Mean Annual Discharge and Steelhead

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Function Updated by leah.egeryhaley on Tue, 06/23/2026 - 18:38.

Species Information

Common Name: Steelhead
Genus: Oncorhynchus mykiss irideus

Stressor Details

Stressor Name: Flow
Units: %
Metric: Mean Annual Discharge (MAD)
Scale: linear
Function Type: continuous
Vital Rate/Process: Over-summer survival

Life Stage & Context

Life Stages: Juvenile
Geography: Maacama Creek, Mark West Creek, Santa Rosa Creek, Green Valley Creek. California, USA
Season: Summer

Descriptions

Overview

Final curve was derived from a linear regression.

System capacity was derived from oversummer survival with data spanning years 1994-2002. The original data points represent 50-55 sites yielding 523 observations where oversummer surviva. Survival was estimated by sampling twice, in midsummer and late summer through repeated census counts using pole seins and blocking nets were used until no fish were captured (typically 3-5 passes) which were then sorted as species then counted.
To normalize and rescale each ecological response, each value was scaled by the maximum ecological response observed in the study such that mean habitat capacity percentage (normalized response) = response / maximum ecological response observed.
Note: Only used 75th percentile data in overall analysis because 10th percentile flows are extremely small. SR function represents medium catchments.
Implicit pathway of effect: Oversummer survival of juvenile steelhead increases with higher summer discharge

Function Derivation

Observational data. Final curve was derived from linear regression.

Transferability of Function

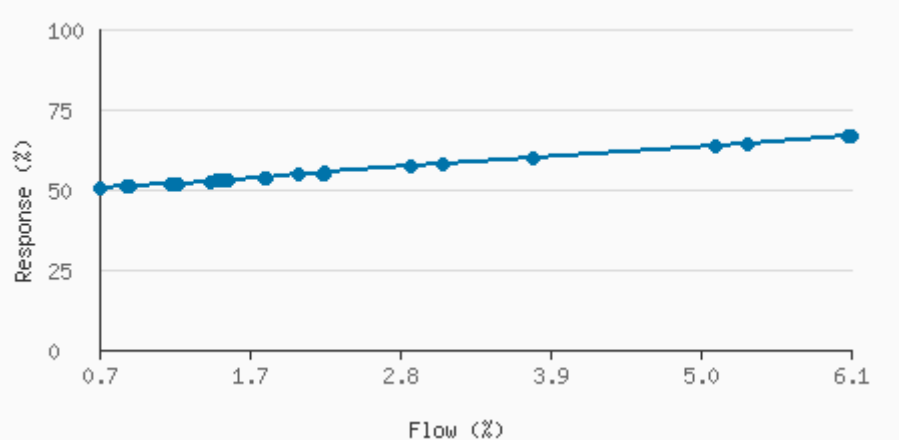
Appropriate for summer stream flow impacts on over-summer survival of juvenile steelhead. General transferability to other salmon stocks in unclear, but likely appropriate for other spring-spawning salmonids (i.e., regions with similar hydrology to the Maacama Creek, Mark West Creek, Santa Rosa Creek, Green Valley Creek system).
The relationship may be unreliable if extrapolated to a flow range outside the original data (see the Average Salmonid flow-ecology SR function entry based on Rosenfeld and Enright (2025) for a more generalizable function across a wider range of flows).

Note: This entry reflects only the subset including medium catchments (40-90 sqkm), see other entries for other catchment sizes.

Source of Stressor Data

> The summer streamflow data (discharge) for each reach during the 9 years of sampling was estimated by the original authors (Grantham et al. 2012) based off a rain-fall run-off regression model based off of daily rainfall records. Data was sourced from the U.S. Geological Survey. Estimates was scaled by reach area. Estimates were later validated with measured flows at all sites with at least 12 measurements. See Grantham et al. 2012 for further details.
> Data was then standardized by dividing absolute flow by MAD to achieve %MAD values (see Rosenfeld & Enright 2024). Such standardization allows for comparison of flow metrics across a wide range of stream sizes (see Rosenfeld et al. 2017).

Stressor Response Data



?PERCENT_MAD	Mean System Capacity (%)	SD	low.limit	up.limit
0.6601	50.043305	0	0	100
0.6631	50.052455	0	0	100
0.66987	50.0731035	0	0	100
0.85964	50.651902	0	0	100
0.86415	50.6656575	0	0	100
0.86663	50.6732215	0	0	100
0.86666	50.673313	0	0	100
0.87754	50.706497	0	0	100
0.88402	50.726261	0	0	100
1.17291	51.6073755	0	0	100
1.18126	51.632843	0	0	100
1.18134	51.633087	0	0	100
1.18268	51.637174	0	0	100
1.18697	51.6502585	0	0	100
1.23652	51.801386	0	0	100
1.45809	52.4771745	0	0	100
1.50269	52.6132045	0	0	100
1.50298	52.614089	0	0	100
1.51016	52.635988	0	0	100
1.51021	52.6361405	0	0	100
1.51662	52.655691	0	0	100

1.57039	52.8196895	0	0	100
1.5719	52.824295	0	0	100
1.57312	52.828016	0	0	100
1.58179	52.8544595	0	0	100
1.59	52.8795	0	0	100
1.85929	53.7008345	0	0	100
1.86198	53.709039	0	0	100
1.86456	53.716908	0	0	100
2.09807	54.4291135	0	0	100
2.10072	54.437196	0	0	100
2.10146	54.439453	0	0	100
2.10238	54.442259	0	0	100
2.10317	54.4446685	0	0	100
2.2719	54.959295	0	0	100
2.27529	54.9696345	0	0	100
2.27551	54.9703055	0	0	100
2.28156	54.988758	0	0	100
2.28408	54.996444	0	0	100
2.28562	55.001141	0	0	100
2.2909	55.017245	0	0	100
2.91219	56.9121795	0	0	100
2.91456	56.919408	0	0	100
2.91459	56.9194995	0	0	100
2.91576	56.923068	0	0	100
3.14616	57.625788	0	0	100
3.14741	57.6296005	0	0	100
3.15263	57.6455215	0	0	100
3.15278	57.645979	0	0	100
3.79367	59.6006935	0	0	100
3.79446	59.603103	0	0	100
3.79593	59.6075865	0	0	100
5.11091	63.6182755	0	0	100
5.1153	63.631665	0	0	100
5.11649	63.6352945	0	0	100
5.11654	63.635447	0	0	100
5.34772	64.340546	0	0	100
5.34893	64.3442365	0	0	100
5.34915	64.3449075	0	0	100
5.35076	64.349818	0	0	100
5.35363	64.3585715	0	0	100
6.0774	66.56607	0	0	100
6.0808	66.57644	0	0	100

6.08455	66.5878775	0	0	100
6.0877	66.597485	0	0	100
6.08791	66.5981255	0	0	100
6.08823	66.5991015	0	0	100
6.09181	66.6100205	0	0	100
6.09193	66.6103865	0	0	100
6.09551	66.6213055	0	0	100

Citations

Grantham, T.E., Newburn, D.A., McCarthy, M.A., and Merenlender, A.M. 2012. The role of streamflow and land use in limiting oversummer survival of juvenile steelhead in California streams. Trans. Am. Fish. Soc. 141:585-598.