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I'm writing to let you know about a just-published journal article on historical trends in abundance of hatchery and wild salmon. These trends indicate that **competition between wild and hatchery salmon in the North Pacific Ocean will increase** due to rising hatchery production combined with periodic shifts in ocean salmon productivity.

The most significant findings are as follows:

- **The sum of Asian and North American pink, chum, and sockeye salmon today is more than we have seen before in the North Pacific.** Since comprehensive estimates were first made in the 1950s, total abundance has doubled, which is likely mostly due to more favorable ocean conditions for juvenile salmon.
- Since the 1950s, **the release of juvenile hatchery salmon into the North Pacific Ocean – or salmon ranching – has skyrocketed to about 5 billion fish per year.** Adult hatchery salmon now account for at least 20% of total adult salmon production and rising. In some regions, hatchery salmon dominate (>50% of total) wild fish. For example, in Asia 76% of all adult chum salmon are now produced by salmon hatcheries. In contrast to wild sockeye and pinks, wild chum production did not increase significantly after the mid-1970s ocean regime shift, prompting concerns that hatchery chum production limits wild chum production.
- Evidence indicates that **the ocean is getting over-crowded with salmon, raising the question of how many more fish the ocean can sustain.** The ocean is always changing, and current favorable ecological conditions for salmon will not last indefinitely. Unless international agreements are developed to manage production levels, hatchery fish may dominate in the ocean as soon as ocean conditions deteriorate. The net result could be a perfect storm for wild salmon, precipitated by the following events:
 - **Higher competition:** If ocean productivity decreases, there would be less food for all salmon, wild or hatchery, leading to slower growth and lower survival. Fishery managers might respond by ramping up hatchery production, attempting to maintain or increase returns of adult salmon in leaner times, but creating even more severe competition among all salmon for increasingly limited resources.
 - **More overfishing:** At the same time, pressure would be intense for fishery management agencies to target fishing on hatchery fish that, in some cases, would lead to overharvest of less productive wild stocks.

- **Lower diversity:** High levels of hatchery straying onto spawning grounds, combined with low numbers of wild fish, could further erode wild salmon diversity that helps stabilize salmon returns.
- **Large-scale hatchery production might impact salmon from distant regions.** Stocks from distant regions of Asia and North America mix in the open ocean and there is evidence that different species of salmon compete for food—directly or indirectly—on the high seas.
- Even though the total number of wild pink, chum, and sockeye salmon in the North Pacific is at an all-time high, **many individual salmon populations are at low abundances** due to overharvesting, loss of habitat, and other factors. This conservation issue is not just a problem in southern streams, where the changing climate appears to be reducing habitat suitability. For example, some stocks are classified as “of concern” in pristine areas of Western Alaska, e.g., Arctic-Yukon-Kuskokwim chum, Yukon Chinook, and Kvichak sockeye. Conservation concerns are particularly acute at the southern end of the ranges of these species in both North America and Asia.

The paper is co-authored by Greg Ruggerone, Randall Peterman, Brigitte Dorner, and Katherine Myers. Our findings are published in the October 2010 issue of *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science* at <http://afs-journals.org/doi/full/10.1577/C09-054.1>.

Please let me know whether I can answer any questions for you about these findings or put you directly in touch with one of my co-authors.

Sincerely,

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