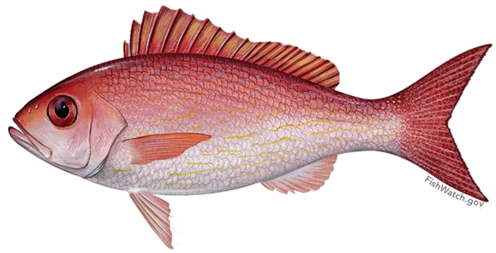

Gulf of Mexico Vermilion Snapper

SEDAR 67 Executive Summary

May 2020

This document serves as a summary of the full SEDAR 67 Stock Assessment Report (SAR), which can be found at *http://sedarweb.org/docs/sar/S67_Final_SAR.pdf*.

Stock

This assessment documents the status of the Vermilion Snapper (*Rhomboplites aurorubens*) resource in the Gulf of Mexico (Gulf) through 2017 and projects the quotas starting in 2021. Vermilion Snapper are most abundant in the eastern Gulf.

Stock Status

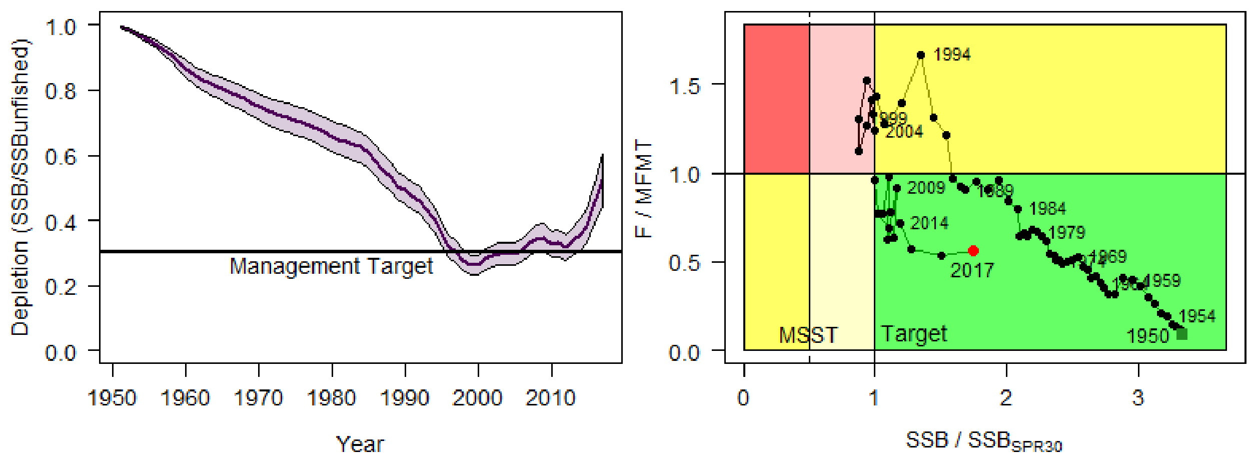

Figure 1: Stock depletion for Gulf Vermilion Snapper with 95% asymptotic confidence intervals (shaded region) [left panel]. Kobe plot showing the progression of exploitation status from 1950 to 2017, with Target Spawning Stock Biomass (SSB) and Minimum Stock Size Threshold (MSST) denoted [right panel].

Projections were to be completed by forecasting fishing mortality (F) ay maximum sustainable yield (F_{MSY}) using the base assessment model configuration. However, it was not possible to calculate MSY and its associated reference points (F_{MSY} and B_{MSY}) since the spawner-recruit relationship was deemed unreliable; therefore, a proxy for F_{MSY} was required. Using a spawning potential ratio (SPR) of 30% as the benchmark for defining the MSST and maximum fishing mortality threshold (MFMT), the assessment results indicated that Vermilion Snapper in the Gulf is not overfished nor undergoing overfishing (Figure 1). In 2017, the stock was being harvested at 56% of MFMT, SSB was 350% of MSST and 175% of $SSB_{SPR30\%}$ with a terminal year depletion level (SSB_{2017}/SSB_0) of 52% (Table 1). The Kobe plot (Figure 1) illustrates that over the course of the years included in the assessment (i.e., 1950 - 2017), overfishing occurred from

1992 - 2004; however, over the last decade, overfishing has not occurred and the stock has not been overfished. After the intense fishing pressure of the late 1980s and early 1990s, SSB showed declines below $SSB_{SPR30\%}$ from 1998 to 2005, but never declined below the MSST. With the recent (2007 - 2017) declines in fishing mortality, strong recruitment events, and the subsequent increases in SSB, Vermilion Snapper appears to be healthy and capable of supporting increased yield over the near term.

Table 1: Summary of Magnuson-Stevens Reauthorization Act benchmarks and reference points for SEDAR 67. SSB is in billions of eggs, whereas F is a harvest rate (total numbers killed / total exploitable numbers [age 1+]).

Reference Point Criteria		**Current Benchmarks**	
Base natural mortality (M)	0.25	SSB_{2017}	352,682
Steepness	0.713	$F_{Current}$(geom. mean: 2015 – 2017)	0.075
Generation Time	7.23	SSB_{2017} / SSB_0 (SPR_{2017})	0.52
SSB_0 (Unfished)	672,597	SSB_{2017} / $SSB_{SPR30\%}$	1.75
Target SSB = $SSB_{SPR30\%}$	201,747	SSB_{2017} / MSST	3.5
MSST=0.5*$SSB_{SPR30\%}$	100,874	--MSST Overfished?	No
F_{MSY}	Not Estimable	$F_{Current}$ / MFMT	0.56
MFMT = $F_{SPR30\%}$	0.135	--Overfishing?	No
F_{OY} (F at optimum yield)	0.115		

Scientific and Statistical Committee (SSC)

The SEDAR 67 stock assessment and projections are scheduled to be reviewed by the SSC on June 1, 2020.

Socioeconomic and Ecosystem Considerations

Although no socioeconomic or ecosystem considerations were incorporated into SEDAR 67, information on Gulf Vermilion Snapper was collected from anglers via the Gulf of Mexico Fishery Management Council's Something's Fishy tool. This tool facilitates input from stakeholders into the stock assessment process by querying those stakeholders about a particular species ahead of its assessment. Responses (n=63) were received between November 1 and December 14, 2019. A majority of respondents (73%, n=46) identified as private anglers whose observations were made off the coast of the Florida panhandle, Alabama, and eastern Texas. Responses were analyzed manually and using automated sentiment analysis to determine if they indicated positive, negative, or neutral trends in the Gulf Vermilion Snapper stock.

Manual (reader-validated) and automated (performed in R) sentiment analysis produced similar results, with both indicating a positive trend in the perception of stock abundance (60% of responses, n=38). Anglers noted that the stock has been continuously healthy for years and may be "healthier than ever". Anglers also observed larger Vermilion Snapper in deep waters, and that Vermilion Snapper are moving into shallower waters than then have been historically. Anglers that indicated negative trends in abundance (29%, n=18) speculated that Vermilion Snapper are being outcompeted by Gray Triggerfish and Red Snapper. They also noted that juveniles are being found in Lionfish stomachs, and that dolphin depredation is especially prevalent. Fishing effort may be shifting to Vermilion Snapper because of unhealthy perceptions of grouper stocks, short seasons for other species, and increased commercial pressure. Anglers also postulated that Vermilion Snapper have been displaced from traditional habitats by red tide and the *Deepwater Horizon* oil spill.

Projections

The retained yield and associated depletion were projected under the assumption that all recent fishery dynamics would continue indefinitely (e.g., relative fishing effort, selectivity and retention) and that recruitment would remain constant at the mean value from 2005-2014 (~22 million fish). Forecasts were carried out at the F_{MSY} proxy ($F_{SPR30\%}$) in order to determine the overfishing limits (OFLs). Forecasts begin in 2021, because the 2018 and 2019 fishing years are already completed and annual catch limits (ACLs) have already been set for 2020. Since the stock is currently above the SPR 30% target, forecasts indicate that a declining yield stream is possible in the near-term in order to fish the stock down towards the target SPR (Figure 2). An OY (yield resulting from fishing at 75% of $F_{SPR30\%}$) projection was also completed. The trends obtained from the OY projection are the same as the F_{MSY} run, but result in a relatively higher SPR (35%) with slightly lower annual yield (Figure 2).

Forecasted yields had unrealistically small uncertainty estimates due to a combination of fixed inputs (e.g., natural mortality, length-weight relationship, growth, etc.) and a small stock recruitment variance term (σ_R = 0.3). Consequently, application of the P* approach failed to establish an adequate buffer between the OFL and acceptable biological catch (ABC). Therefore, assessment uncertainty for SEDAR 67 may be better accounted for by using OY as the basis for the ABC instead of the P* approach. In addition, using the 10-year average OY (6.42 million pounds) would provide consistent management for the fishery and ensure that the ABC is less than the OFL through the completion of the 2025 fishing season.

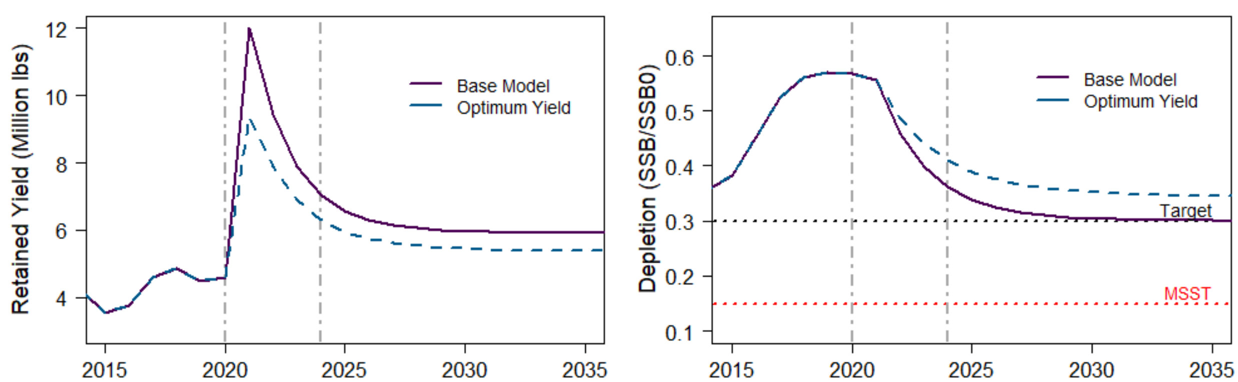

Figure 2: Retained Yield (left panel) and resulting Depletion (right panel) for projections fishing at $F_{SPR30\%}$ (Base Model) and at 75% of this level (OY). All scenarios assume recent average recruitment (2005-2014), and reference points are marked with horizontal dotted lines.

Data and Assessment

The assessment model used was Stock Synthesis version 3.30.14. Removal data used in the model include landings and discards for two commercial fishing fleets (east and west vertical line) and one combined (Marine Recreational Information Program [MRIP] and Southeast Region Headboat Survey [SRHS]) recreational fishing fleet. Bycatch removals from the Gulf shrimp fleet were also included. Fishery-dependent indices of relative abundance were included for the eastern and western Gulf commercial vertical line fleets (truncated in 2007 due to the implementation of the Red Snapper individual fishing quota program), the recreational charter-private fishery in the eastern Gulf, and the recreational headboat fisheries in the eastern and western Gulf (Figure 3, left panel). The combined video survey and the Southeast Area Monitoring and Assessment Program (SEAMAP) summer groundfish survey were included as fishery-independent indices of relative abundance (Figure 3, right panel). A larval survey was included and modeled as an index of SSB (Figure 3, right panel). Taken collectively, the indices broadly support the assessment's conclusion of increased abundance over the last decade. Age composition data were used to estimate selectivity in the directed fleets, while length composition data were used to estimate selectivity for the fishery-independent surveys. Length composition data for the discards were inadequate for modeling purposes, so retention functions were assumed to be knife-edged at the fleet and regulation-specific minimum size limits.

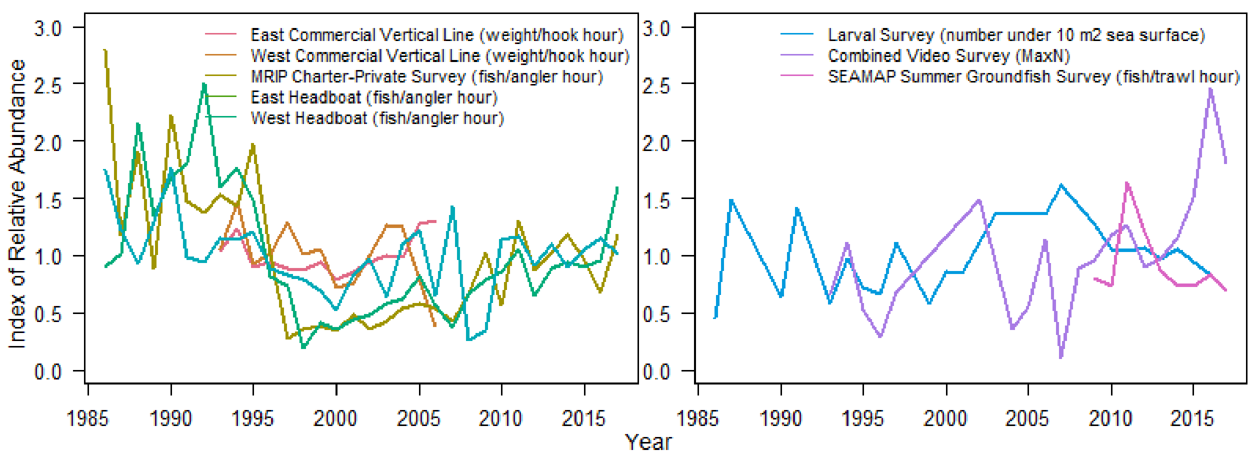

Figure 3: Vermilion Snapper observed indices from SEDAR 67 by fishery (left panel) and survey (right panel), 1986-2017.

Life history equations and parameters used in SEDAR 67 are reported in Table 2. A fixed length-weight relationship was used to convert body length (cm) to body weight (kg). Growth was modeled externally using a single size-modified von Bertalanffy growth curve for both sexes combined, which considers the non-random sampling due to minimum size restrictions. An age-specific vector of M was obtained using the Lorenzen estimator and a target M of 0.25 $year^{-1}$. Total fecundity-at-age was modeled as a function of proportion mature, batch fecundity, and number of batches per year. The SSB was defined as the number of eggs. The Beverton-Holt stock-recruitment model was used in this assessment with steepness (the fraction of virgin recruits produced at 20% of the equilibrium SSB) and virgin recruitment estimated.

Table 2: Overview of life history equations and recommended parameters used in SEDAR 67. All lengths and weights were reported in fork length (FL) and whole weight (ww), respectively.

Definition	Equation	Parameters
Total to Fork	$FL = a + b * TL_{max}$	a= 1.98 cm , b= 0.8876
Length to Weight	$W(t) = a * L(t)^b$	a= 2.66E-08 kg*cm^{-b} , b= 2.916
Age to Length	$L(t)=L_{inf}*[1-e^{-K(t-t0)}]$	L_{inf}= 34.4 cm , K= 0.3254 yr^{-1} , t_0= -0.7953 yr
Base M	Expert Opinion (see SEDAR 9)	M= 0.25
Maturity	$Pmat = \frac{1}{1 + e^{Slope*(Length - Length_{50\%})}}$	Slope = -0.574 , $Length_{50\%}$ = 14.087
Annual Fecundity	$BF(t) = a * L(t)^b$	a= 2.79E+02 eggs*cm^{-3*b} , b= 3.042
Recruitment	$R_{yr}=[4hR_0SSB_{yr}]*[SSB_0(1-h)+SSB_{yr}(5h-1)]^{-1}$	h= 0.713 , R_0= 27.32 million recruits

Recruitment

With the recruit variance term fixed at 0.3, the steepness was estimated to be 0.713 and virgin recruitment was estimated at 27.32 million fish. Since the mid-1990s (when recruitment deviations were estimated), recruitment has fluctuated between 13.69 and 52.72 million fish with no consistent trend (Figure 4). Recruitments since 2010 have been generally above average with an exceptionally strong year class estimated in 2015 (52.72 million fish), followed by the second highest recruitment class in the time series in 2016 (34.13 million fish). The terminal year recruitment (2017) was estimated to be slightly below average (19.9 million fish).

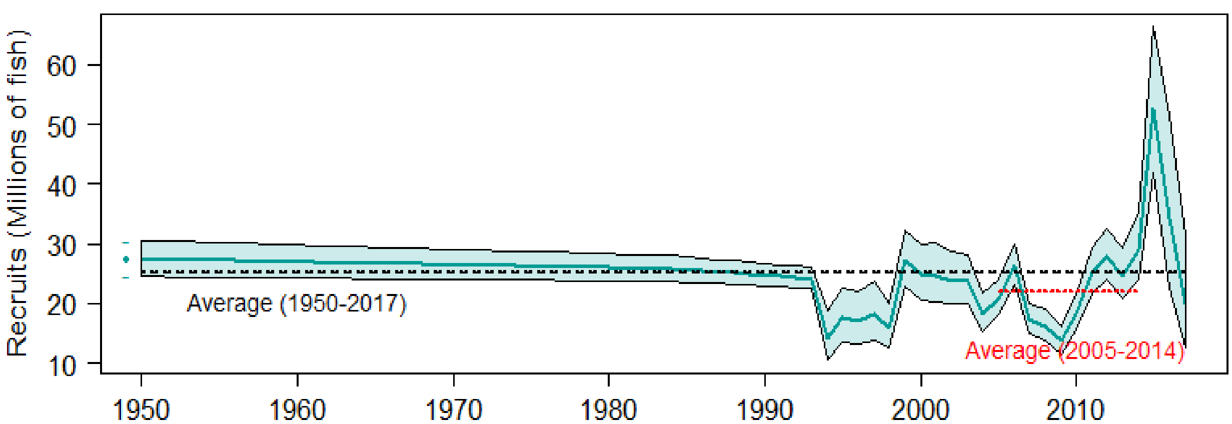

Figure 4: Estimated recruitment (millions of fish) for Gulf Vermilion Snapper with 95% asymptotic confidence intervals (shaded region). Thin dashed lines represent average recruitment during the entire time series (upper line) and the period used for projections (2005-2014; lower line).

Landings

Commercial landings of Vermilion Snapper from 1950 through 2017 were obtained from the Accumulated Landings System. Commercial landings after 1993 were adjusted by self-reported logbook data to apportion annual state landings by gear type (longline, vertical line, trap, or other) and area. Estimates of Vermilion Snapper commercial landings averaged 2.03 million pounds [mp] ww from 1950 to 2017, with a low of 1.37 mp ww in 2015, and a peak of 3.69 mp ww in 2009 (Figure 5). [See Tables 4 and 5 of the SAR for observed commercial landings used in the assessment.]

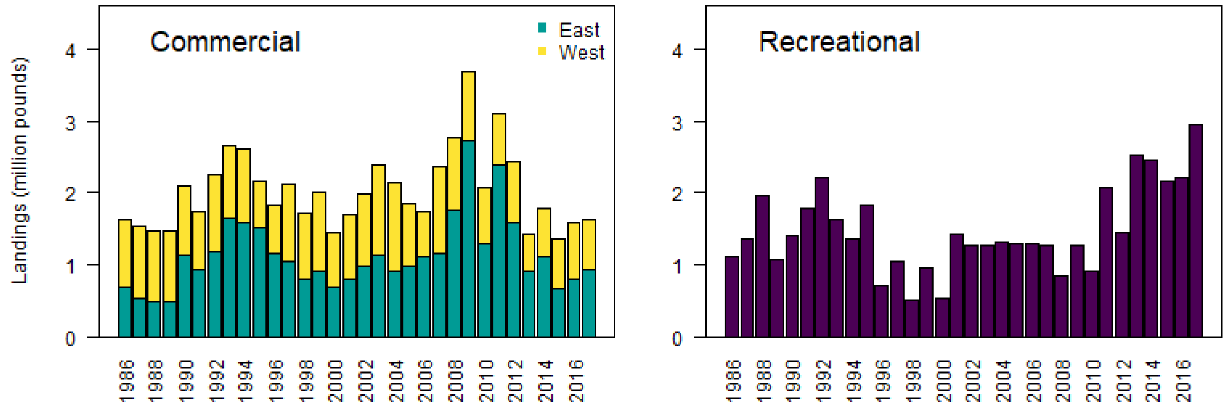

Figure 5: Final Vermilion Snapper landings estimates from SEDAR 67 for commercial and recreational fisheries in millions of pounds, 1986-2017.

Recreational landings of Vermilion Snapper were obtained from MRIP, adjusted for the Access Point Angler Intercept Survey (APAIS), and the SRHS. Estimates of recreational fishing effort came from the MRIP Fishing Effort Survey (FES; which replaced the Coastal Household Telephone Survey [CHTS]), and the SRHS. A charter calibration analysis was conducted by the Southeast Fisheries Science Center on the newly released MRIP data to correct for the change from the CHTS to the For-Hire Telephone Survey. Recreational landings derived from MRIP were comprised of Vermilion Snapper landed whole and observed by interviewers ("Type A") and Vermilion Snapper reported as killed by fishers ("Type B1"). Estimates of Vermilion Snapper recreational landings averaged 1.48 mp ww from 1950 to 2017, with a low of 0.51 mp ww in 1998 and a peak of 2.96 mp ww in 2017. [See Table 6 of the SAR for observed recreational landings used in the assessment.]

Discards

Commercial discards of Vermilion Snapper were estimated beginning in 1993 using a catch-per-unit-effort expansion approach that used the coastal observer program (2007-2017) in conjunction with total fishing effort from the commercial reef fish logbook program (1993-2017). Commercial discards were low until the implementation of the 11-inch minimum size limit in 2005 and have been generally decreasing since that time (Figure 6). Recreational discards were derived from MRIP estimates of live released fish (B2) between 1982 and 2017, and self-reported discards in the SRHS logbooks since 2004. Vermilion Snapper discards from headboats for years prior to 2004 in Florida were estimated using the MRIP Charter:SRHS discard ratio as a proxy. Three management changes to the recreational Gulf Vermilion Snapper fishery impacted the discard rate: (1) the minimum size limit was increased in 1998 from 8 inches to 10 inches total length (TL), (2) the minimum size limit was subsequently increased in 2005 to 11 inches TL, and (3) the minimum size limit was again reduced in 2008 to 10 inches TL. The overall magnitude of recreational discards relative to landings was generally small, but did have some strong peaks (greater than 20% of landings) in the mid-1990s and since the late

2000s (see Table 8 of the SAR). Discards have been increasing rapidly in recent years in conjunction with the precipitous rise in recreational landings since around 2005 (Figure 6). For all fleets and all years, the discard mortality rate was assumed to be 15.0%.

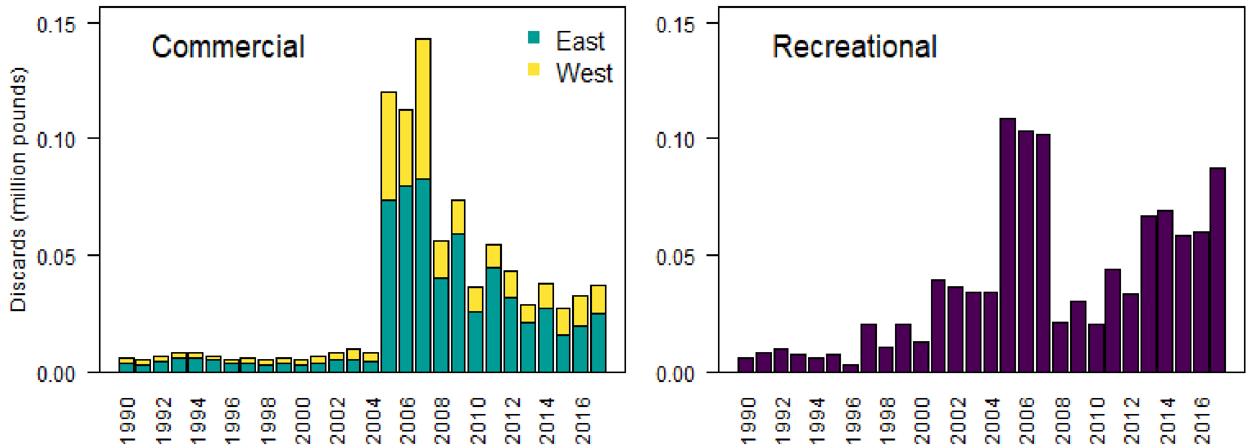

Figure 6: Final Vermilion Snapper discard estimates from SEDAR 67 for commercial (left panel, by fleet) and recreational (right panel) fisheries in millions of pounds, 1990-2017.

Due to modeling issues that developed when trying to fit the observed discards, the SEDAR 67 panel determined that the discard data should not be fit directly. As a result, the predicted discards were calculated based on estimated landings and retention functions and were not constrained to fit the observed discards (see Section 3.1.9 of the SAR for more information on the discard modeling approach). While not ideal, this compromise allowed for removals due to regulatory discards to be accounted for in the model without compromising the fit to the other (more reliable) sources of data (e.g., landings, indices of abundance).