

13. Assessment of the Rougheye and Blackspotted rockfish stock complex in the Gulf of Alaska

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Executive Summary

The scheduled frequency for some stock assessments was recently changed in response to the National Stock Assessment Prioritization effort (Methot 2015; Hollowed et al. 2016). In previous years, all Gulf of Alaska (GOA) rockfish stocks were assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. There was no change in this schedule for the rougheye and blackspotted (RE/BS) rockfish complex. For this off-cycle (even) year, we present a partial assessment consisting of an executive summary with recent fishery catch and survey trends as well as recommend harvest levels for the next two years. In on-cycle (odd) years, we will present a full stock assessment document with updated assessment and projection model results to recommend harvest levels for the next two years. Please refer to last year's full stock assessment and fishery evaluation (SAFE) report for further information regarding the stock assessment (Shotwell et al., 2017, available online at <https://www.afsc.noaa.gov/REFM/Docs/2017/GOArougheye.pdf>).

We use a statistical age-structured model as the primary assessment tool for the Gulf of Alaska rougheye and blackspotted (RE/BS) rockfish complex which qualifies as a Tier 3 stock. This assessment consists of a population model, which uses survey and fishery data to generate a historical time series of population estimates, and a projection model, which uses results from the population model to predict future population estimates and recommended harvest levels. The data sets used in this assessment include total catch biomass, fishery age and size compositions, trawl and longline survey abundance estimates, trawl survey age compositions, and longline survey size compositions. For an off-cycle year, we do not re-run the assessment model, but do update the projection model with new catch information. This incorporates the most current catch information without re-estimating model parameters and biological reference points. As with last year, we use the full assessment base model from 2015.

Summary of Changes in Assessment Inputs

Changes in the input data: There were no changes made to the assessment model inputs since this was an off-cycle year. New data added to the projection model included an updated 2017 catch estimate (523 t) and new catch estimates for 2018-2020. The 2018 catch was estimated by increasing the official catch as of October 6, 2018, by an expansion factor of 1.6%, which represents the average fraction of catch taken after October 6 in the last three complete years (2015-2017). This expansion factor slightly decreased from last year's expansion factor (1.7%) and resulted in an estimated catch for 2018 of 711 t. To estimate future catches, we updated the yield ratio to 0.46, which was the average of the ratio of catch to ABC for the last three complete catch years (2015-2017). This yield ratio was multiplied by the projected ABCs from the updated projection model to generate catches of 650 t in 2019 and 630 t in 2020. The yield ratio was lower than last year's ratio of 0.52 because the larger yield ratio from 2014 (0.60) dropped out.

Changes in the assessment methodology: There were no changes in assessment methodology since this was an off-cycle year.

Summary of Results

For the 2019 fishery, we recommend the maximum allowable ABC of 1,428 t from the updated projection model. This ABC is very similar to last year's ABC of 1,444 t and nearly identical to last year's projected 2019 ABC of 1,427 t. Reference values for GOA RE/BS rockfish are summarized in the following table, with the recommended ABC and OFL values for 2019 in bold.

Quantity	As estimated or <i>specified last year for:</i>		As estimated or <i>recommended this year for:*</i>	
	2018	2019	2019	2020
M (natural mortality rate)	0.036	0.036	0.036	0.036
Tier	3a	3a	3a	3a
Projected total (ages 3+) biomass (t)	45,624	45,346	45,363	45,186
Projected female spawning biomass (t)	15,059	14,972	14,992	14,926
$B_{100\%}$	22,495	22,495	22,495	22,495
$B_{40\%}$	8,998	8,998	8,998	8,998
$B_{35\%}$	7,873	7,873	7,873	7,873
F_{OFL}	0.048	0.048	0.048	0.048
$maxF_{ABC}$	0.040	0.040	0.040	0.040
F_{ABC}	0.040	0.040	0.040	0.040
OFL (t)	1,735	1,715	1,715	1,699
maxABC (t)	1,444	1,427	1,428	1,414
ABC (t)	1,444	1,427	1,428	1,414
Status	As determined <i>last year for:</i>		As determined <i>this year for:</i>	
	2016	2017	2017	2018
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

*Projections are based on an updated catch of 523 t for 2017, an estimated catch of 711 t for 2018, and estimates of 650 t and 630 t used in place of maximum permissible ABC for 2019 and 2020. These calculations are in response to management requests to obtain more accurate projections.

The stock is not being subject to overfishing, is not currently overfished, nor is it approaching a condition of being overfished. The tests for evaluating these three statements on status determination require examining the official total catch from the most recent complete year and the current model projections of spawning biomass relative to $B_{35\%}$ for 2018 and 2020. The official total catch for 2017 is 523 t which is less than the 2017 OFL of 1,594 t; therefore, the stock is not being subjected to overfishing. The estimates of spawning biomass for 2018 and 2020 from the current year (2018) projection model are 15,057 t and 14,926 t, respectively. Both estimates are well above the estimate of $B_{35\%}$ at 7,873 t and, therefore, the stock is not currently overfished nor approaching an overfished condition.

Fishery Trends

Updated catch data (t) for RE/BS rockfish in the Gulf of Alaska as of October 6, 2018 (NMFS Alaska Regional Office Catch Accounting System via the Alaska Fisheries Information Network (AKFIN) database, <http://www.akfin.org>) are summarized in the following table:

Year	Western	Central	Eastern	Gulfwide Total	Gulfwide ABC	Gulfwide TAC
2017	35	329	159	523	1,327	1,327
2018	78	421	201	700	1,444	1,444

Catch of rougheye and blackspotted rockfish increased in all areas in 2018 compared to 2017 but remains within the range of the time series. The increase is consistent across gear types with one-third taken in longline fisheries and two-thirds taken in trawl fisheries. The majority of the RE/BS rockfish catch remains in the rockfish and sablefish fisheries, with some increase in the flatfish fisheries. The RE/BS rockfish catch/biomass ratio has ranged from 0.006 to 0.02 from 1991 through 2018 (Figure 13-1). Since 2014, the ratio has been slightly cyclical but very close to the mean of 0.01.

Survey Trends

The 2018 longline survey abundance estimate (relative population number or RPN) decreased about 31% from the 2017 estimate and is slightly below the long-term mean (Figure 13-2). The decrease was consistent across areas with the exception of the West Yakutat region which had a 20% decrease. This information was not used for updating the 2018 projection model for RE/BS rockfish as this was an off-cycle year.

Area Allocation of Harvests

The apportionment percentages are the same as in the 2017 full assessment. The following table shows the recommended apportionment for 2019 and 2020 (in bold) using the three-survey weighted average method. We provide the apportionment using the random effects method as reference. Please refer to the last full stock assessment for information regarding the apportionment rationale for RE/BS rockfish. For 2019 and 2020 we continue to recommend the three-survey weighted average method until the next full assessment where we will evaluate multiple survey apportionment options.

Method	Area Allocation	Western GOA	Central GOA	Eastern GOA	Total	
Three Survey Weighted Average	2019	Area ABC (t)	12.2%	38.5%	49.3%	100%
		OFL (t)	174	550	704	1,428
	2020	Area ABC (t)	172	545	697	1,414
		OFL (t)				1,699
Random Effects	2019	Area ABC (t)	8.6%	38.4%	53.0%	100%
		OFL (t)	123	548	757	1,428
	2020	Area ABC (t)	122	543	749	1,414
		OFL (t)				1,699

Since 2005, the total allowable catches (TACs) for RE/BS rockfish have not been fully taken and are generally between 20-60% of annual quotas. Specifically, in the Western GOA, where recent overages have occurred for several other species of rockfish, catches for RE/BS rockfish have remained between 18-44% of potential Western GOA apportionment since 2011.

Summaries for Plan Team

Species	Year	Biomass ¹	OFL	ABC	TAC	Catch ²
RE/BS complex	2017	41,650	1,594	1,327	1,327	523
	2018	45,624	1,735	1,444	1,444	700
	2019	45,363	1,715	1,428		
	2020	45,186	1,699	1,414		

Stock/ Assemblage	Area	2018				2019		2020	
		OFL	ABC	TAC	Catch ²	OFL	ABC	OFL	ABC
RE/BS complex	W		176	176	78		174		172
	C		556	556	421		550		545
	E		712	712	201		704		697

¹Total biomass (ages 3+) from the age-structured model

²Current as of October 6, 2018. Source: NMFS Alaska Regional Office Catch Accounting System via the AKFIN database (<http://www.akfin.org>).

Responses to SSC and Plan Team Comments on Assessments in General

In this section, we list new or outstanding comments on assessments in general from the last full assessment in 2017. Since this is a partial assessment, we only respond to priority comments in the executive summary. We will respond to remaining and future comments in the next full assessment.

“The SSC recommends that, for those sets of environmental and fisheries observations that support the inference of an impending severe decline in stock biomass, the issue of concern be brought to the SSC, with an integrated analysis of the indices in future stock assessment cycles. To be of greatest value, to the extent possible, this information should be presented at the October Council meeting so that there is sufficient time for the Plan Teams and industry to react to the possible reduction in fishing opportunity.” (SSC October 2017)

To facilitate a coordinated response to this request, the co-chairs and coordinators of the BSAI and GOA Groundfish Plan Teams, with concurrence from stock assessment program leadership at the AFSC, have suggested that authors address it by using the previous year’s Ecosystem Status Report (ESR) as follows:

“No later than the summer of each year, the lead author of each assessment should review the previous year’s ESR and determine whether any factor or set of factors described in that ESR implies an impending severe decline in stock/complex biomass, where “severe decline” means a decline of at least 20% (or any alternative value that may be established by the SSC), and where biomass is measured as spawning biomass for Tiers 1-3 and survey biomass as smoothed by the standard Tier 5 random effects model for Tiers 4-5. If an author determines that an impending severe decline is likely and if that decline was not anticipated in the most recent stock assessment, he or she should summarize that evidence in a document that will be reviewed by the respective Team in September of that year and by the SSC in October of that year, including a description of at least one plausible mechanism linking the factor or set of factors to an impending severe decline in biomass, and also including an estimate or range of estimates regarding likely impacts on ABC. In the event that new survey or relevant ESR data become available after the document is produced but prior to the October Council meeting of that year, the document should be amended to include those data prior to its review by the SSC, and the degree to which they corroborate or refute the predicted severe decline should be noted, with the estimate or range of estimates regarding likely impacts on ABC modified in light of the new data as necessary.”

“Stock assessment authors are encouraged to work with ESR analysts to identify a small subset of indicators prior to analysis, and preferably based on mechanistic hypotheses.” (SSC October 2018)

Only one indicator was presented in the GOA 2017 Ecosystem Status Report concerning rougheye and blackspotted rockfish (RE/BS rockfish). This indicator analyzed GOA bottom trawl survey data for several species of adult rockfish and compared the CPUE along environmental gradients of depth, bottom temperature and position (Rooper et al., 2017). No significant trends were observed across any rockfish species. Additional indicators regarding rockfish in general concerned an analysis of fish condition using GOA bottom trawl survey data (Boldt et al., 2017) and young-of-the-year (YOY) rockfish abundance in the eastern GOA surface trawl survey (Strasburger et al., 2017). Fish condition for northern rockfish was the lowest on record and second lowest on record for Pacific ocean perch in 2017 (Boldt et al., 2017). YOY rockfish abundance was low in 2017 compared to previous years with a potentially northerly distribution shift based on the center of gravity estimates as well as some range expansion (Strasburger et al., 2017). Generally, RE/BS rockfish adults live deeper than northern rockfish or Pacific ocean perch so these indicators may not represent the same conditions experienced by RE/BS rockfish. Additionally, the decline observed in the 2018 longline survey estimate for RE/BS rockfish is proportional to what has been observed previously and resulted in less than a 2% decline of SSB in the model. The 2017 longline survey relative population number estimate was the fourth largest in the time series and the recent trawl survey biomass estimates have been steadily increasing since the low in 2013 to be now near the long-term average. Based on this information we do not anticipate an impending severe decline in biomass for RE/BS rockfish in the GOA.

“The SSC also recommends explicit consideration and documentation of ecosystem and stock assessment status for each stock ... during the December Council meeting to aid in identifying stocks of concern.” (SSC October 2017)

Clarification during December 2017 SSC meeting and then re-clarified during June 2018 SSC meeting. In the interest of efficiency, the clarification from the December 2017 minutes is not included here. The relevant portion of the clarification from the June 2018 minutes reads as follows:

“This request was recently clarified by the SSC by replacing the terms ‘ecosystem status’ and ‘stock assessment status’ with ‘Ecosystem Status Report information’ and ‘Stock Assessment Information,’ where the potential determinations for each will consist of ‘Okay’ and ‘Not Okay,’ and by issuing the following guidance:

- *The SSC clarifies that ‘stock assessment status’ is a fundamental requirement of the SAFEs and is not really very useful to this exercise, because virtually all stocks are never overfished nor is overfishing occurring.*
- *Rather the SSC suggests that recent trends in recruitment and stock abundance could indicate warning signs well before a critical official status determination is reached. It may also be useful to consider some sort of ratio of how close a stock is to a limit or target reference point (e.g., B/B35). Thus, additional results for the stock assessments will need to be considered to make the ‘Okay’ or ‘Not Okay’ determinations.*
- *The SSC retracts its previous request for development of an ecosystem status for each stock/complex. Instead, while considering ecosystem status report information, it may be useful to attempt to develop thresholds for action concerning broad-scale ecosystem changes that are likely to impact multiple stocks/complexes.*
- *Implementation of these stock and ecosystem determinations will be an iterative process and will require a dialogue between the stock assessment authors, Plan Teams, ecosystem modelers, ESR editors, and the SSC.”*

“The Teams recommend that the terms ‘current and future ecosystem condition’ and ‘current and future stock condition’ be used in place of ‘ESR information’ and ‘stock assessment information’.” (Plan Team September 2018)

“The SSC recognized that because formal criteria for these categorizations have not been developed by the PT, they will not be presented in December 2018.” (SSC October 2018)

The iterative process described in the final bullet above was scheduled to begin at the September 2018 meeting of the Joint BSAI and GOA Plan Teams. However, no formal criteria for these categorizations were developed by the Plan Teams in September 2018. As specified by the SSC in October, we will not provide determinations for rougheye and blackspotted rockfish at this time and will provide determinations when formal criteria are established.

“The Team recommended that the authors simply report in words or a table whether catches exceed ABC as an indicator for “partial update” stocks. (Plan Team November 2017)

In this partial assessment, we report catches for last year and this year along with ABC to determine whether catches exceed ABC (please see **Fishery Trends** section above for more details)

“The SSC reminds authors of the need to balance the desire to improve model fit with increased risk of model misspecification.” (SSC December 2017)

Clarification: *“In the absence of strict objective guidelines, the SSC recommends that thorough documentation of model evaluation and the logical basis for changes in model complexity be provided in all cases.”* (SSC June 2018)

Please refer to the 2015 and 2017 full SAFE reports for thorough documentation of model evaluation regarding the RE/BS model (Shotwell et al., 2015, Shotwell et al., 2017, available online at <https://www.afsc.noaa.gov/REFM/Docs/2015/GOArougheye.pdf> and <https://www.afsc.noaa.gov/REFM/Docs/2017/GOArougheye.pdf>).

“Report a consistent metric (or set of metrics) to describe fish condition among assessments and ecosystem documents where possible.” (SSC December 2017)

We do not as yet report fish condition for RE/BS rockfish. However, if we do report this metric in the future then we will be consistent with the weight-length residual approach to report fish condition as described in the Ecosystem Status Report.

“Projections ... clearly illustrate the lack of uncertainty propagation in the ‘proj’ program used by assessment authors. The SSC encourages authors to investigate alternative methods for projection that incorporate uncertainty in model parameters in addition to recruitment deviations. Further, the SSC noted that projections made on the basis of fishing mortality rates (Fs) only will tend to underestimate the uncertainty (and perhaps introduce bias if the population distribution is skewed). Instead, a two-stage approach that first includes a projection using F to find the catch associated with that F and then a second projection using that fixed catch may produce differing results that may warrant consideration.” (SSC December 2017)

We plan to implement modified projection code in the RE/BS rockfish projection model to consider additional uncertainty in model parameters when standardized, AFSC-produced software for making the requested projections becomes available.

“The Teams recommend that the appropriate use, or non-use, of new model based estimates in this assessment cycle be left to individual authors’ discretion. The Teams further recommend that, if an author chooses to incorporate these into the assessment, the assessment should also contain appropriate comparative models and a full set of diagnostics.” (Plan Team September 2018)

“The SSC supports the PT recommendation to make the use of model-based survey estimates at the individual author’s discretion for 2018.” (SSC October 2018)

At this time model-based estimates are not available for RE/BS rockfish. In the future, model-based are anticipated to be produced by the Groundfish Assessment Program (GAP). When these estimates do become available for RE/BS rockfish, we will consider using the estimates if they can be tailored

appropriately for RE/BS rockfish and provide an improvement over the design-based estimates. The VAST model may also be tailored to combine multiple surveys and this may be useful for apportionment considerations. A working group was formed to investigate criteria for use of the model-based estimates in a variety of groundfish life histories. We will consult the guidelines from this working group for determining use of the model-based estimates for RE/BS rockfish when they become available.

“The SSC also noted that, in order to save resources, authors should not conduct additional assessments beyond the prioritized schedule unless they specifically trigger one or more of the criteria identified.” (SSC October 2018)

As we did not trigger either of the criteria identified to require an off-cycle assessment, we will not conduct a full assessment for RE/BS rockfish at this time.

Responses to SSC and Plan Team Comments Specific to this Assessment

In this section, we list new or outstanding comments specific to RE/BS rockfish from the last full assessment in 2017. Since this is an off-cycle year we only respond to priority comments in the executive summary. We will respond to remaining and future comments in the next full assessment.

“The Team recommend that the authors implement as worst case (bookended), dynamic weighting or apply genetically verified data to adjust the model for differences in maturity.” (Plan Team November 2017)

“The SSC supports the Plan Team recommendation for an analysis that provides a more realistic range of management risk of combining RE/BS in one stock than is currently in the assessment. A variety of methods could be used, including catch composition analysis, genetic vs visual survey ids, maturity curve differences, etc.” (SSC December 2017)

In the last full assessment, we considered “worst-case” scenarios using a Tier 5 approach and the genetic identification rates for RE/BS rockfish (please see **Responses to SSC and Plan Team Comments Specific to this Assessment** section for more details). Results of that analysis indicated that if every fish caught by the fishery were blackspotted rockfish, then we could exceed Tier 5 OFLs. Since then, we conducted a study on the fishery ages for RE/BS rockfish using otolith morphology and growth characteristics to distinguish the two species which has enabled the historical reconstruction of species composition in the fishery. We will provide a summary report of this study in the next full assessment which we believe will help guide management concerns in response to disproportionate harvest by species within this complex. In the future, we may consider expanding this project to include survey ages for RE/BS rockfish as well.

“The Team agreed with the authors that apportionment using the 4:6:9 standard was acceptable until the longline and trawl survey inputs can be combined to determine apportionment.” (Plan Team November 2017)

We continue with the status quo (three survey weighted average) apportionment for RE/BS rockfish in this partial assessment. until a multiple survey option becomes available. In the next full assessment, we will evaluate the options that are available for considering multiple surveys in apportionment. This may be through the random effects model (see GOA Thornyhead, current SAFE) or possibly through the VAST model (C. Cunningham pers. comm.).

“Species identification continues to be a problem both in the survey and fishery data. The SSC appreciates the authors continued work on this issue and highlights the importance of improving species composition information. As noted in the assessment, there appears to be continued improvement for correctly identifying blackspotted rockfish in the field (from 31% to 9%), while the opposite seems to be occurring for rougheye rockfish with increased misidentification rates over the three surveys (6% to 25%). In addition to genetic methods, otolith morphology identification methods would be useful for evaluating historical and future data collections- near-infrared reflectance (NIR) spectroscopy maybe

one area of further investigation. The SSC also looks forward to results on the AFSC observer program special project that collected multi-spectral images, paired with genetics, from survey samples of BS/RE for development of an image analysis application for species identification.” (SSC December 2017)

We will provide details on the progress of the species identification projects in the next full assessment.

“The SSC continues to be concerned about grouping species in the assessment without considering important differences in life history. Specifically, Conrath (2017) found age at maturity for the species fork length at 50% maturity was similar for rougheye rockfish (45.0 cm) and blackspotted rockfish (45.3 cm), but the age at 50% maturity was considerably younger for rougheye rockfish (19.6 years) than for blackspotted Rockfish (27.4 years). The SSC supports the authors’ recommendation to evaluate maturity information and explore fitting separate maturity curves. This would allow treatment of the differences in maturity between the species within the assessment.” (SSC December 2017)

We will respond to this request and consider the new maturity information in the next full assessment.

“The authors should clarify how the fishery age data by gear type is being incorporated into the model. It appears that longline and trawl ages are being combined. However, these fisheries have different sampling methods, catch characteristics, and sampling rates (e.g., full coverage versus partial coverage) that influence sample size for each gear type. A description of sample sizes from each gear-type, and the years for which age data by each gear-type was used for the model would provide additional information on this potential issue.” (SSC December 2017)

We will provide a description of the fishery ages by gear type in the next full assessment.

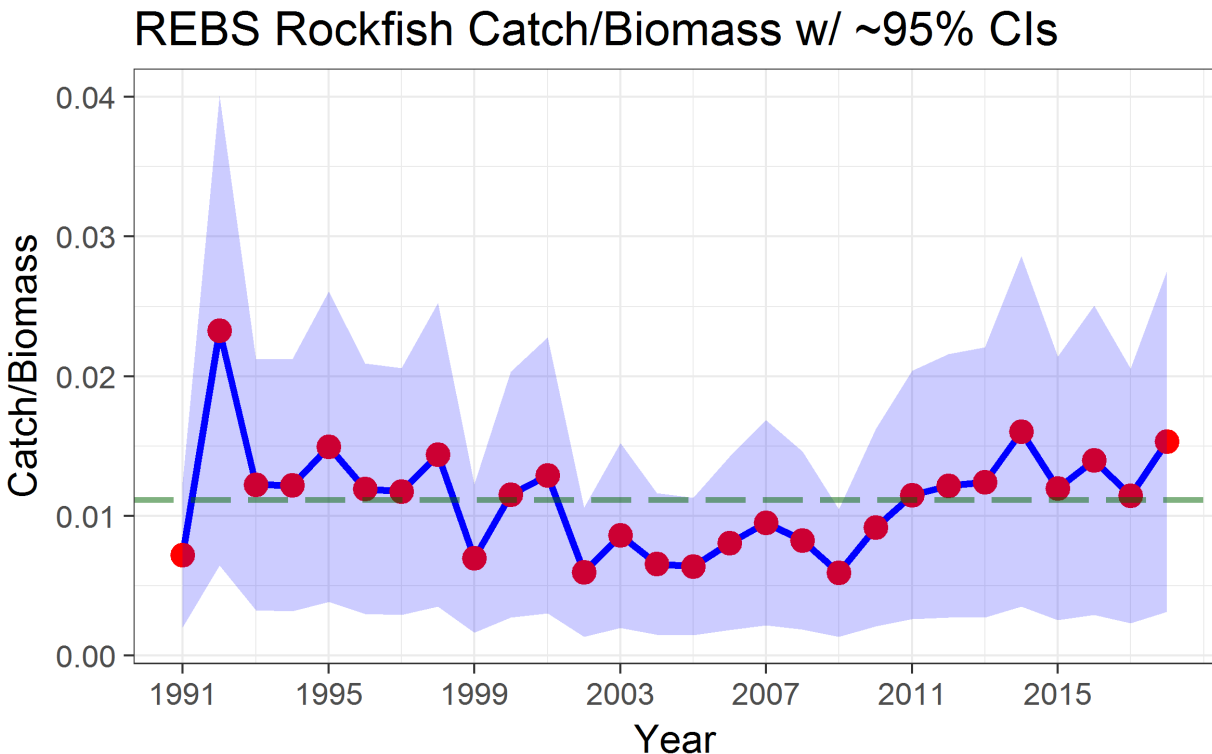


Figure 13-1. Catch divided by biomass (age 3+) from the age-structured model (point estimates in red circles) with 95% sampling error confidence intervals for GOA RE/BS rockfish (shaded area) from 1991-2018. Green dashed line is long-term average for the time series.

GOA Rougheye longline survey RPNs

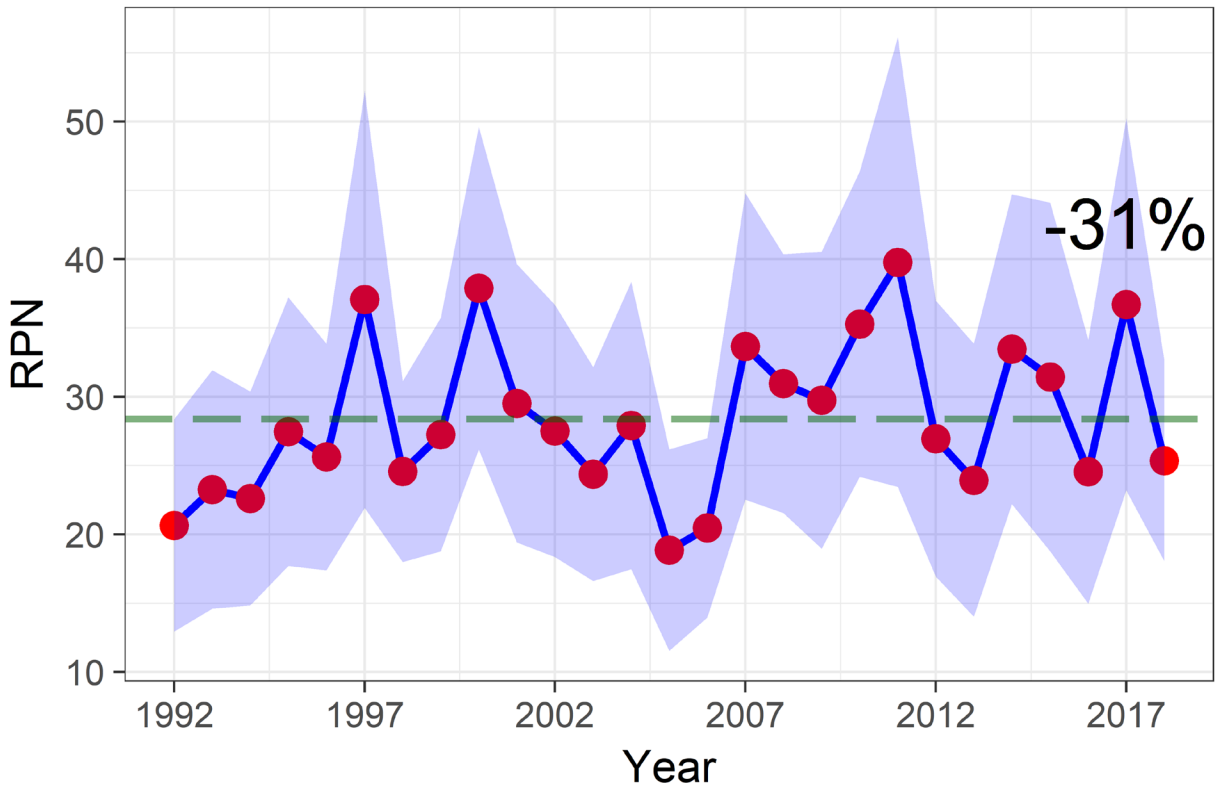


Figure 13-2. AFSC longline survey relative population numbers (RPN in thousands, point estimates in red circles) with 95% sampling error confidence intervals for GOA RE/BS rockfish (shaded area) from 1993-2018. Green dashed line is long-term average for the time series. Text percentage is the decrease of the 2018 RPN from the 2017 RPN.