in the model results, particularly in the recent years.

Double counting of catches between the CAS and HFICE data for spiny dogfish may be a relatively minor issue since this is a non-target species. While the quality of the HFICE data is a more general issue, the Plan Team did not feel it was defensible to drop the HFICE dataset. The Plan Team encourages the inclusion of the HFICE data in future models, and possibly some measure of fishing effort. Also, the Team suggested that using some alternative series (e.g., the ratio estimator for the period prior to 2003) may be useful for sensitivity analysis.

Reproductive biology of rockfish species in the GOA

Christina Conrath presented work on this topic noting that five species of rockfish were studied with samples coming from surveys, charters and observers. For POP there were 600+ samples with all months of the year represented. Species has parturition in May with elevated reproductive metrics (GSI and oocyte/ova diameter) during January-May. The L_{50} (FL) of this species was 33.4 cm with an A_{50} of 8.5 yrs.

Rougheye rockfish have a shorter spawning season compared to POP; a peak in January/February in mean oocyte/ova diameter was evident. Upon review of Nov. – Jan GSI fish, maturity was redefined to include fish that had evidence of prior spawning (late stage atresia). When compared with the new definition, L_{50} data changed from 47.9 to 47.3 cm and A_{50} changed from 24.8 to 22.4 years. Based on a lack of elevated reproductive metrics during the period examined, it was determined that ~15% of mature fish were skipping spawning in the year examined. Rougheye L_{50} and A_{50} numbers will be further refined in the next few weeks.

For blackspotted rockfish, the available samples lack mature fish (fish that will spawn that year) from the Nov. – Jan. period and in samples from May through August. These samples included fish up to 55 cm FL (by comparison, increases in GSI were observed starting at 42.5 cm FL for Rougheye rockfish). Shortraker rockfish samples will be analyzed in the upcoming year but preliminary evidence indicates this species also exhibits skipped spawning. The Plan Team thanked Christina for the presentation and hard work and looks forward to seeing these data incorporated into future stock assessments. In particular, it was noted that rather than supplying simply A_{50} and other estimates, some of the raw maturity results may suit the approach authors have taken in recent years (i.e., using a probabilistic approach to account for uncertainty in maturity estimates explicitly within the assessment model).

Octopus consumption model

Kerim Aydin gave a presentation on GOA octopus consumption estimates. The GOA octopus complex contains multiple species but is dominated by *Enteroctopus dofleini*. GOA octopus are in Tier 6 (with a pseudo Tier 5 ABC/OFL calculation). The trawl survey biomass estimates are considered poor indicators of abundance and there is no reliable estimate of *M* for an appropriate Tier 5 specification of ABC/OFL.

A consumption-based estimate of *M* is presented for evaluation for a Tier 6 alternate method for (pseudo Tier 5) ABC/OFL calculation The approach involves estimating annual consumption of octopus by predators. Predators may be a better sampler of octopus than the survey. About 50% of octopus are consumed by grenadiers in GOA. The remainder is Pacific cod (11%), halibut (8%), and sablefish (7%). This year as an extremely conservative estimate only Pacific cod consumption was used (it was selected since it has the greatest number of samples).

Numbers of cod from the survey by length categories, cod ration, and diet composition from survey were tracked relative to the occurrence of octopus in diets. Preliminary minimal annual estimates of octopus consumed from 1990 to 2009 (no extrapolation, no error) were provided. Kerim noted the following:

Advantages: Cod are a good sampler of octopus, method provides error estimates and confidence intervals (will be provided by Nov.). Octopus are available in all years and in amounts greater than historical catch estimates. Using only Pacific cod is extremely conservative (still <50% of *M*).

Disadvantages: SSC concerned about size, location, and species of predation versus catch. GOA sample sizes may miss some strata/predatory size/year combinations. Low percentage of octopus in diets results in noisy estimates (error bounds should reflect this). Data are based only on one predator and only in summer diets only.

The Team recommended that they proceed with this approach for November. The Team requested that estimation uncertainty be provided (Kerim indicated that it was possible to do so) and at that point evaluate smoothing algorithms as presented in the survey average report be used.

Stock structure

The Team examined the approach for selecting stocks for evaluation using the stock structure template. From an earlier report they noted the following:

Potential criteria for selecting stocks for application of the template

> *(From Joint Plan Team, 2010): The Joint Plan Team requested that the SSWG present criteria for prioritizing stock structure analyses. Potential criteria presented by the Plan Team include: 1) Region-wide ABC/OFLs; 2) Catches close to ABC.*
>
> *(From SSWG presentation to Joint Plan Team, 2011): Proposed criteria for prioritizing stock structure analyses include: 1) region-wide ABC/OFL; 2) high vulnerability scores from PSA analysis; and 3) existing information and/or questions regarding stock structure.*

The following list of stocks for which we have applied the stock structure template.

2009 The original report was presented to the Joint Plan Team, along with several overview talks.
2010 A revised report was presented, along with following three case studies:
1) BSAI Blackspotted/rougheye rockfish
2) BSAI Atka mackerel
3) GOA Rougheye/blackspotted rockfish

The first two case studies were also in the report, along with BSAI Pacific cod.

2011 GOA dusky rockfish
2012 BSAI northern rockfish
BSAI skates
BSAI yellowfin sole
GOA walleye pollock
GOA Atka mackerel
GOA POP
GOA and BSAI sharks
2013 candidates (to be selected in November)
GOA shortraker rockfish
Other rockfish
GOA skates

The Team discussed the candidates for 2013 and for efficiency the Team recommended that species initially complete the table and then be evaluated for further analysis and a full report.

For POP, the fine scale ABC and the need for area specific OFLs was addressed in the stock structure work was presented in the JPT meeting. This should be evaluated specifically for the November meeting. In particular, the need for maintaining area specific OFLs and/or finer scale regional ABCs.

Specifications

The Team adopted the current OFLs and ABCs for GOA groundfish as the Team's recommendations for proposed specifications for both 2013 and 2014, as no new information was received. Team recommendations are attached to these minutes. Final harvest specifications will be based on the stock assessments in the 2012 SAFE Report.

Adjourn

The GOA Team adjourned at 2:30PM on September 14th 2012.

Plan Team Recommendations from the September 2012 Meeting

The following is a short summary of the Plan Teams recommendations to groundfish assessment authors.

Joint Plan Team Recommendations

Total catch accounting

The Teams recommend that authors continue to include other removals in an appendix for 2013. Authors may apply those removals in estimating ABC and OFL; however, if this is done, results based on the approach used in the previous assessment must also be presented.

The Teams recommend that the "other" removals data set continue to be compiled, and expanded to include all sources of removal.

The Teams recommend that computation of new HFICE estimates not be continued during the coming year. Once a sufficient amount of observer data are available to compare with HFICE, the time series could be filled out retroactively if comparison suggests this is appropriate. In the meantime, if individual authors want to continue the time series on their own, the code will be made available.

The Teams recommend that a joint SSC/GPT workshop on TCA be held once NS1 guidance is provided.

The Teams recommend that NMFS AKRO include a discussion of NEFMC and MAFMC research set-asides in its upcoming discussion paper on accounting for Scientific Research Permits/Exempted Fishing Permit removals (scheduled for review in December 2012).

Retrospective analysis

For the November 2012 SAFE report, the Teams recommend that authors conduct a retrospective analysis back 10 years (thus, back to 2002 for the 2012 assessments), and show the patterns for spawning biomass (both the time series of estimates and the time series of proportional changes relative to the 2012 run). This is consistent with a December 2011 NPFMC SSC request for stock assessment authors to conduct a retrospective analysis. The base model used for the retrospective analysis should be the author's recommended model, even if it differs from the accepted model from previous years.

Methods for averaging surveys

The Plan Teams recommend that assessment authors retain status quo assessment approaches for the November 2012 SAFE report but also apply the Kalman filter or random effects survey averaging methods for Tier 5 stocks and summarize the analytical results for comparison purposes only. ADMB code for implementing the random effects method will be made available.

Discard mortality

The Plan Teams recommend establishing a list of species which are most likely to have rates less than 100%. The RO staff could then provide input on the level of discard by species while the assessment scientists could provide an overview of viability estimates. How the prioritization is established would depend on a number of factors and would likely involve the Council as well.

Stock structure: BSAI yellowfin sole

The Plan Teams recommend that a genetic study be conducted to estimate isolation by distance in yellowfin sole.

Stock structure: BSAI skates

The Plan Teams recommended adding error bars to the abundance plots to show uncertainty in the observations.

Stock structure: BSAI and GOA sharks

The Plan Teams recommend continuation of FMP-wide harvest specifications for sharks.

Stock structure: general discussion

The Plan Teams recommend that: 1) the separate Teams identify the next set of stocks for application of the stock structure template, to be completed by the September 2013 meeting; 2) metrics be developed (perhaps by a yet-to-be-established Plan Team working group) to help decide when to lump or split areal ABCs and OFLs; and 3) stock structure concerns and management implications (e.g., effects of splitting on discards) be included in these metrics.

Because there may be difficulty with interpretation of areal overages without the context of areal biomass, the Plan Teams also recommend that a detailed discussion of this subject occur next September and that, in the interim, biomass be included as part of the next set of stock structure analyses, similar to what Paul Spencer provided this year for RE/BS and northern rockfish.

BSAI Plan Team recommendations

EBS pollock survey and assessment

The Team recommends development of more complete documentation prior to accepting the model-based abundance indices as integral to the EBS pollock assessment.

EBS Pacific cod

Regarding candidate models for November, the Plan Team recommends including Model 1 (because it is the currently accepted model, inclusion of Model 1 should be considered automatic), and also Model 5 because it is very parsimonious and includes a number of features that Grant showed to improve the fit.

There was also a lot of interest in a model intermediate between Model 1 and Model 5, such as a version of Model 5 in which the commercial fishery data are still broken out by gear and season, with selectivity parameters estimated by time block. The Team recommends that the author investigate a model like that and bring it forward on his own if it looks worthwhile.

While they are not candidates for the specifications, we think that Models 1.1 and 4 provide a useful check on the candidate models and recommend that they be reported in November (and next September).

Aleutian Islands Pacific cod

The Plan Team recommends trying a model with smaller average sample sizes for the length composition data.

The Plan Team also recommends that the two models presented in the preliminary assessment be updated with the most recent data and presented at the November Plan Team meeting so as to continue progress on development of this assessment.

Skates

The Plan Team recommends that the author include the following three models for November: 1) last year's model, 2) the new model with fixed growth parameters as proposed by the author, and 3) the new model with growth parameters estimated within the model.

The Plan Team also recommends that the author try running the new model(s) with the beginning of the length+ group lowered to 110 cm (after trying this, the author can use his own judgment as to whether this change should be incorporated into the new models).

Kamchatka flounder

The Plan Team feels that the model presented in the preliminary assessment is a good initial model, which increases understanding of the population. However, the Team recommends further sensitivity studies with alternative values of M (e.g., Hoenig estimate).

Based on the results of this initial model, the Plan Team recommends that the November assessment include an alternative Tier 5 analysis using M = 0.13. The Team also recommends that the author provide an update on age-structured modeling of this stock next September.

Yellowfin sole area-specific exploitation

The Plan Team supports the author's conclusion, and recommends not splitting the yellowfin sole ABC or OFL.

Biennial cycle for certain flatfish

The Team agreed that assessments of these stocks are not needed every year and recommends that the Science Center make the decision on which assessments to update each year.

Greenland turbot

For the November meeting, the Team recommends that the author present two or possibly three models: 1) a reference model, which is the original 2011 model with updated and corrected data; 2) an alternative model similar to the author's preferred model from the preliminary assessment with a few modifications (see below for details); and 3) a third model of the author's choosing, included at the author's discretion.

Noting the potential influence of catches from earlier years (i.e., 1960s) on reference points, the Plan Team recommends further evaluation of that influence by starting the model at different points in time with single large catches, rather than a time series of catches, and including this change in Model 2 for November at the author's discretion and if the analysis can be completed in time. If this evaluation cannot be conducted in time for the November 2012 meeting, the Team recommends that it be completed for the September 2013 meeting.

The Plan Team recommends that only the logistic selectivity curve be used for the ABL longline survey in Model 2 for November. The Team also recommends that the author follow through with his plan to estimate separate selectivities for directed catch and bycatch in the trawl fishery in next year's assessment.

For November, the Plan Team recommends that the Model 2 estimate shelf survey catchability with as diffuse a prior as possible. The Team also recommends further exploration of alternative catchability assumptions for the September 2013 meeting.

For November, the Team recommends fixing Sigma R at a value of 0.6 in Model 2, while allowing a small amount of autocorrelation.

The Team also recommends additional exploration of Sigma R and recruitment autocorrelation for next year.

Northern rockfish and Pacific ocean perch

For November, the Team recommends that the authors include two models (for both northern rockfish and POP): 1) the approved model from the most recent assessment; and 2) a revised model, with the ageing error matrix updated and the maturity curve weighted or constrained to pass through (or close to) the origin.

Stock structure (northern rockfish in particular, and policy in general)

The Team recommends that future stock structure presentations and discussions take place at the same time rather than on separate days like this year, and that the presentations be made to the respective Team rather than to the combined Teams.

For 2013, the Team recommends that the stock structure template be applied to the following 3 stocks:

1. Aleutian Island pollock, as an example of a stock that is managed as an "AI only" stock, with a discussion of the rationale for this;
2. Shortraker rockfish, as an example of a long-lived Tier 5 stock that has moderate data availability; and
3. Flathead sole, as an example of a mixed-species stock complex that has both a dominant species and a much less abundant species (Bering flounder).

Proposed specifications

The Team recommends adoption of the current 2013 OFLs and ABCs for BSAI groundfish as the proposed specifications for both 2013 and 2014, as no new information was received.

GOA Plan Team recommendations

Prince William Sound GHL calculation

The Team encourages the state to work with NMFS MACE for acoustic survey information and the GOA pollock assessment author in order to provide a biomass-based evaluation for PWS prior to fixing a percentage in regulation.

GOA Pacific cod

The Team recommended that discrepancy in likelihoods (table 1 in assessment) be examined more closely. It appears Model C had a worse fit to the indices compared to Model A (as expected since fewer catchability parameters are involved) whereas the length and age composition data had a *far better* fit for Model C compared to Model A.

The Team recommended that the GOA Pacific cod author explore models with the following specifications:

1) Fix q=1
2) Drop sub27 data
3) Drop mean length-at-age
4) Author's own explorations

DSR/Yelloweye rockfish

Regarding the age-structured assessment model (ASA) the Team encouraged:

- Maintaining the area-specific models but to investigate using the same selectivity relationships for all models.
- Investigate possible synchrony in recruitment among the three areas.

- Improving the ASA model and writing a complete stock assessment report in near future. Since the last submersible derived estimates of biomass occurred in 2005, 2007, and 2009, it would also be worthwhile to compare the a retrospective ASA model run from 2005, 2007, and 2009 to see how the area specific model biomass compares to the area specific submersible biomass estimates for a matching year.

Relative to the ROV work, the Team recommended that Kristen provide an expanded yelloweye executive summary at the November 2012 PT meeting which includes a summary of other yelloweye assessment work done by other agencies (DFO-Canada).

GOA flatfish

The Team requested to have a document of the proposed model and preliminary runs with the data for the November meeting and further SSC/Team review. The features presented are nearly complete (~90%) and are encouraged.

The Team also **requests that a full assessment be provided for next September** at the latest.

The Team **recommends using survey averaging methods** from the workgroup (i.e., the Kalman filter) in the assessment this year for the Dover sole assessment.

Northern and southern rock sole

The Team concluded that Model 1 should be retired, and Model 3 (fit to the age composition data) was the most promising. A full assessment document for Model 3 was requested for the Team to review at the November 2012 meeting.

Shark model

The Plan Team encourages the inclusion of the HFICE data in future models, and possibly some measure of fishing effort. Also, the Team suggested that using some alternative series (e.g., the ratio estimator for the period prior to 2003) may be useful for sensitivity analysis.

Octopus consumption model

The Team recommended that they proceed with this approach for November. The Team requested that estimation uncertainty be provided (Kerim indicated that it was possible to do so) and at that point evaluate smoothing algorithms as presented in the survey average report be used.

DRAFT September BSAI Plan Team Proposed OFL and ABC Recommendations (metric tons) for 2013-2014

		2012				2013			2014		
Species	Area	OFL	ABC	TAC	Catch	OFL	ABC	TAC	OFL	ABC	TAC
Pollock	EBS	2,474,000	1,220,000	1,186,000	1,097,694	2,840,000	1,360,000		2,840,000	1,360,000	
	AI	39,600	32,500	19,000	961	42,900	35,200		42,900	35,200	
	Bogoslof	22,000	16,500	500	79	22,000	16,500		22,000	16,500	
Pacific cod	BSAI	369,000	314,000	275,000	191,209	374,000	319,000		374,000	319,000	
Sablefish	BS	2,640	2,230	2,230	526	2,610	2,200		2,610	2,200	
	AI	2,430	2,050	2,050	859	2,400	2,020		2,400	2,020	
Yellowfin sole	BSAI	222,000	203,000	202,000	95,142	226,000	207,000		226,000	207,000	
Greenland turbot	Total	11,700	9,660	8,660	3,843	9,700	8,030		9,700	8,030	
	BS	n/a	7,230	6,230	2,203	n/a	6,010		n/a	6,010	
	AI	n/a	2,430	2,430	1,640	n/a	2,020		n/a	2,020	
Arrowtooth flounder	BSAI	181,000	150,000	25,000	20,550	186,000	152,000		186,000	152,000	
Kamchatka flounder	BSAI	24,800	18,600	17,700	9,302	24,800	18,600		24,800	18,600	
Northern rock sole	BSAI	231,000	208,000	87,000	73,466	217,000	196,000		217,000	196,000	
Flathead sole	BSAI	84,500	70,400	34,134	9,912	83,100	69,200		83,100	69,200	
Alaska plaice	BSAI	64,600	53,400	24,000	10,105	65,000	54,000		65,000	54,000	
Other flatfish	BSAI	17,100	12,700	3,200	3,208	17,100	12,700		17,100	12,700	
Pacific Ocean perch	BSAI	35,000	24,700	24,700	17,641	33,700	28,300		33,700	28,300	
	BS	n/a	5,710	5,710	1,465	n/a	6,540		n/a	6,540	
	EAI	n/a	5,620	5,620	3,737	n/a	6,440		n/a	6,440	
	CAI	n/a	4,990	4,990	4,206	n/a	5,710		n/a	5,710	
	WAI	n/a	8,380	8,380	8,233	n/a	9,610		n/a	9,610	
Northern rockfish	BSAI	10,500	8,610	4,700	2,161	10,400	8,490		10,400	8,490	
Blackspotted/Rougheye rockfish	BSAI	576	475	475	162	605	499		605	499	
	EBS/EAI	n/a	231	231	65	n/a	241		n/a	241	
	CAI/WAI	n/a	244	244	97	n/a	258		n/a	258	
Shortraker rockfish	BSAI	524	393	393	273	524	393		524	393	
Other rockfish	BSAI	1,700	1,280	1,070	614	1,700	1,280		1,700	1,280	
	BS	n/a	710	500	152	n/a	710		n/a	710	
	AI	n/a	570	570	462	n/a	570		n/a	570	
Atka mackerel	Total	96,500	81,400	50,763	32,165	78,300	67,100		78,300	67,100	
	EAI/BS	n/a	38,500	38,500	22,386	n/a	31,700		n/a	31,700	
	CAI	n/a	22,900	10,763	9,584	n/a	18,900		n/a	18,900	
	WAI	n/a	20,000	1,500	195	n/a	16,500		n/a	16,500	
Squid	BSAI	2,620	1,970	425	599	2,620	1,970		2,620	1,970	
Skate	BSAI	39,100	32,600	24,700	17,469	38,300	32,000		38,300	32,000	
Shark	BSAI	1,360	1,020	200	71	1,360	1,020		1,360	1,020	
Octopus	BSAI	3,450	2,590	900	46	3,450	2,590		3,450	2,590	
Sculpin	BSAI	58,300	43,700	5,200	4,398	58,300	43,700		58,300	43,700	
Total	BSAI	3,996,000	2,511,778	2,000,000	1,592,455	4,341,869	2,639,792		4,341,869	2,639,792	

Sources: 2012 OFLs, ABCs, and TACs and 2013 OFLs and ABCs are from harvest specifications adopted by the Council in December 2011; 2014 OFLs and ABCs equal 2013; 2012 catches through September 1 from AKR Catch Accounting.

DRAFT September 2012 GOA Plan Team Proposed OFL and ABC Recommendations (mt) for 2013-2014 (Page 1)

		2012				2013			2014		
Species	Area	OFL	ABC	TAC	Catch	OFL	ABC	TAC	OFL	ABC	TAC
Pollock	W (61)		30,270	30,270	15,508		32,816			32,816	
	C (62)		45,808	45,808	32,182		49,662			49,662	
	C (63)		26,348	26,348	8,951		28,565			28,565	
	WYAK		3,244	3,244	2,380		3,517			3,517	
	Subtotal	143,716	105,670	105,670	59,021	155,402	114,560		155,402	114,560	
	EYAK/SEO	14,366	10,774	10,774	-	14,366	10,774		14,366	10,774	
	Total	158,082	116,444	116,444	59,021	169,768	125,334		169,768	125,334	
Pacific Cod	W		28,032	21,024	13,194		29,120			29,120	
	C		56,940	42,705	28,399		59,150			59,150	
	E		2,628	1,971	342		2,730			2,730	
	Total	104,000	87,600	65,700	41,935	108,000	91,000		108,000	91,000	
Sablefish	W		1,780	1,780	1,129		1,757			1,757	
	C		5,760	5,760	4,525		5,686			5,686	
	WYAK		2,247	2,247	1,770		2,219			2,219	
	SEO		3,176	3,176	2,516		3,132			3,132	
	Total	15,330	12,960	12,960	9,940	15,129	12,794		15,129	12,794	
Shallow-Water Flatfish	W		21,994	13,250	134		20,171			20,171	
	C		22,910	18,000	1,955		21,012			21,012	
	WYAK		4,307	4,307	-		3,950			3,950	
	EYAK/SEO		1,472	1,472	-		1,350			1,350	
	Total	61,681	50,683	37,029	2,089	56,781	46,483		56,781	46,483	
Deep-Water Flatfish	W		176	176	5		176			176	
	C		2,308	2,308	227		2,308			2,308	
	WYAK		1,581	1,581	3		1,581			1,581	
	EYAK/SEO		1,061	1,061	2		1,061			1,061	
	Total	6,834	5,126	5,126	237	6,834	5,126		6,834	5,126	
Rex Sole	W		1,307	1,307	215		1,283			1,283	
	C		6,412	6,412	1,835		6,291			6,291	
	WYAK		836	836	-		821			821	
	EYAK/SEO		1,057	1,057	-		1,037			1,037	
	Total	12,561	9,612	9,612	2,050	12,326	9,432		12,326	9,432	
Arrowtooth Flounder	W		27,495	14,500	903		27,386			27,386	
	C		143,162	75,000	13,852		142,591			142,591	
	WYAK		21,159	6,900	30		21,074			21,074	
	EYAK/SEO		21,066	6,900	65		20,982			20,982	
	Total	250,100	212,882	103,300	14,850	249,066	212,033		249,066	212,033	
Flathead Sole	W		15,300	8,650	251		15,518			15,518	
	C		25,838	15,400	1,361		26,205			26,205	
	WYAK		4,558	4,558	-		4,623			4,623	
	EYAK/SEO		1,711	1,711	-		1,735			1,735	
	Total	59,380	47,407	30,319	1,612	60,219	48,081		60,219	48,081	

Sources: 2012 OFLs, ABCs, and TACs and 2013 OFLs and ABCs are from harvest specifications adopted by the Council in December 2011; 2014 OFLs and ABCs equal 2013; 2012 catches through September 1 from AKR Catch Accounting.

Draft September 2012 GOA Plan Team Proposed OFL and ABC Recommendations (mt) for 2013-2014 (Page 2)

		2012				2013			2014		
Species	Area	OFL	ABC	TAC	Catch	OFL	ABC	TAC	OFL	ABC	TAC
Pacific Ocean Perch	W	2,423	2,102	2,102	2,450	2,364	2,050		2,364	2,050	
	C	12,980	11,263	11,263	10,355	12,662	10,985		12,662	10,985	
	WYAK		1,692	1,692	1,682		1,650			1,650	
	SEO		1,861	1,861	-		1,815			1,815	
	E(subtotal)	4,095	3,553	3,553	1,682	3,995	3,465		3,995	3,465	
	Total	19,498	16,918	16,918	14,487	19,021	16,500		19,021	16,500	
Northern Rockfish	W		2,156	2,156	1,816		2,017			2,017	
	C		3,351	3,351	2,996		3,136			3,136	
	E		0	0	-		-			-	
	Total	6,574	5,507	5,507	4,812	6,152	5,153		6,152	5,153	
Shortraker Rockfish	W		104	104	95		104			104	
	C		452	452	202		452			452	
	E		525	525	217		525			525	
	Total	1,441	1,081	1,081	514	1,441	1,081		1,441	1,081	
Other Rockfish (Other slope)	W		44	44	246		44			44	
	C		606	606	693		606			606	
	WYAK		230	230	34		230			230	
	EYAK/SEO		3,165	200	16		3,165			3,165	
	Total	5,305	4,045	1,080	989	5,305	4,045		5,305	4,045	
Dusky Rockfish	W		409	409	433		381			381	
	C		3,849	3,849	3,462		3,581			3,581	
	WYAK		542	542	2		504			504	
	EYAK/SEO		318	318	-		296			296	
	Total	6,257	5,118	5,118	3,897	5,822	4,762		5,822	4,762	
Rougheye and Blackspotted Rockfish	W		80	80	30		82			82	
	C		850	850	342		861			861	
	E		293	293	150		297			297	
	Total	1,472	1,223	1,223	522	1,492	1,240		1,492	1,240	
Demersal shelf rockfish	Total	467	293	293	59	467	293		467	293	
Thornyhead Rockfish	W		150	150	156		150			150	
	C		766	766	292		766			766	
	E		749	749	182		749			749	
	Total	2,220	1,665	1,665	630	2,220	1,665		2,220	1,665	
Atka mackerel	Total	6,200	4,700	2,000	1,176	6,200	4,700		6,200	4,700	
Big Skate	W		469	469	59		469			469	
	C		1,793	1,793	1,276		1,793			1,793	
	E		1,505	1,505	40		1,505			1,505	
	Total	5,023	3,767	3,767	1,375	5,023	3,767		5,023	3,767	
Longnose Skate	W		70	70	20		70			70	
	C		1,879	1,879	531		1,879			1,879	
	E		676	676	95		676			676	
	Total	3,500	2,625	2,625	646	3,500	2,625		3,500	2,625	
Other Skates	Total	2,706	2,030	2,030	1,032	2,706	2,030		2,706	2,030	
Squid	GOA-wide	1,530	1,146	1,146	13	1,530	1,148		1,530	1,148	
Sharks	GOA-wide	8,037	6,028	6,028	538	8,037	6,028		8,037	6,028	
Octopus	GOA-wide	1,941	1,455	1,455	122	1,941	1,455		1,941	1,455	
Sculpins	GOA-wide	7,641	5,731	5,731	717	7,641	5,731		7,641	5,731	
Total		747,780	606,048	438,159	163,263	756,621	612,506		756,621	612,506	

Sources: 2012 OFLs, ABCs, and TACs and 2013 OFLs and ABCs are from harvest specifications adopted by the Council in December 2011; 2014 OFLs and ABCs equal 2013; 2012 catches through September 1 from AKR Catch Accounting.

Table 8. Recommended Pacific halibut discard mortality rates (DMRs) for 2013-2015 CDQ and non-CDQ groundfish fisheries off Alaska.

I. Non-CDQ

Bering Sea/Aleutians			Gulf of Alaska		
Gear/Target	Used in 2010-2012	2013-2015 Recommendation	Gear/Target	Used in 2010-2012	2013-2015 Recommendation
Trawl			***Trawl***		
Atka mack	76	77	Bottom poll	59	60
Bottom poll	73	77	Pacific cod	62	62
Pacific cod	71	71	Dpwtr flats	48	43
Other Flats	72	71	Shallwtr flats	71	67
Rockfish	81	79	Rockfish	67	66
Flathead sole	74	73	Flathead sole	65	65
Midwtr poll	89	88	Midwtr poll	76	71
Rock sole	82	85	Sablefish	65	71
Sablefish	75	75	Arr. fldr	72	73
Turbot	67	64	Rex sole	64	69
Arr. fldr	76	76			
YF sole	81	83			
Pot			***Pot***		
Pacific cod	8	8	Pacific cod	17	17
Longline			***Longline***		
Pacific cod	10	9	Pacific cod	12	11
Rockfish	9	4	Rockfish	9	9
Turbot	11	13			

II. Bering Sea/Aleutians CDQ

Gear/Target	Used in 2010-2012	2013-2015 Recommendation
Trawl		
Atka mackerel	85	86
Bottom pollock	85	83
Pacific cod	90	90
Rockfish	84	80
Flathead sole	84	79
Midwtr pollock	90	90
Rock sole	87	88
Turbot	88	89
Yellowfin sole	85	86
Pot		
Sablefish	32	34
Longline		
Pacific cod	10	10
Turbot	4	4

Report of the Joint Plan Team Working Group on Assessment/Management Issues Related to Recruitment

August 2012

Introduction

The Groundfish Plan Teams and Crab Plan Team ("GPTs" and "CPT," respectively) appointed a working group (Robert Foy, James Ianelli, Diana Stram, and Grant Thompson) to list and evaluate alternatives for a number of assessment and management issues related to recruitment. To aid the working group in accomplishing its task, a workshop was held at the AFSC Seattle laboratory during the dates of April 4-5, 2012. The workshop was intended to address a long-standing request from the BSAI GPT for analysis of recruitment-related issues such as: which cohorts to include in estimation of reference points, how to estimate parameters related to recruitment (including parameters of a stock-recruitment relationship), and how to determine the reliability of the F_{MSY} probability density function. The workshop was also intended to satisfy the following SSC request (from the February 2012 minutes):

> *"The SSC supports the previous recommendation of the Groundfish PT ... to hold a workshop to develop guidelines on how to address environmental changes in the SR relationship into biological reference points and how to model environmental forcing in stock projection models.... The SSC believes it would be useful to have members from both the Groundfish and Crab Plan Teams present, because the issues are common to both groups."*

The workshop agenda, a list of modifications to the agenda that occurred during the workshop itself, a list of references, and a list of participants are attached in Appendix A. The workshop initiated discussion of existing and proposed approaches and provided ideas for further analysis of the ten workshop topics:

A. Identification of regime shifts, either for an ecosystem or some subunit thereof
   1. Current policy on identification of regime shifts
   2. Possible improvements to current policy, including consideration of risk

B. Estimation of parameters (average recruitment, stock-recruitment relationships, σ_R)
   1. Establishing criteria for excluding individual within-regime year classes from estimates
   2. Use of "conditioned" stock-recruitment parameters (e.g., $F_{MSY}=F_{35\%}$, $B_{MSY}=B_{35\%}$)
   3. Specification of priors, including hierarchical Bayes and other meta-analytic approaches
   4. Alternatives for setting/estimating σ_R
   5. Determining "reliability" of the F_{MSY} pdf
   6. Other issues involving the stock-recruitment relationship

C. Forecasting environmental variability
   1. Best practices for incorporating environmental forcing in stock assessments
   2. How knowledge of environmental forcing changes perceptions of reference points

Phase I of the working group report was completed just before the May 2012 meeting of the CPT. The Phase I report was created on such a short timeline because guidance on four of the ten workshop topics was deemed essential for the May 2012 CPT meeting to be successful. These four topics were A1, A2, B1, and C2. The Phase I report contained a listing of alternatives for these four topics, qualitative analysis for each of those alternatives and quantitative analysis for some, and a provisional recommendation for each of the four topics. The Phase I report was reviewed by the CPT at its May 2012 meeting and by the SSC at its June 2012 meeting. The present ("Phase II") report was intended to address

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all ten of the workshop topics in a similar manner. However, the available time proved insufficient to accomplish this task. Instead, this report includes only a slightly modified version of the Phase I report and a listing of alternatives with provisional recommendations—but no analysis—for the six topics not covered in the Phase I report. The modifications to the Phase I report resulted from consideration of CPT and SSC comments, which are shown below:

From the May 2012 CPT minutes:

> *"The CPT recommended that the default assumption for recruitment is to start with the full time series and use the alternatives listed in A2.2 – A2.6 (or other) to recommend a modification to the default timeframe. The team noted the necessity of consistency across stocks in how the set of recruitments is evaluated, and that all authors should look at several ways to detect breakpoints in productivity. Once a breakpoint has been identified, some plausible biological explanation or rationale should also be provided to support the identified change in productivity. The team stressed the need for transparency in how the breakpoint years are selected when defining reference point, and that the same software should be employed by all authors. The software would include all of the main approaches raised in the report and discussed by the team. André and Steve will pursue software for use by authors prior to the September assessments. The software will include the core methods to be used across all assessments."*

From the June 2012 SSC minutes:

> *"The SSC views the April workshop a great success.... The SSC agrees that the recommendations made in the Phase 1 report should be viewed as preliminary until the report is finalized and it receives review by both the Crab and Groundfish Plan Teams. The SSC notes that environmental forcing need not express itself through regime shifts and urges researchers to also consider environmental events and relationships. The SSC requests thorough documentation of the breakpoint analysis and software, including assumptions and statistical methodology or modeling. The SSC would also like to see some discussion of how workshop recommendations affect determination of virgin (or unfished) biomass. The SSC also suggests that life history, length frequency distribution, and ecosystem considerations could be useful in refining recommendations about analyzing SRRs. The SSC suggested that the Plan Teams should consider life history when selecting the years to exclude from the time series. The SSC anticipates that a deliberative process will be needed to finalize recommendations and so does not expect all recommendations to be implemented until 2013. The SSC looks forward to the final workshop report."*

The working group plans to continue development of the alternatives and provisional recommendations contained in this report during the coming year, with the goal of producing a complete report by the September 2013 Groundfish Plan Team meeting.

Topics and Alternatives

Disclaimer: All recommendations made here are strictly provisional. Much more work can be done on almost every topic, but the working group felt that it would be useful to propose at least an initial recommendation for each topic.

In the following, "SRR" stands for "stock-recruitment relationship."

A1: Current policy on identification of regime shifts

Alternative A1.1 (status quo):

For groundfish, the status quo approach is contained in a 1999 memorandum from James Balsiger (who was at that time AFSC Director) to the AFSC groundfish stock assessment authors, and consists of the following two sentences: *"Projections of future stock sizes and estimation of reference points should be based only on year classes spawned in 1977 or later, unless a compelling case can be made to begin the time series in some other year. The fact that earlier estimates are available does not in itself constitute a compelling case."*

For crab, the status quo approach is described in various parts of the policy listed in Appendix B. Briefly, this approach calls for identification of potential mechanisms to support regime shifts. Such identification should consider evidence of a change in magnitude and direction of life-history characteristics. Candidate life-history characteristics include natural mortality, growth, maturity, fecundity, recruitment, and recruits per unit of spawning. Candidate ecosystem characteristics include the "Overland method" of regime shift detection, change in production of benthic species in the Eastern Bering Sea, and consumption (from ecosystem model outputs). If stock-recruitment data are available, they are to be examined for evidence of multiple SRRs that are consistent with a proposed regime shift.

Because item A1 is restricted to the status quo by definition, no other alternatives are presented for this item. Also, because the status quo is a matter of fact, no recommendation is made for this item.

A2: Possible improvements to current policy, including consideration of risk

Alternative A2.1: Do not consider effects of regime shifts.

Pro: 1) Extremely easy to implement. 2) Minimizes chance of a "false positive" regime shift identification. 3) If the regimes that occurred during the period spanned by the full time series of data constitute a random sample from the distribution of regimes that will occur in the long-term future, this method would give an unbiased estimate of future conditions over the long term.

Con: 1) Maximizes chance of a "false negative" regime shift (non)identification. 2) Given that regimes (almost by definition) persist for a period of at least several years, this method is likely to give a biased estimate of future conditions over the short term. 3) Because environmental regimes typically appear to persist over approximately decadal time scales and because most datasets for BSAI and GOA groundfish and crab typically extend back only a few decades, it is unlikely that the set of regimes that occurred during the period spanned by the data constitutes a random sample from the distribution of regimes that will occur in the long-term future; in which case this method is also likely to give a biased estimate of future conditions over the long term.

Alternative A2.2: Estimate breakpoints in the time series of recruits using an appropriate statistical test such as AIC or likelihood ratio, and possibly employing additional constraints such as a minimum length for the current regime or a maximum permissible CV for parameter estimates.

Pro: 1) Basing the analysis on the time series of recruits, without considering recruits per unit of spawning or a curvilinear SRR, is similar to existing practice for Tier 3 groundfish. 2) If the true SRR is of Beverton-Holt (or similar, asymptotic) form and spawning biomass has been sufficiently high throughout the time series (such that the recruitment predicted by the curve is almost independent of spawning biomass), this method will likely produce results similar to those that would be produced by the more complicated alternative of considering a fully parameterized SRR.

Con: 1) If spawning biomass has been sufficiently low for the most recent part of the time series, low recruitments from those recent years will be mistaken for a new regime even though the true SRR has not changed. 2) Because this method implicitly assumes that the true SRR is approximately horizontal across the observed range of spawning biomasses, productivity will be overestimated if the assumption is extrapolated all the way down to the origin.

Alternative A2.3: Estimate breakpoints in the time series of recruits per unit of spawning using an appropriate statistical test such as AIC or likelihood ratio, and possibly employing additional constraints such as a minimum length for the current regime or a maximum permissible CV for parameter estimates.

Pro: 1) Avoids the problem identified under "Con" for Alternative A2.2. 2) If spawning biomass has been severely depleted throughout the time series (such that spawning biomass is always close to zero), this method will likely produce results similar to those that would be produced by the more complicated alternative of considering a fully parameterized SRR.

Con: 1) If the true SRR is of Beverton-Holt (or similar, asymptotic) form and spawning biomass has been sufficiently high throughout the time series (such that the recruitment predicted by the curve is almost independent of spawning biomass) but spawning biomass has declined significantly during the most recent part of the time series, recent decreases in recruits per unit of spawning will be mistaken for a new regime even though the true SRR has not changed. 2) Because this method implicitly assumes that the true relationship between recruits and spawning is proportional across the observed range of spawning biomasses, productivity will be underestimated if the assumption is extrapolated far beyond the range of the data.

Alternative A2.4: Estimate breakpoints in the time series of an environmental time series such as the Pacific Decadal Oscillation (PDO) using an appropriate statistical test such as AIC or likelihood ratio, and possibly employing additional constraints such as a minimum length for the current regime or a maximum permissible CV for parameter estimates.

Pro: 1) The necessary data may be available even when recruitment data are not. 2) Breakpoints in environmental time series such as the PDO have already been well studied and shown to be significant predictors of many things. 3) This approach would eliminate the need to conduct a separate analysis for every stock.

Con: 1) If the productivity of a particular stock is not linked, directly or indirectly, to the environmental variable(s) used in the analysis, a "false positive" regime shift identification will result. 2) If the productivity of a stock changes only in response to some variable *not* used in the analysis, a "false negative" regime shift (non)identification will result.

Alternative A2.5: Estimate both parameters of a two-parameter SRR for every age- or length-structured stock assessment, with breakpoints estimated using an appropriate statistical test such as AIC or likelihood ratio, and possibly employing additional constraints such as a minimum length for the current regime or a maximum permissible CV for parameter estimates.

Pro: 1) Eliminates the need to use proxy reference points. 2) Does not imply functional forms for the SRR (e.g., horizontal or linear through the origin) that are almost certain to be implausible if extrapolated across the entire range of possible spawning biomasses.

Con: 1) Reliably estimating both parameters of a two-parameter SRR has proven to be very difficult for the vast majority of BSAI and GOA groundfish and crab stocks.

Alternative A2.6 (*provisional recommendation*): Condition the productivity parameter of a two-parameter SRR on one or more F_{MSY} proxies specified or implied by the harvest control rules in the respective FMP, then estimate the scale parameter of the SRR for every age- or length-structured stock assessment, with breakpoints estimated using an appropriate statistical test such as AIC or likelihood ratio, and possibly employing additional constraints such as a minimum length for the current regime or a maximum permissible CV for parameter estimates.

Pro: 1) Results in management recommendations that are consistent with existing F_{MSY} proxies. 2) Does not imply functional forms for the SRR (e.g., horizontal or linear through the origin) that are almost certain to be implausible if extrapolated across the entire range of possible spawning biomasses. 3) Eliminates the need to estimate the more difficult-to-estimate of the two SRR parameters, instead requiring estimation of only the scale parameter, which is analogous to the "average recruitment" currently estimated in all Tier 3 groundfish assessments. 4) This approach has been tested on 11 BSAI and GOA groundfish stocks using a very simple model, and the results appear to be reasonable wherever the assumptions are not violated too severely (6 of the 11 stocks were shown to have breakpoints that passed five statistical tests of significance, with the starting years of the current regimes for these 6 stocks ranging from 1968 to 1990).

Con: 1) Requires use of F_{MSY} proxies. 2) Estimates of derived quantities such as B_{MSY} can be implausible if the F_{MSY} proxies are inconsistent with the data (however, this approach is intended only to estimate the *breakpoints*; estimates of other quantities obtained in the process of determining the breakpoints do not have to be used for management purposes).

Option for any of the above except A2.1: Use a decision-theoretic approach to compute the optimal breakpoints, possibly employing additional constraints such as a minimum length for the current regime or a maximum permissible CV for parameter estimates.

Pro: 1) Costs of mis-estimating a breakpoint are weighted appropriately.

Con: 1) Requires specification of a loss (cost) function. 2) More complicated than an approach that does not weight the costs of mis-estimating a breakpoint appropriately.

B1: Establishing criteria for excluding individual within-regime year classes from estimates

A simple but quantitative evaluation of the alternatives listed here is contained in Appendix C.

Alternative B1.1: Do not exclude any individual within-regime year classes from estimates.

Pro: 1) Eliminates the need to specify quantitative criteria for excluding individual year classes.

Con: 1) May include poorly estimated year classes (e.g., will stock assessment authors be required to estimate strengths of *all* year classes in the current regime, even age 0 in the current year?).

Alternative B1.2 (*provisional recommendation*): Exclude all year classes within the last X years (*provisional recommendation*: X=floor(1/(1−exp(−sqrt(M)))), where year 1 is defined as the first age with a survey selectivity of at least 10%).

Pro: 1) Extremely easy to implement. 2) Always feasible, unless X is set higher than the largest age in the model.

Con: 2) No necessary relationship to precision of estimated year class strengths.

Alternative B1.3: Exclude all year classes with model-estimated CVs greater than X.

Pro: 1) Very easy to implement, where feasible. 2) Clear relationship to precision of estimated year class strengths.

Con: 1) May not be feasible, because model-estimated CVs vary greatly across assessments (for example, looking at the CVs of estimated year class strengths from 1977-2009 in the sablefish and EBS Pacific cod assessments, sablefish had only 3 year classes with a CV of less than 10% compared to 25 year classes for Pacific cod, while sablefish had 25 year classes with a CV of greater than 20% compared to 1 year class for Pacific cod).

Alternative B1.4: Exclude all year classes with model-estimated CVs greater than a fraction X (<1) of the CV at the first age included in the model.

Pro: 1) Very easy to implement, where feasible. 2) Clear relationship to precision of estimated year class strengths. 3) May be more feasible than B1.3, because the *relative* CV (rather than the *absolute* CV) is the criterion.

Con: 1) May still be infeasible (i.e., if X is set too low).

Alternative B1.5: Exclude all year classes with model-estimated CVs greater than a fraction X (>1) of the asymptotic CV (i.e., the limiting CV that is approached as the number of times a year class is observed becomes large).

Pro: 1) Clear relationship to precision of estimated year class strengths. 2) Where feasible, may be more intuitive than the other approaches, because this approach explicitly focuses on using only those year classes where the estimates have truly stabilized.

Con: 1) May be infeasible, because an asymptotic CV does not always exist. 2) The most difficult alternative to implement, because the asymptotic CV may vary from year class to year class.

B2: Use of "conditioned" stock-recruitment parameters (e.g., F_{MSY}=$F_{35\%}$, B_{MSY}=$B_{35\%}$)

(Note: The following alternatives apply to Tier 3 stocks only.)

Alternative B2.1: Do not use conditioned stock-recruitment parameters.

Pro: 1)

Con: 1)

Alternative B2.2 (*provisional recommendation*): Condition the SRR by forcing F_{MSY}=$F_{35\%}$, but estimate B_{MSY} as a free parameter.

Pro: 1)

Con: 1)

Alternative B2.3: Condition the SRR by forcing F_{MSY}=$F_{35\%}$ and B_{MSY}=$B_{35\%}$.

Pro: 1)

Con: 1)

B3: Specification of priors, including hierarchical Bayes and other meta-analytic approaches

Alternative B3.1: Use non-constraining uniform priors only.

Pro: 1)

Con: 1)

Alternative B3.2 (*provisional recommendation*): Use priors that reflect the true amount of prior uncertainty.

Pro: 1)

Con: 1)

Alternative B3.3: Use priors derived from hierarchical Bayes analysis of congeneric stocks.

Pro: 1)

Con: 1)

B4: Alternatives for setting/estimating σ_R

Alternative B4.1: Set σ_R=0.6.

Pro: 1)

Con: 1)

Alternative B4.2: Estimate σ_R iteratively.

Pro: 1)

Con: 1)

Alternative B4.3: Estimate σ_R according to the method presented at the recruitment workshop, which provides the MLE for a univariate, linear-normal model. This method consisted of the following three steps: 1) Estimate recruitment deviations when σ_R is set, provisionally, at a high (i.e., non-constraining value); label this vector **r**. 2) Estimate σ_R iteratively by matching the standard deviations of the estimated recruitment deviations; label this σ. 3) Obtain a final estimate of σ_R as sqrt(var(**r**) – σ·(stdev(**r**)–σ)).

Pro: 1)

Con: 1)

Alternative B4.4: Estimate σ_R as a free parameter.

Pro: 1)

Con: 1)

Alternative B4.5 (*provisional recommendation*): Set σ_R at the maximum of the estimate obtained by the method presented at the workshop and the estimate obtained by treating σ_R as a free parameter.

Pro: 1)
Con: 1)

B5: Determining "reliability" of the F_{MSY} pdf

Alternative B5.1: Determine that the F_{MSY} pdf is reliable if the Hessian matrix is positive definite.
Pro: 1)
Con: 1)

Alternative B5.2 (*provisional recommendation*): Determine that the F_{MSY} pdf is reliable if: 1) the Hessian matrix is positive definite, 2) the average ratio of multinomial effective sample size to multinomial input sample size exceeds unity for all size composition and age composition likelihood components, 3) the mean standardized log-scale residual for each survey abundance likelihood component is between –0.1 and 0.1, and 4) the root-mean-squared standardized log-scale residual for each survey abundance likelihood component is between 0.9 and 1.1.
Pro: 1)
Con: 1)

Alternative B5.3: Determine that the F_{MSY} pdf is reliable if no parameter has an estimated standard deviation (obtained by inverting the Hessian matrix) greater than X or a CV greater than Y.
Pro: 1)
Con: 1)

B6: Other issues involving the stock-recruitment relationship

Alternative B6.1: Continue trying to estimate SRR parameters whenever possible.
Pro: 1)
Con: 1)

Alternative B6.2 (*provisional recommendation*): Continue trying to estimate SRR parameters whenever possible, but also continue research into assessment and management methods that are robust to lack of information about these parameters.
Pro: 1)
Con: 1)

C1: Best practices for incorporating environmental forcing in stock assessments

Alternative C1.1: Do not incorporate environmental forcing in stock assessments.
Pro: 1)
Con: 1)

Alternative C1.2 (*provisional recommendation*): Identify plausible environmental covariates of recruitment outside of the assessment model, then include them as log-linear explanatory variables in the SRR, with parameters estimated inside the assessment model.
Pro: 1)
Con: 1)

Alternative C1.3: Identify plausible environmental covariates of recruitment outside of the assessment model, then include them (adjusted for sign, as appropriate) as pseudo-surveys of recruitment in the assessment model.
Pro: 1)
Con: 1)

C2: How knowledge of environmental forcing changes perceptions of reference points

Alternative C2.1 (*provisional recommendation*): Acknowledge that current knowledge of environmental forcing is insufficient to alter perceptions of reference points quantitatively.

Pro: 1) Extremely easy to implement. 2) Probably an accurate description of the current state of knowledge for the vast majority (if not all) BSAI and GOA groundfish and crab stocks.

Con: 1) Does not advance the state of the art.

Alternative C2.2: Use knowledge of environmental forcing to compare past, present, and projected stock sizes with past, present, and future values of environmentally forced reference points.

Pro: 1) Keeps BSAI and GOA groundfish and crab on the cutting edge of fishery science and management. 2) Avoids comparing apples and oranges in terms of stock status and reference points (i.e., for any year, stock size would be compared to the reference point applicable to that year, as determined by the relevant past, present, or future values of the relevant environmental variables).

Con: 1) Extremely difficult to implement anytime in the near future. 2) Criteria used to make status determinations and to measure rebuilding will be moving targets, even for a fixed set of biological data.

Appendix A: The April 2012 Workshop on Assessment/Management Issues Related to Recruitment

Agenda

	Wednesday, April 4	**Speakers**
0900	Welcome, purpose of workshop, introductions, appointment of rapporteurs	
	A. Identification of regime shifts, either for an ecosystem or some subunit thereof	
	1. Current policy on identification of regime shifts*	
0920	Estimating B_{MSY} for Tier 4 crab stocks and recruitment for Tier 3 crab stocks: Which years are representative?	B. Foy, D. Stram
0945	Jim Balsiger's memo of September 1999	Grant Thompson
0950	Discussion	
1010	- Break -	
	2. Possible improvements to current policy, including consideration of risk*	
1020	A null hypothesis to explain regime-like transitions in ecosystem time series	Emanuele Di Lorenzo
1045	Considerations of biological factors affecting potential crab production regimes	L. Rugolo, J. Turnoc
1110	Identification and management of stocks with regime-based recruitment	Cody Szuwalski
1135	Risk-based selection of regime boundaries for a stock managed under a sloping, SPR-based control rule	Grant Thompson
1200	Discussion	
1220	- Lunch -	
	B. Estimation of parameters (average recruitment, stock-recruitment relationships, σ_R)	
	1. Establishing criteria for excluding individual within-regime year classes from estimates*	
1320	Criteria for excluding individual within-regime year classes from estimates: current practice for EBS pollock	Jim Ianelli
1345	Accounting for uncertainty in estimated recruitment when computing stock status reference points: an example from the 2010 BSAI blackspotted/rougheye rockfish assessment	Paul Spencer
1410	Choice of recruitment periods for OFL determination and its impacts on Bristol Bay red king crab	Jie Zheng
1435	Discussion	
1455	Break	
	2. Use of "conditioned" stock-recruitment parameters (e.g., FMSY=F35%, BMSY=B35%)	
1505	Deriving steepness from F_{MSY} or F_{spr}	Steve Martell
1530	Discussion	
	3. Specification of priors, including hierarchical Bayes and other meta-analytic approaches	
1550	Use of stock-recruit steepness priors based on meta-analysis in West Coast rockfish assessments	Martin Dorn
1615	Preliminary results for developing Bayesian priors for relative cohort strength of groundfishes off the U.S. West Coast using multi-species Stock Synthesis models	Jim Thorson
1640	Discussion	
1700	- Adjourn for the day -	

* Critical items for May 2012 Crab Plan Team meeting

	Thursday April 5th	
B. Estimation of parameters, continued		
	4. Alternatives for setting/estimating σ_R	
0900	Problems associated with estimating recruitment and σ_R in a random effects model	G. Thompson
0925	Discussion	
	5. Determining "reliability" of the F_{MSY} pdf	
0945	Environmental factors affecting EBS pollock S-R relationships	Jim Ianelli
1010	Discussion	
1030	- Break -	
	6. Other issues involving the stock-recruitment relationship	
1040	Improving ecological validity and linkage among spawner recruitment, mortality, age structure, and harvesting models: An example from western rock lobster fishery neutrality harvesting model	Yuk W. Cheng
1105	Comprehensive analysis of the stock-recruitment relationship and reference points	Mark Maunder
1130	A new paradigm for stock-recruitment relationships: Viewing the stock-recruitment relationship as density dependent survival invalidates the Beverton-Holt and Ricker models	Mark Maunder
1155	Discussion	
1215	- Lunch -	
C. Forecasting environmental variability		
	1. Best practices for incorporating environmental forcing in stock assessments	
1315	Advice for estimating fishery management reference points given low frequency between-year environmental variability	Melissa Haltuch
1340	Multispecies modeling, including projections and effects of temperature variability and predators on mortality estimates	Kirstin Holsman
1405	Environmental forcing of recruitment in the Bering Sea and Gulf of Alaska and its use in stock assessments and stock projections	Franz Mueter
1430	Recruitment products and indices from FOCI and BASIS – new proposed products for the Plan Teams and SSC	Jeff Napp
1455	Discussion	
1515	- Break -	
	2. How knowledge of environmental forcing changes perceptions of reference points*	
1525	F_{msy} and B_{msy} proxies by regime	Jim Ianelli
1550	Discussion	
1610	Wrap-up	
1630	- Adjourn -	

* Critical items for May 2012 Crab Plan Team meeting

Modifications to the Agenda

1. Lou Rugulo and Jack Turnock's presentation under item A2 was withdrawn.
2. Unscheduled presentation by Andre Punt on use of surplus production models to estimate B_{MSY} in crab stocks was added in place of Rugulo and Turnock's presentation under A2.
3. Martin Dorn's presentation under item B3 was withdrawn.
4. Unscheduled presentation by Kerim Aydin on a multispecies model with an "emergent" stock-recruitment relationship was added under item C1.
5. Jim Ianelli's presentation under item C2 was withdrawn.

References

A'mar, T. Z., A. E. Punt, and M. W. Dorn. 2009. The impact of regime shifts on the performance of management strategies for the Gulf of Alaska walleye pollock (Theragra chalcogramma) fishery. Canadian Journal of Fisheries and Aquatic Sciences 66:2222-2242.

Arregui, I., H. Arrizabalaga, D. S. Kirby, and J. M. Martin-Gonzalez. 2006. Stock–environment–recruitment models for North Atlantic albacore (*Thunnus alalunga*). Fish. Oceanogr. 15:5, 402–412.

Borja, A., Uriarte, A., Egana, J., Motos, L., and Valencia, V. 1998. Relationship between anchovy (Engraulis encrasicolus) recruitment and environment in the Bay of Biscay (1967-1996).

Brander, K. M. 2005. Cod recruitment is strongly affected by climate when stock biomass is low. ICES Journal of Marine Science, 62: 339-343.

Brooks, E. N., and J. E. Powers. 2007. Generalized compensation in stock-recruit functions: properties and implications for management. ICES Journal of Marine Science: Journal du Conseil 64(3):413-424.

Brooks, E. N., J. E. Powers, and E. Cortés. 2010. Analytical reference points for age-structured models: application to data-poor fisheries. ICES Journal of Marine Science: Journal du Conseil 67(1):165-175.

Chen, D. G.. 2001. Detecting environmental regimes in fish stock– recruitment relationships by fuzzy logic. Can. J. Fish. Aquat. Sci. 58: 2139–2148.

Chen, D. G., and D. M. Ware. 1999. A neural network model for forecasting fish stock recruitment. Can. J. Fish. Aquat. Sci. 56: 2385–2396.

Conn, P. B., E. H. Williams, and K. W. Shertzer. 2010. When can we reliably estimate the productivity of fish stocks? Canadian Journal of Fisheries and Aquatic Sciences 67(3):511-523.

Deriso, R.B., M. N. Maunder, and W. H. Pearson. 2008. Incorporating covariates into fisheries stock assessment models with application to Pacific herring of Prince William Sound, Alaska. Ecological Applications 18(5): 1270-1286.

Deriso, R.B., M. N. Maunder, and J. R. Skalski. 2007. Variance estimation in integrated assessment models and its importance for hypothesis testing. Can. J. Fish. Aquat. Sci. 64: 187-197.

Dorn, M. W. 1995. The effects of age composition and oceanographic conditions on the annual migration of Pacific whiting, *Merluccius productus*. CalCOFI Rep., Vol. 36, 1995.

Forrest, R. E., M. K. McAllister, M. W. Dorn, S. J. D. Martell, and R. D. Stanley. 2010. Hierarchical Bayesian estimation of recruitment parameters and reference points for Pacific rockfishes (Sebastes spp.) under alternative assumptions about the stockrecruit function. Canadian Journal of Fisheries and Aquatic Sciences 67(10):1611-1634.

Francis, R. I. C. C. 2006. Measuring the strength of environment–recruitment relationships: the importance of including predictor screening within cross-validations. ICES Journal of Marine Science: Journal du Conseil 63(4):594-599.

Haltuch, M. A., A. E. Punt, M. W. Dorn. 2009. Evaluating the estimation of fishery management reference points in a variable environment. Fisheries Research 100(42-56).

Haltuch, M. A., and A. E. Punt. 2011. The promises and pitfalls of including decadal-scale climate forcing of recruitment in groundfish stock assessment. Canadian Journal of Fisheries and Aquatic Sciences 68(5):912-926.

Haltuch, M. A., A. E. Punt, and M. W. Dorn. 2008. Evaluating alternative estimators of fishery management reference points. Fisheries Research 94(3):290-303.

Holt, C. A., and A. E. Punt. 2009. Incorporating climate information into rebuilding plans for overfished groundfish species of the U.S. west coast. Fisheries Research 100:57-67.

Humston, R., J. S. Ault, M. Lutcavage, and D. B. Olson. 2000. Schooling and migration of large pelagic fishes relative to environmental cues. Fish. Oceanogr. 9:2, 136-146.

Lee, H-H., Maunder, M.N., Piner, K.R., and Methot, R.D. (in press) Can steepness of the stock-recruitment relationship be estimated in fishery stock assessment models? Fisheries Research. (http://www.sciencedirect.com/science/article/pii/S0165783612001099?v=s5)

Litzow, M. A. 2006. Climate regime shifts and community reorganization in the Gulf of Alaska: how do recent shifts compare with 1976/1977? ICES Journal of Marine Science, 63:1386-1396.

Maunder, M.N. 1998. Problems with using an environmental based recruitment index: examples from a New Zealand snapper (*Pagrus auratus*) assessment. In fishery stock assessment models, edited by F. Funk, T.J. Quinn II, J. Heifetz, J.N. Ianelli, J.E. Powers, J.J. Schweigert, P.J. Sullivan, and C.I. Zhang, Alaska Sea Grant College Program Report No. AK-SG-98-01, University of Alaska Fairbanks, pp. 679-692.

Maunder, M.N. 2004. Population Viability Analysis, Based on Combining Integrated, Bayesian, and Hierarchical Analyses. Acta Oecologica 26: 85-94. Special issue for the Extinction Working Group of the National Center for Ecological Synthesis and Analysis.

Maunder, M.N. 2012. Evaluating the stock-recruitment relationship and management reference points: Application to summer flounder (Paralichthys dentatus) in the U.S. mid-Atlantic. Fisheries Research 125-126: 20-26. (http://www.sciencedirect.com/science/article/pii/S0165783612000811)

Maunder, M. N., and R. B. Deriso. 2003. Estimation of recruitment in catch-at-age models. Canadian Journal of Fisheries and Aquatic Sciences 60:1204-1216.

Maunder, M. N. and R. B. Deriso. 2010. Dealing with missing covariate data in fishery stock assessment models. Fisheries Research 101: 80-86.

Maunder, M. N. and R. B. Deriso. 2011. A state–space multistage life cycle model to evaluate population impacts in the presence of density dependence: illustrated with application to delta smelt (*Hyposmesus transpacificus*). Can. J. Fish. Aquat. Sci. 68: 1285–1306.

Maunder, M. N., S. J. Harley, and J. Hampton. 2006. Including parameter uncertainty in forward projections of computationally intensive statistical population dynamic models. ICES Journal of Marine Science, 63:969-979.

Maunder, M.N. and Starr, P.J. 1998. Validating the Hauraki Gulf snapper pre-recruit trawl surveys and temperature recruitment relationship using catch at age analysis with auxiliary information. New Zealand Fisheries Assessment Research Document 98/15 23p.

Maunder, M. N., and G. M. Watters. 2003. A general framework for integrating environmental time series into stock assessment models: model description, simulation testing, and example. Fishery Bulletin 101: 89-99.

Methot, R. D., and I. G. Taylor. 2011. Adjusting for bias due to variability of estimated recruitments in fishery assessment models. Canadian Journal of Fisheries and Aquatic Sciences 68:1744-1760.

Myers, R.A. 1998. When do environment–recruitment correlations work? Rev. Fish Biol. Fish. 8(3): 285–305. doi:10.1023/ A:1008828730759.

Punt, A. E. 2011. The impact of climate change on the performance of rebuilding strategies for overfished groundfish species on the U.S. west coast. Fish and Fisheries 109(2-3):320-329.

Schirripa, M. J., C. P. Goodyear, and R. D. Methot. 2009. Testing different methods of incorporating climate data into the assessment of US West Coast sablefish. ICES Journal of Marine Science 66:1605-1613.

Sinclair, F., and W. R. Crawford. 2005. Incorporating an environmental stock–recruitment relationship in the assessment of Pacific cod (Gadus macrocephalus) Fish. Oceanogr. 14:2, 138–150.

Walters, C. J., R. Hilborn, and V. Christensen. 2008. Surplus production dynamics in declining and recovering fish populations. Canadian Journal of Fisheries and Aquatic Sciences 65(11):2536-2551.

Williams, E. H., and K. W. Shertzer. 2003. Implications of life-history invariants for biological reference points used in fishery management. Canadian Journal of Fisheries and Aquatic Sciences 60(6):710-720.

Zhu, J-F, Chen, Y., Dai, X.J., Harley, S.J., Hoyle, S.D., Maunder, M.N., Aires-da-Silva, A. 2012. Implications of uncertainty in the spawner-recruitment relationship for fisheries management: an illustration using bigeye tuna (Thunnus obesus) in the eastern Pacific Ocean. Fisheries Research 119–120:89–93. (http://www.sciencedirect.com/science/article/pii/S0165783611003869)

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Appendix B: Establishing Criteria in Estimating B_{MSY}

CPT (May 2011) with SSC revision (June 2011)

These criteria to select the time period to represent B_{MSY} or B_{MSYproxy} should be included in the analysis in each SAFE.

The time period should be representative of the stock fluctuating around B_{MSY}. The time period should be representative of the stock being fished at an average rate near F_{MSY}. For Tier 3 we are looking for an average recruitment and not an average biomass (B_{MSYproxy} formally only applies to Tier 4).

1. Provide an estimate of the production potential of the stock over the full time period of the assessment.
    a. Identify if the stock below a threshold for responding to increase production.
    b. For Tier-3 stocks, provide the time series of ln(R/S) and recruitment (R). For crab stocks, S is mature male biomass at the time of mating, and R is model estimate of recruitment.
    c. For Tier-4 stocks, provide a surplus production analysis using biomass and catch to evaluate the production potential over time. Give the formula for surplus production (units of MMB). Annual surplus production (ASP_t) is equivalent to the amount of yield that could have been taken in a given year that would have left the stock at equilibrium,

    $ASP_t = B_{t+1} - B_t + C_t$

    B_{t+1} = biomass in year t+1

    B_t = biomass in year t

    C_t = catch in year t

    Also, evaluate the time series of survey recruiting size class as a recruitment index. If it looks consistent look at time series of survey R/S.

    d. Identify potential mechanisms that should be considered to support production changes (i.e. Regime Shifts) based on a. and b. above. Consider evidence of a change in magnitude and direction of life-history characteristics that support a proposed change in production.

    Candidate life-history characteristics (empirical data) include:

    i. Natural Mortality (M)
    ii. Growth
    iii. Maturity (maturity schedule)

iv. Fecundity
v. Recruitment & recruits/spawner
vi. Candidate ecosystem characteristics (empirical data) include:
   1. Overland method of Regime Shift detection
   2. Change in production of benthic spp. in EBS.
   3. Consumption (ecosystem model output).

2. Provide a plot of the history of the exploitation rate on MMB at the time of the fishery relative to F_{MSY} (Tier-3) or relative to the F_{MSY}=M proxy (Tier-4).
3. Provide a plot of the history of the exploitation rate on MMB at the time of the fishery relative to ln(R/S) (Tier-3) or relative to $\ln(R_{OBS}/MMB_{OBS})$ (Tier-4) where R_{OBS} is observed survey recruitment and MMB_{OBS} is observed survey MMB at the time of mating.
4. Examine the stock-recruitment relationship (SRR) for evidence of:
   a. Depensation in the SRR.
   b. Multiple SRRs consistent with a proposed regime shift paradigm.

The following methods were discussed by the CPT and SSC but considered not to be viable (see June 2011 SSC minutes). They are left in this version so that authors may comment on/ or consider their use.

5. For many crab stocks, historical rates of exploitation were higher or lower than current estimates of maximum rates fishing at F_{MSY}. The resultant B_{MSY} would be a biased (low or high) measure of reproductive potential since MMB at mating is tabulated after the extraction of the catch. If recruitment was maintained despite the difference, the extent of this bias is proportional to the magnitude of the catch above or below fishing at F_{MSY}. The recalculated B_{MSY} should be a better reference biomass estimate regardless of whether catches were larger or smaller than F_{MSY} catch.

6. For Tier-4 stocks, an alternative $B_{MSYproxy}$ can be estimated that adjusts for stock losses in excess of F_{MSY}. The analyst should estimate $B_{MSYproxy}$ based on the following approach:
   a. Using observed survey mature male biomass, estimate mature male biomass at the time of the fishery.
   b. Using the F_{MSY} proxy, estimate the catch using the biomass from (a).
   c. In years where exploitation rates exceeded those at F_{MSY}, replace the observed catch with that from (b) and recalculate MMB at mating.

d. Produce a new time series of MMB at mating replacing those years where MMB was recalculated in (c).
e. Recalculate $B_{MSYproxy}$ over the reference time period with the new time series of MMB at mating derived in (d).

Appendix C: A simple analysis of the B1 alternatives

Assumptions common to all examples discussed here:

A. The observational data consist of a survey time series (of length n) of numbers at age, which, when log-transformed, are distributed normally about the true log numbers at age.
B. The time series of Q, selectivity at age, and Z at age are known.

Given the above assumptions, after n observations, the CV of a cohort's estimated initial abundance (i.e., the abundance at some age prior to the age at the first observation) is equal to sqrt($h(n)/n$), where $h(n)$ is the harmonic mean of the time series of the log-scale observation error variances. To make things even simpler, an additional assumption will be used:

C. The log-scale observation error variance is equal to the following constant function of age (t): sigma^2 = exp($a + b*t + c*t$^2).
   a. In the special case where b=c=0, the CV of the estimated initial abundance after n years is CV(n)=sqrt(exp(a)/n). Note that this value equals zero in the limit as n approaches infinity.
   b. In the special case where b≠0 and c=0, the CV of the estimated initial abundance after n years is CV(n)=sqrt(exp(a)*(exp(b)-1)/(1-exp(-b*n))). Note that this value equals zero in the limit as n approaches infinity, as in the b=c=0 case.
   c. In the general case where b≠0 and c≠0, there is no short-hand formula for the CV of the estimated initial abundance after n years . In contrast to the two previous cases, CV(n) reaches a positive asymptote (the "asymptotic CV") in the limit as n approaches infinity.

Alternatives for criteria pertaining to exclusion of the most recent within-regime year classes:

1. Exclude no year classes.
2. Exclude all year classes within the last X years.
   a. In the special case where b=c=0, the *proportional reduction* in CV relative to CV(1) will depend only on X, but the *absolute* CV will also depend on a.
   b. In the special case where b≠0 and c=0, the *proportional reduction* in CV relative to CV(1) will depend only on X and b, but the *absolute* CV will also depend on a.
   c. In the case where b≠0 and c≠0, both the *proportional reduction* in CV relative to CV(1) will depend only on X, b, and c; but the *absolute* CV will also depend on a.
3. Exclude all year classes with model-estimated CVs greater than X.
   a. In the special case where b=c=0, the number of years needed to achieve CV(n)=X and the *proportional reduction* in CV relative to CV(1) will both depend on X and a.
   b. In the special case where b≠0 and c=0, the number of years needed to achieve CV(n)=X and the *proportional reduction* in CV relative to CV(1) will both depend on X, a, and b.
   c. In the case where b≠0 and c≠0, it will be impossible to achieve CV(n)=X if X is set too low. If X is set sufficiently high, the number of years needed to achieve CV(n)=X and the *proportional reduction* in CV relative to CV(1) will both depend on X, a, b, and c.
4. Exclude all year classes with model-estimated CVs greater than a fraction X (<1) of the CV at the first age included in the model.

   a. In the special case where $b=c=0$, the number of years needed to achieve CV(n)=X*CV(1) will depend only on X, but the *absolute* CV will also depend on a.
   b. In the special case where $b\neq0$ and $c=0$, the number of years needed to achieve CV(n)=X*CV(1) will depend only on X and b, but the *absolute* CV will also depend on a.
   c. In the case where $b\neq0$ and $c\neq0$, it will be impossible to achieve CV(n)=X*CV(1) if X is set too low. If X is set sufficiently high, the number of years needed to achieve CV(n)=X*CV(1) will depend only on X, b, and c; but the *absolute* CV will also depend on a.
5. Exclude all year classes with model-estimated CVs greater than a fraction X (>1) of the asymptotic CV.
   a. In the special case where $b=c=0$, the asymptotic CV is zero, so the number of years needed to achieve CV(n)=X*CV(∞) will always be infinite.
   b. In the special case where $b\neq0$ and $c=0$, the asymptotic CV is zero, so the number of years needed to achieve CV(n)=X*CV(∞) will always be infinite.
   c. In the case where $b\neq0$ and $c\neq0$, the number of years needed to achieve CV(n)=X*CV(∞) will depend only on X, b, and c; but the *absolute* CV will also depend on a.

Note that Alternative #1 is the only one that works regardless of the values of the parameters. However, this begs the question of what to count as the "first observation." Here are some alternatives:

I. The first observation is the first age in the model. This definition could be problematic, because some models start at an age prior to the first age with data (e.g., SS always starts at age zero); conversely, an author might start the model well past the first age with data.

II. The first observation is the first age with relative abundance data for the cohort in question. This definition could be problematic if only a trivial amount of abundance data exist at the first age thus defined.

III. The first observation is the first age with *significant* relative abundance data for the cohort in question. This begs the question of what constitutes "significant." Some sub-alternatives:
   i. "Significant" means an observation error CV of less than X. This definition could be problematic if X is set so low that the definition cannot be satisfied at any reasonably low age (or, worse, not at all).
   ii. "Significant" means estimated survey selectivity greater than X in the respective age and year.

Report of the retrospective analysis working group

Alaska Groundfish Plan Teams: Bill Clark, Dana Hanselman, and Mike Sigler

September 2012

The Plan Teams tasked a group of three members to review the value of adding retrospective analyses to Alaska fisheries stock assessments. We were fortunate that a comprehensive review already was available (LeGault 2009). In our review, we summarize the comprehensive review, recommend an approach for Alaska stock assessments, and show some examples for Alaska stock assessments.

Summarize LeGault (2009)

A workshop on retrospective patterns in stock assessment estimates was held in Woods Hole in 2008 (Legault 2009). The group considered different measurements of retrospective differences, causes of retrospective patterns, feasibility of identifying the causes of retrospective patterns, and feasibility of fixing retrospective patterns. The following definition of a retrospective pattern and the group's conclusions and recommendations are taken from the report.

Definition

A retrospective pattern is a systematic inconsistency among a series of estimates of population size, or related assessment variables, based on increasing periods of data (Mohn 1999). There are two types of retrospective patterns: historical and within-model. The historical retrospective analysis is conducted by examining the results of each final assessment for a number of years in a row and determining whether there was a consistent pattern of overestimating or underestimating assessment values in successive years. This type of retrospective pattern can be caused by changes in the data, type of assessment model, or assessment model formulation and is most important to managers because it relates directly to the management choices made in the past based on the information available at the time. In contrast, the within-model retrospective analysis uses the same data, type of assessment model, and assessment model formulation and trims the most recent year's data in successive model runs. The within-model retrospective patterns are most useful for determining an internal inconsistency in the data because the only changes in the different runs are the number of years of data in the model.

Conclusions of the workshop

1. A retrospective pattern is an indication something is inconsistent (data and/or model).
2. Lack of a retrospective pattern does not mean all is well. Based on simulations, data or model inconsistency does not always produce a retrospective pattern. Retrospective patterning is just one diagnostic to be considered when conducting stock assessments.
3. Simulated retrospective patterns can be caused by time trending changes in biological characteristics, catch, survey catchability, or spatial concentration of the population. Multiple sources may occur in assessments.
4. The source(s) of the retrospective pattern can be anywhere in the time series. Some methods were presented to identify when the change took place (moving window, q surface, mean square residual local inference surface).
5. The true source(s) of a retrospective pattern have not been identified using current methods.

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Knowledge of events in the fishery or biological information may help identify probable sources.
6. Interventions (correlated errors) are more likely to cause retrospective patterns than random noise.
7. Splitting surveys, changing *M*, or changing catch may reduce the retrospective pattern, but do not necessarily produce an assessment closer to the truth, although the other diagnostics for the new assessment may be fine.
8. The retrospective statistic, rho, may be a useful measure of the amount of retrospective pattern. A strong retrospective pattern can be defined by the degree of overlap between confidence intervals from different terminal years.
9. Local influence surface analysis using rho is not useful for diagnosing the timing or source of retrospective patterns. In many stocks, strong retrospective patterns typically persist.

Recommendations of the workshop

1. Always check for the presence of a retrospective pattern.
2. If a model shows a retrospective pattern, then consider alternative models or model assumptions.
3. Develop objective and consistent criteria for the acceptance of assessments with retrospective patterns.
4. A strong retrospective pattern is grounds to reject the assessment model as an indication of stock status or the basis for management advice.
5. When a moderate retrospective pattern is encountered: (not an exhaustive list)
    a. Consider alternative states of nature approach to advice.
    b. Investigate the performance of alternative methods for retrospective adjustments through management strategy evaluations.
6. Use biological and fishery hypotheses and auxiliary information as a basis for adjustments for retrospective patterns.
7. Consider use of survey swept area numbers instead of mean catch per tow in assessment models.
8. The presence and implications of a retrospective pattern as a source of uncertainty in the assessment should be clearly communicated to managers.

Recommendation for stock assessment authors

There is currently not an accepted level of retrospective bias beyond which an assessment is deemed to exhibit a retrospective pattern (LeGault 2009). Simulation exercises specifically designed to mimic the level of uncertainty in the assessment data may reveal how often a pattern might be expected in real assessments could provide guidance. However, this approach would be labor intensive and be done for each model formulation of a specific assessment (LeGault 2009). Instead, the typical approach has been to focus on within-model effects, look at the plots and make a subjective decision based on the number of years which deviate from the full time series assessment in the same direction.

For Alaska groundfish assessments with age-structured models (Tier 3 and higher),we recommend that a retrospective analysis be presented as part of the model evaluation. Specifically, stock assessment authors are requested to conduct the within-model approach and rerun the model, successively dropping data one year at a time. Specifically the analysis should include:

1. Running retrospectives back to 2002 (where 2002 would be a terminal year) for the base-case assessment in 2012 (i.e., drop 10 years of most recent data);
2. Plotting spawning biomass time series for each model run;
3. Plot of relative changes referenced to the terminal model run.

We envisage having this for all full assessments presented for the 2012 November-December Council review cycle. Example plots requested are (from Legault 2009):

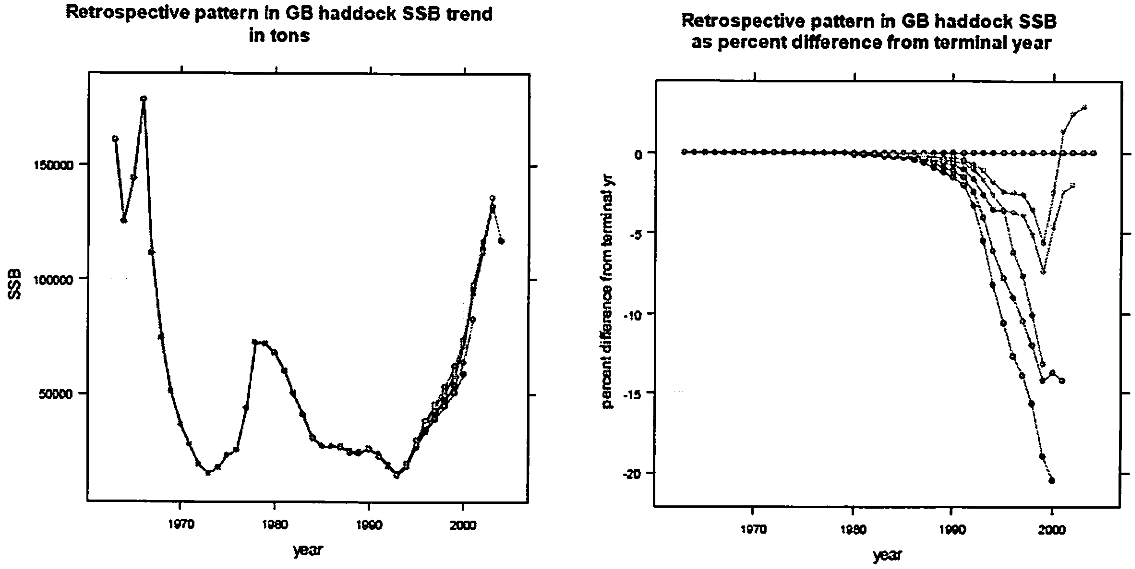

Figure 4. Retrospective plots for Georges Bank haddock, standard plot on left and relative plot on right.

Examples

We include several examples of the recommended analyses (Figs. 1-3). In these examples, there appear to be two distinct types of retrospective pattern. For Gulf of Alaska Pacific ocean perch and northern rockfish (Figs. 1 and 2), the retrospective patterns in the assessment results appear to be data-driven. The retrospective change in estimates occurs only when a new trawl survey is included (every two years). Both of these species have had relatively large, imprecise increases in trawl survey biomass estimates since 1999. However, the two species age structures are quite different. The bulk of the increase in survey biomass for the northern rockfish population appear to be driven by increases in the abundance in the older age-classes, while the bulk of the increase in Pacific ocean perch survey biomass is driven by increased abundance of the younger age classes. Increased survey abundance in the older age-classes over time is the likely cause of the changes in the historical estimates (1960-1990) of northern rockfish, because as each successive survey is added the model increases the historical abundance to explain the increased abundance in the older age classes that was observed in the survey. Alternatively, changes in historical abundance estimates is not as drastic in the Pacific ocean perch model, rather estimates of abundance change in recent years are likely due to observations of younger fish in the survey that influence estimates of recruitment in the model. These data-driven examples exhibit retrospective patterns that probably are of little concern.

Another type of retrospective pattern is illustrated by Alaska sablefish (Fig. 3). This retrospective pattern is unlikely to be considered severe, but at issue is the "one-way" pattern. As data are added, the recent estimates of spawning biomass decrease slightly for each of the 10-year retrospectives. This contrasts with the rockfish examples because the patterns of fits relative to the survey indices varied (both increasing and decreasing). This is likely because the Alaska sablefish model integrates a larger number of datasets (e.g., the model has three abundance indices compared to one for the rockfish examples). Also, in the last several years the magnitude of the retrospective pattern seems to have dissipated. It is difficult to isolate the cause of this pattern but several possibilities exist. For example, hypotheses could include environmental changes in catchability, time-varying natural mortality, or changes in selectivity of the fishery or survey.

While the patterns in these examples may be acceptable, it would be worthwhile for assessment authors to evaluate which parameters or model configurations that might best be altered to remove the pattern. Although, as advised in Legault (2009), isolating a parameter that fixes the retrospective pattern does not necessarily warrant changing that parameter in the model or that the fixed model is any closer to the 'truth', but is a good exercise in model exploration and sensitivity.

If an approach and the final model specification fail to correct a strong one-way retrospective pattern, then we recommend that this be highlighted as a rationale for potentially setting the recommended ABC below the maximum permissible value if the model-driven pattern is biased high. Conversely, a strong retrospective pattern that is consistently biased-low could be used as evidence to set the ABC at maximum permissible despite other evidence of low stock size. The Plan Teams will need to review these retrospective analyses across Alaska stocks to determine what constitutes a "strong" one-way pattern.

Acknowledgement
We thank Pete Hulson for providing the rockfish retrospective runs and figures.

References

Legault, C.M., Chair. 2009. Report of the Retrospective Working Group, January 14-16, 2008, Woods Hole, Massachusetts. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 09-01; 30 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

Mohn, R. 1999. The retrospective problem in sequential population analysis: An investigation using cod fishery and simulated data. ICES J. Mar. Sci. 56: 473-488.

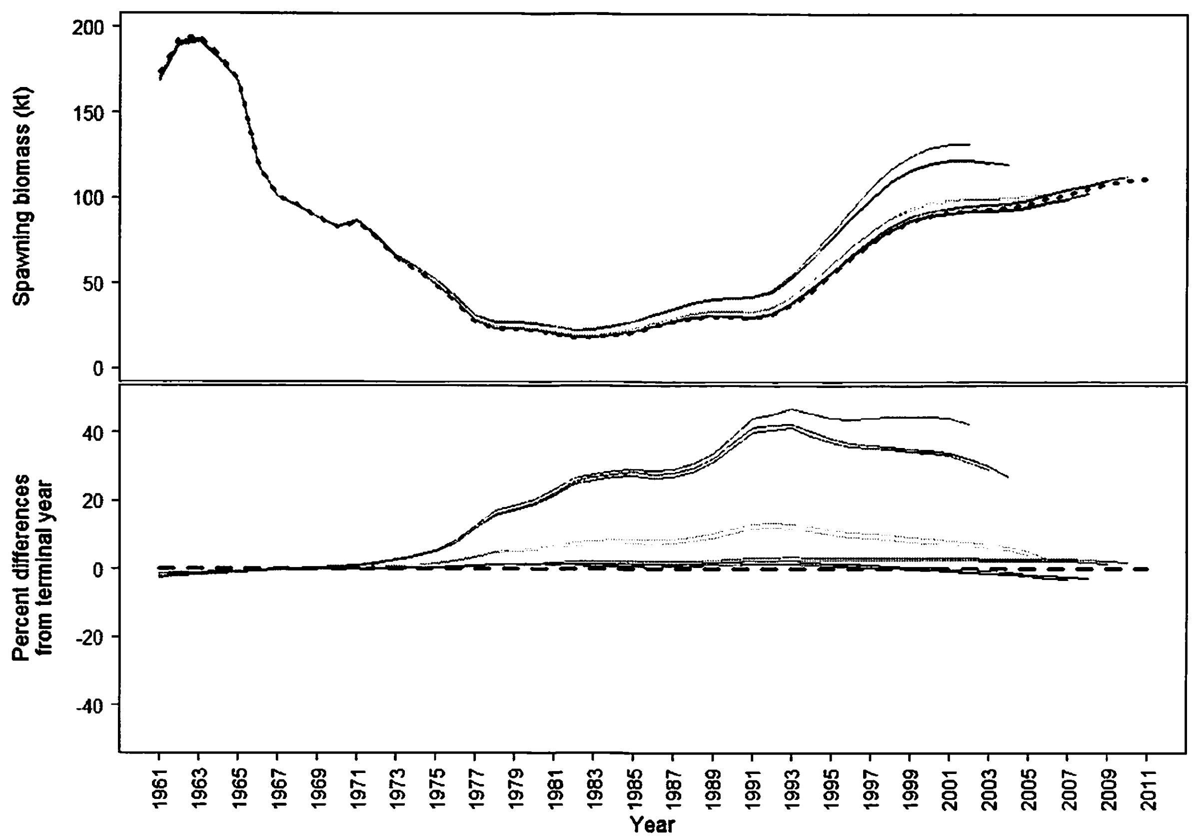

Figure 1. Within – model retrospective plots for Gulf of Alaska Pacific ocean perch. Top panel is absolute change in female spawning biomass. Bottom panel is the relative difference in each year to the terminal year estimates. Black dashed line is the terminal year estimates, while pairs of the same color are based on the same survey results due to biennial surveys.

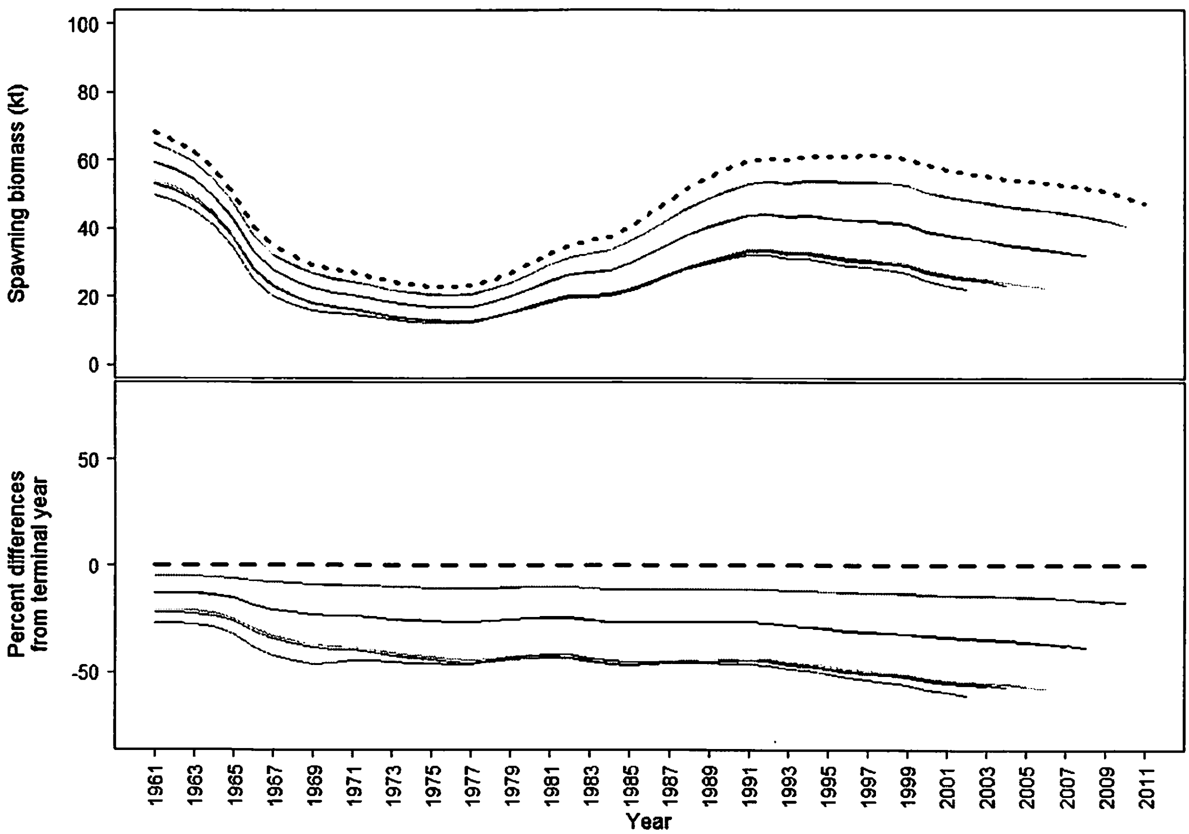

Figure 2. Within – model retrospective plots for Gulf of Alaska Pacific northern rockfish. Top panel is absolute change in female spawning biomass. Bottom panel is the relative difference in each year to the terminal year estimates. Black dashed line is the terminal year estimates, while pairs of the same color are based on the same survey results due to biennial surveys.

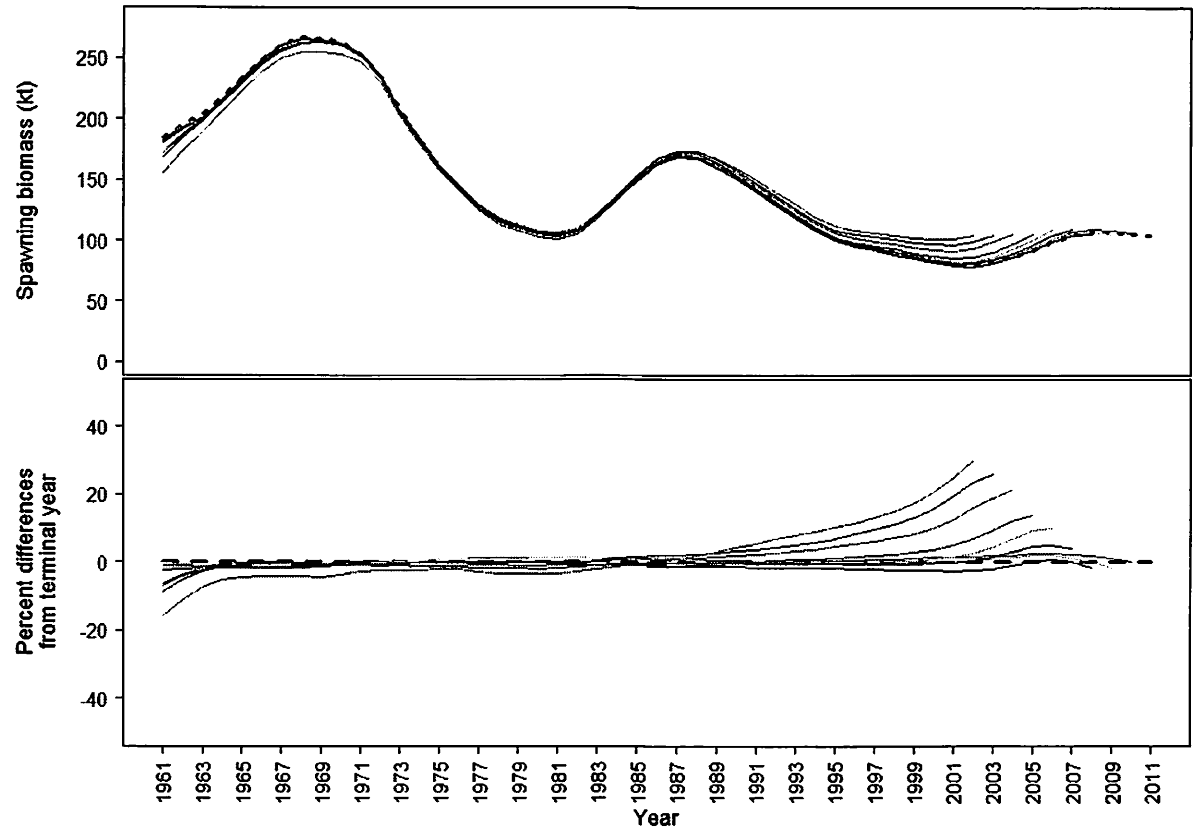

Figure 3. Within – model retrospective plots for Alaska sablefish. Top panel is absolute change in female spawning biomass. Bottom panel is the relative difference in each year to the terminal year estimates. Black dashed line is the terminal year estimates.

Report of the working group on methods for averaging surveys

Background

For the 2012 assessment cycle, the Groundfish Plan Teams appointed a number of working groups. General terms of reference for the working groups were as follow:

> "Working groups are tasked with developing/collating and analyzing alternative policies/approaches for their respective topic. Analyses can be either quantitative or qualitative (i.e., listing likely pros and cons). Ideally, the working group reports will be substantial enough that the Teams can use them to make informed policy recommendations, which will then be forwarded to the SSC for comment."

This report describes the progress of the working group tasked with addressing issues pertaining to averaging of survey biomass estimates (Jon Heifetz, Jim Ianelli, Paul Spencer, and Grant Thompson). Specific topics assigned to the group included the following:

1. Methods for using survey time series to produce a "reliable" estimate of biomass for stocks/complexes managed under Tier 5, including an inventory of methods presently in use.
2. Methods for using survey time series to apportion ABC among areas.
3. Methods for filling in unsurveyed areas during years when survey funding was unavailable. For example, this applies to the groundfish bottom trawl survey in the GOA, and some periods for the sablefish longline survey (e.g., where the eastern Aleutian area is surveyed in alternate years with EBS slope areas).

The working group focused on topics #1 and #2. Further work on topic #2 is needed and work on topic #3 was initiated based on an extension of topic #1.

Simulation modeling

Two simulation models were developed in order to generate data sets for testing various methods for obtaining reliable biomass estimates and subarea proportions from survey time series. First, a single-area model was developed to evaluate estimation of biomass. Operational models were developed for "Pacific ocean perch" (POP) and "walleye pollock" life-history patterns. The group considered the following variables in conducting the simulations: coefficient of variation (CV) of survey biomass estimates, survey frequency/data availability, stock longevity/productivity, trend in fishing mortality/biomass, and recruitment variability. The single-area model simulations used the following parameter settings:

Survey CV:
This was approximated by the σ parameter of a lognormal distribution, and values of 0.15 and 0.35 were used.

Natural mortality (*M*):
Set to 0.06 and 0.30 for the POP and walleye pollock life history types, respectively.

Recruitment variability (σ_R):
Evaluated at 0.8 and 0.4.

Survey frequency:
We considered annual, biannual, and triannual survey schedules.

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Trend in fishing rate/biomass:
Trends in biomass were produced by varying the fishing rate over time. Three patterns were evaluated: 1) an increasing biomass trend (F_{spr} changes from $F_{20\%}$ to $F_{100\%}$ over the simulation); 2) a decreasing biomass trend (F_{spr} changes from $F_{100\%}$ to $F_{20\%}$ over the simulation); and 3) a constant trend (F_{spr} held at $F_{50\%}$ over the simulation).

The variables above result in 36 permutations for each life history type. For each permutation, 100 simulations of 54 years were conducted (this ensured that the end year had a survey for each of the three survey frequencies)

Simulations with movement

For analysis of estimation of area proportions, the single-area model was expanded to a three-area model, with the areas organized in a linear pattern (as along a coastline or island chain). At each time step, the total number of recruits was obtained from a Beverton-Holt recruitment function applied to the total level of spawning stock biomass. The total predicted recruits were distributed with 40% to the central area and 30% to each of the other two areas. Recruitment variability was then added to the predicted recruits in each subarea, and this variability incorporated global variability (identical for all subareas) and local variability (separate for each subarea). The variability was modeled with lognormal distributions, with the global values of σ evaluated at 0.8 and 0.4, and the local values of σ were set to one half the global value.

Adults were allowed to move between areas. The proportion of adults moving from a subarea was modeled as function of age with a logistic function. Two levels for maximum proportion of fish (by age) moving were used (0.1 and 0.3). The age at which the movement rate reached 50% of maximum was set to age 3 for pollock and age 8 for POP; these ages roughly correspond to the age at 50% maturity.

In the multiple-area model, estimates of survey biomass are modeled for each subarea. Because of this finer scale of resolution, the subarea survey CVs were increased from those used in the single area model. Values of 0.25 and 0.6 were evaluated.

Evaluation of the two values of maximum proportion of adult movement increased the number of permutations for each life-history type to 72. As with the single-area model, 100 simulations of 54 years were conducted for each permutation.

Estimation methods

Inventory of current methods

The first task completed was an inventory of methods used for averaging survey estimates for stock assessment and ABC considerations for the BSAI and GOA (Table 1). The methods used for different stocks vary and are listed in Table 2. This illustrates the variety of methods presently in use and also provided guidance on a range of methods to evaluate against the simulated data:

1. The most recent survey estimate
2. Simple recent N survey average (N= 3, 4)
3. Weighted versions of 2)
4. Simple Kalman filter, with trend assumed to be zero (i.e., random walk).

In the BSAI, methods for obtaining biomass for Tier 5 stocks include all of the methods listed above, with a simple average and the most recent survey biomass estimate being the most common. For GOA Tier 5 stocks, a simple average was the most common method, being used in 7 of 11 cases. In the BSAI, weighted averages were used to produce area proportions in 4 of the

6 cases where they were used to estimate overall biomass. In contrast, area proportions were used in 19 cases in the GOA, with the most common methods being weighted average (7 cases) and most recent survey (7 cases).

The Kalman Filter (KF) approach applied here partitions the variability due to underlying processes (i.e., changes in population "state" from one year to the next) from the observation errors due to sampling. The KF model will estimate high values for process errors when the population appears to fluctuate broadly and observations are highly precise. In situations where observation errors are high, the ability to detect population fluctuations will decrease and the overall uncertainty may remain high. In addition to applying the KF to the simulated datasets, we also provide a graphical presentation of a similar approach (a random-walk model in which the process errors are treated as random effects) applied to actual survey estimates from the GOA and Aleutian Islands.

Performance statistics selected include the mean relative error of biomass (relative error is defined here as estimate/true-1) and variability in relative errors.

Results

Estimation of survey biomass

For the pollock stock, Tables 3 and 4 show the mean relative error (averaged across runs for each scenario) while Tables 5 and 6 show the standard deviation of the relative errors for the different simulation cases and estimation methods. Analogous results for the POP stock are provided in Tables 7-10. Column labels for the "weighted average" methods represent exponential weighting terms applied to the entire time series. Column labels for the "unweighted average" methods represent the number of years included in the average (note that weighted and unweighted averages with parameter 1 are identical).

Over all the scenarios, some weighted average methods performed well in terms of low bias, as did the Kalman filter. However, the variability was higher for these and hence the Kalman filter would be preferred.

Between species, the Kalman filter performed better (over all scenarios) for pollock than POP relative to the alternatives tested (Table 11).

Estimation of area proportions

"Relative proportion error (individual areas, pollock).xlsx[1]" and "Relative proportion error (individual areas, POP).xlsx" show statistics pertaining to the relative errors in estimates of ending biomass *proportions* among areas for each species, scenario, and method. Two groups of three sheets are included in each file, with each group being analogous to the tables described above. The first set of three sheets bases the calculations on the proportions of the averages, whereas the second set of three sheets bases the calculations on the averages of the proportions.

Two conclusions are especially apparent: First, the mean relative errors are *extremely* small for all methods (rarely exceeding 1%). Second, the methods which come closest to taking an arithmetic average of the entire time series tend to produce the smallest standard deviations, which was not at all the case in the first set of simulations (see preceding subsection). Both of these results are likely explained by the fact that, because recruitment was distributed in constant proportion to all three areas (albeit with some additional local variability) and because fishing

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[1] Available at www.afsc.noaa.gov/refm/stock/Plan_Team/working_groups/simulations.htm

mortality trends were identical across all three areas, the proportion of biomass in each of the three areas was fairly stable over time.

Application of the Kalman Filter approach to example datasets

An approximation to the Kalman Filter can be written as a random effects (RE) model where the process errors (step changes) from one year to the next are the random effects to be integrated over and the process error variance is a free parameter. The observations can be irregularly spaced. The box below shows the contents of a typical data file:

```
# Aleutian Islands Kamchatka flounder
# Year range
1991 2013
#Number of observations
8
#Years of observations
 1991  1994  1997  2000  2002  2004  2006  2010
#Biomass estimates
16255 49156 37664 28535 49035 39219 45369 53962
#Std Errors of biomass estimates
4458  18522  9588  6601 13634  9219 11058 20567
```

Results from this model for selected Aleutian Islands stocks are shown in Fig. 1. Note the interplay between the magnitude of the observation errors and that predicted by the model and how this can provide a way to naturally weight observations going forward.

This model can also be applied to situations where there are missing regions in some years as is the case with the GOA. Figures 2 and 3 show two stocks where the model is fit to each region independently, noting that the values for 2001 are missing due to lack of funding to complete a GOA-wide survey. Given that the performance of the KF method tested well for individual time series, it may follow that applying it to regional time series to “fill in” missing years of data may be appropriate (and it should be feasible to compute uncertainties for application in P^*-based ACLs).

Discussion

Webster (2011) conducted an evaluation (without simulations) using a Kalman filter approach with alternative models including the trendless random walk used here along with 3 other forms that allowed for underlying trends to be estimated. He concluded that the trendless model performed adequately and based on evaluations of halibut longline survey data from a variety of different areas that a general historical weighting scheme was a suitable approximation to the results from the Kalman Filter application (with the 3-most recent surveys being weighted 70:25:5 (with 70 being the most recent). The KF method applied here could be used to develop similar “rules of thumb” but this may likely vary by species.

Our workgroup was tasked with three topics:

1) obtaining a reliable” estimate of biomass for Tier 5 stocks
2) Methods for using survey time series to apportion ABC among areas and
3) Methods for covering unsurveyed areas.

For tier 5) stocks the KF or RE model could be used to address all three topics simultaneously. The KF or RE model could be applied to each area separately which would enable calculation of apportionments and filling in for unsurveyed areas. The overall ABC could then be based on the sums of the individual areas.

Recommendations

The Kalman Filter approach was simple to apply and performed well in the simulations, and the RE model gave very similar results in limited testing. A next step would be to apply the methods described here to a range of species and compare ABC values and apportionments to that currently used. The KF has the added benefit of providing estimates of biomass variances which combine the process errors and observation errors. This approach could prove useful for application to risk-averse ACL specifications. In particular, it provides insight on the loss of information as surveys become more or less infrequent.

We recommend that the Kalman filter or RE model be applied to obtain the "reliable biomass" estimate required for Tier 5 stocks. Depending upon how quickly a generic and user-friendly computer program can be developed, we recommend that this change be instituted for the 2012 assessments if possible, but no later than the 2013 assessments.

Regarding apportionment, while further work is needed, the KF and RE methods also hold promise since they naturally weight the time series of information by region according to the level of sampling (e.g., if an area is missed in a survey year or less well covered).

Future work

As mentioned above, the ability of the methods to estimate relative proportions could reflect the strongly coupled dynamics between the subareas assumed in the simulation, which resulted in the true proportions not varying extensively over time. This modeling approach was consistent with viewing the three subareas as components of a single stock, as strongly different population trends between the subareas would suggest relatively isolated population units. Nonetheless, further work involving greater variability in biomass proportions over time (from some combination of spatial variation in fishing pressure and recruitment dynamics) will be needed to further evaluate the various methods' usefulness in making area apportionments.

Another method that the working group hopes to pursue in the coming year is a vector autoregressive model in which the two elements of the state vector are survey biomass (scaled relative to the time series mean) and the ratio of catch to survey biomass. The only data required are the time series of survey biomass and catch, plus standard errors for each. The model is cast in state-space form and estimated via the Kalman filter. The correlation between observations of the two state variables is accounted for in the observation error covariance matrix. In addition to producing estimates of the biomass time series and projections of future biomass, the model also estimates MSY, the MSY exploitation rate (MSY divided by survey biomass at MSY), and OFL; and is capable of estimating a probability-based ABC. Preliminary testing of the approach has been very limited but also very promising, with performance so far being equal to or better than a full age-structured assessment.

Tables

Table 1. Summary of methods used for different stocks by tiers for the BSAI and GOA.

Bering Sea Aleutian Islands

Tier:	1	2	3	4	5	6
Number of stocks	3	0	12	0	7	3
Biomass estimation method						
NA	3		11			3
Average			1		3	
Weighted average					1	
Kalman filter					1	
Most recent					2	
Proportion estimation method						
NA	3		7		6	3
Average			1			
Weighted average			4		1	

Gulf of Alaska

Tier	1	2	3	4	5	6
Number of stocks	0	0	9	2	11	5
Biomass estimation method						
NA			9			5
Average				1	7	
Most recent				1	3	
Mature biomass from model					1	
Proportion estimation method						
NA				1	3	4
Average			2		2	
Weighted average			4	1	2	
Most recent			3		4	
Proportion of historical catch						1

Table 2. Inventory of methods used for different stocks which involved some form of survey averaging (unless otherwise specified).

Area	Stock	Tier	Biomass	Proportions
BSAI	Pacific cod	3	Scaled to BSAI using Kalman filter	NA
AK	Sablefish	3	NA	5 year weighted average of survey and fishery indices
BSAI	Greenland Turbot	3	NA	Most recent three
BSAI	POP	3	NA	4-6-9 weighting by subarea
BSAI	Rougheye/BS	3	NA	4-6-9 weighting by subarea
BSAI	Alaska skate	3	NA	NA
BSAI	Atka mackerel	3	NA	8-12-18-27 weighting
BSAI	Kamchatka	5	7-year average	NA
Bogo	Pollock	5	Most recent	NA
BSAI	Other flatfish	5	Most recent	NA
BSAI	Shortraker rockfish	5	Kalman filter	NA
BSAI	other rockfish	5	4-6-9 weighting	4-6-9 weighting
BSAI	other skates	5	Most recent three	NA
BSAI	sculpins	5	Most recent three	NA
GOA	pollock	3	NA	4 most recent average
GOA	Pacific cod	3	NA	3 most recent average
GOA	Arrowtooth	3	NA	Most recent
GOA	flathead sole	3	NA	Most recent
GOA	northern rockfish	3	NA	4-6-9 weighting
GOA	Pel. shelf rockfish (dusky)	3	NA	4-6-9 weighting
GOA	POP	3	NA	4-6-9 weighting
GOA	RE/BS rockfish	3	NA	4-6-9 weighting
GOA	Shallow flats N, S rock sole	3	NA	Most recent
GOA	Demersal shelf	4	Most recent	NA
GOA	Other rockfish - sharpchin	4	Most recent three	4-6-9 weighting
GOA	Big skate	5	Most recent three	Most recent three
GOA	deep flats Dover sole	5	most recent	Most recent (dover)
GOA	longnose skate	5	Most recent three	Most recent three
GOA	Oher rockfish - other	5	Most recent three	4-6-9 weighting
GOA	Other skates	5	Most recent three	NA
GOA	rex sole	5	Mature biomass from model	Most recent
GOA	Sculpins	5	Most recent four	NA
GOA	shallow flats - others	5	Most recent	Most recent
GOA	Sharks - spiny dogfish	5	Most recent three	NA
GOA	shortraker rockfish	5	Most recent three	4-6-9 weighting
GOA	Thornyhead	5	Most recent	Most recent
GOA	Atka mackerel	6	NA	NA
GOA	deep flats others	6	NA	Proportion of historical catch
GOA	octopus	6	NA	NA
GOA	Sharks - others	6	NA	NA
GOA	squids	6	NA	NA

Table 3. Mean relative biomass error for combined areas "pollock" like simulations comparing weighted average methods with Kalman filter based on 100 simulations for each row.

Factors					Weighted average methods									Kalman
trend	sigmaR	survey CV	survey freq.	max. move.	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	filter
up	0.8	0.25	1	0.1	-0.15	-0.06	-0.03	-0.02	-0.01	-0.01	0.00	0.00	0.00	-0.06
up	0.4	0.25	1	0.1	-0.19	-0.09	-0.06	-0.04	-0.03	-0.02	-0.02	-0.01	-0.01	-0.08
up	0.8	0.6	1	0.1	-0.14	-0.06	-0.04	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.14
up	0.4	0.6	1	0.1	-0.18	-0.10	-0.07	-0.06	-0.06	-0.05	-0.04	-0.03	-0.02	-0.15
down	0.8	0.25	1	0.1	1.34	0.57	0.33	0.21	0.14	0.10	0.06	0.04	0.02	0.02
down	0.4	0.25	1	0.1	1.13	0.48	0.27	0.17	0.11	0.07	0.04	0.02	0.01	0.01
down	0.8	0.6	1	0.1	1.54	0.68	0.38	0.23	0.13	0.06	0.02	-0.02	-0.04	-0.02
down	0.4	0.6	1	0.1	1.17	0.51	0.29	0.18	0.12	0.08	0.05	0.03	0.01	0.06
flat	0.8	0.25	1	0.1	0.13	0.10	0.07	0.05	0.04	0.03	0.03	0.03	0.03	0.02
flat	0.4	0.25	1	0.1	0.01	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02
flat	0.8	0.6	1	0.1	0.08	0.02	-0.01	-0.03	-0.05	-0.05	-0.06	-0.06	-0.06	-0.06
flat	0.4	0.6	1	0.1	0.01	-0.01	-0.03	-0.03	-0.04	-0.04	-0.05	-0.05	-0.05	-0.02
up	0.8	0.25	2	0.1	-0.30	-0.14	-0.08	-0.05	-0.03	-0.02	0.00	0.01	0.02	-0.06
up	0.4	0.25	2	0.1	-0.33	-0.17	-0.10	-0.07	-0.05	-0.04	-0.03	-0.02	-0.01	-0.09
up	0.8	0.6	2	0.1	-0.30	-0.13	-0.07	-0.03	-0.01	0.00	0.01	0.02	0.03	-0.18
up	0.4	0.6	2	0.1	-0.32	-0.16	-0.10	-0.07	-0.04	-0.02	0.00	0.02	0.04	-0.18
down	0.8	0.25	2	0.1	2.83	1.28	0.71	0.44	0.29	0.19	0.12	0.08	0.04	0.02
down	0.4	0.25	2	0.1	2.31	1.08	0.61	0.38	0.24	0.16	0.09	0.05	0.02	0.01
down	0.8	0.6	2	0.1	2.64	1.24	0.70	0.45	0.30	0.21	0.15	0.11	0.07	0.08
down	0.4	0.6	2	0.1	2.16	0.99	0.57	0.36	0.24	0.16	0.11	0.07	0.03	0.08
flat	0.8	0.25	2	0.1	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.00	-0.03
flat	0.4	0.25	2	0.1	0.01	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.03
flat	0.8	0.6	2	0.1	0.12	0.07	0.05	0.03	0.02	0.02	0.01	0.00	0.00	-0.03
flat	0.4	0.6	2	0.1	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	-0.01
up	0.8	0.25	3	0.1	-0.38	-0.18	-0.10	-0.07	-0.05	-0.04	-0.04	-0.04	-0.03	-0.08
up	0.4	0.25	3	0.1	-0.42	-0.23	-0.14	-0.09	-0.06	-0.04	-0.03	-0.02	-0.01	-0.08
up	0.8	0.6	3	0.1	-0.39	-0.20	-0.11	-0.07	-0.05	-0.03	-0.03	-0.02	-0.01	-0.21
up	0.4	0.6	3	0.1	-0.42	-0.22	-0.13	-0.08	-0.05	-0.03	-0.01	0.00	0.00	-0.19
down	0.8	0.25	3	0.1	3.27	1.71	1.01	0.64	0.41	0.27	0.16	0.08	0.02	-0.01
down	0.4	0.25	3	0.1	2.86	1.48	0.87	0.55	0.37	0.24	0.16	0.10	0.05	0.03
down	0.8	0.6	3	0.1	3.98	2.12	1.26	0.80	0.53	0.34	0.21	0.11	0.03	0.02
down	0.4	0.6	3	0.1	3.10	1.56	0.90	0.56	0.37	0.24	0.15	0.08	0.03	0.05
flat	0.8	0.25	3	0.1	0.17	0.12	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.01
flat	0.4	0.25	3	0.1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-0.01
flat	0.8	0.6	3	0.1	0.14	0.10	0.07	0.04	0.01	0.00	-0.02	-0.03	-0.03	-0.08
flat	0.4	0.6	3	0.1	0.07	0.06	0.05	0.04	0.02	0.01	-0.01	-0.02	-0.03	0.02
up	0.8	0.25	1	0.3	-0.17	-0.08	-0.05	-0.03	-0.02	-0.01	-0.01	-0.01	0.00	-0.06
up	0.4	0.25	1	0.3	-0.18	-0.08	-0.05	-0.04	-0.03	-0.03	-0.02	-0.02	-0.02	-0.07
up	0.8	0.6	1	0.3	-0.11	-0.05	-0.03	-0.02	-0.01	0.00	0.02	0.03	0.05	-0.12
up	0.4	0.6	1	0.3	-0.16	-0.06	-0.03	-0.01	0.00	0.01	0.01	0.02	0.02	-0.12
down	0.8	0.25	1	0.3	1.39	0.58	0.33	0.21	0.14	0.09	0.06	0.04	0.02	0.01
down	0.4	0.25	1	0.3	1.10	0.47	0.27	0.16	0.10	0.06	0.03	0.01	-0.01	-0.01
down	0.8	0.6	1	0.3	1.43	0.62	0.34	0.19	0.09	0.03	-0.01	-0.05	-0.07	-0.04
down	0.4	0.6	1	0.3	1.20	0.52	0.30	0.19	0.12	0.08	0.05	0.03	0.01	0.06
flat	0.8	0.25	1	0.3	0.09	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00	-0.02
flat	0.4	0.25	1	0.3	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
flat	0.8	0.6	1	0.3	0.07	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.06	-0.01
flat	0.4	0.6	1	0.3	0.01	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
up	0.8	0.25	2	0.3	-0.30	-0.14	-0.08	-0.06	-0.04	-0.04	-0.03	-0.03	-0.03	-0.08
up	0.4	0.25	2	0.3	-0.32	-0.16	-0.09	-0.06	-0.03	-0.02	-0.01	0.00	0.01	-0.07
up	0.8	0.6	2	0.3	-0.28	-0.12	-0.07	-0.05	-0.04	-0.03	-0.04	-0.04	-0.04	-0.15
up	0.4	0.6	2	0.3	-0.32	-0.15	-0.08	-0.05	-0.03	-0.01	0.00	0.00	0.01	-0.17
down	0.8	0.25	2	0.3	2.81	1.33	0.78	0.50	0.34	0.23	0.15	0.09	0.04	0.02
down	0.4	0.25	2	0.3	2.09	0.96	0.54	0.34	0.22	0.14	0.09	0.05	0.02	0.01
down	0.8	0.6	2	0.3	2.59	1.23	0.72	0.47	0.31	0.21	0.13	0.08	0.03	0.04
down	0.4	0.6	2	0.3	2.30	1.08	0.62	0.39	0.25	0.16	0.09	0.03	-0.01	0.04
flat	0.8	0.25	2	0.3	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.00	-0.03
flat	0.4	0.25	2	0.3	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02
flat	0.8	0.6	2	0.3	0.05	0.02	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.05	-0.10
flat	0.4	0.6	2	0.3	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.03
up	0.8	0.25	3	0.3	-0.40	-0.20	-0.12	-0.07	-0.05	-0.03	-0.02	-0.02	-0.01	-0.07
up	0.4	0.25	3	0.3	-0.42	-0.23	-0.14	-0.09	-0.06	-0.04	-0.03	-0.02	-0.01	-0.08
up	0.8	0.6	3	0.3	-0.40	-0.21	-0.13	-0.09	-0.07	-0.06	-0.05	-0.04	-0.04	-0.21
up	0.4	0.6	3	0.3	-0.41	-0.21	-0.12	-0.07	-0.03	-0.01	0.00	0.01	0.02	-0.17
down	0.8	0.25	3	0.3	3.58	1.86	1.10	0.71	0.48	0.32	0.21	0.12	0.04	0.00
down	0.4	0.25	3	0.3	3.02	1.60	0.96	0.62	0.41	0.27	0.18	0.10	0.05	0.02
down	0.8	0.6	3	0.3	3.51	1.90	1.16	0.76	0.52	0.35	0.22	0.13	0.06	0.05
down	0.4	0.6	3	0.3	3.02	1.57	0.91	0.58	0.38	0.25	0.16	0.09	0.04	0.06
flat	0.8	0.25	3	0.3	0.09	0.08	0.06	0.04	0.03	0.02	0.01	0.00	-0.01	-0.03
flat	0.4	0.25	3	0.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02
flat	0.8	0.6	3	0.3	0.11	0.09	0.08	0.07	0.07	0.06	0.06	0.05	0.05	-0.04
flat	0.4	0.6	3	0.3	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	-0.01
					0.70	0.35	0.20	0.13	0.08	0.05	0.03	0.02	0.00	-0.04

Table 4. Mean relative biomass error for combined areas "pollock" like simulations comparing unweighted average methods with Kalman filter based on 100 simulations for each row.

Factors					Unweighted average methods										Kalman
trend	sigmaR	survey CV	survey freq.	max. move.	1	2	3	4	5	6	7	8	9	10	filter
up	0.8	0.25	1	0.1	0.00	0.00	-0.02	-0.02	-0.03	-0.04	-0.05	-0.05	-0.06	-0.07	-0.06
up	0.4	0.25	1	0.1	-0.01	-0.02	-0.02	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09	-0.10	-0.08
up	0.8	0.6	1	0.1	-0.03	-0.02	-0.03	-0.03	-0.04	-0.03	-0.04	-0.05	-0.06	-0.06	-0.14
up	0.4	0.6	1	0.1	-0.01	-0.07	-0.07	-0.07	-0.07	-0.07	-0.08	-0.09	-0.09	-0.10	-0.15
down	0.8	0.25	1	0.1	0.00	0.08	0.14	0.20	0.27	0.33	0.41	0.48	0.56	0.63	0.02
down	0.4	0.25	1	0.1	-0.01	0.06	0.10	0.15	0.22	0.28	0.34	0.41	0.48	0.55	0.01
down	0.8	0.6	1	0.1	-0.06	0.02	0.12	0.25	0.36	0.43	0.52	0.59	0.68	0.75	-0.02
down	0.4	0.6	1	0.1	0.00	0.06	0.12	0.18	0.25	0.31	0.38	0.44	0.51	0.56	0.06
flat	0.8	0.25	1	0.1	0.03	0.02	0.02	0.04	0.06	0.08	0.10	0.11	0.12	0.12	0.02
flat	0.4	0.25	1	0.1	-0.02	-0.02	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02
flat	0.8	0.6	1	0.1	-0.06	-0.05	-0.06	-0.04	-0.02	0.00	0.01	0.02	0.03	0.04	-0.06
flat	0.4	0.6	1	0.1	-0.05	-0.06	-0.03	-0.04	-0.02	-0.02	-0.01	-0.01	0.00	0.00	-0.02
up	0.8	0.25	2	0.1	0.03	-0.02	-0.04	-0.05	-0.07	-0.07	-0.09	-0.11	-0.13	-0.15	-0.06
up	0.4	0.25	2	0.1	-0.01	-0.03	-0.05	-0.07	-0.09	-0.11	-0.13	-0.15	-0.17	-0.19	-0.09
up	0.8	0.6	2	0.1	0.04	0.00	-0.01	-0.04	-0.05	-0.07	-0.09	-0.11	-0.13	-0.15	-0.18
up	0.4	0.6	2	0.1	0.06	-0.04	-0.07	-0.09	-0.10	-0.12	-0.13	-0.15	-0.16	-0.18	-0.18
down	0.8	0.25	2	0.1	0.02	0.13	0.26	0.42	0.56	0.72	0.88	1.05	1.21	1.40	0.02
down	0.4	0.25	2	0.1	-0.01	0.10	0.23	0.37	0.51	0.65	0.79	0.93	1.07	1.21	0.01
down	0.8	0.6	2	0.1	0.05	0.15	0.30	0.42	0.55	0.69	0.86	1.04	1.22	1.40	0.08
down	0.4	0.6	2	0.1	0.01	0.12	0.25	0.34	0.47	0.57	0.69	0.83	0.97	1.11	0.08
flat	0.8	0.25	2	0.1	0.01	-0.01	0.01	0.03	0.05	0.06	0.06	0.06	0.06	0.07	-0.03
flat	0.4	0.25	2	0.1	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0.01	0.01	0.01	0.02	-0.03
flat	0.8	0.6	2	0.1	-0.01	0.03	0.02	0.02	0.05	0.06	0.08	0.08	0.08	0.09	-0.03
flat	0.4	0.6	2	0.1	0.01	0.01	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-0.01
up	0.8	0.25	3	0.1	-0.03	-0.04	-0.05	-0.06	-0.07	-0.09	-0.11	-0.14	-0.17	-0.20	-0.08
up	0.4	0.25	3	0.1	0.00	-0.03	-0.06	-0.09	-0.12	-0.15	-0.18	-0.21	-0.24	-0.27	-0.08
up	0.8	0.6	3	0.1	-0.01	-0.02	-0.05	-0.07	-0.08	-0.10	-0.12	-0.15	-0.19	-0.22	-0.21
up	0.4	0.6	3	0.1	0.00	0.00	-0.04	-0.08	-0.12	-0.15	-0.18	-0.20	-0.23	-0.27	-0.19
down	0.8	0.25	3	0.1	-0.02	0.18	0.43	0.63	0.85	1.04	1.28	1.53	1.77	2.00	-0.01
down	0.4	0.25	3	0.1	0.01	0.18	0.36	0.54	0.72	0.91	1.10	1.29	1.50	1.70	0.03
down	0.8	0.6	3	0.1	-0.04	0.25	0.56	0.79	1.03	1.39	1.63	1.90	2.16	2.45	0.02
down	0.4	0.6	3	0.1	-0.01	0.18	0.38	0.54	0.73	0.91	1.11	1.35	1.54	1.76	0.05
flat	0.8	0.25	3	0.1	0.02	0.04	0.06	0.09	0.11	0.13	0.13	0.13	0.13	0.13	0.01
flat	0.4	0.25	3	0.1	0.01	0.03	0.01	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	-0.01
flat	0.8	0.6	3	0.1	-0.04	-0.03	0.02	0.05	0.08	0.10	0.12	0.13	0.12	0.13	-0.08
flat	0.4	0.6	3	0.1	-0.04	0.01	0.04	0.07	0.06	0.06	0.06	0.08	0.09	0.09	0.02
up	0.8	0.25	1	0.3	0.00	-0.01	-0.02	-0.03	-0.04	-0.06	-0.06	-0.08	-0.09	-0.09	-0.06
up	0.4	0.25	1	0.3	-0.02	-0.03	-0.03	-0.03	-0.04	-0.05	-0.07	-0.08	-0.09	-0.09	-0.07
up	0.8	0.6	1	0.3	0.06	-0.03	-0.03	-0.03	-0.04	-0.05	-0.05	-0.05	-0.05	-0.05	-0.12
up	0.4	0.6	1	0.3	0.03	0.00	-0.01	-0.01	-0.01	-0.02	-0.03	-0.04	-0.05	-0.07	-0.12
down	0.8	0.25	1	0.3	0.01	0.07	0.13	0.21	0.27	0.33	0.40	0.47	0.55	0.63	0.01
down	0.4	0.25	1	0.3	-0.03	0.04	0.11	0.17	0.23	0.29	0.35	0.41	0.47	0.53	-0.01
down	0.8	0.6	1	0.3	-0.10	0.02	0.09	0.17	0.30	0.39	0.46	0.57	0.64	0.70	-0.04
down	0.4	0.6	1	0.3	0.00	0.05	0.11	0.18	0.26	0.32	0.38	0.46	0.51	0.57	0.06
flat	0.8	0.25	1	0.3	0.00	0.00	0.01	0.01	0.01	0.03	0.04	0.05	0.06	0.06	-0.02
flat	0.4	0.25	1	0.3	0.00	-0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	-0.01
flat	0.8	0.6	1	0.3	0.07	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.05	-0.01
flat	0.4	0.6	1	0.3	0.00	-0.03	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
up	0.8	0.25	2	0.3	-0.02	-0.03	-0.04	-0.06	-0.06	-0.07	-0.09	-0.11	-0.12	-0.14	-0.08
up	0.4	0.25	2	0.3	0.02	-0.01	-0.03	-0.06	-0.08	-0.10	-0.12	-0.14	-0.16	-0.18	-0.07
up	0.8	0.6	2	0.3	-0.05	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07	-0.09	-0.10	-0.12	-0.15
up	0.4	0.6	2	0.3	0.01	0.00	-0.03	-0.04	-0.07	-0.09	-0.11	-0.13	-0.15	-0.17	-0.17
down	0.8	0.25	2	0.3	0.01	0.16	0.34	0.50	0.66	0.84	1.03	1.19	1.34	1.50	0.02
down	0.4	0.25	2	0.3	-0.01	0.11	0.22	0.33	0.44	0.57	0.70	0.82	0.94	1.07	0.01
down	0.8	0.6	2	0.3	0.00	0.16	0.31	0.50	0.64	0.77	0.91	1.07	1.22	1.39	0.04
down	0.4	0.6	2	0.3	-0.05	0.13	0.26	0.39	0.53	0.65	0.82	0.96	1.08	1.21	0.04
flat	0.8	0.25	2	0.3	0.00	0.01	0.02	0.04	0.06	0.06	0.06	0.06	0.05	0.05	-0.03
flat	0.4	0.25	2	0.3	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	-0.02
flat	0.8	0.6	2	0.3	-0.06	-0.04	-0.02	-0.01	0.01	0.04	0.04	0.03	0.02	0.03	-0.10
flat	0.4	0.6	2	0.3	-0.01	0.01	0.00	-0.01	0.00	-0.01	0.00	0.00	0.01	0.01	-0.03
up	0.8	0.25	3	0.3	-0.01	-0.02	-0.04	-0.06	-0.10	-0.12	-0.15	-0.17	-0.20	-0.24	-0.07
up	0.4	0.25	3	0.3	-0.01	-0.02	-0.06	-0.10	-0.12	-0.15	-0.18	-0.21	-0.24	-0.27	-0.08
up	0.8	0.6	3	0.3	-0.03	-0.05	-0.07	-0.08	-0.10	-0.12	-0.14	-0.18	-0.21	-0.24	-0.21
up	0.4	0.6	3	0.3	0.03	0.00	-0.03	-0.07	-0.10	-0.13	-0.16	-0.20	-0.23	-0.26	-0.17
down	0.8	0.25	3	0.3	-0.01	0.25	0.53	0.74	0.92	1.12	1.34	1.60	1.87	2.13	0.00
down	0.4	0.25	3	0.3	0.00	0.20	0.41	0.61	0.81	1.03	1.24	1.44	1.64	1.86	0.02
down	0.8	0.6	3	0.3	0.00	0.26	0.53	0.79	1.05	1.25	1.49	1.73	2.00	2.18	0.05
down	0.4	0.6	3	0.3	0.00	0.18	0.35	0.57	0.78	0.97	1.15	1.33	1.59	1.79	0.06
flat	0.8	0.25	3	0.3	-0.01	0.01	0.02	0.05	0.07	0.09	0.11	0.11	0.11	0.10	-0.03
flat	0.4	0.25	3	0.3	-0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02
flat	0.8	0.6	3	0.3	0.04	0.06	0.09	0.07	0.06	0.07	0.08	0.09	0.08	0.09	-0.04
flat	0.4	0.6	3	0.3	0.01	-0.02	-0.02	0.00	0.00	0.00	0.00	0.01	0.02	0.03	-0.01
					0.00	0.04	0.08	0.13	0.17	0.22	0.26	0.31	0.35	0.39	-0.04

Table 5. Standard deviation for relative biomass error for combined areas "pollock" like simulations comparing weighted average methods with Kalman filter based on 100 simulations for each row.

Factors					Weighted average methods									Kalman
trend	sigmaR	survey CV	survey freq.	max. move.	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	filter
up	0.8	0.25	1	0.1	0.16	0.13	0.11	0.10	0.10	0.10	0.11	0.12	0.13	0.12
up	0.4	0.25	1	0.1	0.08	0.07	0.07	0.07	0.08	0.09	0.10	0.11	0.12	0.07
up	0.8	0.6	1	0.1	0.18	0.16	0.16	0.18	0.21	0.25	0.28	0.31	0.35	0.20
up	0.4	0.6	1	0.1	0.12	0.16	0.18	0.20	0.23	0.26	0.29	0.32	0.35	0.16
down	0.8	0.25	1	0.1	0.88	0.47	0.32	0.24	0.18	0.14	0.12	0.12	0.12	0.13
down	0.4	0.25	1	0.1	0.39	0.24	0.17	0.13	0.11	0.10	0.10	0.10	0.11	0.11
down	0.8	0.6	1	0.1	0.95	0.50	0.36	0.31	0.29	0.29	0.30	0.33	0.36	0.32
down	0.4	0.6	1	0.1	0.38	0.24	0.21	0.21	0.23	0.25	0.27	0.30	0.34	0.26
flat	0.8	0.25	1	0.1	0.29	0.22	0.17	0.14	0.12	0.12	0.12	0.13	0.14	0.13
flat	0.4	0.25	1	0.1	0.13	0.10	0.09	0.08	0.08	0.08	0.08	0.09	0.10	0.08
flat	0.8	0.6	1	0.1	0.34	0.27	0.23	0.21	0.21	0.22	0.24	0.26	0.29	0.24
flat	0.4	0.6	1	0.1	0.15	0.15	0.15	0.16	0.18	0.19	0.21	0.23	0.26	0.16
up	0.8	0.25	2	0.1	0.16	0.16	0.15	0.13	0.12	0.12	0.12	0.12	0.13	0.14
up	0.4	0.25	2	0.1	0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.12	0.13	0.10
up	0.8	0.6	2	0.1	0.16	0.19	0.20	0.21	0.23	0.25	0.28	0.31	0.34	0.21
up	0.4	0.6	2	0.1	0.11	0.15	0.19	0.23	0.27	0.31	0.35	0.39	0.44	0.24
down	0.8	0.25	2	0.1	1.73	0.87	0.54	0.38	0.29	0.23	0.19	0.17	0.17	0.17
down	0.4	0.25	2	0.1	0.57	0.35	0.25	0.19	0.15	0.13	0.12	0.13	0.14	0.14
down	0.8	0.6	2	0.1	1.29	0.73	0.51	0.41	0.36	0.34	0.33	0.35	0.37	0.35
down	0.4	0.6	2	0.1	0.80	0.46	0.34	0.30	0.28	0.29	0.30	0.31	0.33	0.31
flat	0.8	0.25	2	0.1	0.33	0.29	0.25	0.20	0.16	0.13	0.12	0.11	0.11	0.12
flat	0.4	0.25	2	0.1	0.15	0.12	0.11	0.10	0.10	0.10	0.10	0.11	0.12	0.11
flat	0.8	0.6	2	0.1	0.39	0.32	0.28	0.26	0.26	0.27	0.29	0.31	0.34	0.30
flat	0.4	0.6	2	0.1	0.16	0.17	0.19	0.21	0.23	0.26	0.29	0.31	0.34	0.18
up	0.8	0.25	3	0.1	0.14	0.16	0.16	0.14	0.13	0.12	0.11	0.11	0.12	0.12
up	0.4	0.25	3	0.1	0.06	0.07	0.08	0.08	0.09	0.10	0.11	0.12	0.14	0.09
up	0.8	0.6	3	0.1	0.18	0.21	0.22	0.23	0.24	0.26	0.29	0.31	0.34	0.26
up	0.4	0.6	3	0.1	0.08	0.12	0.15	0.17	0.19	0.21	0.23	0.25	0.28	0.16
down	0.8	0.25	3	0.1	1.64	0.95	0.62	0.45	0.33	0.25	0.19	0.15	0.13	0.13
down	0.4	0.25	3	0.1	0.79	0.45	0.30	0.22	0.17	0.15	0.14	0.14	0.14	0.14
down	0.8	0.6	3	0.1	2.15	1.16	0.78	0.60	0.50	0.42	0.36	0.33	0.33	0.32
down	0.4	0.6	3	0.1	1.05	0.60	0.43	0.35	0.31	0.29	0.30	0.32	0.35	0.32
flat	0.8	0.25	3	0.1	0.41	0.33	0.27	0.23	0.19	0.17	0.15	0.14	0.14	0.15
flat	0.4	0.25	3	0.1	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.13	0.13	0.12
flat	0.8	0.6	3	0.1	0.44	0.37	0.32	0.28	0.26	0.26	0.27	0.29	0.32	0.27
flat	0.4	0.6	3	0.1	0.23	0.22	0.21	0.21	0.22	0.23	0.25	0.27	0.30	0.21
up	0.8	0.25	1	0.3	0.15	0.12	0.10	0.09	0.09	0.09	0.10	0.11	0.12	0.11
up	0.4	0.25	1	0.3	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.11	0.12	0.08
up	0.8	0.6	1	0.3	0.20	0.17	0.18	0.21	0.24	0.27	0.31	0.34	0.38	0.19
up	0.4	0.6	1	0.3	0.11	0.14	0.17	0.19	0.21	0.23	0.25	0.28	0.31	0.14
down	0.8	0.25	1	0.3	0.72	0.38	0.26	0.20	0.16	0.13	0.11	0.11	0.12	0.12
down	0.4	0.25	1	0.3	0.33	0.20	0.15	0.13	0.12	0.12	0.12	0.13	0.14	0.14
down	0.8	0.6	1	0.3	0.90	0.54	0.38	0.29	0.26	0.25	0.26	0.28	0.30	0.28
down	0.4	0.6	1	0.3	0.37	0.24	0.22	0.22	0.24	0.26	0.29	0.32	0.35	0.29
flat	0.8	0.25	1	0.3	0.29	0.21	0.16	0.13	0.11	0.11	0.11	0.11	0.12	0.11
flat	0.4	0.25	1	0.3	0.13	0.11	0.10	0.10	0.10	0.10	0.11	0.12	0.13	0.10
flat	0.8	0.6	1	0.3	0.27	0.23	0.23	0.24	0.26	0.29	0.32	0.36	0.41	0.23
flat	0.4	0.6	1	0.3	0.14	0.17	0.21	0.24	0.28	0.32	0.36	0.40	0.44	0.19
up	0.8	0.25	2	0.3	0.16	0.16	0.14	0.12	0.11	0.11	0.11	0.11	0.13	0.13
up	0.4	0.25	2	0.3	0.07	0.07	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.08
up	0.8	0.6	2	0.3	0.19	0.23	0.24	0.25	0.27	0.29	0.31	0.34	0.37	0.25
up	0.4	0.6	2	0.3	0.11	0.16	0.19	0.23	0.26	0.29	0.32	0.34	0.37	0.20
down	0.8	0.25	2	0.3	1.39	0.75	0.49	0.34	0.25	0.19	0.16	0.14	0.13	0.14
down	0.4	0.25	2	0.3	0.61	0.34	0.24	0.18	0.14	0.12	0.12	0.12	0.13	0.14
down	0.8	0.6	2	0.3	1.62	0.92	0.64	0.48	0.38	0.33	0.31	0.32	0.35	0.33
down	0.4	0.6	2	0.3	0.71	0.41	0.31	0.27	0.26	0.27	0.29	0.31	0.34	0.31
flat	0.8	0.25	2	0.3	0.34	0.27	0.22	0.18	0.15	0.13	0.12	0.11	0.12	0.13
flat	0.4	0.25	2	0.3	0.15	0.13	0.11	0.11	0.10	0.11	0.11	0.12	0.13	0.11
flat	0.8	0.6	2	0.3	0.35	0.31	0.28	0.26	0.25	0.25	0.26	0.28	0.31	0.26
flat	0.4	0.6	2	0.3	0.16	0.17	0.19	0.22	0.24	0.27	0.30	0.33	0.37	0.19
up	0.8	0.25	3	0.3	0.14	0.17	0.17	0.16	0.15	0.14	0.13	0.13	0.14	0.16
up	0.4	0.25	3	0.3	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.10
up	0.8	0.6	3	0.3	0.13	0.16	0.17	0.18	0.20	0.21	0.24	0.26	0.29	0.20
up	0.4	0.6	3	0.3	0.10	0.15	0.18	0.22	0.26	0.29	0.33	0.37	0.42	0.22
down	0.8	0.25	3	0.3	1.69	0.98	0.64	0.46	0.35	0.27	0.21	0.17	0.15	0.15
down	0.4	0.25	3	0.3	0.78	0.46	0.31	0.23	0.18	0.15	0.14	0.13	0.14	0.15
down	0.8	0.6	3	0.3	1.89	1.18	0.87	0.68	0.55	0.45	0.39	0.37	0.37	0.36
down	0.4	0.6	3	0.3	1.10	0.56	0.39	0.32	0.28	0.26	0.26	0.27	0.30	0.29
flat	0.8	0.25	3	0.3	0.37	0.31	0.26	0.22	0.19	0.16	0.14	0.13	0.13	0.15
flat	0.4	0.25	3	0.3	0.14	0.12	0.11	0.11	0.11	0.11	0.12	0.13	0.14	0.12
flat	0.8	0.6	3	0.3	0.33	0.29	0.27	0.27	0.28	0.29	0.31	0.33	0.36	0.29
flat	0.4	0.6	3	0.3	0.20	0.18	0.18	0.20	0.22	0.25	0.27	0.30	0.34	0.21
					0.47	0.31	0.25	0.22	0.21	0.20	0.21	0.22	0.24	0.18

Table 6. Standard deviation for relative biomass error for combined areas "pollock" like simulations comparing unweighted average methods with Kalman filter based on 100 simulations for each row.

Factors					Unweighted average methods										Kalman
trend	sigmaR	survey CV	survey freq.	max. move.	1	2	3	4	5	6	7	8	9	10	filter
up	0.8	0.25	1	0.1	0.14	0.11	0.11	0.11	0.12	0.13	0.14	0.16	0.17	0.18	0.12
up	0.4	0.25	1	0.1	0.14	0.10	0.09	0.08	0.07	0.08	0.08	0.08	0.08	0.08	0.07
up	0.8	0.6	1	0.1	0.39	0.28	0.22	0.17	0.16	0.19	0.20	0.20	0.20	0.21	0.20
up	0.4	0.6	1	0.1	0.39	0.25	0.22	0.20	0.19	0.18	0.17	0.17	0.16	0.16	0.16
down	0.8	0.25	1	0.1	0.14	0.15	0.21	0.29	0.36	0.43	0.48	0.52	0.56	0.60	0.13
down	0.4	0.25	1	0.1	0.12	0.11	0.13	0.16	0.19	0.22	0.24	0.26	0.28	0.30	0.11
down	0.8	0.6	1	0.1	0.39	0.30	0.32	0.38	0.45	0.47	0.50	0.53	0.59	0.63	0.32
down	0.4	0.6	1	0.1	0.38	0.28	0.24	0.24	0.27	0.27	0.28	0.29	0.28	0.29	0.26
flat	0.8	0.25	1	0.1	0.16	0.12	0.13	0.17	0.20	0.24	0.26	0.29	0.29	0.30	0.13
flat	0.4	0.25	1	0.1	0.11	0.09	0.10	0.10	0.10	0.11	0.12	0.12	0.13	0.13	0.08
flat	0.8	0.6	1	0.1	0.32	0.26	0.23	0.25	0.27	0.30	0.33	0.35	0.36	0.36	0.24
flat	0.4	0.6	1	0.1	0.29	0.21	0.20	0.19	0.19	0.19	0.18	0.17	0.17	0.17	0.16
up	0.8	0.25	2	0.1	0.14	0.11	0.14	0.17	0.19	0.20	0.21	0.21	0.21	0.21	0.14
up	0.4	0.25	2	0.1	0.14	0.11	0.11	0.10	0.11	0.11	0.11	0.10	0.10	0.10	0.10
up	0.8	0.6	2	0.1	0.37	0.26	0.25	0.24	0.24	0.24	0.24	0.23	0.23	0.22	0.21
up	0.4	0.6	2	0.1	0.49	0.28	0.24	0.21	0.19	0.18	0.17	0.16	0.15	0.15	0.24
down	0.8	0.25	2	0.1	0.18	0.24	0.34	0.47	0.56	0.63	0.72	0.83	0.96	1.14	0.17
down	0.4	0.25	2	0.1	0.16	0.13	0.18	0.22	0.27	0.32	0.37	0.40	0.41	0.44	0.14
down	0.8	0.6	2	0.1	0.41	0.38	0.44	0.48	0.55	0.63	0.72	0.76	0.86	0.91	0.35
down	0.4	0.6	2	0.1	0.35	0.36	0.31	0.34	0.36	0.40	0.42	0.48	0.54	0.61	0.31
flat	0.8	0.25	2	0.1	0.12	0.14	0.20	0.27	0.33	0.37	0.38	0.38	0.38	0.38	0.12
flat	0.4	0.25	2	0.1	0.13	0.11	0.12	0.12	0.13	0.14	0.15	0.15	0.16	0.16	0.11
flat	0.8	0.6	2	0.1	0.37	0.30	0.27	0.29	0.32	0.34	0.37	0.38	0.39	0.39	0.30
flat	0.4	0.6	2	0.1	0.38	0.29	0.26	0.23	0.21	0.20	0.19	0.18	0.18	0.18	0.18
up	0.8	0.25	3	0.1	0.12	0.13	0.15	0.19	0.20	0.22	0.22	0.22	0.21	0.20	0.12
up	0.4	0.25	3	0.1	0.15	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.08	0.09
up	0.8	0.6	3	0.1	0.37	0.30	0.25	0.25	0.25	0.27	0.28	0.28	0.27	0.26	0.26
up	0.4	0.6	3	0.1	0.31	0.24	0.20	0.18	0.16	0.14	0.13	0.13	0.12	0.11	0.16
down	0.8	0.25	3	0.1	0.13	0.23	0.45	0.57	0.71	0.76	0.84	0.95	1.06	1.19	0.13
down	0.4	0.25	3	0.1	0.15	0.19	0.22	0.26	0.31	0.34	0.40	0.45	0.51	0.56	0.14
down	0.8	0.6	3	0.1	0.36	0.50	0.71	0.84	0.85	1.04	1.07	1.20	1.29	1.44	0.32
down	0.4	0.6	3	0.1	0.39	0.33	0.41	0.44	0.50	0.54	0.57	0.65	0.68	0.73	0.32
flat	0.8	0.25	3	0.1	0.15	0.20	0.24	0.29	0.33	0.38	0.38	0.39	0.40	0.41	0.15
flat	0.4	0.25	3	0.1	0.15	0.14	0.13	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.12
flat	0.8	0.6	3	0.1	0.35	0.27	0.30	0.36	0.40	0.42	0.45	0.44	0.44	0.45	0.27
flat	0.4	0.6	3	0.1	0.33	0.28	0.25	0.24	0.24	0.24	0.25	0.26	0.27	0.27	0.21
up	0.8	0.25	1	0.3	0.14	0.10	0.09	0.10	0.10	0.12	0.14	0.14	0.15	0.16	0.11
up	0.4	0.25	1	0.3	0.14	0.09	0.08	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.08
up	0.8	0.6	1	0.3	0.42	0.26	0.22	0.19	0.18	0.18	0.17	0.19	0.19	0.20	0.19
up	0.4	0.6	1	0.3	0.34	0.24	0.21	0.21	0.19	0.17	0.15	0.14	0.15	0.14	0.14
down	0.8	0.25	1	0.3	0.13	0.12	0.20	0.27	0.32	0.36	0.37	0.40	0.44	0.47	0.12
down	0.4	0.25	1	0.3	0.15	0.13	0.14	0.15	0.17	0.19	0.21	0.23	0.25	0.26	0.14
down	0.8	0.6	1	0.3	0.34	0.27	0.30	0.32	0.41	0.51	0.58	0.68	0.71	0.71	0.28
down	0.4	0.6	1	0.3	0.39	0.28	0.26	0.26	0.24	0.25	0.26	0.28	0.30	0.31	0.29
flat	0.8	0.25	1	0.3	0.13	0.11	0.14	0.16	0.18	0.22	0.24	0.26	0.28	0.28	0.11
flat	0.4	0.25	1	0.3	0.14	0.11	0.10	0.11	0.12	0.13	0.14	0.14	0.14	0.14	0.10
flat	0.8	0.6	1	0.3	0.45	0.27	0.24	0.26	0.25	0.26	0.26	0.26	0.27	0.29	0.23
flat	0.4	0.6	1	0.3	0.49	0.30	0.26	0.24	0.21	0.22	0.20	0.19	0.18	0.17	0.19
up	0.8	0.25	2	0.3	0.14	0.12	0.14	0.16	0.18	0.19	0.21	0.21	0.22	0.22	0.13
up	0.4	0.25	2	0.3	0.15	0.11	0.10	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.08
up	0.8	0.6	2	0.3	0.40	0.33	0.29	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.25
up	0.4	0.6	2	0.3	0.40	0.36	0.27	0.22	0.18	0.18	0.17	0.17	0.16	0.15	0.20
down	0.8	0.25	2	0.3	0.14	0.21	0.33	0.40	0.52	0.65	0.76	0.86	0.90	0.95	0.14
down	0.4	0.25	2	0.3	0.15	0.13	0.18	0.22	0.26	0.30	0.35	0.38	0.39	0.40	0.14
down	0.8	0.6	2	0.3	0.40	0.34	0.40	0.63	0.71	0.87	0.98	1.02	1.07	1.17	0.33
down	0.4	0.6	2	0.3	0.37	0.32	0.28	0.32	0.39	0.36	0.42	0.45	0.51	0.53	0.31
flat	0.8	0.25	2	0.3	0.13	0.14	0.19	0.24	0.28	0.31	0.32	0.33	0.34	0.35	0.13
flat	0.4	0.25	2	0.3	0.14	0.12	0.12	0.13	0.14	0.15	0.16	0.16	0.17	0.16	0.11
flat	0.8	0.6	2	0.3	0.34	0.27	0.31	0.33	0.34	0.40	0.40	0.38	0.37	0.38	0.26
flat	0.4	0.6	2	0.3	0.41	0.27	0.25	0.25	0.23	0.21	0.20	0.19	0.19	0.19	0.19
up	0.8	0.25	3	0.3	0.15	0.15	0.19	0.21	0.21	0.21	0.22	0.21	0.21	0.21	0.16
up	0.4	0.25	3	0.3	0.15	0.12	0.10	0.09	0.08	0.08	0.08	0.08	0.09	0.08	0.10
up	0.8	0.6	3	0.3	0.33	0.24	0.22	0.22	0.22	0.22	0.21	0.20	0.19	0.19	0.20
up	0.4	0.6	3	0.3	0.46	0.29	0.24	0.21	0.18	0.17	0.16	0.15	0.14	0.13	0.22
down	0.8	0.25	3	0.3	0.16	0.29	0.48	0.58	0.67	0.75	0.83	0.98	1.09	1.22	0.15
down	0.4	0.25	3	0.3	0.15	0.19	0.23	0.28	0.33	0.38	0.46	0.50	0.54	0.59	0.15
down	0.8	0.6	3	0.3	0.39	0.53	0.63	0.93	1.15	1.19	1.23	1.28	1.37	1.41	0.36
down	0.4	0.6	3	0.3	0.33	0.30	0.39	0.41	0.47	0.54	0.55	0.58	0.62	0.66	0.29
flat	0.8	0.25	3	0.3	0.14	0.18	0.24	0.30	0.32	0.35	0.37	0.38	0.41	0.41	0.15
flat	0.4	0.25	3	0.3	0.15	0.12	0.13	0.13	0.14	0.14	0.14	0.14	0.15	0.15	0.12
flat	0.8	0.6	3	0.3	0.40	0.34	0.33	0.32	0.31	0.32	0.33	0.34	0.34	0.35	0.29
flat	0.4	0.6	3	0.3	0.37	0.26	0.22	0.20	0.19	0.20	0.20	0.21	0.21	0.22	0.21
					0.26	0.22	0.23	0.26	0.29	0.31	0.33	0.35	0.37	0.39	0.18

Table 7. Mean relative biomass error for combined areas "rockfish" like simulations comparing weighted average methods with Kalman filter based on 100 simulations for each row.

Factors					Weighted average methods									Kalman
trend	sigmaR	survey CV	survey freq.	max. move.	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	filter
up	0.8	0.25	1	0.1	-0.18	-0.09	-0.06	-0.04	-0.03	-0.03	-0.02	-0.02	-0.02	-0.08
up	0.4	0.25	1	0.1	-0.18	-0.08	-0.05	-0.03	-0.03	-0.02	-0.02	-0.01	-0.01	-0.07
up	0.8	0.6	1	0.1	-0.20	-0.11	-0.08	-0.07	-0.06	-0.06	-0.05	-0.05	-0.05	-0.17
up	0.4	0.6	1	0.1	-0.18	-0.09	-0.06	-0.05	-0.05	-0.05	-0.05	-0.06	-0.06	-0.15
down	0.8	0.25	1	0.1	0.47	0.22	0.13	0.08	0.05	0.03	0.01	0.00	0.00	0.03
down	0.4	0.25	1	0.1	0.43	0.20	0.11	0.07	0.04	0.03	0.01	0.01	0.00	0.04
down	0.8	0.6	1	0.1	0.43	0.18	0.09	0.04	0.01	-0.01	-0.02	-0.03	-0.05	0.06
down	0.4	0.6	1	0.1	0.42	0.18	0.10	0.05	0.03	0.01	0.00	-0.01	-0.01	0.08
flat	0.8	0.25	1	0.1	0.01	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	0.00
flat	0.4	0.25	1	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
flat	0.8	0.6	1	0.1	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
flat	0.4	0.6	1	0.1	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03	0.00
up	0.8	0.25	2	0.1	-0.31	-0.16	-0.10	-0.06	-0.04	-0.03	-0.02	-0.02	-0.01	-0.08
up	0.4	0.25	2	0.1	-0.31	-0.16	-0.10	-0.07	-0.05	-0.04	-0.03	-0.03	-0.02	-0.09
up	0.8	0.6	2	0.1	-0.30	-0.15	-0.09	-0.05	-0.02	0.00	0.01	0.03	0.04	-0.17
up	0.4	0.6	2	0.1	-0.32	-0.17	-0.10	-0.07	-0.05	-0.03	-0.02	-0.01	-0.01	-0.18
down	0.8	0.25	2	0.1	0.78	0.41	0.25	0.16	0.11	0.07	0.05	0.03	0.01	0.05
down	0.4	0.25	2	0.1	0.74	0.38	0.23	0.15	0.10	0.06	0.04	0.02	0.00	0.04
down	0.8	0.6	2	0.1	0.74	0.38	0.22	0.13	0.07	0.03	-0.01	-0.04	-0.07	0.11
down	0.4	0.6	2	0.1	0.74	0.38	0.22	0.14	0.09	0.06	0.04	0.03	0.01	0.13
flat	0.8	0.25	2	0.1	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
flat	0.4	0.25	2	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
flat	0.8	0.6	2	0.1	0.02	0.02	0.01	0.00	-0.01	-0.01	-0.02	-0.02	-0.02	-0.01
flat	0.4	0.6	2	0.1	0.01	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	0.00
up	0.8	0.25	3	0.1	-0.39	-0.22	-0.14	-0.09	-0.06	-0.04	-0.03	-0.02	-0.02	-0.08
up	0.4	0.25	3	0.1	-0.40	-0.23	-0.14	-0.09	-0.06	-0.04	-0.02	-0.01	0.00	-0.09
up	0.8	0.6	3	0.1	-0.38	-0.22	-0.14	-0.10	-0.08	-0.07	-0.06	-0.06	-0.06	-0.19
up	0.4	0.6	3	0.1	-0.40	-0.23	-0.15	-0.11	-0.09	-0.07	-0.07	-0.07	-0.07	-0.21
down	0.8	0.25	3	0.1	1.03	0.60	0.39	0.26	0.18	0.12	0.08	0.05	0.03	0.05
down	0.4	0.25	3	0.1	0.96	0.56	0.36	0.24	0.16	0.11	0.07	0.04	0.02	0.05
down	0.8	0.6	3	0.1	1.01	0.58	0.35	0.23	0.14	0.09	0.05	0.02	0.00	0.14
down	0.4	0.6	3	0.1	0.94	0.56	0.36	0.24	0.17	0.11	0.07	0.04	0.01	0.18
flat	0.8	0.25	3	0.1	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00
flat	0.4	0.25	3	0.1	-0.01	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.00
flat	0.8	0.6	3	0.1	0.02	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.02	-0.03
flat	0.4	0.6	3	0.1	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	-0.01
up	0.8	0.25	1	0.3	-0.17	-0.08	-0.05	-0.03	-0.02	-0.02	-0.02	-0.02	-0.01	-0.06
up	0.4	0.25	1	0.3	-0.17	-0.07	-0.04	-0.02	-0.01	0.00	0.01	0.01	0.02	-0.06
up	0.8	0.6	1	0.3	-0.18	-0.07	-0.03	-0.01	0.00	0.00	0.01	0.01	0.02	-0.14
up	0.4	0.6	1	0.3	-0.19	-0.10	-0.06	-0.04	-0.02	-0.01	0.00	0.01	0.01	-0.16
down	0.8	0.25	1	0.3	0.44	0.21	0.12	0.08	0.06	0.04	0.03	0.02	0.02	0.04
down	0.4	0.25	1	0.3	0.45	0.21	0.12	0.07	0.04	0.02	0.00	-0.01	-0.02	0.03
down	0.8	0.6	1	0.3	0.46	0.22	0.13	0.08	0.05	0.03	0.01	0.00	-0.02	0.11
down	0.4	0.6	1	0.3	0.45	0.23	0.15	0.11	0.08	0.06	0.05	0.03	0.02	0.14
flat	0.8	0.25	1	0.3	0.00	-0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.02	-0.01
flat	0.4	0.25	1	0.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
flat	0.8	0.6	1	0.3	-0.01	-0.03	-0.03	-0.04	-0.04	-0.04	-0.04	-0.04	-0.03	-0.03
flat	0.4	0.6	1	0.3	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.00
up	0.8	0.25	2	0.3	-0.32	-0.17	-0.12	-0.08	-0.07	-0.05	-0.05	-0.04	-0.04	-0.11
up	0.4	0.25	2	0.3	-0.31	-0.17	-0.11	-0.07	-0.05	-0.04	-0.03	-0.02	-0.02	-0.09
up	0.8	0.6	2	0.3	-0.31	-0.17	-0.11	-0.07	-0.05	-0.03	-0.02	-0.01	0.00	-0.20
up	0.4	0.6	2	0.3	-0.32	-0.16	-0.09	-0.06	-0.03	-0.01	0.00	0.01	0.02	-0.19
down	0.8	0.25	2	0.3	0.82	0.43	0.26	0.17	0.11	0.07	0.04	0.02	0.01	0.04
down	0.4	0.25	2	0.3	0.74	0.39	0.23	0.15	0.10	0.07	0.04	0.02	0.01	0.04
down	0.8	0.6	2	0.3	0.77	0.39	0.22	0.14	0.10	0.07	0.05	0.04	0.03	0.11
down	0.4	0.6	2	0.3	0.73	0.38	0.23	0.15	0.11	0.08	0.06	0.04	0.04	0.16
flat	0.8	0.25	2	0.3	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01
flat	0.4	0.25	2	0.3	-0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00
flat	0.8	0.6	2	0.3	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.02	-0.01
flat	0.4	0.6	2	0.3	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
up	0.8	0.25	3	0.3	-0.39	-0.22	-0.14	-0.09	-0.06	-0.05	-0.03	-0.02	-0.01	-0.09
up	0.4	0.25	3	0.3	-0.40	-0.23	-0.15	-0.10	-0.08	-0.06	-0.05	-0.04	-0.03	-0.10
up	0.8	0.6	3	0.3	-0.40	-0.24	-0.17	-0.13	-0.11	-0.09	-0.08	-0.07	-0.06	-0.22
up	0.4	0.6	3	0.3	-0.40	-0.23	-0.13	-0.07	-0.03	0.00	0.03	0.05	0.07	-0.20
down	0.8	0.25	3	0.3	0.98	0.57	0.36	0.24	0.16	0.11	0.07	0.04	0.02	0.05
down	0.4	0.25	3	0.3	0.97	0.56	0.36	0.24	0.16	0.11	0.07	0.04	0.01	0.04
down	0.8	0.6	3	0.3	1.00	0.60	0.39	0.27	0.19	0.14	0.10	0.07	0.05	0.19
down	0.4	0.6	3	0.3	0.94	0.56	0.36	0.25	0.17	0.12	0.07	0.04	0.02	0.19
flat	0.8	0.25	3	0.3	0.05	0.03	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.01
flat	0.4	0.25	3	0.3	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
flat	0.8	0.6	3	0.3	0.02	0.02	0.02	0.01	0.01	0.01	0.00	0.00	-0.01	-0.03
flat	0.4	0.6	3	0.3	0.02	0.01	0.01	0.01	0.00	-0.01	-0.02	-0.03	-0.04	0.01
					0.15	0.08	0.05	0.03	0.02	0.01	0.01	0.00	0.00	-0.02

Table 8. Mean relative biomass error for combined areas "rockfish" like simulations comparing unweighted average methods with Kalman filter based on 100 simulations for each row.

Factors					Unweighted average methods										Kalman
trend	sigmaR	survey CV	survey freq.	max. move.	1	2	3	4	5	6	7	8	9	10	filter
up	0.8	0.25	1	0.1	-0.02	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07	-0.09	-0.10	-0.11	-0.08
up	0.4	0.25	1	0.1	0.00	-0.02	-0.03	-0.03	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09	-0.07
up	0.8	0.6	1	0.1	-0.05	-0.05	-0.06	-0.08	-0.08	-0.08	-0.09	-0.10	-0.11	-0.12	-0.17
up	0.4	0.6	1	0.1	-0.07	-0.05	-0.03	-0.03	-0.04	-0.06	-0.07	-0.07	-0.08	-0.09	-0.15
down	0.8	0.25	1	0.1	-0.01	0.02	0.05	0.08	0.11	0.14	0.17	0.20	0.23	0.25	0.03
down	0.4	0.25	1	0.1	0.00	0.01	0.04	0.07	0.10	0.13	0.15	0.18	0.20	0.23	0.04
down	0.8	0.6	1	0.1	-0.06	-0.01	0.03	0.04	0.08	0.10	0.13	0.16	0.18	0.20	0.06
down	0.4	0.6	1	0.1	-0.01	-0.01	0.03	0.05	0.08	0.10	0.14	0.17	0.20	0.21	0.08
flat	0.8	0.25	1	0.1	-0.03	-0.02	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
flat	0.4	0.25	1	0.1	0.00	-0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
flat	0.8	0.6	1	0.1	0.00	0.00	-0.02	-0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.00
flat	0.4	0.6	1	0.1	-0.04	0.00	0.00	-0.01	-0.02	-0.01	0.00	-0.01	-0.01	0.00	0.00
up	0.8	0.25	2	0.1	-0.01	-0.02	-0.04	-0.06	-0.08	-0.10	-0.13	-0.15	-0.17	-0.19	-0.08
up	0.4	0.25	2	0.1	-0.02	-0.03	-0.04	-0.07	-0.09	-0.11	-0.13	-0.15	-0.17	-0.19	-0.09
up	0.8	0.6	2	0.1	0.05	0.00	-0.04	-0.06	-0.08	-0.10	-0.12	-0.14	-0.16	-0.18	-0.17
up	0.4	0.6	2	0.1	0.00	-0.02	-0.05	-0.08	-0.08	-0.11	-0.12	-0.15	-0.17	-0.20	-0.18
down	0.8	0.25	2	0.1	0.00	0.06	0.11	0.17	0.22	0.27	0.33	0.39	0.44	0.49	0.05
down	0.4	0.25	2	0.1	-0.01	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.46	0.04
down	0.8	0.6	2	0.1	-0.09	0.03	0.09	0.16	0.21	0.25	0.31	0.34	0.40	0.45	0.11
down	0.4	0.6	2	0.1	0.00	0.05	0.08	0.13	0.19	0.23	0.29	0.35	0.40	0.46	0.13
flat	0.8	0.25	2	0.1	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.00
flat	0.4	0.25	2	0.1	-0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	-0.01
flat	0.8	0.6	2	0.1	-0.02	-0.02	-0.01	0.01	0.02	0.03	0.04	0.04	0.03	0.02	-0.01
flat	0.4	0.6	2	0.1	-0.01	0.00	-0.01	-0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00
up	0.8	0.25	3	0.1	-0.02	-0.03	-0.06	-0.09	-0.12	-0.15	-0.18	-0.21	-0.24	-0.27	-0.08
up	0.4	0.25	3	0.1	0.01	-0.03	-0.06	-0.10	-0.13	-0.16	-0.19	-0.22	-0.25	-0.28	-0.09
up	0.8	0.6	3	0.1	-0.06	-0.04	-0.06	-0.09	-0.12	-0.14	-0.17	-0.20	-0.23	-0.26	-0.19
up	0.4	0.6	3	0.1	-0.07	-0.06	-0.06	-0.10	-0.13	-0.16	-0.19	-0.22	-0.25	-0.28	-0.21
down	0.8	0.25	3	0.1	0.01	0.09	0.19	0.27	0.36	0.43	0.52	0.59	0.66	0.73	0.05
down	0.4	0.25	3	0.1	0.00	0.08	0.16	0.24	0.32	0.40	0.48	0.55	0.62	0.68	0.05
down	0.8	0.6	3	0.1	-0.02	0.06	0.13	0.24	0.32	0.40	0.48	0.55	0.64	0.70	0.14
down	0.4	0.6	3	0.1	-0.01	0.09	0.18	0.26	0.32	0.41	0.47	0.55	0.62	0.70	0.18
flat	0.8	0.25	3	0.1	-0.01	0.01	0.01	0.01	0.00	0.02	0.02	0.03	0.03	0.04	0.00
flat	0.4	0.25	3	0.1	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00
flat	0.8	0.6	3	0.1	-0.03	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	-0.01	-0.03
flat	0.4	0.6	3	0.1	0.05	0.00	-0.01	-0.02	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01
up	0.8	0.25	1	0.3	-0.01	-0.02	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09	-0.06
up	0.4	0.25	1	0.3	0.02	0.00	-0.01	-0.02	-0.04	-0.04	-0.05	-0.06	-0.07	-0.09	-0.06
up	0.8	0.6	1	0.3	0.02	0.00	0.00	-0.01	-0.02	-0.03	-0.05	-0.06	-0.07	-0.09	-0.14
up	0.4	0.6	1	0.3	0.02	-0.01	-0.03	-0.05	-0.06	-0.07	-0.08	-0.09	-0.11	-0.12	-0.16
down	0.8	0.25	1	0.3	0.01	0.03	0.06	0.08	0.10	0.12	0.16	0.18	0.20	0.23	0.04
down	0.4	0.25	1	0.3	-0.03	0.01	0.04	0.07	0.10	0.13	0.16	0.19	0.22	0.25	0.03
down	0.8	0.6	1	0.3	-0.03	0.04	0.07	0.08	0.11	0.14	0.17	0.22	0.23	0.25	0.11
down	0.4	0.6	1	0.3	0.02	0.05	0.09	0.11	0.15	0.17	0.18	0.20	0.22	0.24	0.14
flat	0.8	0.25	1	0.3	0.02	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
flat	0.4	0.25	1	0.3	0.00	0.01	0.01	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00
flat	0.8	0.6	1	0.3	-0.03	-0.05	-0.05	-0.04	-0.03	-0.03	-0.02	-0.02	-0.02	-0.02	-0.03
flat	0.4	0.6	1	0.3	0.03	0.00	-0.01	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	0.00
up	0.8	0.25	2	0.3	-0.03	-0.05	-0.06	-0.08	-0.10	-0.12	-0.14	-0.16	-0.18	-0.20	-0.11
up	0.4	0.25	2	0.3	-0.02	-0.03	-0.05	-0.08	-0.09	-0.11	-0.13	-0.15	-0.17	-0.19	-0.09
up	0.8	0.6	2	0.3	0.00	-0.02	-0.05	-0.08	-0.10	-0.12	-0.14	-0.16	-0.18	-0.20	-0.20
up	0.4	0.6	2	0.3	0.03	0.00	-0.05	-0.06	-0.08	-0.10	-0.13	-0.15	-0.17	-0.19	-0.19
down	0.8	0.25	2	0.3	-0.01	0.05	0.11	0.17	0.23	0.29	0.35	0.40	0.45	0.50	0.04
down	0.4	0.25	2	0.3	0.00	0.06	0.10	0.15	0.20	0.26	0.30	0.35	0.40	0.45	0.04
down	0.8	0.6	2	0.3	0.02	0.05	0.08	0.15	0.17	0.23	0.29	0.33	0.39	0.44	0.11
down	0.4	0.6	2	0.3	0.03	0.05	0.09	0.16	0.20	0.24	0.29	0.36	0.40	0.44	0.16
flat	0.8	0.25	2	0.3	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
flat	0.4	0.25	2	0.3	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00
flat	0.8	0.6	2	0.3	0.03	0.00	0.00	0.02	0.02	0.02	0.01	0.02	0.01	0.02	-0.01
flat	0.4	0.6	2	0.3	0.01	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
up	0.8	0.25	3	0.3	-0.01	-0.04	-0.06	-0.09	-0.12	-0.15	-0.18	-0.21	-0.24	-0.27	-0.09
up	0.4	0.25	3	0.3	-0.03	-0.04	-0.07	-0.10	-0.13	-0.16	-0.19	-0.22	-0.25	-0.28	-0.10
up	0.8	0.6	3	0.3	-0.06	-0.09	-0.11	-0.13	-0.15	-0.17	-0.20	-0.22	-0.25	-0.27	-0.22
up	0.4	0.6	3	0.3	0.10	-0.02	-0.05	-0.08	-0.12	-0.16	-0.19	-0.22	-0.25	-0.28	-0.20
down	0.8	0.25	3	0.3	0.00	0.08	0.16	0.24	0.33	0.40	0.48	0.56	0.62	0.69	0.05
down	0.4	0.25	3	0.3	-0.01	0.09	0.17	0.24	0.32	0.39	0.47	0.55	0.61	0.68	0.04
down	0.8	0.6	3	0.3	0.03	0.11	0.19	0.26	0.35	0.44	0.53	0.61	0.68	0.73	0.19
down	0.4	0.6	3	0.3	0.00	0.08	0.18	0.26	0.35	0.42	0.49	0.55	0.61	0.68	0.19
flat	0.8	0.25	3	0.3	0.01	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.01
flat	0.4	0.25	3	0.3	0.00	0.00	-0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00
flat	0.8	0.6	3	0.3	-0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.03	0.03	0.02	-0.03
flat	0.4	0.6	3	0.3	-0.05	-0.01	0.02	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01
					-0.01	0.01	0.02	0.03	0.04	0.05	0.07	0.08	0.09	0.09	-0.02

Table 9. Standard deviation for relative biomass error for combined areas "rockfish" like simulations comparing weighted average methods with Kalman filter based on 100 simulations for each row.

Factors					Weighted average methods									Kalman
trend	sigmaR	survey CV	survey freq.	max. move.	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	filter
up	0.8	0.25	1	0.1	0.08	0.07	0.07	0.08	0.08	0.09	0.10	0.12	0.13	0.07
up	0.4	0.25	1	0.1	0.04	0.05	0.05	0.06	0.07	0.09	0.10	0.11	0.13	0.05
up	0.8	0.6	1	0.1	0.10	0.12	0.16	0.19	0.22	0.26	0.29	0.33	0.37	0.12
up	0.4	0.6	1	0.1	0.08	0.12	0.15	0.18	0.20	0.22	0.25	0.27	0.30	0.10
down	0.8	0.25	1	0.1	0.17	0.11	0.09	0.09	0.10	0.11	0.12	0.13	0.14	0.11
down	0.4	0.25	1	0.1	0.09	0.07	0.07	0.08	0.09	0.10	0.11	0.11	0.12	0.09
down	0.8	0.6	1	0.1	0.20	0.14	0.15	0.17	0.19	0.21	0.24	0.26	0.30	0.16
down	0.4	0.6	1	0.1	0.15	0.15	0.17	0.19	0.22	0.24	0.26	0.28	0.31	0.18
flat	0.8	0.25	1	0.1	0.09	0.07	0.07	0.07	0.08	0.09	0.10	0.11	0.13	0.08
flat	0.4	0.25	1	0.1	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.06
flat	0.8	0.6	1	0.1	0.12	0.13	0.16	0.19	0.22	0.25	0.27	0.30	0.32	0.14
flat	0.4	0.6	1	0.1	0.09	0.12	0.15	0.18	0.21	0.23	0.26	0.29	0.32	0.09
up	0.8	0.25	2	0.1	0.06	0.06	0.07	0.08	0.09	0.11	0.12	0.14	0.15	0.08
up	0.4	0.25	2	0.1	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.07
up	0.8	0.6	2	0.1	0.11	0.15	0.18	0.21	0.25	0.28	0.30	0.33	0.36	0.18
up	0.4	0.6	2	0.1	0.09	0.12	0.16	0.19	0.23	0.26	0.30	0.34	0.38	0.18
down	0.8	0.25	2	0.1	0.26	0.17	0.12	0.10	0.10	0.10	0.11	0.12	0.14	0.12
down	0.4	0.25	2	0.1	0.11	0.08	0.08	0.08	0.09	0.10	0.11	0.12	0.13	0.11
down	0.8	0.6	2	0.1	0.28	0.21	0.19	0.20	0.21	0.23	0.25	0.27	0.30	0.25
down	0.4	0.6	2	0.1	0.17	0.13	0.14	0.16	0.18	0.21	0.24	0.27	0.30	0.20
flat	0.8	0.25	2	0.1	0.12	0.10	0.09	0.08	0.09	0.10	0.11	0.12	0.13	0.10
flat	0.4	0.25	2	0.1	0.07	0.07	0.07	0.08	0.08	0.09	0.10	0.11	0.12	0.08
flat	0.8	0.6	2	0.1	0.13	0.12	0.14	0.16	0.19	0.22	0.25	0.27	0.30	0.14
flat	0.4	0.6	2	0.1	0.10	0.13	0.16	0.19	0.21	0.24	0.26	0.29	0.31	0.12
up	0.8	0.25	3	0.1	0.06	0.07	0.08	0.08	0.09	0.10	0.11	0.12	0.13	0.10
up	0.4	0.25	3	0.1	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.12	0.13	0.08
up	0.8	0.6	3	0.1	0.10	0.14	0.17	0.20	0.24	0.27	0.31	0.34	0.38	0.23
up	0.4	0.6	3	0.1	0.08	0.12	0.15	0.17	0.20	0.22	0.24	0.27	0.29	0.17
down	0.8	0.25	3	0.1	0.32	0.22	0.17	0.14	0.13	0.12	0.12	0.13	0.14	0.14
down	0.4	0.25	3	0.1	0.15	0.10	0.09	0.09	0.09	0.10	0.10	0.12	0.13	0.12
down	0.8	0.6	3	0.1	0.43	0.27	0.22	0.21	0.22	0.25	0.27	0.30	0.34	0.29
down	0.4	0.6	3	0.1	0.27	0.19	0.19	0.20	0.22	0.23	0.25	0.28	0.30	0.27
flat	0.8	0.25	3	0.1	0.13	0.10	0.09	0.09	0.09	0.10	0.10	0.11	0.13	0.11
flat	0.4	0.25	3	0.1	0.07	0.06	0.07	0.08	0.10	0.11	0.12	0.14	0.16	0.08
flat	0.8	0.6	3	0.1	0.18	0.18	0.19	0.21	0.23	0.25	0.27	0.29	0.32	0.19
flat	0.4	0.6	3	0.1	0.12	0.13	0.15	0.18	0.22	0.25	0.28	0.31	0.35	0.12
up	0.8	0.25	1	0.3	0.06	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.06
up	0.4	0.25	1	0.3	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.06
up	0.8	0.6	1	0.3	0.10	0.12	0.15	0.17	0.20	0.22	0.25	0.27	0.30	0.13
up	0.4	0.6	1	0.3	0.08	0.12	0.15	0.18	0.21	0.24	0.27	0.30	0.33	0.11
down	0.8	0.25	1	0.3	0.17	0.11	0.09	0.09	0.09	0.10	0.11	0.11	0.13	0.10
down	0.4	0.25	1	0.3	0.08	0.07	0.07	0.08	0.08	0.09	0.10	0.11	0.12	0.09
down	0.8	0.6	1	0.3	0.22	0.18	0.20	0.22	0.24	0.27	0.29	0.32	0.34	0.23
down	0.4	0.6	1	0.3	0.13	0.15	0.19	0.21	0.24	0.25	0.27	0.28	0.30	0.19
flat	0.8	0.25	1	0.3	0.11	0.09	0.08	0.08	0.09	0.10	0.11	0.12	0.13	0.09
flat	0.4	0.25	1	0.3	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.06
flat	0.8	0.6	1	0.3	0.13	0.12	0.14	0.16	0.19	0.22	0.25	0.28	0.31	0.13
flat	0.4	0.6	1	0.3	0.09	0.12	0.15	0.17	0.19	0.22	0.24	0.27	0.30	0.10
up	0.8	0.25	2	0.3	0.06	0.06	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.07
up	0.4	0.25	2	0.3	0.04	0.05	0.06	0.07	0.08	0.09	0.11	0.12	0.13	0.07
up	0.8	0.6	2	0.3	0.11	0.14	0.17	0.20	0.22	0.25	0.28	0.31	0.34	0.17
up	0.4	0.6	2	0.3	0.09	0.13	0.16	0.19	0.23	0.26	0.30	0.33	0.37	0.15
down	0.8	0.25	2	0.3	0.26	0.16	0.13	0.11	0.11	0.11	0.11	0.12	0.13	0.12
down	0.4	0.25	2	0.3	0.13	0.09	0.08	0.08	0.09	0.10	0.11	0.12	0.14	0.11
down	0.8	0.6	2	0.3	0.29	0.20	0.19	0.19	0.21	0.23	0.26	0.28	0.31	0.22
down	0.4	0.6	2	0.3	0.17	0.17	0.18	0.20	0.23	0.26	0.29	0.32	0.36	0.24
flat	0.8	0.25	2	0.3	0.14	0.12	0.10	0.10	0.09	0.10	0.10	0.11	0.12	0.11
flat	0.4	0.25	2	0.3	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.07
flat	0.8	0.6	2	0.3	0.16	0.15	0.16	0.18	0.20	0.23	0.26	0.30	0.33	0.16
flat	0.4	0.6	2	0.3	0.11	0.13	0.15	0.17	0.19	0.22	0.25	0.29	0.33	0.12
up	0.8	0.25	3	0.3	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.11	0.12	0.09
up	0.4	0.25	3	0.3	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.08
up	0.8	0.6	3	0.3	0.09	0.12	0.15	0.17	0.20	0.23	0.25	0.28	0.32	0.18
up	0.4	0.6	3	0.3	0.08	0.14	0.18	0.22	0.26	0.30	0.34	0.38	0.42	0.23
down	0.8	0.25	3	0.3	0.27	0.19	0.15	0.12	0.11	0.11	0.11	0.12	0.14	0.13
down	0.4	0.25	3	0.3	0.17	0.11	0.10	0.10	0.10	0.10	0.11	0.12	0.13	0.12
down	0.8	0.6	3	0.3	0.35	0.24	0.21	0.22	0.23	0.25	0.27	0.30	0.33	0.28
down	0.4	0.6	3	0.3	0.22	0.16	0.17	0.19	0.21	0.23	0.26	0.30	0.34	0.27
flat	0.8	0.25	3	0.3	0.16	0.12	0.09	0.09	0.09	0.10	0.10	0.12	0.13	0.11
flat	0.4	0.25	3	0.3	0.06	0.06	0.07	0.07	0.08	0.09	0.11	0.12	0.13	0.07
flat	0.8	0.6	3	0.3	0.18	0.16	0.17	0.20	0.22	0.25	0.28	0.31	0.33	0.17
flat	0.4	0.6	3	0.3	0.16	0.15	0.18	0.20	0.23	0.25	0.28	0.31	0.33	0.14
					0.13	0.12	0.12	0.14	0.15	0.17	0.19	0.21	0.23	0.13

Table 10. Standard deviation for relative biomass error for combined areas "rockfish" like simulations comparing unweighted average methods with Kalman filter based on 100 simulations for each row.

Factors					Unweighted average methods										Kalman
trend	sigmaR	survey CV	survey freq.	max. move.	1	2	3	4	5	6	7	8	9	10	filter
up	0.8	0.25	1	0.1	0.14	0.10	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07
up	0.4	0.25	1	0.1	0.14	0.09	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05
up	0.8	0.6	1	0.1	0.42	0.25	0.21	0.17	0.16	0.15	0.14	0.13	0.12	0.12	0.12
up	0.4	0.6	1	0.1	0.34	0.26	0.21	0.19	0.16	0.14	0.13	0.11	0.11	0.10	0.10
down	0.8	0.25	1	0.1	0.15	0.12	0.10	0.09	0.09	0.10	0.10	0.11	0.12	0.13	0.11
down	0.4	0.25	1	0.1	0.13	0.11	0.09	0.09	0.08	0.08	0.07	0.08	0.08	0.08	0.09
down	0.8	0.6	1	0.1	0.33	0.22	0.22	0.18	0.17	0.16	0.17	0.18	0.17	0.18	0.16
down	0.4	0.6	1	0.1	0.33	0.27	0.23	0.20	0.20	0.19	0.17	0.17	0.16	0.16	0.18
flat	0.8	0.25	1	0.1	0.14	0.10	0.08	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08
flat	0.4	0.25	1	0.1	0.15	0.11	0.08	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06
flat	0.8	0.6	1	0.1	0.35	0.27	0.22	0.19	0.16	0.13	0.14	0.14	0.13	0.13	0.14
flat	0.4	0.6	1	0.1	0.35	0.26	0.21	0.17	0.16	0.15	0.13	0.13	0.12	0.12	0.09
up	0.8	0.25	2	0.1	0.17	0.12	0.09	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08
up	0.4	0.25	2	0.1	0.14	0.09	0.08	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.07
up	0.8	0.6	2	0.1	0.39	0.29	0.24	0.20	0.18	0.17	0.16	0.14	0.14	0.14	0.18
up	0.4	0.6	2	0.1	0.43	0.26	0.22	0.16	0.14	0.14	0.13	0.12	0.12	0.11	0.18
down	0.8	0.25	2	0.1	0.15	0.10	0.11	0.11	0.13	0.15	0.17	0.19	0.20	0.22	0.12
down	0.4	0.25	2	0.1	0.15	0.11	0.09	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.11
down	0.8	0.6	2	0.1	0.33	0.26	0.24	0.24	0.23	0.22	0.23	0.24	0.25	0.26	0.25
down	0.4	0.6	2	0.1	0.33	0.24	0.20	0.17	0.17	0.16	0.17	0.17	0.18	0.17	0.20
flat	0.8	0.25	2	0.1	0.14	0.10	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.10
flat	0.4	0.25	2	0.1	0.13	0.10	0.09	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.08
flat	0.8	0.6	2	0.1	0.33	0.25	0.19	0.18	0.17	0.15	0.16	0.15	0.15	0.15	0.14
flat	0.4	0.6	2	0.1	0.34	0.26	0.24	0.19	0.16	0.16	0.16	0.14	0.13	0.13	0.12
up	0.8	0.25	3	0.1	0.15	0.11	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.10
up	0.4	0.25	3	0.1	0.15	0.09	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.05	0.08
up	0.8	0.6	3	0.1	0.41	0.30	0.21	0.17	0.16	0.16	0.16	0.15	0.14	0.13	0.23
up	0.4	0.6	3	0.1	0.32	0.24	0.22	0.17	0.15	0.14	0.13	0.12	0.11	0.10	0.17
down	0.8	0.25	3	0.1	0.15	0.13	0.14	0.17	0.19	0.21	0.24	0.26	0.27	0.29	0.14
down	0.4	0.25	3	0.1	0.14	0.10	0.11	0.10	0.11	0.11	0.11	0.12	0.13	0.13	0.12
down	0.8	0.6	3	0.1	0.37	0.27	0.24	0.26	0.26	0.27	0.29	0.31	0.35	0.36	0.29
down	0.4	0.6	3	0.1	0.33	0.26	0.26	0.24	0.22	0.23	0.21	0.22	0.24	0.24	0.27
flat	0.8	0.25	3	0.1	0.14	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.13	0.13	0.11
flat	0.4	0.25	3	0.1	0.17	0.12	0.09	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.08
flat	0.8	0.6	3	0.1	0.35	0.31	0.26	0.22	0.21	0.21	0.20	0.20	0.20	0.20	0.19
flat	0.4	0.6	3	0.1	0.38	0.26	0.20	0.16	0.15	0.15	0.14	0.13	0.13	0.13	0.12
up	0.8	0.25	1	0.3	0.14	0.10	0.08	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.06
up	0.4	0.25	1	0.3	0.14	0.10	0.08	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06
up	0.8	0.6	1	0.3	0.32	0.26	0.20	0.18	0.16	0.14	0.13	0.13	0.12	0.12	0.13
up	0.4	0.6	1	0.3	0.37	0.23	0.20	0.18	0.15	0.13	0.13	0.12	0.11	0.10	0.11
down	0.8	0.25	1	0.3	0.14	0.10	0.11	0.11	0.10	0.11	0.11	0.12	0.13	0.14	0.10
down	0.4	0.25	1	0.3	0.13	0.10	0.10	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.09
down	0.8	0.6	1	0.3	0.38	0.30	0.26	0.22	0.22	0.21	0.21	0.22	0.20	0.20	0.23
down	0.4	0.6	1	0.3	0.32	0.34	0.29	0.22	0.20	0.18	0.18	0.17	0.16	0.16	0.19
flat	0.8	0.25	1	0.3	0.15	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.09
flat	0.4	0.25	1	0.3	0.15	0.10	0.08	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.06
flat	0.8	0.6	1	0.3	0.35	0.23	0.18	0.18	0.16	0.15	0.14	0.13	0.13	0.13	0.13
flat	0.4	0.6	1	0.3	0.34	0.22	0.20	0.17	0.17	0.17	0.14	0.13	0.13	0.12	0.10
up	0.8	0.25	2	0.3	0.12	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.07
up	0.4	0.25	2	0.3	0.15	0.10	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.05	0.07
up	0.8	0.6	2	0.3	0.38	0.26	0.22	0.18	0.17	0.16	0.15	0.14	0.14	0.13	0.17
up	0.4	0.6	2	0.3	0.41	0.27	0.20	0.17	0.16	0.15	0.14	0.13	0.12	0.11	0.15
down	0.8	0.25	2	0.3	0.14	0.12	0.11	0.11	0.13	0.15	0.16	0.18	0.20	0.21	0.12
down	0.4	0.25	2	0.3	0.15	0.12	0.09	0.09	0.09	0.09	0.09	0.10	0.11	0.12	0.11
down	0.8	0.6	2	0.3	0.34	0.27	0.22	0.24	0.23	0.21	0.23	0.24	0.25	0.27	0.22
down	0.4	0.6	2	0.3	0.40	0.26	0.24	0.23	0.20	0.19	0.19	0.20	0.20	0.21	0.24
flat	0.8	0.25	2	0.3	0.13	0.10	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.14	0.11
flat	0.4	0.25	2	0.3	0.15	0.10	0.08	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.07
flat	0.8	0.6	2	0.3	0.37	0.26	0.21	0.19	0.18	0.19	0.18	0.17	0.17	0.17	0.16
flat	0.4	0.6	2	0.3	0.37	0.23	0.18	0.20	0.18	0.17	0.17	0.15	0.14	0.14	0.12
up	0.8	0.25	3	0.3	0.14	0.10	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09
up	0.4	0.25	3	0.3	0.13	0.10	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.05	0.08
up	0.8	0.6	3	0.3	0.35	0.24	0.20	0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.18
up	0.4	0.6	3	0.3	0.47	0.30	0.24	0.20	0.16	0.15	0.14	0.13	0.11	0.10	0.23
down	0.8	0.25	3	0.3	0.16	0.11	0.12	0.15	0.17	0.19	0.21	0.22	0.23	0.25	0.13
down	0.4	0.25	3	0.3	0.14	0.13	0.11	0.11	0.11	0.12	0.13	0.13	0.14	0.14	0.12
down	0.8	0.6	3	0.3	0.37	0.29	0.26	0.26	0.25	0.29	0.30	0.32	0.31	0.33	0.28
down	0.4	0.6	3	0.3	0.38	0.26	0.25	0.24	0.22	0.21	0.20	0.21	0.22	0.22	0.27
flat	0.8	0.25	3	0.3	0.15	0.11	0.10	0.10	0.11	0.11	0.13	0.14	0.15	0.15	0.11
flat	0.4	0.25	3	0.3	0.15	0.10	0.09	0.08	0.07	0.07	0.08	0.08	0.08	0.08	0.07
flat	0.8	0.6	3	0.3	0.36	0.28	0.23	0.19	0.19	0.19	0.19	0.19	0.20	0.19	0.17
flat	0.4	0.6	3	0.3	0.36	0.31	0.24	0.20	0.18	0.17	0.16	0.16	0.15	0.15	0.14
					0.25	0.18	0.16	0.14	0.14	0.13	0.13	0.13	0.13	0.14	0.13

Table 11. Summary over the 36 different population/survey scenarios showing the minimum and maximum mean relative error (and the range) along with the mean standard deviation between the different stocks. Shadings are relative to the values within the row (darker being worse).

	Weighted average methods									Unweighted average methods										Kalman
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	2	3	4	5	6	7	8	9	10	filter
Rockfish-like																				
Min	-0.40	-0.24	-0.17	-0.13	-0.11	-0.09	-0.08	-0.07	-0.07	-0.09	-0.09	-0.11	-0.13	-0.15	-0.17	-0.20	-0.22	-0.25	-0.28	-0.22
Max	1.03	0.60	0.39	0.27	0.19	0.14	0.10	0.07	0.07	0.10	0.11	0.19	0.27	0.36	0.44	0.53	0.61	0.68	0.73	0.19
Range	1.43	0.85	0.56	0.40	0.30	0.23	0.18	0.14	0.14	0.18	0.20	0.31	0.40	0.50	0.62	0.73	0.83	0.93	1.01	0.41
Std Dev	0.13	0.12	0.12	0.14	0.15	0.17	0.19	0.21	0.23	0.25	0.18	0.16	0.14	0.14	0.13	0.13	0.13	0.13	0.14	0.13
Pollock-like																				
Min	-0.42	-0.23	-0.14	-0.09	-0.07	-0.06	-0.06	-0.06	-0.07	-0.10	-0.07	-0.07	-0.10	-0.12	-0.15	-0.18	-0.21	-0.24	-0.27	-0.21
Max	3.98	2.12	1.26	0.80	0.53	0.35	0.22	0.13	0.07	0.07	0.26	0.56	0.79	1.05	1.39	1.63	1.90	2.16	2.45	0.08
Range	4.40	2.35	1.40	0.89	0.60	0.40	0.28	0.19	0.15	0.17	0.33	0.64	0.89	1.18	1.54	1.81	2.11	2.40	2.72	0.29
Std Dev	0.47	0.31	0.25	0.22	0.21	0.20	0.21	0.22	0.24	0.26	0.22	0.23	0.26	0.29	0.31	0.33	0.35	0.37	0.39	0.18

Figures

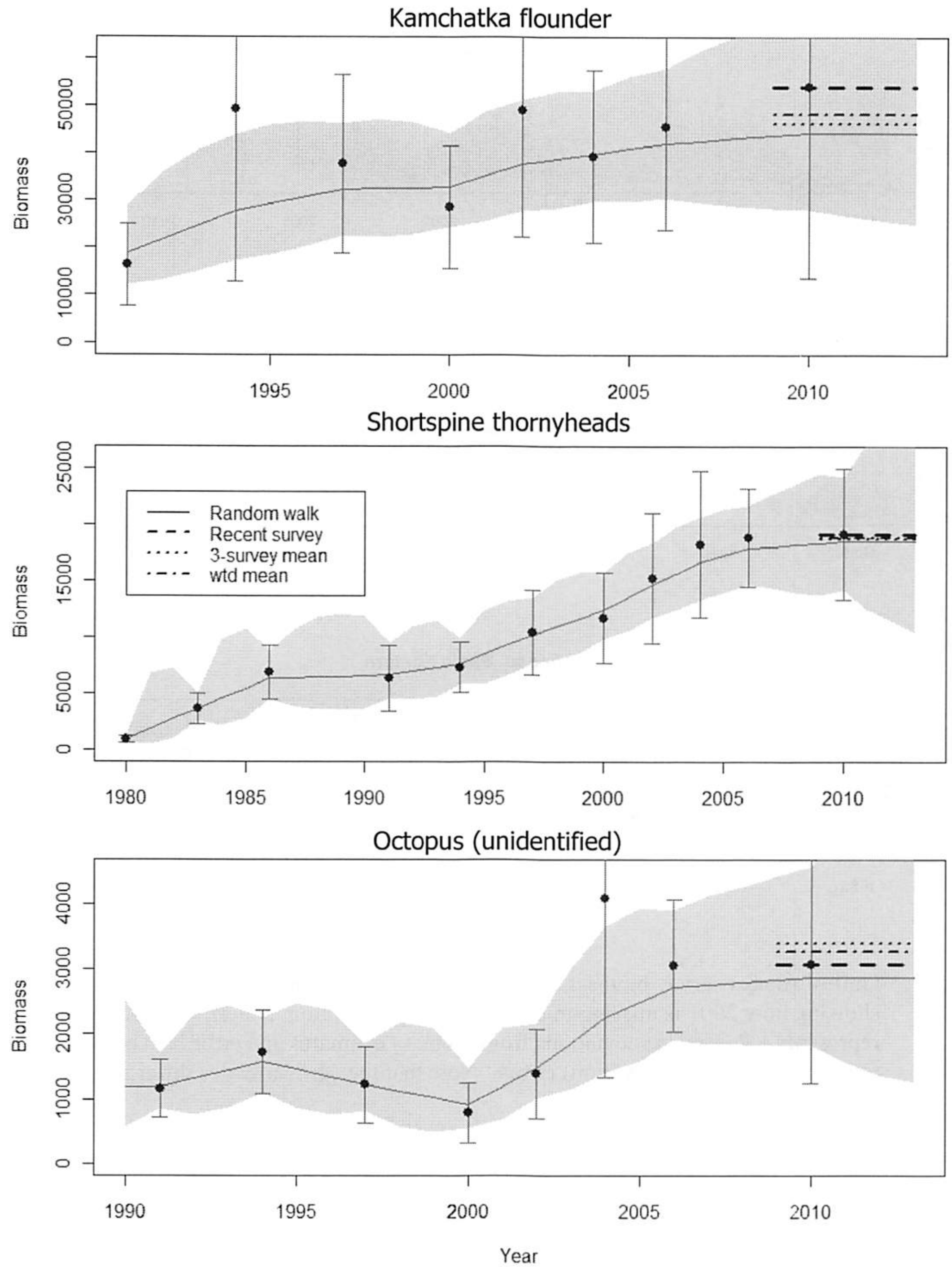

Figure 1. Aleutian Islands survey biomass fits for the random-walk model for some selected stocks. Shaded region represents $\pm$ 2 standard deviations from biomass estimates and error bars on points represents survey (observation) errors.

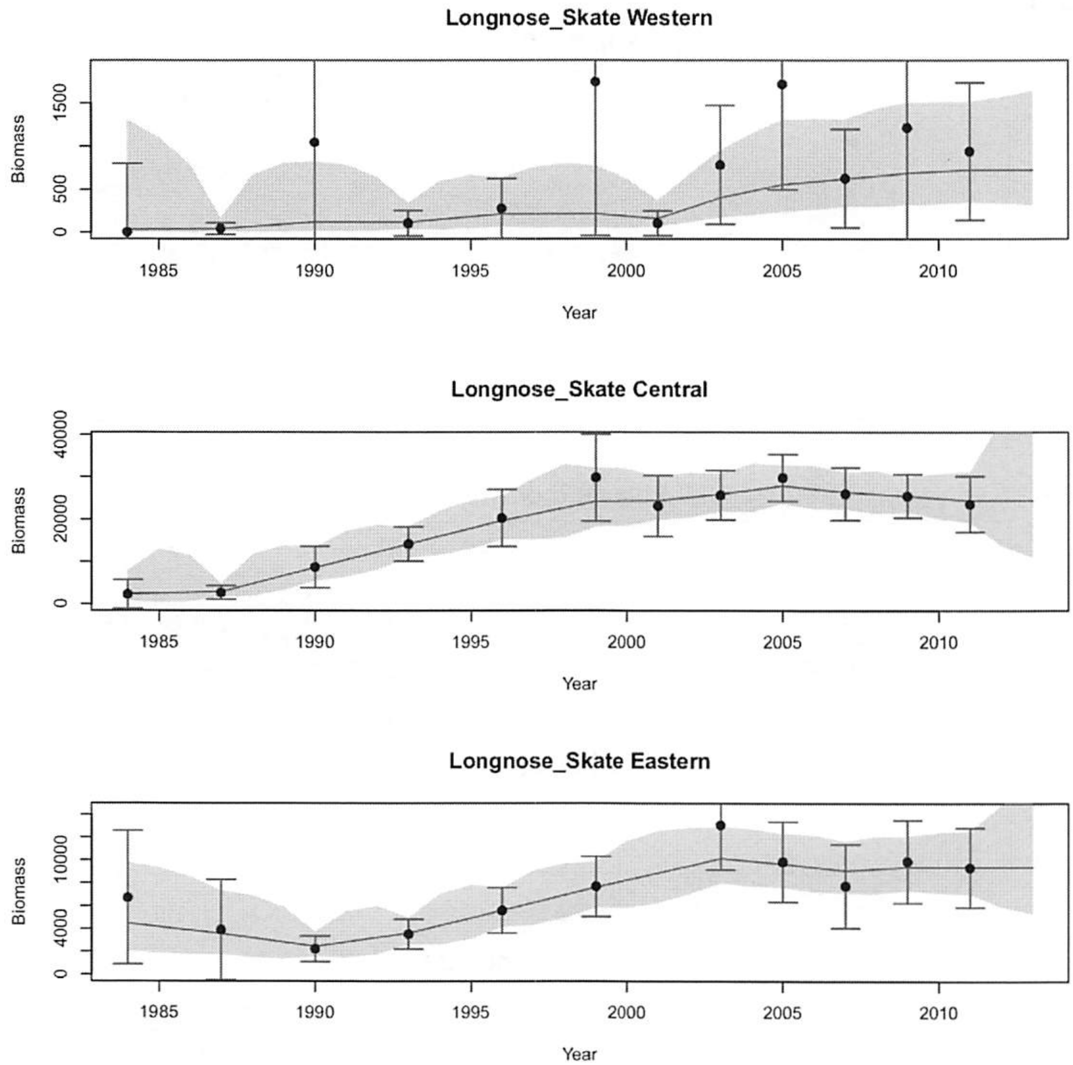

Figure 2. Gulf of Alaska survey biomass fits for the random-walk model for longnose skate showing how 2001 is missing in the eastern region (bottom panel). Shaded region represents $\pm$ 2 standard deviations from biomass estimates and error bars on points represents survey (observation) errors. Note that the vertical scales differ between regions.

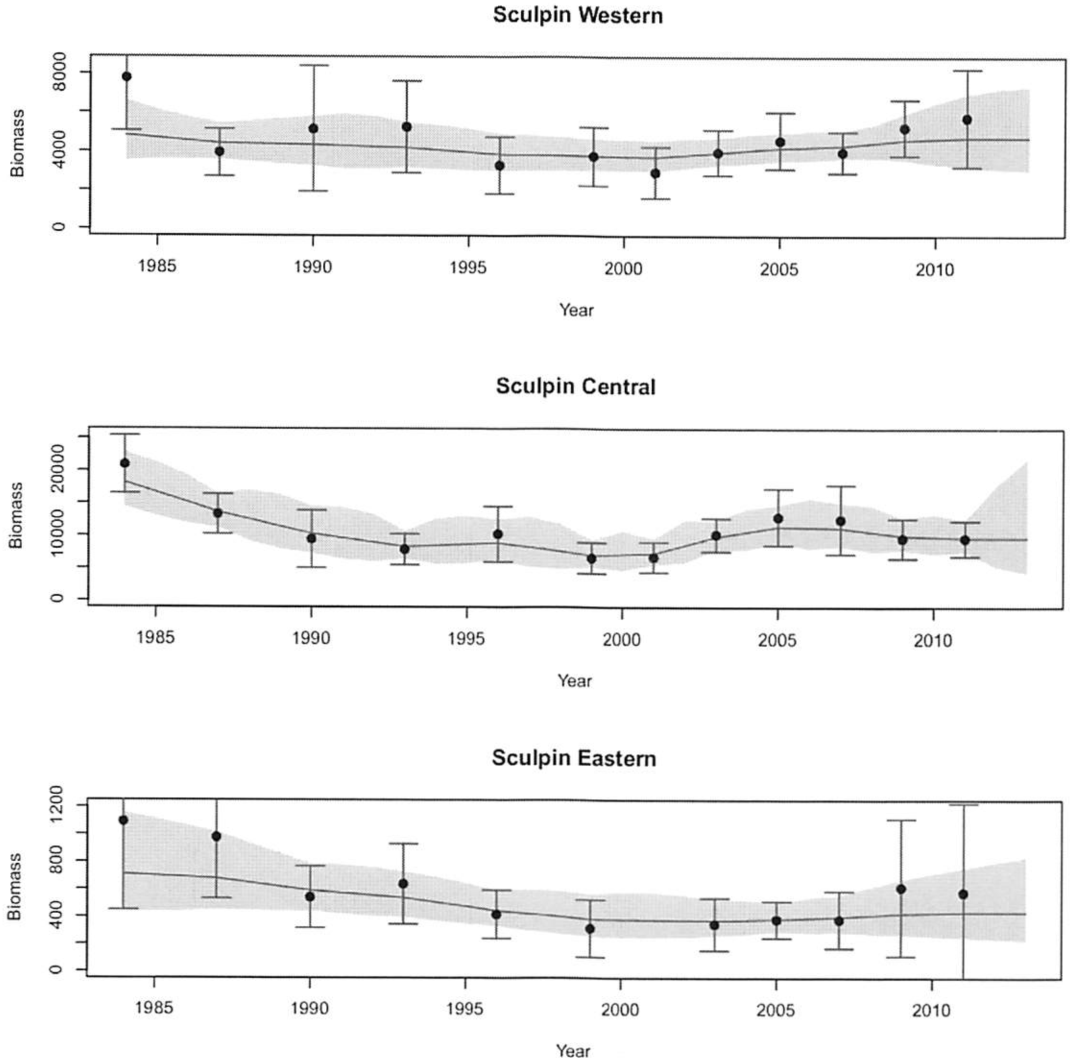

Figure 3. Gulf of Alaska survey biomass fits for the random-walk model for the sculpin complex showing how 2001 is missing in the eastern region (bottom panel). Shaded region represents $\pm$ 2 standard deviations from biomass estimates and error bars on points represents survey (observation) errors. Note that the vertical scales differ between regions.

Joint Plan Team Total Catch Accounting Working Group

May 22, 2012

Members: Grant Thompson (BSAI Plan Team Co-chair), Sandra Lowe (GOA Plan Team), Chris Lunsford (GOA Plan Team), Mary Furuness (BSAI Plan Team), Jane DiCosimo (BSAI Plan Team Coordinator), and Jason Gasper (Crab Plan Team)

Other participants: Melanie Brown and Jeff Hartman (AKRO)

The objective of the Working Group is to assist the Plan Teams in making recommendations for changes deemed necessary to comply with the Magnuson-Stevens Act (MSA) and the National Standard Guidelines, specifically related to total catch accounting (TCA). The National Standard Guidelines for the MSA require accounting for all removals. The Working Group identified its first priority as providing comments on an advance notice of proposed rulemaking (ANPR) to revise NMFS guidelines for National Standard 1 (NS1), because the deadline for public comments is August 1, which is prior to the next meeting of the joint groundfish plan teams. This report is organized according to the Working Group's agenda (attached).

1. NS1

Jeff Hartman provided background on an early opportunity for NMFS AKRO staff to provide comment to NOAA Fisheries HQ on its plans to publish an ANPR for NS1. The Working Group discussed whether the uncertainty caused by the ANPR should postpone the Plan Teams' attempts to comply with the 2009 National Standard 1 Guidelines. *The Working Group recommended no changes to current practices for total catch accounting (TCA) during the 2012 stock assessment cycle* because the NS1 Guidelines are being evaluated and may be revised (see next item also).

2. AKRO paper on research removals

Jeff Hartman and Melanie Brown reported on a planned discussion paper on total catch accounting for research removals of groundfishes. The paper, originally planned for June SSC review, is now planned for September Plan Team review and October SSC review. The authors plan to incorporate SSC and Council comments on the ANPR from June 2012 into the September draft. Resolution of TCA issues could be delayed as a result of the ANPR.

3. Data
   a) What are the official "catch" data? In August 2011 the Groundfish Plan Teams recommended that total catch should, in principle, be taken into account in the stock assessment determinations of OFL and ABC so that downward adjustments of the TAC are not necessary. However, the Plan Teams also felt that existing estimates of removals other than those taken in the groundfish fisheries were too preliminary to be used for determining OFLs and ABCs in November 2011 for the 2012/2013 assessment cycle. In addition, the Teams felt that the Council should not make allocative decisions between research removals and commercial catch. As of 2011, NMFS (through AKFIN) provides estimates of total catch available to authors for incorporation into the stock assessments for the groundfish fisheries by October 1 each year, although it should be noted that these estimates do not currently include all sources of removal; for example, Pacific cod catches in the BSAI crab fishery are not included.

      The Working Group considered a June 2011 discussion paper prepared by Grant Thompson (reference topic #3 in that paper). When considering incorporation of "other" catches in the SAFE reports, the Working Group noted the importance of distinguishing between:

      - listing other catches but not using them for anything,
      - using other catches to estimate reference fishing mortality rates (F40%, F35%, etc.),

- using other catches to estimate reference harvest amounts (maxABC, OFL, etc.) given the reference fishing mortality rates, and
- including other catches in the total against which harvest specifications are compared.

If "other" catches are to be used to estimate maxABC, OFL, etc., how should this be done? One idea proposed by the GOA Plan Team at its November 2011 meeting is to subtract "other" catches from the begin-year biomass. This approach would not be consistent with how most other harvest calculations are made, but it would be simple to apply for stocks managed under Tiers 5 or 6. The Working Group, however, did not identify a method for applying this approach to stocks with age-structured models.

b) Time series of research, subsistence, personal use, recreational, and exempted fishing permit removals – Jason Gasper confirmed that AKRO (through AKFIN) would complete the accounting of 2010 and 2011 "other" catch removals and have it available on AKFIN October 1. An accurate time series for these data is currently unavailable because data prior to 2010 are incomplete for some historical surveys (e.g., State of Alaska and RACE). An outstanding issue is what to do about years in which surveys occurred but no data have been entered into the AKRO database. Prior to the 2014 stock assessment cycle, AKRO will query providers for missing data to help establish a times series of removals.

c) Other data sets – The Working Group reviewed the history of Halibut Fisheries Incidental Catch Estimation (HFICE) data. In August 2011 the Teams recommended that all authors provide the 2001-2010 HFICE and a dataset including 2010 research, subsistence, personal use, recreational, and exempted fishing permit removals as an appendix to each assessment chapter in November 2011, but the Teams did not use these data for determining OFLs and ABCs in November 2011 for the 2012/2013 assessment cycle. Since these estimates are preliminary and the Teams have not reviewed the complete database or assessed the potential effects on determination of OFL and ABC for each stock, further analysis is needed before the Teams can recommend incorporation of these estimates in their OFL/ABC recommendations. The Teams raised some issues regarding how authors should use the databases in the future: 1) how to use catch estimates with no size/age composition information in the models (similar issues occur in the Pacific halibut stock assessment), 2) how the AKRO could or would incorporate these estimates into in-season management (to avoid overharvesting), and 3) development of a single catch estimation time series incorporating all data components. The Teams recommended that they investigate the implications of estimated removals from sources other than the groundfish fisheries on ABC estimation in September 2012. The Teams would then consider whether and how such estimates would be used in stock assessments in November 2012 for the 2013/2014 assessment cycle. The Working Group however noted that this would be a huge undertaking and recommended taking no action until issues surrounding the ANPR for NS1 Guidelines are clarified.

The Working Group considered the HFICE as a partial time series and an indicator of groundfish catch in the directed IFQ halibut fishery, but not a complete estimate that should necessarily be added to existing Catch Accounting System (CAS) estimates. Removals generated by major non-groundfish fisheries (BSAI crab and Pacific halibut) are generally incomplete. Reporting non-compliance is still a management and enforcement issue for past years, even if resolved for current years. The Working Group concluded that HFICE would not be included in the CAS and that extending it beyond 2011 was not necessary due to data from the observer restructuring being incorporated into the CAS in 2013. Further, programming and maintenance of HFICE requires significant staff and budgetary resources from both the AKRO and the AFSC that, given the priority of observer restructuring, is not feasible.

The Working Group recommended that the 2001-2011 HFICE appendix continue to be included in each assessment chapter until these interim indicators of groundfish catch in the halibut fishery are replaced by data collected under the restructured observer program. The Working Group recommended no further action on HFICE.

The Working Group discussed total accounting of Pacific cod caught for bait purposes in the crab fishery. Pacific cod catch in crab fisheries was first required to be reported on crab tickets in 2011. Compliance appears to be low and reported catches are likely underestimates. Fish ticket reports of Pacific cod caught for bait in the BSAI crab fishery will be included in the "other" catch data set available to stock assessment authors.

4. Stock assessment use
   a) Mary Furuness compiled a table (attached) listing which annual harvest specifications accommodate state removals and the approach adopted (e.g., PWS pollock, GOA Pacific cod, BSAI Pacific cod, BS and AI sablefish).
   b) and c) For all SAFE chapters, the Working Group recommended that authors continue to report "other" removals in an appendix but not apply those removals in the models.
   d) The Working Group recommends that further Plan Team discussion of how "other" removals would affect determination of OFL and ABC be tabled, pending potentially revised NS1 guidance.
   e) The Working Group discussed whether it would be beneficial to schedule a CIE review of how best to incorporate these data sets into stock assessments. Because CIE reviewers are often unfamiliar with the MSFCMA, the NS1 guidelines, or management of BSAI and GOA groundfish, the Working Group instead recommended a joint SSC/GPT workshop, perhaps in February 2013 or some other time outside the August – December assessment cycle. The Working Group noted that one cannot address how to incorporate the databases into the stock assessment without also discussing how the fishery is managed. Further interpretation of NS1 guidelines is necessary for incorporation of "other" catch data into stock assessments and harvest specifications.
   f) The Working Group recommended no new Instructions to Authors, but did recommend continued inclusion of appendices from 2011.

5. Next Steps. The Working Group will discuss/decide whether to convene again after it reviews the SSC recommendations on this topic from its June 2012 meeting. When it is appropriate to resume the TCA discussion, the following outstanding issues will need to be resolved (these are identified above, but are repeated here for convenience):
   - When considering use of "other" catches (i.e., catches other than those taken in the groundfish fishery) in assessment and management, it will be necessary to distinguish between:
     i. listing those catches but not using them for determination of catch limits,
     ii. using those catches to estimate reference fishing mortality rates (F40%, F35%, etc.),
     iii. using those catches to estimate reference harvest amounts (maxABC, OFL, etc.) given the reference fishing mortality rates, and
     iv. including those catches in the total against which harvest specifications are compared.
   - It will also be necessary to determine whether the use of "other" catches should differ depending on the source of the removals (e.g., should research catches be treated differently from catches taken in non-groundfish fisheries?).

- In the event that "other" catches will be used to estimate either reference fishing mortality rates or reference harvest amounts, methods will need to be devised for doing so, noting that these methods will need to address all tiers.
- What, if anything, to do with the HFICE time series (2001-2011).
- What to do about *years* for which "other" catches were known to have occurred, but for which no direct estimate of magnitude is available (e.g., years in which surveys occurred but no data have been entered into the AKRO database).
- What to do about *sources* for which "other" catches were known to have occurred, but for which no direct estimate of magnitude is available (e.g., catches taken in non-groundfish fisheries).

ATTACHMENT: Annual harvest specifications that accommodate state removals and the approach adopted (Source: AKRO)

BSAI		
BSAI stock assessments	**Federal TAC**	**State GHL**
Eastern Bering Sea Pollock	<=ABC	none
Aleutian Islands Pollock	<=ABC	none
Bogoslof Island Pollock	<=ABC, set for incidental catch amounts	none
BSAI Pacific cod	<= 97% of ABC	3% of ABC
AK Sablefish[1]	<=ABC	5% of BS and AI TAC
BSAI Yellowfin Sole	<=ABC	none
BSAI Greenland turbot	<=ABC	none
BSAI Arrowtooth flounder	<=ABC	none
BSAI Kamchatka flounder	<=ABC	none
BSAI Northern Rock Sole	<=ABC	none
BSAI Flathead Sole	<=ABC	none
BSAI Alaska Plaice	<=ABC	none
BSAI Other Flatfish	<=ABC	none
BSAI Pacific Ocean Perch	<=ABC	none
BSAI Northern Rockfish	<=ABC	none
BSAI Blackspotted and Rougheye rockfis	<=ABC	none
BSAI Shortraker rockfish	<=ABC	none
BSAI Other Rockfish	<=ABC	none
BSAI Atka Mackerel	<=ABC	none
BSAI Skates	<=ABC	none
BSAI Sculpin	<=ABC	none
BSAI Sharks	<=ABC	none
BSAI Squids	<=ABC	none
BSAI Octopus	<=ABC	none

[1]Sablefish State GHL is set by the State as 5% of the Federal BS and AI TAC. However, this amount is not deducted from the Federal TACs.

GOA

GOA stock assements	Federal TAC	State GHL
GOA Pollock	<=ABC	set prior to Federal AB(
GOA Pacific cod	<=75% of ABC	25% of Federal ABC
AK Sablefish	<=ABC	none
GOA Shallow-water Flatfish	<=ABC	none
GOA Deep-water Flatfish	<=ABC	none
GOA Rex Sole	<=ABC	none
GOA Arrowtooth Flounder	<=ABC	none
GOA Flathead Sole	<=ABC	none
GOA Pacific Ocean Perch	<=ABC	none
GOA Northern Rockfish	<=ABC	none
GOA Shortraker rockfish	<=ABC	none
GOA Dusky Rockfish (PSR)	<=ABC	none
GOA Rougheye and Blackspotted rockfis	<=ABC	none
GOA Demersal Shelf Rockfish	<=ABC	none
GOA Thornyheads	<=ABC	none
GOA Other Rockfish (other slope)	<=ABC	none
GOA Atka Mackerel	<=ABC	none
GOA Skates	<=ABC	none
GOA Sculpin	<=ABC	none
GOA Sharks	<=ABC	none
GOA Squids	<=ABC	none
GOA Octopus	<=ABC	none

Plan Team - Catch Accounting Working Group Agenda **May 22, 2012**

1. National Standard 1
    a. Headquarters recommendation/guidance to Alaska and Council
    b. Is there or will there be ACL interpretation in writing (does ABC = ACL)
2. AKRO discussion paper for October SSC meeting
    a. Jeff/Melanie authors
    b. Examines consistency of AK accounting of SRP and EFP with NS1?
3. Data Interpretations
    a. What is official "catch" data
        i. AKRO CAS estimates?
        ii. Or "proxy" data sets generated independently?
    b. Time series of research catches –
        i. Yearly updates
        ii. 2010 gathered in 2011, AKFIN is developing database
        iii. Stock assessment authors need time series to effectively work with data. Is it possible to build up or can we at least capture the majority of it through a compilation of available data?
        iv. Years
        v. Data ownership – AKRO catch accounting branch annually provides to AKFIN.
        vi. Access – AKFIN
    c. Other data sets
        i. Halibut Fishery Incidental Catch Estimates (HFICE) - The Plan Teams recommended that the authors consider issues for sablefish where there is overlap between the data sources in these HFICE estimates. In general, for all species, it would be good to understand the unaccounted-for catches and the degree of overlap between the CAS and HFICE estimates and to discuss this at the September 2012 Plan Team in.
            1. Who will generate HFICE estimates and take ownership
                a. Currently working group is planning to compute 2011 estimates and then writing up time series (2001-2011) as a Tech Memo
                b. If not incorporated in CAS then what are the recommendations to authors
                c. Is/was HFICE a one-time analysis
        ii. Removals generated by other fisheries(e.g., Pacific cod taken for use as bait in the crab fisheries)
4. Stock assessment use
    a. Should we survey all current assessments that may already make concessions of ABC/TAC – ex. GOA Pollock?
    b. Need to clarify that this must be incorporated in all assessments including non-modeled assessments (esp Tier 6 – avg catch = ABC)
    c. Potential options for incorporating these estimates
        i. Include in the model as part of catch history
            1. What are the effects
        ii. Run projections of ABC with research catches included and compare to current projections (no research catches included)
        iii. Develop a risk assessment outside of model but included in assessment – somehow evaluates model derived ABC recommendations in relation to magnitude of "other catches"
        iv. Appendix – not in the model
    d. Interaction with OFL and ABC, TAC for the Council/Secretary of Commerce.

e. Is there potential to have a CIE review of how to incorporate these data sets in stock assessments?
f. Instructions to Authors

5. September 2012 Plan Team discussion
    a. Presenter?
    b. Format?
        i. Needs to inform Teams of issue
        ii. How do we recommend anything under heading 4 without guidance from heading 1?

DRAFT September BSAI Plan Team Proposed OFL and ABC Recommendations (metric tons) for 2013-2014

		2012				2013			2014		
Species	Area	OFL	ABC	TAC	Catch	OFL	ABC	TAC	OFL	ABC	TAC
Pollock	EBS	2,474,000	1,220,000	1,186,000	1,097,694	2,840,000	1,360,000		2,840,000	1,360,000	
	AI	39,600	32,500	19,000	961	42,900	35,200		42,900	35,200	
	Bogoslof	22,000	16,500	500	79	22,000	16,500		22,000	16,500	
Pacific cod	BSAI	369,000	314,000	275,000	191,209	374,000	319,000		374,000	319,000	
Sablefish	BS	2,640	2,230	2,230	526	2,610	2,200		2,610	2,200	
	AI	2,430	2,050	2,050	859	2,400	2,020		2,400	2,020	
Yellowfin sole	BSAI	222,000	203,000	202,000	95,142	226,000	207,000		226,000	207,000	
Greenland turbot	Total	11,700	9,660	8,660	3,843	9,700	8,030		9,700	8,030	
	BS	n/a	7,230	6,230	2,203	n/a	6,010		n/a	6,010	
	AI	n/a	2,430	2,430	1,640	n/a	2,020		n/a	2,020	
Arrowtooth flounder	BSAI	181,000	150,000	25,000	20,550	186,000	152,000		186,000	152,000	
Kamchatka flounder	BSAI	24,800	18,600	17,700	9,302	24,800	18,600		24,800	18,600	
Northern rock sole	BSAI	231,000	208,000	87,000	73,466	217,000	196,000		217,000	196,000	
Flathead sole	BSAI	84,500	70,400	34,134	9,912	83,100	69,200		83,100	69,200	
Alaska plaice	BSAI	64,600	53,400	24,000	10,105	65,000	54,000		65,000	54,000	
Other flatfish	BSAI	17,100	12,700	3,200	3,208	17,100	12,700		17,100	12,700	
Pacific Ocean perch	BSAI	35,000	24,700	24,700	17,641	33,700	28,300		33,700	28,300	
	BS	n/a	5,710	5,710	1,465	n/a	6,540		n/a	6,540	
	EAI	n/a	5,620	5,620	3,737	n/a	6,440		n/a	6,440	
	CAI	n/a	4,990	4,990	4,206	n/a	5,710		n/a	5,710	
	WAI	n/a	8,380	8,380	8,233	n/a	9,610		n/a	9,610	
Northern rockfish	BSAI	10,500	8,610	4,700	2,161	10,400	8,490		10,400	8,490	
Blackspotted/Rougheye rockfish	BSAI	576	475	475	162	605	499		605	499	
	EBS/EAI	n/a	231	231	65	n/a	241		n/a	241	
	CAI/WAI	n/a	244	244	97	n/a	258		n/a	258	
Shortraker rockfish	BSAI	524	393	393	273	524	393		524	393	
Other rockfish	BSAI	1,700	1,280	1,070	614	1,700	1,280		1,700	1,280	
	BS	n/a	710	500	152	n/a	710		n/a	710	
	AI	n/a	570	570	462	n/a	570		n/a	570	
Atka mackerel	Total	96,500	81,400	50,763	32,165	78,300	67,100		78,300	67,100	
	EAI/BS	n/a	38,500	38,500	22,386	n/a	31,700		n/a	31,700	
	CAI	n/a	22,900	10,763	9,584	n/a	18,900		n/a	18,900	
	WAI	n/a	20,000	1,500	195	n/a	16,500		n/a	16,500	
Squid	BSAI	2,620	1,970	425	599	2,620	1,970		2,620	1,970	
Skate	BSAI	39,100	32,600	24,700	17,469	38,300	32,000		38,300	32,000	
Shark	BSAI	1,360	1,020	200	71	1,360	1,020		1,360	1,020	
Octopus	BSAI	3,450	2,590	900	46	3,450	2,590		3,450	2,590	
Sculpin	BSAI	58,300	43,700	5,200	4,398	58,300	43,700		58,300	43,700	
Total	BSAI	3,996,000	2,511,778	2,000,000	1,592,455	4,341,869	2,639,792		4,341,869	2,639,792	

Sources: 2012 OFLs, ABCs, and TACs and 2013 OFLs and ABCs are from harvest specifications adopted by the Council in December 2011; 2014 OFLs and ABCs equal 2013; 2012 catches through September 1 from AKR Catch Accounting.

DRAFT September 2012 GOA Plan Team Proposed OFL and ABC Recommendations (mt) for 2013-2014 (Page 1)

		2012				2013			2014		
Species	Area	OFL	ABC	TAC	Catch	OFL	ABC	TAC	OFL	ABC	TAC
Pollock	W (61)		30,270	30,270	15,508		32,816			32,816	
	C (62)		45,808	45,808	32,182		49,662			49,662	
	C (63)		26,348	26,348	8,951		28,565			28,565	
	WYAK		3,244	3,244	2,380		3,517			3,517	
	Subtotal	143,716	105,670	105,670	59,021	155,402	114,560		155,402	114,560	
	EYAK/SEO	14,366	10,774	10,774	-	14,366	10,774		14,366	10,774	
	Total	158,082	116,444	116,444	59,021	169,768	125,334		169,768	125,334	
Pacific Cod	W		28,032	21,024	13,194		29,120			29,120	
	C		56,940	42,705	28,399		59,150			59,150	
	E		2,628	1,971	342		2,730			2,730	
	Total	104,000	87,600	65,700	41,935	108,000	91,000		108,000	91,000	
Sablefish	W		1,780	1,780	1,129		1,757			1,757	
	C		5,760	5,760	4,525		5,686			5,686	
	WYAK		2,247	2,247	1,770		2,219			2,219	
	SEO		3,176	3,176	2,516		3,132			3,132	
	Total	15,330	12,960	12,960	9,940	15,129	12,794		15,129	12,794	
Shallow-Water Flatfish	W		21,994	13,250	134		20,171			20,171	
	C		22,910	18,000	1,955		21,012			21,012	
	WYAK		4,307	4,307	-		3,950			3,950	
	EYAK/SEO		1,472	1,472	-		1,350			1,350	
	Total	61,681	50,683	37,029	2,089	56,781	46,483		56,781	46,483	
Deep-Water Flatfish	W		176	176	5		176			176	
	C		2,308	2,308	227		2,308			2,308	
	WYAK		1,581	1,581	3		1,581			1,581	
	EYAK/SEO		1,061	1,061	2		1,061			1,061	
	Total	6,834	5,126	5,126	237	6,834	5,126		6,834	5,126	
Rex Sole	W		1,307	1,307	215		1,283			1,283	
	C		6,412	6,412	1,835		6,291			6,291	
	WYAK		836	836	-		821			821	
	EYAK/SEO		1,057	1,057	-		1,037			1,037	
	Total	12,561	9,612	9,612	2,050	12,326	9,432		12,326	9,432	
Arrowtooth Flounder	W		27,495	14,500	903		27,386			27,386	
	C		143,162	75,000	13,852		142,591			142,591	
	WYAK		21,159	6,900	30		21,074			21,074	
	EYAK/SEO		21,066	6,900	65		20,982			20,982	
	Total	250,100	212,882	103,300	14,850	249,066	212,033		249,066	212,033	
Flathead Sole	W		15,300	8,650	251		15,518			15,518	
	C		25,838	15,400	1,361		26,205			26,205	
	WYAK		4,558	4,558	-		4,623			4,623	
	EYAK/SEO		1,711	1,711	-		1,735			1,735	
	Total	59,380	47,407	30,319	1,612	60,219	48,081		60,219	48,081	

Sources: 2012 OFLs, ABCs, and TACs and 2013 OFLs and ABCs are from harvest specifications adopted by the Council in December 2011; 2014 OFLs and ABCs equal 2013; 2012 catches through September 1 from AKR Catch Accounting.

Draft September 2012 GOA Plan Team Proposed OFL and ABC Recommendations (mt) for 2013-2014 (Page 2)

		2012				2013			2014		
Species	Area	OFL	ABC	TAC	Catch	OFL	ABC	TAC	OFL	ABC	TAC
Pacific Ocean Perch	W	2,423	2,102	2,102	2,450	2,364	2,050		2,364	2,050	
	C	12,980	11,263	11,263	10,355	12,662	10,985		12,662	10,985	
	WYAK		1,692	1,692	1,682		1,650			1,650	
	SEO		1,861	1,861	-		1,815			1,815	
	E(subtotal)	4,095	3,553	3,553	1,682	3,995	3,465		3,995	3,465	
	Total	19,498	16,918	16,918	14,487	19,021	16,500		19,021	16,500	
Northern Rockfish	W		2,156	2,156	1,816		2,017			2,017	
	C		3,351	3,351	2,996		3,136			3,136	
	E		0	0	-		-			-	
	Total	6,574	5,507	5,507	4,812	6,152	5,153		6,152	5,153	
Shortraker Rockfish	W		104	104	95		104			104	
	C		452	452	202		452			452	
	E		525	525	217		525			525	
	Total	1,441	1,081	1,081	514	1,441	1,081		1,441	1,081	
Other Rockfish (Other slope)	W		44	44	246		44			44	
	C		606	606	693		606			606	
	WYAK		230	230	34		230			230	
	EYAK/SEO		3,165	200	16		3,165			3,165	
	Total	5,305	4,045	1,080	989	5,305	4,045		5,305	4,045	
Dusky Rockfish	W		409	409	433		381			381	
	C		3,849	3,849	3,462		3,581			3,581	
	WYAK		542	542	2		504			504	
	EYAK/SEO		318	318	-		296			296	
	Total	6,257	5,118	5,118	3,897	5,822	4,762		5,822	4,762	
Rougheye and Blackspotted Rockfish	W		80	80	30		82			82	
	C		850	850	342		861			861	
	E		293	293	150		297			297	
	Total	1,472	1,223	1,223	522	1,492	1,240		1,492	1,240	
Demersal shelf rockfish	Total	467	293	293	59	467	293		467	293	
Thornyhead Rockfish	W		150	150	156		150			150	
	C		766	766	292		766			766	
	E		749	749	182		749			749	
	Total	2,220	1,665	1,665	630	2,220	1,665		2,220	1,665	
Atka mackerel	Total	6,200	4,700	2,000	1,176	6,200	4,700		6,200	4,700	
Big Skate	W		469	469	59		469			469	
	C		1,793	1,793	1,276		1,793			1,793	
	E		1,505	1,505	40		1,505			1,505	
	Total	5,023	3,767	3,767	1,375	5,023	3,767		5,023	3,767	
Longnose Skate	W		70	70	20		70			70	
	C		1,879	1,879	531		1,879			1,879	
	E		676	676	95		676			676	
	Total	3,500	2,625	2,625	646	3,500	2,625		3,500	2,625	
Other Skates	Total	2,706	2,030	2,030	1,032	2,706	2,030		2,706	2,030	
Squid	GOA-wide	1,530	1,146	1,146	13	1,530	1,148		1,530	1,148	
Sharks	GOA-wide	8,037	6,028	6,028	538	8,037	6,028		8,037	6,028	
Octopus	GOA-wide	1,941	1,455	1,455	122	1,941	1,455		1,941	1,455	
Sculpins	GOA-wide	7,641	5,731	5,731	717	7,641	5,731		7,641	5,731	
Total		747,780	606,048	438,159	163,263	756,621	612,506		756,621	612,506	

Sources: 2012 OFLs, ABCs, and TACs and 2013 OFLs and ABCs are from harvest specifications adopted by the Council in December 2011; 2014 OFLs and ABCs equal 2013; 2012 catches through September 1 from AKR Catch Accounting.

Table 8. Recommended Pacific halibut discard mortality rates (DMRs) for 2013-2015 CDQ and non-CDQ groundfish fisheries off Alaska.

I. Non-CDQ

Bering Sea/Aleutians			Gulf of Alaska		
Gear/Target	Used in 2010-2012	2013-2015 Recommendation	Gear/Target	Used in 2010-2012	2013-2015 Recommendation
Trawl			***Trawl***		
Atka mack	76	77	Bottom poll	59	60
Bottom poll	73	77	Pacific cod	62	62
Pacific cod	71	71	Dpwtr flats	48	43
Other Flats	72	71	Shallwtr flats	71	67
Rockfish	81	79	Rockfish	67	66
Flathead sole	74	73	Flathead sole	65	65
Midwtr poll	89	88	Midwtr poll	76	71
Rock sole	82	85	Sablefish	65	71
Sablefish	75	75	Arr. fldr	72	73
Turbot	67	64	Rex sole	64	69
Arr. fldr	76	76			
YF sole	81	83			
Pot			***Pot***		
Pacific cod	8	8	Pacific cod	17	17
Longline			***Longline***		
Pacific cod	10	9	Pacific cod	12	11
Rockfish	9	4	Rockfish	9	9
Turbot	11	13			

II. Bering Sea/Aleutians CDQ

Gear/Target	Used in 2010-2012	2013-2015 Recommendation
Trawl		
Atka mackerel	85	86
Bottom pollock	85	83
Pacific cod	90	90
Rockfish	84	80
Flathead sole	84	79
Midwtr pollock	90	90
Rock sole	87	88
Turbot	88	89
Yellowfin sole	85	86
Pot		
Sablefish	32	34
Longline		
Pacific cod	10	10
Turbot	4	4

Recommendations for Pacific halibut discard mortality rates in the 2013-2015 groundfish fisheries off Alaska

Gregg H. Williams

Abstract

Analysis of 2009-2011 observer data on the release condition of halibut from trawl, longline and pot vessels fishing groundfish off Alaska has resulted in new estimates of discard mortality rates for discarded halibut in each target fishery in those years. The new rates are similar to those determined in previous analyses. The rates were added to the accumulated time series and serve as the basis for recommendations to the North Pacific Fishery Management Council and the National Marine Fisheries Service for assumed rates to be used in the inseason estimation of halibut bycatch mortality for the 2013-2015 groundfish fisheries off Alaska.

Introduction

Pacific halibut discard mortality rates (DMRs) in the Alaskan groundfish fisheries are estimated from viability (injury and condition) data collected by fishery observers. These data are analyzed each year by staff of the International Pacific Halibut Commission (IPHC). This paper reports on an analysis of viability data collected during the 2009-2011 Community Development Quota (CDQ) and non-CDQ groundfish fisheries off Alaska. The results also form the basis for recommended DMRs to be used for inseason estimation and management of halibut bycatch mortality in the 2013-2015 CDQ and non-CDQ groundfish fisheries.

Data description and methods

The analysis followed the same approach that has been employed since 1996, which was originally described by Williams (1996). Observer haul data from the NMFS groundfish observer database formed the basis of the analysis. The data records included the catch of groundfish by species or species group, estimates of the number and weight (kg) of halibut, and the number and length of halibut assessed for release viability by category (excellent/poor/dead for trawl and pot gear; minor/moderate/severe/dead for longline gear). Records for all hauls sampled by observers in 2009-2011 were obtained; hauls not sampled for species composition were excluded.

The records were assigned to target fishery categories based on the catch of the particular species within the haul catch composition, relative to the overall total and retained catches (Table 1). For example, hauls were coded as midwater pollock if pollock comprised 95% or more of the summed total catch for the reporting week (Sunday-Saturday). Flatfish targets in the Bering Sea/Aleutians (BSA) were determined in a succession of comparisons of individual flatfish species compositions in the catch. The determination for the flatfish targets was based on the greatest percentage of the non-arrowtooth flounder catch. Table 1 shows the target codes and definitions used.

Fishery observers examined halibut for release condition or injury immediately before being returned to the sea. Each fish was judged according to a set of criteria (Williams and Chen 2003), which were used to determine the presence and extent of internal and external injuries, and body damage from predators (e.g., amphipods and marine mammals). A dichotomous key, introduced in 2000, was supplied to observers to reduce subjectivity in the determinations of condition and injury. Observers recorded the number of halibut in excellent, poor, and dead condition (trawls and pots) or with minor, moderate, severe injuries, or dead (longlines) on each haul or set sampled, respectively. Samples were only collected on hauls that were sampled for species composition. The species composition sampling provides an estimate of the total number of halibut caught in the haul, as well as the catch of groundfish, necessary for determining the target. Observers were instructed to limit the number of fish examined to a maximum of 20, although this was occasionally exceeded by enthusiastic observers.

Next, the viability distribution for a target fishery was calculated. First, for each haul, the proportion of halibut in each category was extrapolated to the total number of halibut caught. The extrapolated numbers of halibut for each vessel by viability category were then summed within each region/gear/target strata.

The general model for calculating the DMR for halibut caught by gear g was of the form:

$$DMR_g = \sum_{i=1}^{4} \left(m_{i,g} \times P_i \right)$$

where ***m*** is the mortality rate for gear ***g***, and ***P*** is the proportion of halibut in condition ***i***, where 1 is excellent/minor, 2 is poor/moderate, 3 is dead (trawl or pot)/severe, and 4 is dead (longline).

There are several factors that contribute to release viability, which vary by gear type. With trawl-caught halibut, condition is related to the size of the catch, tow duration, and halibut size. For longline bycatch, injuries are most frequently caused by improper release methods used by vessel crews. Another significant factor is the length of the soak time, which can exacerbate the mortality caused by hooking injuries and also increase the potential for amphipod predation. The condition of halibut caught in pots is affected by soak time and the presence of other animals in the pot, especially crabs, whose spiny carapace has been observed to scratch and abrade the skin of the captive halibut.

The mortality rate ***m*** varies among gear types and represents the aggregate effects of external and internal injuries to the fish and the presence of predation by amphipods or marine mammals. The mortality rates have been determined through long term tagging studies conducted by IPHC. See Clark et al. (1992) for trawls, Williams (1996) for pots, and Kaimmer and Trumble (1998) for longlines. Estimated halibut mortality rates by gear and condition/injury were as follows:

Gear (*g*)	m_{exc}	m_{poor}	m_{dead}	
Trawl	0.20	0.55	0.90	
Pot	0.00	1.00	1.00	
	m_{minor}	$m_{moderate}$	m_{severe}	m_{dead}
Longline	0.035	0.363	0.662	1.00

Mean fishery DMRs and associated standard errors were estimated by assuming that each vessel acts as a separate sampling unit, so that a DMR was calculated for each individual vessel in a target fishery. The DMR for a target fishery was then estimated as the mean of vessel DMRs, where the vessel's proportion of the total number of bycaught halibut was used as a weighting factor, as follows:

Let DMR_v = observed DMR on vessel v
p_v = proportion of total number of halibut caught on vessel v in a fishery

Then $$\overline{DMR} = \sum_{v=1}^{n} (p_v \times DMR_v)$$

Standard errors of the weighted mean DMR were estimated as:

$$V(\overline{DMR}) = \sum_{v=1}^{n} (p_v^2 \times V(DMR_v))$$

and $$SE(\overline{DMR}) = \sqrt{V(\overline{DMR})}$$

where $V(DMR_v)$ is the sample variance of all the $DMRs_v$, and $V(\overline{DMR})$ and $SE(\overline{DMR})$ are the variance and standard error of $\overline{DMR}$, respectively.

Results

Non-CDQ fisheries

A summary of observer coverage, sampling, and halibut size composition data is shown in Table 2. Coverage and sampling in the major targets produced a large number of sampled hauls, and a substantial number of halibut sampled. For example, observers sampled over 5,000 hauls and 4,200 halibut in the BSA midwater pollock fishery in 2009. Two flatfish targets, yellowfin and rock soles, often had some of the largest halibut sample sizes than any other target. Sample sizes were generally very high (>1,000 hauls and/or >1,000 halibut measured) in most BSA trawl fisheries. The longline fishery for cod was the only BSA longline fishery to receive significant sampling in 2009-2011. In past years, sampling has also occurred on rockfish and turbot vessels but only minimally, and 2009-2011 was no exception, as only turbot fishing had any sampling. Pot fishing was focused on cod, as in past years.

Most of the sampling in GOA trawl fisheries occurred in the cod, rockfish, and flatfish targets. The rockfish fishery tallied the largest number of observed tows; this probably reflects the higher observer coverage requirements of the Central Gulf Rockfish Program. Sampling of the cod and the two pollock fisheries occurred at similar levels (31-39 vessels; roughly 200-400 hauls). Sampling of flatfish fishing occurred in the shallow water flatfish, arrowtooth, and rex sole targets. Only minimal vessel effort was noted in the deepwater flatfish target, which in past years was primarily directed at Dover sole. The number of sampled longline and pot vessels targeting cod was similar to past years.

Sampling and fishery totals of release viability (condition or injury) data by region and fishery are summarized in Table 3. The sample totals represent the summed observations recorded by observers. In most cases, these raw data total less than those shown in Table 2, as the latter include some halibut which were not examined for condition/injury. The observations on each haul were extrapolated upwards to the total number of halibut caught on the haul, and then summed across vessel and target fishery strata. For most fisheries, the distribution of the extrapolated viability data is very similar to the raw data. The complete time series of fishery DMRs is provided in Tables 4 and 5 for the BSA and GOA, respectively.

CDQ fisheries

In 2009-2011, CDQ fishing was conducted using pots, trawls, and longlines. The primary species targeted by trawl operations included pollock, and rock sole and yellowfin sole during 2010-2011. Pacific cod were targeted by longline, and sablefish by pots. Sampling levels and injury/viability data for CDQ operations are summarized in Table 6; the time series of mean annual DMRs is shown in Table 7.

Almost all halibut caught in the trawl operations were dead when examined. Typically this is caused by a larger haul size and/or longer haul duration.

Of the 13 DMRs calculated for the 2009-2011 CDQ trawl targets, all but two were either 0.89 or 0.90. These results are generally higher than what is seen in non-CDQ fishing for the same target, which suggests there are other variables which are negatively affecting the condition of the released halibut. For example, different catch processing or handling methods for CDQ hauls may contribute to poorer release viability.

Longline CDQ fishing consisted of 14-17 vessels targeting cod. In previous analyses, the distribution of release injuries to halibut in the CDQ longline cod fishery has been similar to that observed in the non-CDQ cod fishery. However, the results for 2010 were much higher than the non-CDQ results (0.18 in CDQ vs. 0.09 in non-CDQ).

The pot fishery targeted sablefish, with either two or three vessels observed. Very few halibut were examined by observers, but not many halibut were caught. The fishery DMR (0.50) was unchanged during 2009-2010, but dropped quite a bit (0.31) in 2011, more in line with the long term mean. Halibut mortality is positively correlated with longer pot soak time; long soaks increase the potential for amphipod predation of captured fish in the pot.

Recommendations for 2013-15

The Council is using a plan in which the DMRs used to monitor halibut bycatch are an average of data from the most recent 10-year period. These 10-year mean DMRs for each fishery are used for a 3-year period, with the justification being two-fold: 1) interannual variability of fishery DMRs is relatively small, and 2) to provide stability for the industry to better plan their operations. The following table outlines the range of data used for the specific years of application:

10-Year Basis Period	Years of application
1990-1999	2001 - 2003
1993-2002	2004 – 2006
1996-2005	2007 - 2009
1999-2008	2010 - 2012
2002-2011	2013 - 2015

As shown, information from 2002-2011 is the basis for the DMR recommendations for 2013-2015. The 10-year mean DMRs for 2013-2015 are shown in Table 8. For some targets, a full ten years of data is not available, so the recommended DMR is based on whatever data are available from the 2002-2011 basis period.

For CDQ targets with no past observations or data, such as longline turbot, and pot cod, DMRs derived from non-CDQ fisheries data are recommended. For the 'other species' and any other target not explicitly noted here in the non-CDQ fisheries, the DMR for the cod fishery in that region/gear stratum is recommended.

References

Clark, W.G., Hoag, S.H., Trumble, R.J., and Williams, G.H. 1992. Re-estimation of survival for trawl caught halibut released in different condition factors. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1992:197-206.

Kaimmer, S.M., and Trumble, R.J. 1998. Injury, condition, and mortality of Pacific halibut bycatch following careful release by Pacific cod and sablefish longline fisheries. Fish. Res. 38:131-144.

Williams, G.H. 1997. Pacific halibut discard mortality rates in the 1990-1995 Alaskan groundfish fisheries, with recommendations for monitoring in 1997. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1996:211-228.

Williams, G.H. and Chen, D. 2004. Pacific halibut discard mortality rates in the 1990-2002 Alaskan groundfish fisheries, with recommendations for monitoring in 2004-2006. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2003:227-244.

Table 1. Groundfish target definitions and target determination criteria for observer sampled hauls.

BSA		GOA	
Target	**Definition**	**Target**	**Definition**
A	Atka mackerel	A	Atka mackerel
B	Bottom pollock	B	Bottom pollock
C	Pacific cod	C	Pacific cod
F	Other flatfish	D	Deep water flatfish
K	Rockfish	H	Shallow water flatfish
L	Flathead sole	K	Rockfish
O	Other spp.	L	Flathead sole
P	Midwater pollock	O	Other spp.
R	Rock sole	P	Midwater pollock
S	Sablefish	S	Sablefish
T	Greenland turbot	W	Arrowtooth flounder
W	Arrowtooth flounder	X	Rex sole
Y	Yellowfin sole		

CDQ and Non-CDQ TARGET FISHERY DETERMINATION

Bering Sea/Aleutians

P	if pollock $\geq$ 95% of total catch, or
W	if arrowtooth flounder $\geq$ 65% of total catch.
Y/R/L/F	if (rock sole + other flatfish + yellowfin sole + flathead) is the largest component of the retained catch using this rule:
Y	if yellowfin sole is $\geq$ 70% of (rock sole + other flatfish + yellowfin sole + flathead sole), or
R	if rock sole > other flatfish and rock sole > flathead sole, or
L	if flathead sole > other flatfish and flathead sole > rock sole, or
F	if none of the three conditions above are met.

Note: If target is not P, W, Y, R, L or F, then target is whichever species or species group (A, B, C, K, O, S, or T) forms the largest part of the total catch.

Gulf of Alaska

P	if pollock $\geq$ 95% of total catch, or
W	if arrowtooth flounder $\geq$ 65% of total catch.

Note: If target is not P or W, then target is whichever species or species group (A, B, C, D, H, K, L, O, S, or X) forms the largest part of the total catch.

Table 2. Summary information on fishery effort, observer sampling, and halibut bycatch size composition in nonCDQ fisheries.

2009						
Area/Gear /Target	No. of vsls Sampled	No. of sampled hauls	No. of fish Measured	Mean length (cm)	Percent <65 cm	Percent < 82 cm
BSA Longline						
Pacific cod	37	5723	9372	66.3	50	88
Turbot	2	40	2	77.5	0	50
BSA Pot						
Pacific cod	22	434	57	69.1	0	13
BSA Trawl						
Atka mackerel	7	1149	190	118.7	8	33
Bottom pollock	103	3901	12286	46.7	93	98
Pacific cod	57	2306	3711	54.4	77	93
Other flatfish	0	0	0	--	--	--
Rockfish	10	407	245	65.2	52	80
Flathead sole	12	1165	1883	58.6	71	92
Midwtr pollock	84	5576	4237	69.1	47	78
Rock sole	23	2510	14449	40.5	95	98
Sablefish	0	0	0	--	--	--
Turbot	6	618	149	97.4	11	48
Arrowtooth flndr	3	225	214	67.3	45	92
Yellowfin sole	28	4132	11050	45.4	87	95
GOA Longline						
Pacific cod	21	509	1395	66.9	48	88
GOA Pot						
Pacific cod	15	140	78	71.6	27	76
GOA Trawl						
Bottom pollock	33	289	178	59.5	73	97
Pacific cod	33	293	1582	53.6	84	99
Dp wtr flatfish	0	0	0	--	--	--
Shall wtr flatfish	26	380	1677	54.7	75	93
Rockfish	41	1259	587	73.3	33	75
Flathead sole	11	86	254	54.2	77	94
Midwtr pollock	32	189	9	67.3	22	100
Sablefish	11	76	44	86.8	7	39
Arrowtooth flndr	16	94	281	61.1	70	90
Rex sole	8	352	1088	58.1	72	96

Table 2. (cont'd)

			2010			
Area/Gear /Target	**No. of vsls Sampled**	**No. of sampled hauls**	**No. of fish Measured**	**Mean length (cm)**	**Percent <65 cm**	**Percent < 82 cm**
BSA Longline						
Pacific cod	35	5019	8737	66.7	51	90
Turbot	5	202	17	81.1	17	88
BSA Pot						
Pacific cod	34	571	453	67.2	38	95
BSA Trawl						
Atka mackerel	7	1209	172	99.1	23	51
Bottom pollock	73	1805	3301	54.2	84	96
Pacific cod	45	1042	3640	48.2	91	98
Other flatfish	1	18	187	54.9	82	95
Rockfish	9	428	365	70.1	49	75
Flathead sole	12	1137	1611	63.0	62	88
Midwtr pollock	85	6344	4231	64.4	58	85
Rock sole	19	4091	15310	45.9	90	98
Sablefish	0	0	0	--	0	0
Turbot	6	792	270	106.0	14	31
Arrowtooth flndr	1	32	11	81.3	9	55
Yellowfin sole	26	5089	7905	54.8	79	95
GOA Longline						
Pacific cod	19	781	2048	70.3	31	85
GOA Pot						
Pacific cod	10	143	215	78.9	5	68
GOA Trawl						
Bottom pollock	35	266	547	61.2	66	91
Pacific cod	37	421	1940	54.8	84	97
Dp wtr flatfish	1	13	29	51.9	83	100
Shall wtr flatfish	18	251	901	54.9	77	94
Rockfish	43	1194	751	71.7	30	78
Flathead sole	14	182	431	64.6	57	82
Midwtr pollock	31	202	49	62.8	65	94
Sablefish	9	47	27	69.7	26	89
Arrowtooth flndr	1	5	19	63.0	58	74
Rex sole	8	357	1744	60.5	66	95

Table 2. (cont'd)

2011						
Area/Gear /Target	**No. of vsls Sampled**	**No. of sampled hauls**	**No. of fish Measured**	**Mean length (cm)**	**Percent <65 cm**	**Percent < 82 cm**
BSA Longline						
Pacific cod	31	6094	11536	64.5	56	91
Turbot	7	212	21	71.3	38	81
BSA Pot						
Pacific cod	32	768	1087	64.6	49	97
BSA Trawl						
Atka mackerel	7	1045	521	74.0	39	72
Bottom pollock	101	4241	5881	50.8	85	97
Pacific cod	44	1373	4320	49.5	90	98
Other flatfish	0	0	0	--	--	--
Rockfish	15	646	465	71.7	48	78
Flathead sole	10	599	1009	65.8	55	84
Midwtr pollock	98	11555	5115	58.8	69	92
Rock sole	20	2681	8422	43.1	89	97
Sablefish	0	0	0	--	--	--
Turbot	9	435	245	90.7	17	45
Arrowtooth flndr	5	215	379	67.0	36	92
Yellowfin sole	29	6279	6608	58.3	70	92
GOA Longline						
Pacific cod	16	941	2379	69.5	37	84
GOA Pot						
Pacific cod	16	386	1343	76.0	6	80
GOA Trawl						
Bottom pollock	31	260	563	63.0	59	89
Pacific cod	40	518	2751	60.0	69	97
Dp wtr flatfish	2	19	5	55.8	100	100
Shall wtr flatfish	8	59	257	60.0	65	94
Rockfish	39	1126	825	72.0	34	73
Flathead sole	15	147	309	59.0	76	90
Midwtr pollock	39	328	5	76.2	40	80
Sablefish	12	65	42	74.8	31	74
Arrowtooth flndr	14	208	268	66.3	53	87
Rex sole	6	255	1008	61.7	64	95

Table 3. Distribution of halibut viability/injury data by target fishery.

2009								
	Sample totals			Projected fishery totals				
Target	Exc	Poor	Dead	Exc	Poor	Dead	DMR	SE
BSA Trawl								
Atka mackerel	0	0	15	0	0	1035	**0.900**	0.0000
Bottom pollock	29	54	10924	3229	2859	206254	**0.881**	0.0108
Pacific cod	252	166	986	8363	4724	39002	**0.764**	0.0134
Other flatfish	0	0	0	0	0	0	--	--
Rockfish	16	16	103	284	599	5333	**0.826**	0.0107
Flathead sole	77	62	249	1646	1539	5858	**0.753**	0.0317
Midwtr pollock	28	40	4078	844	113	17307	**0.842**	0.0183
Rock sole	48	280	4873	1839	12810	291328	**0.881**	0.0180
Arrowtooth flounder	0	0	0	0	0	0	--	--
Yellowfin sole	86	129	3991	2132	4345	314938	**0.874**	0.0131
BSA Pot								
Pacific cod	51	4	2	161	15	6	**0.113**	0.1283
GOA Trawl								
Bottom pollock	34	30	49	3493	679	1997	**0.574**	0.0690
Pacific cod	334	186	560	14418	6779	25036	**0.621**	0.0465
Shall wtr flatfish	226	310	462	5539	10740	17238	**0.635**	0.0478
Rockfish	93	88	138	1732	598	4101	**0.670**	0.0419
Flathead sole	20	4	10	529	121	319	**0.452**	0.0100
Midwtr pollock	0	0	0	0	0	0	--	--
Arrowtooth fldr	37	49	153	2785	2680	11634	**0.690**	0.0559
Rex sole	32	67	399	876	1680	21925	**0.841**	0.0396
GOA Pot								
Pacific cod	55	16	7	178	72	30	**0.306**	0.1552

	Sample totals				Projected fishery totals					
Target	Minor	Mod	Severe	Dead	Minor	Mod	Severe	Dead	DMR	SE
BSA Longline										
Pacific cod	8319	705	111	124	243517	20620	3353	3992	**0.084**	0.0181
Turbot	1	0	1	0	0	29	0	29	**0.349**	--
GOA Longline										
Pacific cod	1230	94	15	56	53024	4597	727	2634	**0.103**	0.0397

Table 3. (cont'd)

2010								
	Sample totals			Projected fishery totals				
Target	Exc	Poor	Dead	Exc	Poor	Dead	DMR	SE
BSA Trawl								
Atka mackerel	0	1	19	0	83	971	**0.871**	0.0265
Bottom pollock	45	78	2376	2220	2945	31493	**0.776**	0.0058
Pacific cod	540	507	1377	16693	16084	34176	**0.626**	0.0069
Other flatfish	0	0	0	0	0	0	--	--
Rockfish	1	0	3	103	0	366	**0.667**	0.0057
Flathead sole	3	18	173	49	568	4282	**0.822**	0.0010
Midwtr pollock	7	13	3772	487	117	17254	**0.867**	0.0030
Rock sole	49	135	5045	2048	5543	228545	**0.878**	0.0035
Arrowtooth flounder	0	0	0	0	0	0	--	--
Yellowfin sole	188	226	2083	5831	6276	94215	**0.847**	0.0062
BSA Pot								
Pacific cod	384	48	10	1158	113	36	**0.119**	0.0536
GOA Trawl								
Bottom pollock	137	130	140	4814	6285	4457	**0.535**	0.0188
Pacific cod	226	282	705	4852	7487	20411	**0.695**	0.0089
Shall wtr flatfish	193	194	254	7136	6925	9676	**0.555**	0.0377
Rockfish	51	90	79	850	1605	2527	**0.662**	0.0065
Flathead sole	30	68	137	754	1414	6284	**0.731**	0.0490
Midwtr pollock	0	0	0	0	0	0	--	--
Arrowtooth fldr	0	0	10	0	0	585	**0.900**	0.0000
Rex sole	49	23	378	1155	1001	22087	**0.803**	0.273
GOA Pot								
Pacific cod	194	9	9	704	39	54	**0.130**	0.0618

	Sample totals				Projected fishery totals					
Target	Minor	Mod	Severe	Dead	Minor	Mod	Severe	Dead	DMR	SE
BSA Longline										
Pacific cod	6753	736	99	186	219512	17264	2270	6453	**0.089**	0.0097
Turbot	16	1	0	0	376	17	0	0	**0.062**	0.0000
GOA Longline										
Pacific cod	1823	157	13	55	51683	5121	223	2152	**0.093**	0.0157

Table 3. (cont'd)

2011								
	Sample totals			Projected fishery totals				
Target	**Exc**	**Poor**	**Dead**	**Exc**	**Poor**	**Dead**	**DMR**	**SE**
BSA Trawl								
Atka mackerel	12	6	19	514	258	1455	**0.667**	0.0420
Bottom pollock	70	68	4501	3762	4233	95067	**0.848**	0.0087
Pacific cod	560	1062	1502	13653	24350	29397	**0.646**	0.0354
Other flatfish	0	0	0	0	0	0	---	---
Rockfish	14	15	60	381	206	3305	**0.874**	0.0120
Flathead sole	21	16	32	357	349	821	**0.551**	0.0142
Midwtr pollock	13	32	4297	819	1533	26690	**0.860**	0.0137
Rock sole	74	39	650	2281	1718	51253	**0.840**	0.0315
Arrowtooth fldr	0	0	0	0	0	0	---	---
Yellowfin sole	119	94	967	3871	4379	57537	**0.785**	0.0373
BSA Pot								
Pacific cod	997	37	50	3326	134	158	**0.128**	0.1670
GOA Trawl								
Bottom pollock	115	75	156	3753	3814	6399	**0.566**	0.0396
Pacific cod	416	371	382	19808	13203	16978	**0.515**	0.0324
Shall wtr flatfish	77	81	65	2486	1443	2856	**0.524**	0.0954
Rockfish	64	152	121	1547	4913	4220	**0.629**	0.0514
Flathead sole	33	31	195	713	724	5790	**0.691**	0.0913
Midwtr pollock	0	0	0	0	0	0	--	--
Sablefish	22	5	4	143	49	22	**0.370**	0.0086
Arrowtooth fldr	3	8	15	105	209	623	**0.807**	0.0152
Rex sole	35	102	257	1428	3243	10483	**0.818**	0.0205
GOA Pot								
Pacific cod	1015	84	104	3063	357	210	**0.103**	0.0721

	Sample totals				Projected fishery totals					
Target	**Minor**	**Mod**	**Severe**	**Dead**	**Minor**	**Mod**	**Severe**	**Dead**	**DMR**	**SE**
BSA Longline										
Pacific cod	9285	849	121	250	291669	23754	3877	10531	**0.089**	0.0259
Turbot	19	1	1	0	690	92	44	0	**0.090**	0.0087
GOA Longline										
Pacific cod	2010	205	31	53	62782	4753	682	1604	**0.082**	0.0324

Table 4. Summary of halibut discard mortality rates (DMRs) in the non-CDQ Bering Sea/Aleutian (BSA) groundfish fisheries during 1990-2011.

Gear/Target	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11
BSA Trawl																						
Atka mackerel	66	77	71	69	73	73	83	85	77	81	77	73	85	67	63	67	64	89	90	90	87	67
Bottom pollock	68	74	78	78	80	73	79	72	80	74	67	74	78	65	73	79	74	69	79	88	78	85
Pacific cod	68	64	69	67	64	71	70	67	66	69	69	69	69	67	70	81	77	78	61	76	63	65
Other Flatfish	80	75	76	69	61	68	67	71	78	63	76	81	77	79	80	65	82	-	41	-	-	-
Rockfish	65	67	69	69	75	68	72	71	56	81	89	85	73	84	68	79	90	87	73	83	67	87
Flathead sole	-	-	-	-	67	62	66	57	70	79	74	69	60	69	70	83	75	80	79	75	82	55
Midwtr pollock	85	82	85	85	80	79	83	87	86	87	88	89	90	89	88	90	90	90	85	84	87	86
Rock sole	64	79	78	76	76	73	74	77	79	81	75	77	83	82	85	84	83	83	86	88	88	84
Sablefish	46	66	-	26	20	-	-	-	-	90	60	-	-	-	-	-	-	-	-	-	-	-
Turbot	69	55	-	-	58	75	70	75	86	70	74	68	75	67	31	82	-	-	-	-	-	-
Arrowtooth fldr	-	-	-	-	-	-	-	-	-	-	-	-	-	67	67	90	-	-	78	-	-	-
Yellowfin sole	83	88	83	80	81	77	76	80	82	78	77	74	77	81	86	85	87	77	87	87	85	79
BSA Pot																						
Pacific cod	12	4	12	4	10	10	7	4	13	9	13	6	5	6	7	3	8	15	4	11	12	13
BSA Longline																						
Pacific cod	19	23	21	17	15	14	12	11	11	12	12	12	10	8	10	8	10	9	8	8	9	9
Rockfish	17	55	-	6	23	-	20	4	52	-	12	10	4	-	-	-	-	-	-	-	-	-
Sablefish	14	32	14	13	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbot	15	30	11	10	14	9	15	22	18	17	14	6	23	7	4	6	8	-	17	35	6	9

Table 5. Summary of halibut discard mortality rates (DMRs) in the Gulf of Alaska (GOA) groundfish fisheries during 1990-2011.

Gear/Target	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11
GOA Trawl																						
Atka mackerel	67	89	81	67	53	-	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bottom pollock	51	62	66	57	48	66	79	66	55	55	52	58	55	47	73	45	70	69	70	57	54	57
Pacific cod	60	62	66	59	53	64	70	62	64	54	57	67	59	69	63	66	56	61	63	62	70	52
Deep wtr flats	61	58	70	59	60	56	71	61	51	51	62	49	48	31	49	-	-	-	-	-	-	-
Shall wtr flats	66	71	69	65	62	70	71	71	67	81	67	62	66	80	71	77	70	71	66	64	56	52
Rockfish	65	75	79	75	58	71	65	63	68	74	71	61	64	65	73	66	48	77	75	67	66	63
Flathead sole	-	-	-	-	54	64	67	74	39	51	69	68	74	49	62	57	63	83	78	45	73	69
Midwtr pollock	71	82	72	63	61	51	81	70	80	86	80	89	90	34	88	62	66	87	-	-	-	-
Sablefish	70	60	68	59	67	58	80	61	-	68	38	66	62	-	79	-	89	52	-	-	-	-
Arrowtooth fldr	-	-	-	-	-	-	66	48	62	73	75	86	76	70	65	66	76	64	73	69	90	81
Rex sole	-	-	-	-	56	76	63	47	58	70	71	62	57	69	67	61	45	57	85	84	80	82
GOA Pot																						
Pacific cod	12	7	16	24	17	21	7	11	16	13	8	33	19	21	22	13	15	17	10	31	13	10
GOA Longline																						
Pacific cod	15	18	13	7	11	13	11	22	11	17	16	11	11	13	16	8	13	7	10	10	9	8
Rockfish	6	-	-	7	-	4	13	-	9	-	9	-	-	-	-	-	-	-	-	-	-	-
Sablefish	17	27	28	30	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 6. Summary of vessel sampling and halibut viability/injury data from the Bering Sea/Aleutian Community Development Quota (CDQ) fisheries.

			Sample totals				Projected fishery totals					
Target	# of Vsls	# of Hauls	E	P	D		E	P	D		DMR	SE
2009												
CDQ Trawl												
Atka m	3	195	0	0	0		0	0	0		--	--
B poll	16	116	8	4	249		763	454	3465		0.738	0.091
P cod	5	28	0	0	3		0	0	27		0.900	0.000
Rckfsh	3	41	0	0	0		0	0	0		--	--
M poll	14	897	0	0	955		0	0	4635		0.900	0.000
R sole	3	56	0	0	0		0	0	0		--	--
Turbot	2	114	0	0	31		0	0	417		0.900	0.000
YF sole	3	53	0	0	0		0	0	0		--	--
CDQ Pot												
Sable	3	95	15	8	6		46	26	20		0.503	0.3591
CDQ Longline			Mi	Mo	Sev	De	Mi	Mo	Sev	De	DMR	SE
P cod	17	2096	1740	154	43	32	46952	4818	1151	665	0.080	0.0348
2010												
CDQ Trawl												
Atka m	2	181	0	0	0		0	0	0		--	--
B poll	14	98	0	0	162		0	0	1202		0.900	0.000
P cod	4	31	0	0	0		0	0	0		--	--
Rckfsh	3	49	0	0	0		0	0	0		--	--
M poll	12	806	1	0	474		1	0	1653		0.894	0.0304
R sole	4	122	0	0	4		0	0	158		0.900	0.0000
Turbot	3	15	0	0	0		0	0	0		--	--
YF sole	5	183	0	0	0		0	0	0		--	--
CDQ Pot												
Sable	3	145	29	8	8		93	26	25		0.499	0.1633
CDQ Longline			Mi	Mo	Sev	De	Mi	Mo	Sev	De	DMR	SE
P cod	16	2209	1731	170	19	35	40409	5094	306		0.183	0.0448
2011												
CDQ Trawl												
Atka m	3	96	0	0	3		0	0	196		0.900	---
B poll	20	216	18	11	657		488	213	4824		0.824	0.0260
P cod	7	31	0	0	21		0	0	1290		0.900	0.0000
Rckfish	5	61	0	0	0		0	0	0		---	---
M poll	15	1138	1	0	1652		1	0	8052		0.900	0.0041
R sole	9	264	1	3	99		23	65	4136		0.891	0.0029
Turbot	4	14	0	0	0		0	0	0		---	---
YF sole	9	717	0	4	171		0	134	11248		0.897	0.0017
CDQ Pot												
Sable	2	99	60	8	14		171	17	37		0.313	0.3972
CDQ Longline			Mi	Mo	Sev	De	Mi	Mo	Sev	De	DMR	SE
P cod	14	1596	1524	210	32	41	40637	6967	1503	1145	0.100	0.0418

Table 7. Summary of halibut discard mortality rates (DMRs) in the Community Development Quota (CDQ) Bering Sea/Aleutian (BSA) groundfish fisheries during 1998-2011.

Gear/Target	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CDQ Trawl														
Atka mackerel	-	82	89	80	90	86	87	89	80	79	90	-	-	90
Bottom pollock	90	88	90	90	66	-	84	90	88	83	90	74	90	82
Pac cod	-	-	-	-	-	-	-	-	-	-	90	90	-	90
Rockfish	-	88	-	90	-	-	-	-	69	82	89	-	-	-
Flathead sole	-	-	83	90	-	-	-	-	-	79	-	-	-	-
Midwtr pollock	90	90	88	89	89	90	90	90	90	90	89	90	89	90
Rock sole	-	-	-	-	-	-	-	-	86	89	86	-	90	89
Turbot	-	-	-	-	-	-	-	-	-	-	88	90	-	-
Yellowfin sole	-	83	-	-	81	89	88	88	73	87	89	-	-	90
CDQ Pot														
Sablefish	-	-	38	46	25	22	18	56	40	24	22	50	50	31
CDQ Longline														
Pacific cod	10	10	13	11	9	9	9	10	10	8	9	8	18	10
Turbot	-	-	4	-	-	-	-	-	-	-	-	-	-	-

Table 8. Recommended Pacific halibut discard mortality rates (DMRs) for 2013-2015 CDQ and non-CDQ groundfish fisheries off Alaska.

I. Non-CDQ

Bering Sea/Aleutians			Gulf of Alaska		
Gear/Target	**Used in 2010-2012**	**2013-2015 Recommendation**	**Gear/Target**	**Used in 2010-2012**	**2013-2015 Recommendation**
Trawl			***Trawl***		
Atka mack	76	77	Bottom poll	59	60
Bottom poll	73	77	Pacific cod	62	62
Pacific cod	71	71	Dpwtr flats	48	43
Other Flats	72	71	Shallwtr flats	71	67
Rockfish	81	79	Rockfish	67	66
Flathead sole	74	73	Flathead sole	65	65
Midwtr poll	89	88	Midwtr poll	76	71
Rock sole	82	85	Sablefish	65	71
Sablefish	75	75	Arr. fldr	72	73
Turbot	67	64	Rex sole	64	69
Arr. fldr	76	76			
YF sole	81	83			
Pot			***Pot***		
Pacific cod	8	8	Pacific cod	17	17
Longline			***Longline***		
Pacific cod	10	9	Pacific cod	12	11
Rockfish	9	4	Rockfish	9	9
Turbot	11	13			

II. Bering Sea/Aleutians CDQ

Gear/Target	**Used in 2010-2012**	**2013-2015 Recommendation**
Trawl		
Atka mackerel	85	86
Bottom pollock	85	83
Pacific cod	90	90
Rockfish	84	80
Flathead sole	84	79
Midwtr pollock	90	90
Rock sole	87	88
Turbot	88	89
Yellowfin sole	85	86
Pot		
Sablefish	32	34
Longline		
Pacific cod	10	10
Turbot	4	4

AGENDA C-2(b)
Supplemental
OCTOBER 2012

Freezer Longline Coalition

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www.freezerlonglinecoalition.com

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September 25th 2012

Please find the following comments on behalf of the Freezer Longline Coalition. Dr. Mark Maunder has prepared reviews on the Eastern Bering Sea, Aleutian Islands and Gulf of Alaska Cod Assessment Models.

The Freezer Longline Coalition appreciates the time and efforts of the SSC to review the present and past models. Do not hesitate to contact me should you have questions regarding the given information.

Best Regards,

Kenny Down
Executive Director

AGENDA ITEM: **C-2 Groundfish Specifications**
(a.) Receive Groundfish Plan Team Reports.
(b.) AI Pacific cod model review (SSC only).

$p(\theta \mid y) = \begin{Bmatrix} Q \\ R \\ A \end{Bmatrix}$ uantitative esource ssessment
LLC

Quantitative Resource Assessment LLC
San Diego, CA
USA.

Report on the Pacific cod September 2012 Plan Team Meeting

EBS

The EBS assessment model has been thoroughly evaluated over the past decade and it is unlikely that the model will be significantly improved without the addition of new data or alternative analyses of data outside the assessment model. For example, improved estimates of trawl survey catchability will only be possible with the collection of more archival tag data or comprehensive side-by-side studies of different trawl gear (i.e. comparing the current trawl net with one with a higher head rope). Estimation of the catchability as a model parameter results in a value greater than one, which could be considered unrealistic, with high precision. This indicates that another component of the model might be mispecified. If the catchability could be accurately specified, then a more thorough evaluation could be made of the other components of the model that may be mispecifed (e.g. natural mortality).

The stock assessment model is still unable to fit the peeks in the trawl survey. Some of the year to year changes in the survey are greater than can be expected from a cod like population. The fit of the model to the survey index is poorer than the assumptions (i.e. standard deviations) used in the likelihood function (i.e. the predictions go through the confidence intervals less than 95% of the time). The assessment author has tried to deal with this by adding additional variation to the catchability. Alternatively, the standard deviation of the likelihood function could be estimated. These both simply down weight the survey index relative to the other data and reduce the precision of the model estimates in general. They do not enhance the information contained in the survey index. A better approach may be to re-evaluate how the survey index is calculated. Analysis the survey data using a GLM or other statistical technique that is commonly used for standardisting CPUE data for covariates might produce an index that is more related to the total stock abundance. In particular, given the low height of the head rope, including bottom dwelling prey (e.g. crab) in the analysis might help explain high catch rates of cod in some tows.

AI

This is the first attempt at a full assessment model for the AI stock. The assessment model is still very primary and it is too early to use this model for management advice. There is still a large amount of investigatory work that is needed and this should be encouraged. The following are some comments and suggestions that should be taken into consideration when developing the next set of analyses for this stock.

Given the lack of composition data, it might be useful to retain all the length composition data and not exclude data with less than 400 samples.

Grouping data into a single fishery may bias the analysis. It might be better to keep the gears separate, even if the selectivities are shared so that the assumption of common selectivity can be tested based on the residuals of the fit to the length composition data.

Estimating time varying growth, particularly for the oldest fish, might asking too much from the model given there is no aging data. The estimated variation in mean length at age might just be compensating for not modeling the gears as separate fisheries with different selectivities.

In the 1990s the spawning biomass is estimated to be twice the size of the unexploited spawning biomass. This suggests that dynamic reference points that take the recruitment time series into account should be used.

GoA

The GoA stock assessment had had less attention than the BS assessment and is therefore has had a less thorough evaluation. There are several changes to the model and additional model investigations that might improve the GoA assessment. The following are some comments and suggestions that should be taken into consideration when developing the next set of analyses for this stock.

The assessment model does not fit the length composition data for sub-27cm survey. This implies that the sub-27 abundance index is not corresponding to the correct length in the model and is probably biasing estimates of recruitment. Natural mortality, growth, selectivity, and/or spatial distribution may cause the lack of fit to the survey length composition. A model should be run with the sub-27cm survey and associated length composition data left out of the analysis. The ADFG survey index and length composition data should be investigated as an alternative.

The fit to the 27cm-plus survey also has some issues. The fit to the index of abundance and the timing of the increase in abundance looks like it is off by a year suggesting that the aging may be off by a year. The catchability deviates for 1984-1993 make the survey q much higher than one (a deviate of about exp(0.5)=1.6 so the Q=1.5) which is probably unrealistic. It might be useful to run a model with the catchability fixed for the whole time period, although previous experience suggests that the selectivity curve may be distorted to compensate for the fixed catchability. These high catchability estimates suggest that some component of the model (e.g. natural mortality) is mispecified.

The model is fit to mean length at age data. This is inconsistent with the BS assessment. It might be better to fit to the age conditioned on length data.

United Cook Inlet Drift Association

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SEP 24 2012

Date: September 24, 2012

Addressee: Statistical & Science Committee
North Pacific Fisheries Management Council
605 West 4th
Suite 306
Anchorage, AK 99501-2252

RE: Hook & Release Comments

Dear Sirs:

We offer the following comments on hook and release mortality rates:

1. Older J-Hook Set-Ups – 13-16% Mortality (See Exhibit 1)

   These J-Hooks had several issues:

   a. Safety of crew and deck hands
   b. Deep, in the gullet, hooking characteristics
   c. Very difficult to release U32 fish
   d. Bleeding – gills, gullet and tongue
   e. Often tearing of flesh

2. Circle Hooks (See Exhibits 2 & 3)

   Types of Circle Hooks:

   a. Blunt Hook/Point – 5% Mortality

      - Poor catching rate
      - Variable catching locations
      - Difficult to release

b. Long Slender Hook/Point – Less than 3% Mortality

- Excellent hooking rate
- Consistent hooking in corner of mouth
- Excellent releasing characteristics
- Very little bleeding or flesh tearing

3. Weighted Jig, with Bait, without Plastic Lure – Greater than 13-16% Mortality (See Exhibit 4)

   a. Modified J-Hook
   b. Hook up orientation, line attachment location
   c. Hook in upper mouth and eye sockets
   d. Very difficult to release
   e. Lead weight – causes tearing of flesh
   f. Bleeding often occurs, along with open wounds

4. Treble Hook – Greater than 16% Mortality (See Exhibit 5)

   a. Swallowed deep – often in stomach
   b. Very difficult to release
   c. Bleeding and tearing of flesh

5. Fishing Time – 1-2% Reduced Mortality

   a. Commercial Setline – No more than 4 hours
   b. Not 10 to 12 hours as reported

6. Halibut Stringing – Adds 10% Mortality to Other Factors

   a. String (keep) halibut on rope hung over the side of the boat
   b. Kept or released – dependant on future catch
   c. Rope through the gills – gill abrasion issues

7. Day-After-Day Concentrated Fishing Effort – Adds __% Mortality to Other Factors

   a. In same locations daily
   b. Hook & release and re-hooking events

8. Removing halibut from the water – Adds 2-3% Mortality to Other Factors

   a. Hook removal, measurements
   b. Tail slings

9. Gaffing and Netting – Adds ___% Mortality

   a. Party boats

10. Crucifiers – Adds 10-20% Mortality to Other Factors (See cover of Pacific Fishing)

Sincerely,

Roland Maw

Roland Maw, PhD
UCIDA Executive Director

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