Salmon Management Review

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Salmon Management Review

Identifying the cause of the observed decline in spawning salmon is needed to make an informed management decision in addressing it. After reviewing scientific literature, historic reports, and graphing environmental data against salmon returns, there is strong evidence to suggest that ocean conditions are the lead cause of fluctuations in the salmon fishery.

Sea Surface Temperature

Ocean conditions, in particular sea temperature, have been identified as greatly influencing salmon survival (Northwest Fisheries Science Center, 2023). Although the elevated water temperatures are not favourable for salmon directly, it is the collapse in food availability as sea temperature increases that reduces survival rates (Hertz, et al., 2016).

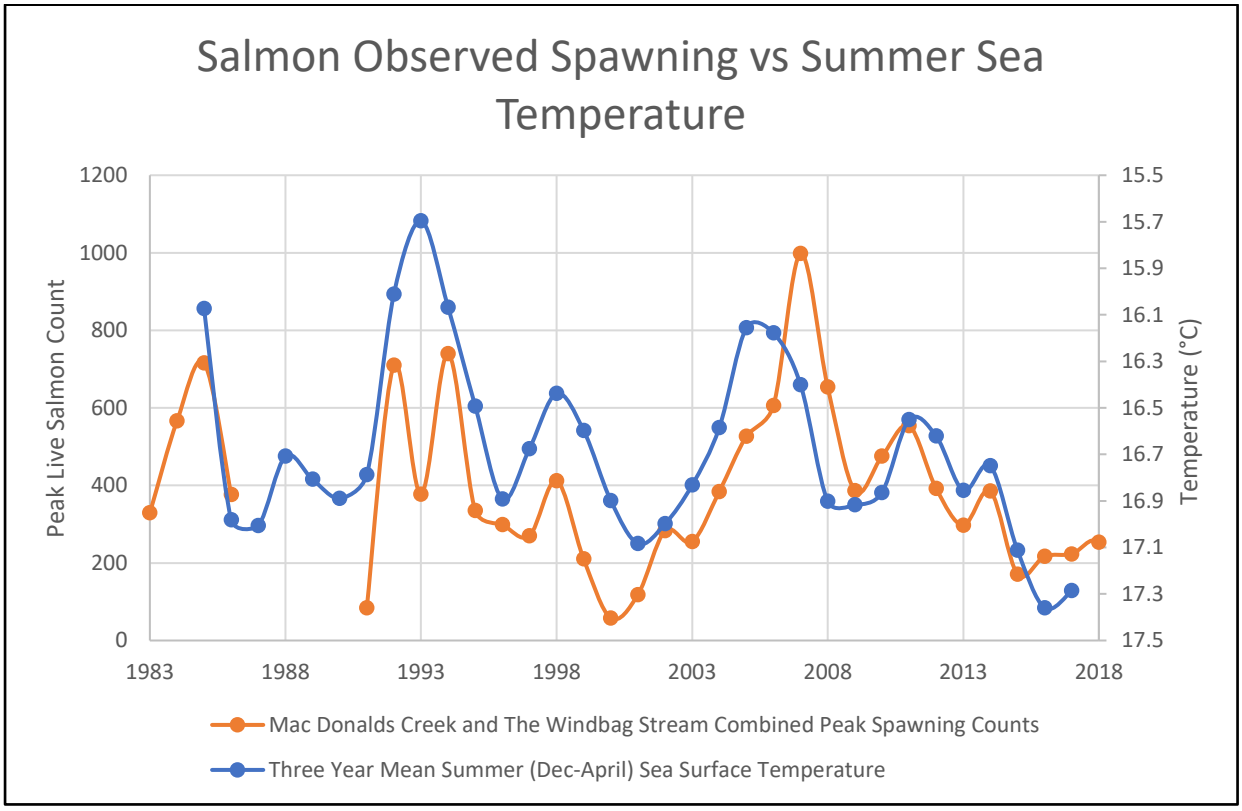

Figure one: Salmon returns vs three-year mean summer (December – April) sea surface temperature of the West Coast 1983 - 2018.

Above are the peak spawning counts for MacDonald Creek and The Windbag stream combined graphed alongside the mean three-year Summer (December – April) sea surface temperature off the West Coast between 1983 and 2018. Annual mean sea surface temperature also mirrored salmon returns but when reviewing the data, focusing on the warmest months through the summer best explained peaks and troughs – indicating this period has the biggest influence on the West Coast salmon population. When other significant variables that would contribute to inconsistencies in the relationship are factored in, such as recruitment success, a good portion of variation in salmon returns can be explained.

Food Availability

National Institute of Water & Atmospheric Research (NIWA) report *Satellite indicators of phytoplankton and ocean surface temperature for New Zealand* identified that off the West Coast, there were negative anomalies of phytoplankton between 1997–2003 and 2012–2018, and positive anomalies of phytoplankton between 2003–2012 (Pinkerton, Sutton, & Wood, 2019). The anomalies of phytoplankton are consistent with West Coast salmon returns.

Furthermore, the marine heat wave during December 2017 and January 2018 was reported to cause strong negative anomalies in chlorophyll-a (indicator of phytoplankton biomass) along the West Coast (Pinkerton, Sutton, & Wood, 2019). This supports that food is the limiting factor during elevated sea temperatures as *"phytoplankton are the foundation of the aquatic food web."* (Lindsey & Scott, 2023).

El Niño Southern Oscillation

The El Niño Southern Oscillation (ENSO), is the change in trade winds resulting in warm water either being pushed towards or away from New Zealand. Off the West Coast, during La Nina events, elevated sea temperatures typically occur, and during periods of El Nino conditions cooler sea temperatures are common. A large portion of variation in sea temperature off the West Coast can be linked to this natural occurring global climate cycle. With limited sea surface temperature and phytoplankton data available for recent years, the Southern Oscillation Index provides a suitable alternative.

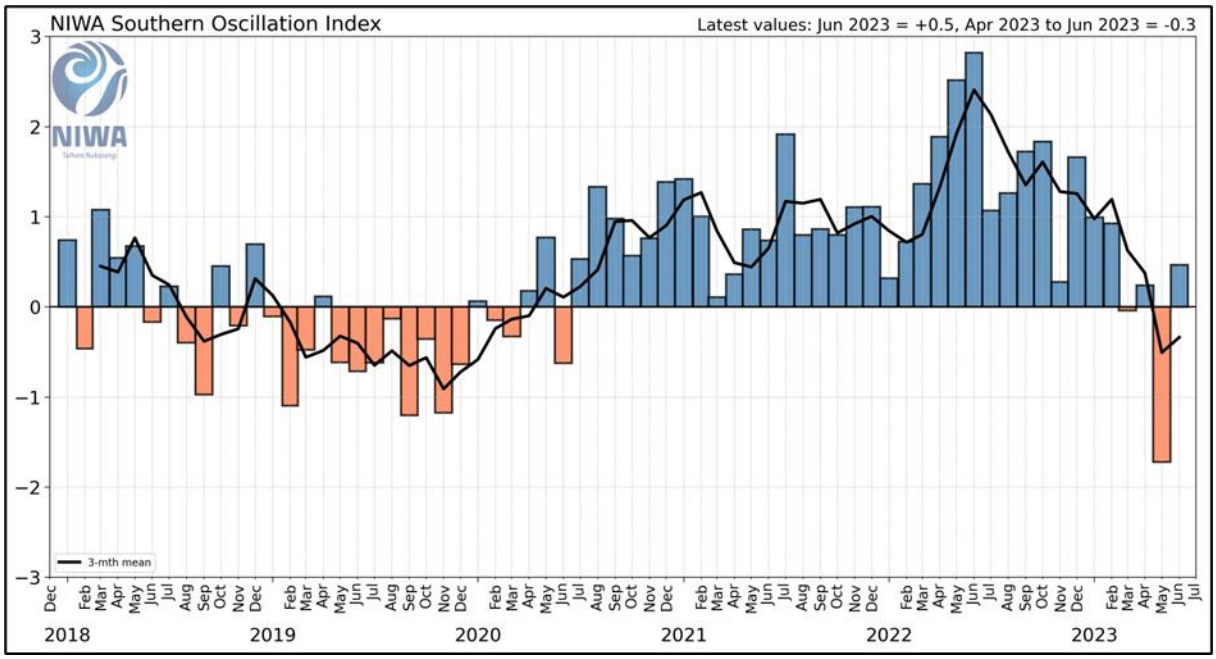

Figure two: The Southern Oscillation Index (SOI) quantifies this pressure difference. Over a period of three months or more, values below -1.0 correspond to El Niño conditions while values above 1.0 correspond to La Niña conditions. Values between -0.5 and -1.0 lean toward El Niño, while values between 0.5 and 1.0 lean toward La Niña. Values between -0.5 and 0.5 are considered neutral. (NIWA, 2023).

Since May 2020 until March 2023, we have experienced strong La Nina conditions and this observation explains why our last above average salmon return was during the 2019/20 season. How was this reflected in sea temperature? NIWA recorded the highest ever monthly sea-surface temperature anomaly observed since records began in 1982 of +3.15°C off the West Coast during

January 2023 (NIWA, 2023). Historically over periods of stable conditions (neither La Niña or El Niño), but espically during El Niños, we have observed an increase in West Coast salmon returns, reflecting the cooler sea temperatures and the increased productivity.

State of the Salmon Fishery

We are predicted to experience favourable El Niño conditions during the 2023/24 summer so this should aid in salmon stocks recovering. If another significant La Nina period is predicted before stocks recover, it would be recommended that the Council close the fishery. Although the lake resident fish are not directly impacted by sea conditions, they are affected by the warm lake conditions a La Nina summer often brings. Catch and release survival reduces in such conditions, therefore a reduction in angling activity will improve lake residents' survival.

The closure of next year was considered greatly but the following key points provided rationale for waiting and reassessing following next year's spawning counts:

- This is the first year with incredibly low returns.
- Improved sea conditions are predicted (NIWA, 2023).
- The 2021 and 2022 salmon run were a sufficient breeding population (Tonkin, 2000).
- Diminishing angling effort and harvest proportional to salmon returns.
- Closure of Southern Lakes Conservancy to salmon fishing between 1970 and 1991 achieved "no overall difference to the average size of the spawning runs" (Tonkin, 2000; Hutchinson, 1980).
- The fishery's current state is induced by unfavourable sea conditions, not harvest.
- Maximising opportunity for licence holders in the event salmon numbers bounce back readily.

The West Coast Fish and Game Council has already taken proactive steps towards protecting the salmon fishery. This was achieved in 2021 by increasing the minimum size for salmon in South Westland lakes to 450mm. The lake resident salmon provide a buffer for bad sea run salmon years especially when sea conditions are unfavourable. To aid in the recovery, it is important staff prioritise protecting the juvenile salmon by doing additional compliance whilst encouraging good ethics and catch and release practices.

Enhancement of the Fishery

A natural response to speed up the recovery of a fishery is to supplement the remaining stock with additional fish. The introduction of genetically different salmon can prevent the wild salmon population from adapting to their local conditions (Holmes, 2018). To reduce these negative impacts and comply with the Fish & Game *National Policy: Commercial Origin Salmon Release,* salmon released would have to be genetically similar to the South Westland salmon and be first generation wild stock (Fish & Game, 2023). From mark and recapture work completed in Lake Paringa between 1969-89 over the period which 606,072 salmon smolt were released, it was concluded that only 0.08% of the salmon ever returned (Tonkin, 2000). The cost of releasing salmon that comply with the policy would be a minimum of $3.00 per salmon smolt, considering previous survival rates of 0.08%, it would therefore cost a minimum $3,750 per adult returning salmon. This cost makes it not financially viable in addition to intervention likely not being beneficial to the wild population.

Staff Recommendation:

- Conduct additional compliance and education in South Westland with a focus of protecting juvenile salmon.
- No changes to salmon regulations.

References

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