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Research Question

How have **Individual Transferable Quotas (ITQs)** impacted fishing effort and economic sustainability in BC's commercial salmon troll fishery?



Data

- Uses **Pacific Region Commercial Salmon Fishery Post-Season Catch Estimates** from Fisheries and Oceans Canada (DFO).
- Covers **2005–2023**, allowing for long-term analysis of changes in the fishery.

- Data includes:
 - **Catch records** (fish kept and fish released).
 - **Fishing effort** (number of boats, fishing days).
 - **ITQ policy data** (where and when quotas were introduced).

Methodology

I use a **Difference-in-Differences (DiD)** method to estimate the effect treatment effect of ITQs. The DiD model is structured as follows:

$$y_{it} = \beta_0 + \beta_1 ITQ_{it} + \gamma X_{it} + \alpha_i + \lambda_t + \varepsilon_{it}$$

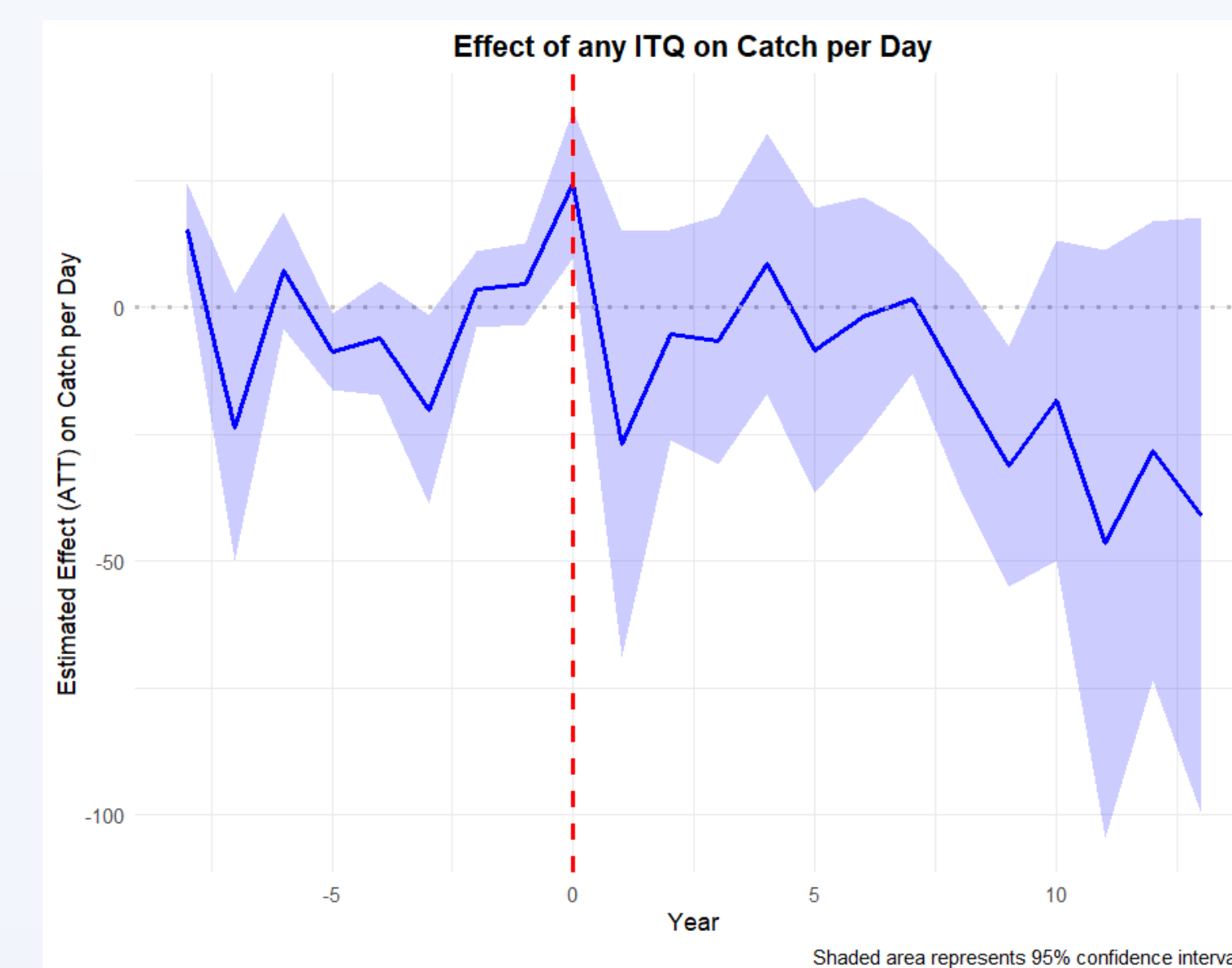
- α_i = management area fixed effects
- λ_t = time fixed effects

Additionally, I employ a Two-Way Fixed Effects Counterfactual model which improves on DiD by creating better comparisons between treated and untreated areas. Instead of assuming all areas respond to ITQs the same way, FECT predicts what would have happened without ITQs and compares it to actual outcomes.

Results

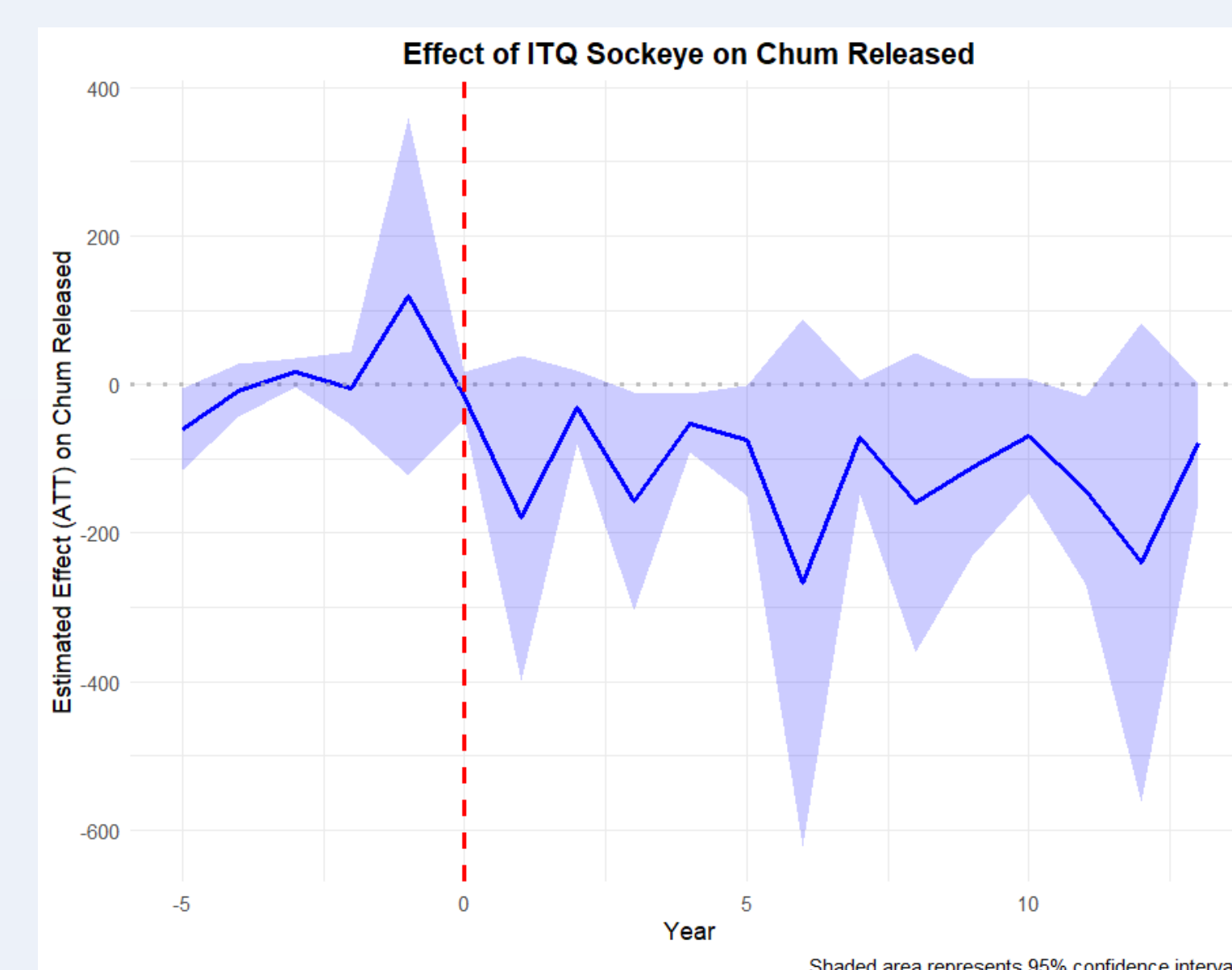
Effort and Season Length: Limited Impact

- ITQs have not significantly extended the fishing season, contrary to expectations.
- Boat days remains unchanged, meaning fishers have not spend more time fishing.
- **Catch per day (CPD) decreased by 37.66%** per year, suggesting that fishing effort was spread more evenly across the fishing season.
- Estimated impact: approximately 520 fewer fish caught per day across the troll fishery. With an average of 175 boat days per year, this comes out too 91,000 less fish caught per year.



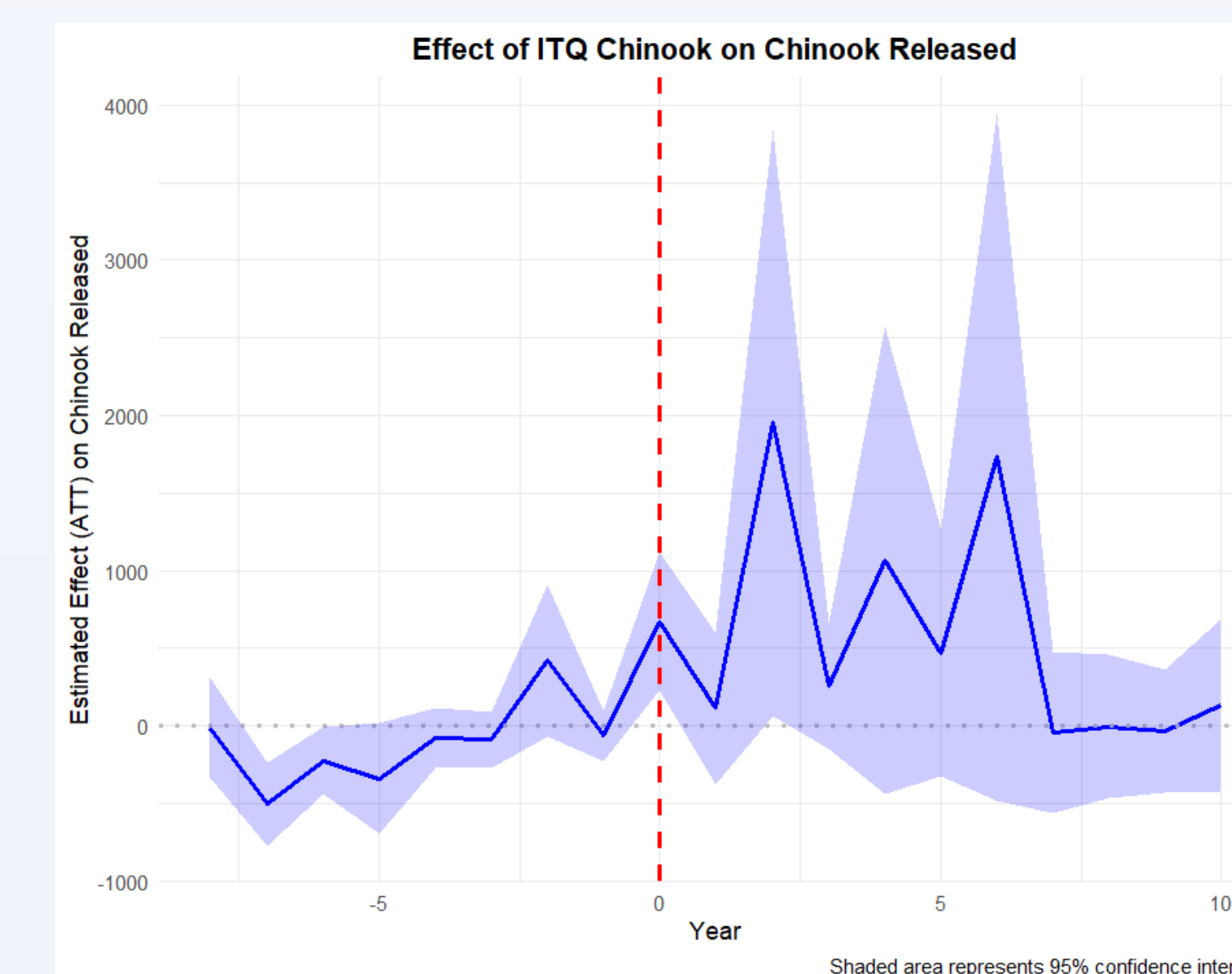
Spillover Effects

- Some fishers may be relocating effort to non-ITQ areas rather than discard fish.
- Effort may be shifting toward non-quota species, increasing pressure on unmanaged stocks.
- Following the Sockeye ITQ, **Chum releases decreased by 153.81%** per year.
- BC's species-specific ITQs may unintentionally increase pressure on species not covered by quotas.
- Without total allowable catch (TAC) data, it is unclear whether shifts in catch are due to ITQs or broader policy changes.



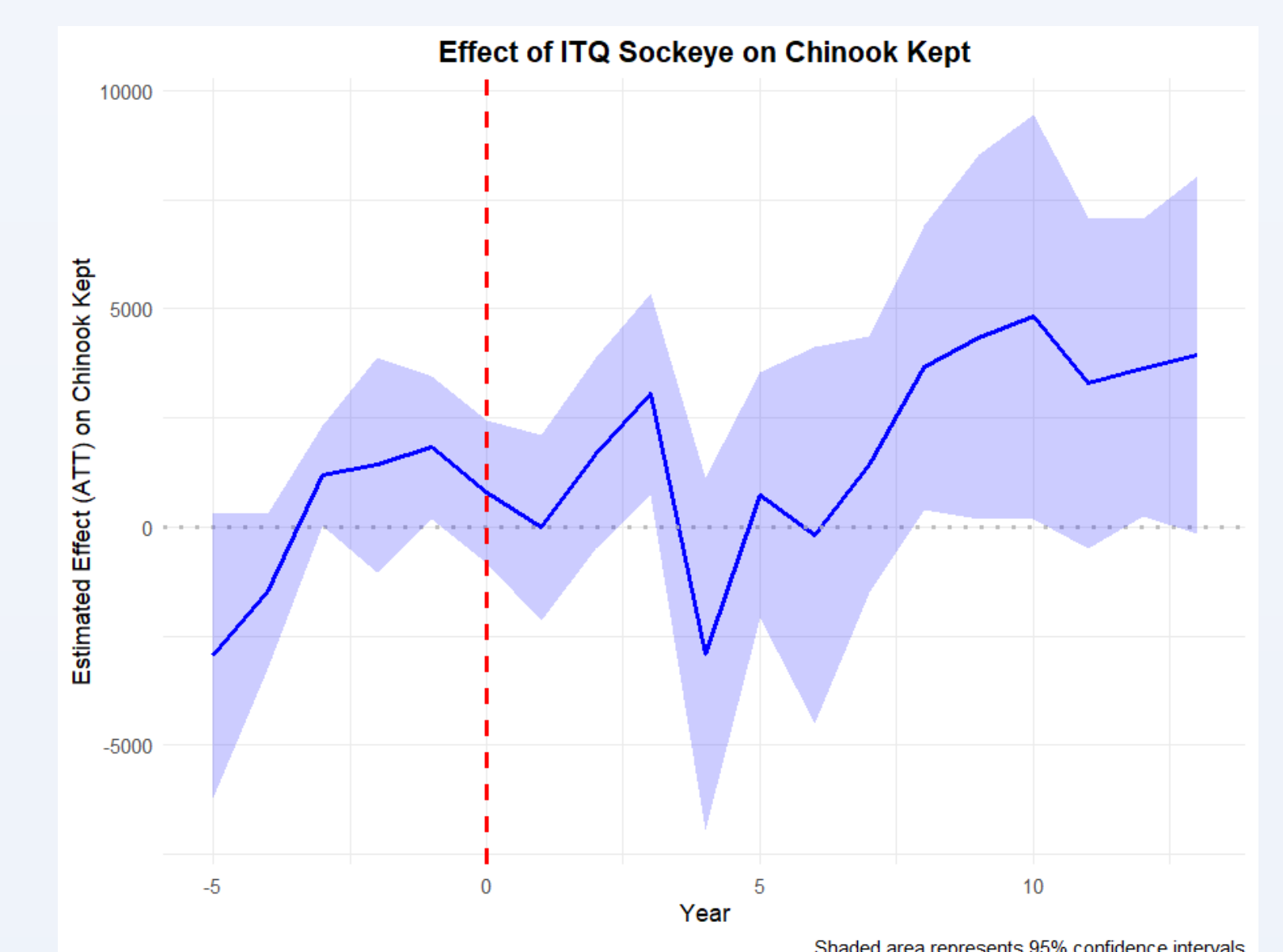
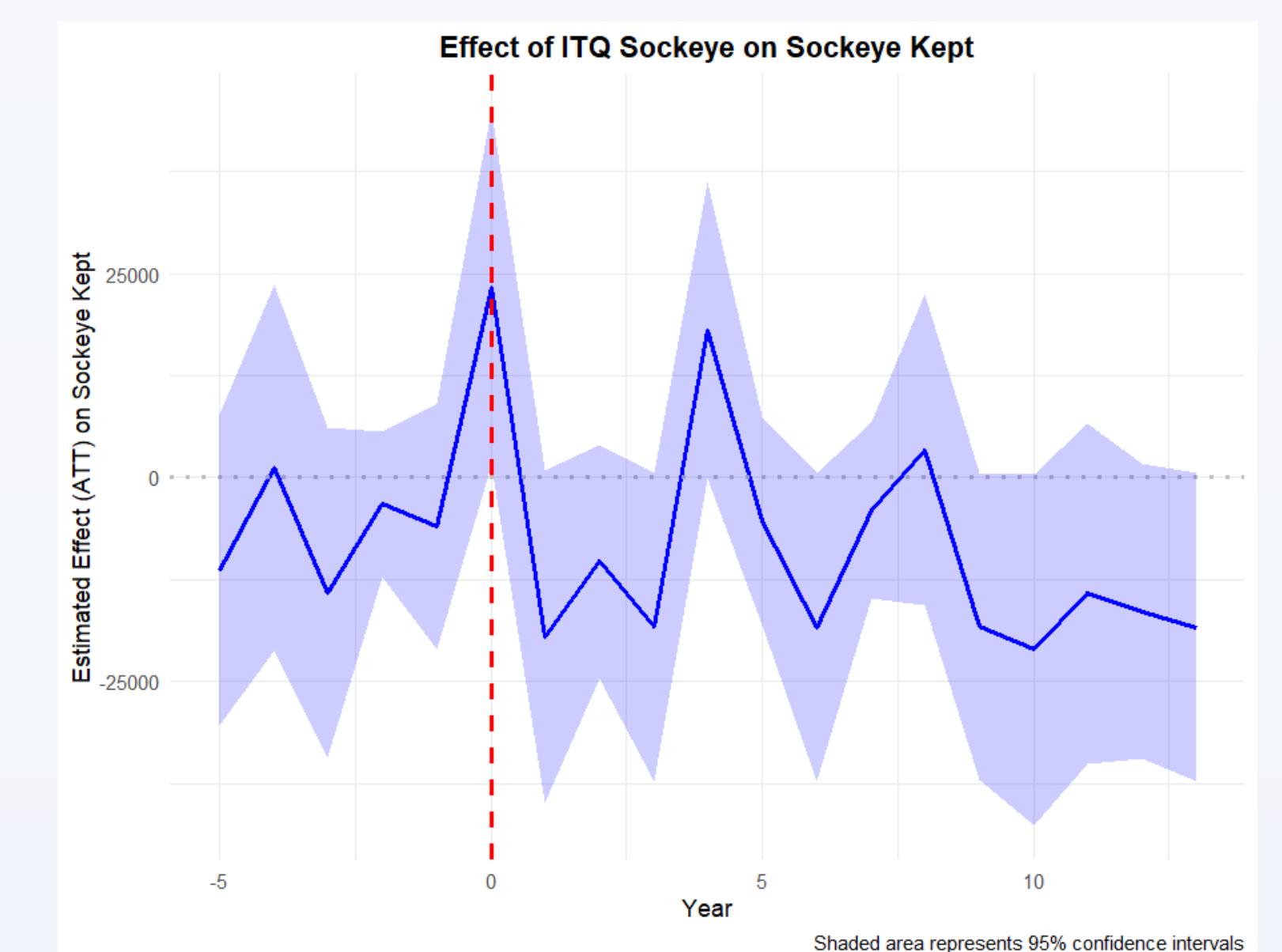
Quota-Induced Highgrading and Discarding

- **Overall discarding (release per day, RPD) has decreased by 44.58%** per year, meaning fewer fish are being thrown back.
- This suggests that ITQs improve quota utilization and reduce waste.
- However, species-specific highgrading is evident:
 - **Chinook releases increased by 75.13%** per year.
- Concern: 40% of released Chinook do not survive according to a study by the DFO in 1999, leading to an estimated 8,650 additional Chinook mortalities per year in this fishery.
- **Wasted Resources:** Discarded fish represent lost economic value and inefficient resource use.
- **Loss of Biodiversity:** Discarding large numbers of fish disrupts marine food webs, reducing prey availability for predators and altering ecosystem balance.



Species Targeting and Effort Redistribution

- ITQs shifted effort toward high-value, non-quota species.
- After Sockeye ITQ implementation:
 - **Sockeye kept has decreased by 529.53%** per year. This reflects an average decrease of 442,920 Sockeye kept per year.
 - **Chinook kept increased by 54%** per year.
- Fishers may be shifting effort to unrestricted species rather than reducing overall effort.



Conclusions

- ITQs redistribute effort but have not significantly increase season length.
- Overall discarding has decreased, but species-specific highgrading remains a concern.
- ITQs shift targeting behavior toward non-quota species.
- Spillover effects may unintentionally increase fishing pressure on unmanaged stocks.
- Further research is needed to separate ITQ effects from TAC adjustments.