

# Aleutian Islands trawl survey biomass summary

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The following show results from modifications to the catch levels in areas 543 and 542 of the Aleutian Islands.

The steps in this process were to run the standard projection model (1,000 simulations each, previous analyses were for only 100 simulations ) for Pacific cod and Atka mackerel and apply mean biomass estimates from the bottom trawl survey in Area 543 and 542 and project forward under different levels of fishing. The projections can be run for any multiplier of the  $F_{ABC}$  value.

## Western area (543) results

Mean biomass estimates were derived from the 2002, 2004, and 2006 surveys to show the variability in proportions (Table 1) and in absolute tonnages (Table 2). Assuming these estimates hold over time, some alternative management actions on Atka mackerel fishing were examined. This included comparing no fishing with 50%, 65% and full-ABC fishing levels for Atka mackerel (Pacific cod status-quo fishing was retained which for area 543 is about 2.5% of the BSAI Pacific cod ABC).

Projected values from the mean survey estimates indicate that the Pacific cod and Atka mackerel biomass would be expected to increase by about 40% in the year 2020 relative to the 2009 levels under a scenario of no fishing ( $F_{ABC}=0$ , Table 3). This contrasts with about a 20% increase at  $F_{ABC}$  set to 25% of its value and only 3% when set to 65% of  $F_{ABC}$ .

Assuming no directed fishing for Pacific cod and the same scenarios for the Atka mackerel indicates that the combined biomass would be expected to increase by about 47% by the year 2020 relative to the 2009 levels under a scenario of no fishing ( $F_{ABC}=0$ , Table 4). This contrasts with about a 28% increase at  $F_{ABC}$  set to 25% of its value and 10% when set to 65% of Atka mackerel  $F_{ABC}$ .

## Central area (542) results

For the central area, mean biomass estimates show a different ranking in proportions (Tables 5 and Table 6). As above, assuming these estimates hold over time and under similar management alternatives, the projected values from the mean survey estimates indicate similar relative biomass changes (Table 7).

To optionally account for longline-only fishing for Pacific cod in area 542 in the Aleutian Islands the relative catch history for Pacific cod by. Assuming that the longline catch that would have occurred in 543 would be redirected into 542, and that catch from other gears would be curtailed, then the catch under longline fishing alone represents 16.2% of the historical catch (2003-2009) from this area. We thus ran the projection model assuming only 16.2% of the maximum permissible  $F_{ABC}$  (using longline-only gear). This scenario increased the contribution of expected Pacific cod and Atka mackerel biomass (Table 8).

Table 1. Summer bottom-trawl survey estimates of groundfish biomass proportions by year and average for the Aleutian Islands region 543.

Groundfish species	2002	2004	2006	Average
Pacific ocean perch	29%	25%	48%	34%
Atka mackerel	36%	43%	17%	32%
Northern rockfish	19%	17%	17%	18%
Pacific cod	3%	1%	3%	3%
Arrowtooth flounder	2%	2%	2%	2%
Northern rock sole	1%	1%	2%	2%
Walleye pollock	2%	1%	1%	1%
Shortraker rockfish	1%	2%	0%	1%
Shortspine thornyhead	1%	1%	2%	1%
Other	6%	7%	7%	7%

Table 2. Summer bottom-trawl survey estimates of groundfish biomass (t) by year and average for the Aleutian Islands region 543.

Groundfish species	2002	2004	2006	Average
Pacific ocean perch	202,124	212,639	281,946	232,236
Atka mackerel	255,115	376,414	100,693	244,074
Northern rockfish	134,519	146,179	101,276	127,324
Pacific cod	23,802	9,637	19,734	17,724
Arrowtooth flounder	14,343	17,400	13,343	15,029
Northern rock sole	10,575	10,434	12,768	11,259
Walleye pollock	12,442	6,605	6,514	8,520
Shortraker rockfish	3,947	16,333	2,471	7,584
Shortspine thornyhead	8,246	12,002	11,116	10,454
Other	40,026	59,387	43,170	47,528
Total	705,139	867,029	593,030	721,733

Table 3. Average Pacific cod trajectories (assuming **Pacific cod status quo fishing level**) and Atka mackerel Aleutian Islands bottom-trawl survey biomass estimates (kt) projected from the BSAI-wide and Aleutian Islands-wide (respectively) models. Alternative multipliers of  $F_{ABC}$  for Atka mackerel are shown for no fishing, 0.25, 0.5, 0.65 (**Council motion**) and full  $F_{ABC}$  values. The percentages are relative to the 2009 values and include both Pacific cod and Atka mackerel. Data are from the 2002, 2004 and 2006 surveys for region **543**.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
543 Pacific cod	17.7	20.1	23.2	25.1	25.5	24.3	23.7	22.8	22.3	22.0	21.8	21.7
<b>Atka mackerel harvest rate</b>												
F=0	244.1	223.4	242.1	262.7	283.0	299.4	312.7	323.7	330.9	337.0	342.8	347.3
F= 0.25 $F_{ABC}$	244.1	223.4	232.6	245.4	259.1	269.5	277.4	283.3	287.0	290.1	293.1	295.3
F= 0.5 $F_{ABC}$	244.1	223.4	223.8	230.3	239.6	246.7	251.8	255.2	257.2	259.0	260.8	262.1
F= 0.65 $F_{ABC}$	244.1	223.4	218.8	222.2	229.8	236.0	240.1	242.6	244.1	245.5	247.0	248.0
F = $F_{ABC}$	244.1	223.4	207.8	205.7	212.6	217.9	220.7	221.9	222.5	223.5	224.6	225.3
<b>Combined Pacific cod and Atka mackerel biomass change</b>												
F=0	100%	93%	101%	110%	118%	124%	129%	132%	135%	137%	139%	141%
F= 0.25 $F_{ABC}$	100%	93%	98%	103%	109%	112%	115%	117%	118%	119%	120%	121%
F= 0.5 $F_{ABC}$	100%	93%	94%	98%	101%	104%	105%	106%	107%	107%	108%	108%
F= 0.65 $F_{ABC}$	100%	93%	92%	94%	98%	99%	101%	101%	102%	102%	103%	103%
F = $F_{ABC}$	100%	93%	88%	88%	91%	93%	93%	93%	94%	94%	94%	94%

Table 4. Average Pacific cod trajectories (**assuming no Pacific cod fishing**) and Atka mackerel Aleutian Islands bottom-trawl survey biomass estimates (kt) projected from the BSAI-wide and Aleutian Islands-wide (respectively) models. Alternative multipliers of  $F_{ABC}$  for Atka mackerel are shown for no fishing, 0.25, 0.5, 0.65 (**Council motion**) and full  $F_{ABC}$  values. The percentages are relative to the 2009 values and include both Pacific cod and Atka mackerel. Data are from the 2002, 2004 and 2006 surveys for region **543**.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
543 Pacific cod	17.7	20.1	25.3	29.5	32.8	34.1	36.1	37.0	37.9	38.5	38.5	38.8
<b>Atka mackerel harvest rate</b>												
F=0	244.1	223.4	242.1	262.7	283.0	299.4	312.7	323.7	330.9	337.0	342.8	347.3
F= 0.25 $F_{ABC}$	244.1	223.4	232.6	245.4	259.1	269.5	277.4	283.3	287.0	290.1	293.1	295.3
F= 0.5 $F_{ABC}$	244.1	223.4	223.8	230.3	239.6	246.7	251.8	255.2	257.2	259.0	260.8	262.1
F= 0.65 $F_{ABC}$	244.1	223.4	218.8	222.2	229.8	236.0	240.1	242.6	244.1	245.5	247.0	248.0
F = $F_{ABC}$	244.1	223.4	207.8	205.7	212.6	217.9	220.7	221.9	222.5	223.5	224.6	225.3
<b>Combined Pacific cod and Atka mackerel biomass change</b>												
F=0	100%	93%	102%	112%	121%	127%	133%	138%	141%	143%	146%	147%
F= 0.25 $F_{ABC}$	100%	93%	101%	109%	117%	122%	127%	131%	133%	135%	137%	138%
F= 0.5 $F_{ABC}$	100%	93%	99%	105%	111%	116%	120%	122%	124%	125%	127%	128%
F= 0.65 $F_{ABC}$	100%	93%	95%	99%	104%	107%	110%	112%	113%	114%	114%	115%
F = $F_{ABC}$	100%	93%	93%	96%	100%	103%	105%	107%	108%	108%	109%	110%

Table 5. Summer bottom-trawl survey estimates of groundfish biomass proportions by year and average for the Aleutian Islands region 542.

Groundfish species	2002	2004	2006	Average
Atka mackerel	43%	41%	39%	41%
Pacific ocean perch	19%	23%	24%	22%
Walleye pollock	15%	2%	3%	6%
Northern rockfish	5%	4%	10%	6%
giant grenadier	1%	9%	4%	5%
Pacific cod	3%	3%	3%	3%
northern rock sole	3%	3%	5%	4%
Kamchatka flounder	3%	3%	2%	2%
arrowtooth flounder	2%	3%	1%	2%
Other	6%	8%	8%	8%

Table 6. Summer bottom-trawl survey estimates of groundfish biomass (t) by year and average for the Aleutian Islands region 542.

Groundfish species	2002	2004	2006	Average
Atka mackerel	322,556	269,320	278,036	289,971
Pacific ocean perch	140,356	152,840	170,942	154,712
walleye pollock	108,244	11,627	18,482	46,118
northern rockfish	38,772	27,050	70,834	45,552
giant grenadier	7,818	57,304	29,672	31,598
Pacific cod	24,327	20,709	22,033	22,356
northern rock sole	22,935	22,343	37,159	27,479
Kamchatka flounder	20,088	19,255	12,263	17,202
arrowtooth flounder	12,950	18,426	8,312	13,230
Other	47,703	55,624	58,919	54,082
	745,747	654,496	706,650	702,298

Table 7. Average Pacific cod trajectories (**status quo fishing level**) and Atka mackerel Aleutian Islands bottom-trawl survey biomass estimates (kt) projected from the BSAI-wide and Aleutian Islands-wide (respectively) models. Alternative multipliers of  $F_{ABC}$  for Atka mackerel are shown for no fishing, 0.25, 0.5, 0.65 (**Council motion**) and full  $F_{ABC}$  values. The percentages are relative to the 2009 values and include both Pacific cod and Atka mackerel. Data are from the 2002, 2004 and 2006 surveys for region **542**.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
<b>542 Pacific cod</b>	22.4	25.3	29.3	31.7	32.2	30.6	29.9	28.8	28.1	27.7	27.4	27.4
<b>Atka mackerel harvest rate</b>												
F=0	290.0	265.4	287.6	312.2	336.3	355.7	371.5	384.5	393.1	400.4	407.3	412.6
F= 0.25 $F_{ABC}$	290.0	265.4	276.4	291.6	307.8	320.2	329.6	336.6	341.0	344.6	348.2	350.8
F= 0.5 $F_{ABC}$	290.0	265.4	265.9	273.6	284.7	293.1	299.1	303.2	305.6	307.7	309.9	311.4
F= 0.65 $F_{ABC}$	290.0	265.4	259.9	264.0	273.0	280.3	285.2	288.3	290.0	291.7	293.4	294.6
F = $F_{ABC}$	290.0	264.8	245.0	240.3	248.1	258.1	268.5	276.1	280.1	281.6	281.4	279.2
<b>Combined Pacific cod and Atka mackerel biomass change</b>												
F=0	100%	93%	101%	110%	118%	124%	129%	132%	135%	137%	139%	141%
F= 0.25 $F_{ABC}$	100%	93%	98%	104%	109%	112%	115%	117%	118%	119%	120%	121%
F= 0.5 $F_{ABC}$	100%	93%	95%	98%	101%	104%	105%	106%	107%	107%	108%	108%
F= 0.65 $F_{ABC}$	100%	93%	93%	95%	98%	100%	101%	102%	102%	102%	103%	103%
F = $F_{ABC}$	100%	93%	88%	87%	90%	92%	96%	98%	99%	99%	99%	98%

Table 8. Average Pacific cod trajectories (**assuming longline-only, 16.2% of status quo fishing level**) and Atka mackerel Aleutian Islands bottom-trawl survey biomass estimates (kt) projected from the BSAI-wide and Aleutian Islands-wide (respectively) models. Alternative multipliers of  $F_{ABC}$  for Atka mackerel are shown for no fishing, 0.25, 0.5, 0.65 (**Council motion**) and full  $F_{ABC}$  values. The percentages are relative to the 2009 values and include both Pacific cod and Atka mackerel. Data are from the 2002, 2004 and 2006 surveys for region **542**.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
<b>542 Pacific cod</b>	22.4	25.4	31.5	36.2	39.7	40.7	42.3	42.5	42.7	42.7	42.3	42.3
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F=0	290.0	265.4	287.6	312.2	336.3	355.7	371.5	384.5	393.1	400.4	407.3	412.6
F= 0.25 $F_{ABC}$	290.0	265.4	276.4	291.6	307.8	320.2	329.6	336.6	341.0	344.6	348.2	350.8
F= 0.5 $F_{ABC}$	290.0	265.4	265.9	273.6	284.7	293.1	299.1	303.2	305.6	307.7	309.9	311.4
F= 0.65 $F_{ABC}$	290.0	265.4	259.9	264.0	273.0	280.3	285.2	288.3	290.0	291.7	293.4	294.6
F = $F_{ABC}$	290.0	264.8	245.0	240.3	248.1	258.1	268.5	276.1	280.1	281.6	281.4	279.2
<b>Combined Pacific cod and Atka mackerel biomass change</b>												
F=0	100%	93%	102%	112%	120%	127%	132%	137%	140%	142%	144%	146%
F= 0.25 $F_{ABC}$	100%	93%	99%	105%	111%	116%	119%	121%	123%	124%	125%	126%
F= 0.5 $F_{ABC}$	100%	93%	95%	99%	104%	107%	109%	111%	111%	112%	113%	113%
F= 0.65 $F_{ABC}$	100%	93%	93%	96%	100%	103%	105%	106%	107%	107%	107%	108%
F = $F_{ABC}$	100%	93%	89%	89%	92%	96%	100%	102%	103%	104%	104%	103%