Revised forecasts for vermilion rockfish and sunset rockfish in U.S. waters off California

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For management purposes, a combined stock for vermilion rockfish (*Sebastes miniatus*) and sunset rockfish (*S. crocotulus*) was recently defined for U.S. waters off California. The most recent stock assessments modeled the population dynamics in California separately for areas north and south of Point Conception, roughly 34° 27′ North latitude (Monk et al. 2021, Dick et al. 2021). This document provides revised forecasts based application of the default 40-10 harvest control rule at the statewide stock level. Buffers between the overfishing limit (OFL) and acceptable biological catch (ABC) were calculated using a "P-star" value of 0.45. Since the assessments for the northern and southern areas were assigned categories of 1 and 2, respectively, a weighted "sigma" value (σ_w) for the statewide stock was calculated as

$$\sigma_w = \frac{OFL_{North}\sigma_{North} + OFL_{South}\sigma_{South}}{OFL_{North} + OFL_{South}} \cong 0.754$$

where the area-specific OFLs were from 2023, the first year that management was based on the 2021 stock assessments. Sigma values for the north and south were 0.5 and 1.0, respectively. In each modeled area, catches were allocated among fleets based the Groundfish Management Team's advice for the 2021 assessments. Recreational catches were modeled in numbers and required the use of a numerical solver at each iteration, for each of the two California models, ensuring that catch in numbers accurately reflected the allocations of catch in weight.

Annual estimates of yield, spawning output, and relative spawning output for the statewide stock definition are provided in Table 1. Since vermilion and sunset rockfishes are managed as part of the shelf rockfish complex, estimates of yield are required for areas north and south of 40° 10′ North latitude (near Cape Mendocino). As in the 2021 assessment, an allocation of 4.4% of the northern area model's harvest projection was used for California's annual catch limit (ACL) and OFL contribution to the northern part of the shelf rockfish complex (Tables 2 and 3). These projections assume that statewide ACL removals are allocated proportional to the area-specific OFL estimates.

Literature cited:

Dick, E.J., M.H. Monk, T.L. Rogers, J.C. Field, E.M. Saas. 2021. The status of Vermilion Rockfish (*Sebastes miniatus*) and Sunset Rockfish (*Sebastes crocotulus*) in U.S. waters off the coast of California south of Point Conception in 2021. Pacific Fisheries Management Council, Portland, Oregon. 317 p.

Monk, M.H., E.J. Dick, J.C. Field, E.M. Saas, T.L. Rogers. 2021. The status of Vermilion Rockfish (*Sebastes miniatus*) and Sunset Rockfish (*Sebastes crocotulus*) in U.S. waters off the coast of California north of Point Conception in 2021. Pacific Fisheries Management Council, Portland, Oregon. 230 p.

Table 1. Annual projections of OFL, ABC, ACL, spawning output, and spawning output relative to unfished levels for the California stock of vermilion and sunset rockfishes. Since stock status is above 40%, ABC=ACL.

Year	Statewide OFL	Buffer	Statewide ABC=ACL	Statewide Spawning Output	Spawning Output Relative to Unfished Spawning Output
2023	313.6	0.903	283.2	974.2	45.9%
2024	315.2	0.897	282.8	1000.3	47.1%
2025	315.2	0.890	280.5	1021.9	48.1%
2026	314.1	0.884	277.6	1037.8	48.9%
2027	312.3	0.878	274.2	1048.5	49.4%
2028	310.2	0.872	270.5	1054.9	49.7%
2029	308.2	0.865	266.6	1058.2	49.8%
2030	306.4	0.859	263.2	1059.3	49.9%
2031	304.9	0.853	260.1	1059.0	49.9%
2032	303.7	0.847	257.2	1057.9	49.8%

Table 2. Area-specific annual harvest contributions from each assessment model, assumed removals (ABC=ACL), and spawning output used to calculate statewide estimates for the California stock.

Year	No. CA OFL Contribution	So. CA OFL Contribution	No. CA ABC Contribution	So. CA ABC Contribution	Assumed No. CA Removals	Assumed So. CA Removals	No. CA Spawning Output	So. CA Spawning Output	No. CA Relative Spawning Output	So. CA Relative Spawning Output
2023	154.3	159.4	139.3	143.9	139.3	143.9	497.2	477.0	43.4%	48.8%
2024	157.6	157.6	141.4	141.4	141.4	141.4	515.9	484.4	45.0%	49.5%
2025	159.0	156.2	141.5	139.0	141.5	139.0	532.3	489.6	46.5%	50.1%
2026	159.1	155.0	140.6	137.0	140.6	137.0	545.5	492.3	47.6%	50.3%
2027	158.4	153.9	139.1	135.1	139.1	135.1	555.5	492.9	48.5%	50.4%
2028	157.3	152.9	137.2	133.3	137.2	133.3	562.8	492.1	49.1%	50.3%
2029	156.1	152.0	135.0	131.5	135.0	131.5	568.0	490.2	49.6%	50.1%
2030	155.1	151.3	133.2	130.0	133.2	130.0	571.5	487.8	49.9%	49.9%
2031	154.1	150.7	131.5	128.6	131.5	128.6	573.8	485.2	50.1%	49.6%
2032	153.4	150.3	130.0	127.3	130.0	127.3	575.3	482.6	50.2%	49.3%

Table 3. Annual projections of OFL and ACL contributions from California vermilion rockfish to the northern and southern shelf rockfish complexes. Contributions to the northern complex are based on 4.4% of the yield from the northern assessment model. Contributions to the southern complex are the remainder (95.6%) of the northern model yields plus the southern model yields. Since the California stock status is above 40% in all years, ABC=ACL.

Year	OFL N. of Cape Mendocino	OFL S. of Cape Mendocino	ACL N. of Cape Mendocino	ACL S. of Cape Mendocino
2023	6.8	306.9	6.1	277.1
2024	6.9	308.3	6.2	276.5
2025	7.0	308.2	6.2	274.3
2026	7.0	307.1	6.2	271.5
2027	7.0	305.3	6.1	268.0
2028	6.9	303.3	6.0	264.4
2029	6.9	301.2	5.9	260.6
2030	6.8	299.6	5.9	257.3
2031	6.8	298.0	5.8	254.3
2032	6.7	297.0	5.7	251.5

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