
From: Rachel Johnson - NOAA Federal <rachel.johnson@noaa.gov>
Sent: Friday, March 15, 2019 3:10 PM
To: Cathy Marcinkevage - NOAA Federal
Subject: Re: ROC LTO BiOp
Attachments: Munsch_et_al-2019-Ecological_Applications.pdf

Cathy- This is a great passage. I added more recent citations (in red) that further supports the climate change aspect especially (Herboldt et al., 2018) and Stephanie Carlson's work on our "weakened salmon portfolio in the CV". I have also included our paper that is in pre-released from Ecological Applications highlighting truncation in juvenile outmigration timing as a function of climate. Hope these are helpful!

Rachel

"California's Central Valley salmon portfolio has weakened over time (Carlson and Satterthwaite 2011, Herbold et al. 2018) The foundation for this "portfolio effect" of spreading risk across populations can be found at the within-population scale (Greene 2009; Bolnick et al. 2011). For example, juvenile Chinook salmon leave their natal rivers at different sizes, ages, and times of the year, and this life history variation is believed to contribute to population resilience (Beechie et al. 2006; Lindley et al. 2009; Miller et al. 2010; Satterthwaite et al. 2014; Sturrock et al. 2015). Life history diversity promotes salmonid population resiliency, thereby reducing a species' extinction risk. Thus, preserving and restoring life history diversity is an integral goal of many salmonid conservation programs (Ruckelshaus et al. 2002). It is increasingly recognized that strengthening a salmon population's resilience to environmental variability (including climate change) will require expanding habitat opportunities to allow a population to express and maintain its full suite of life history strategies (Bottom et al. 2011; Herboldt et al. 2018; Munsch et al. 2019).

Carlson and Satterthwaite 2011: <https://www.nrcresearchpress.com/doi/10.1139/f2011-084#.XIwgdiJKipo>
Herbold et al. 2018: <https://escholarship.org/uc/item/8rb3z3nj>



Ecological Applications

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Devin E. McMahon, Robert B. Jackson
e01879 | First Published: 05 March 2019

Warm, dry winters truncate timing and size distribution of seaward-migrating salmon across a large, regulated watershed

Stuart H. Munsch, Correigh M. Greene, Rachel C. Johnson, William H. Satterthwaite, Hiroo Imaki, Patricia L. Brandes
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On Wed, Mar 13, 2019 at 11:56 PM Cathy Marcinkevage - NOAA Federal <cathy.marcinkevage@noaa.gov> wrote:

Hey Rachel --

I'm updating the analytical approach of our draft biop (more on that later...) and thought that you could help to check whether the following paragraph needs any updating. This isn't super-urgent, but a response in the next week would be great.

Thanks!
Cathy

The foundation for this “portfolio effect” of spreading risk across populations can be found at the within-population scale (Greene 2009; Bolnick et al. 2011). For example, juvenile Chinook salmon leave their natal rivers at different sizes, ages, and times of the year, and this life history variation is believed to contribute to population resilience (Beechie et al. 2006; Lindley et al. 2009; Miller et al. 2010; Satterthwaite et al. 2014; Sturrock et al. 2015). Life history diversity promotes salmonid population resiliency, thereby reducing a species’ extinction risk. Thus, preserving and restoring life history diversity is an integral goal of many salmonid conservation programs (Ruckelshaus et al. 2002). It is increasingly recognized that strengthening a salmon population’s resilience to environmental variability (including climate change) will require expanding habitat opportunities to allow a population to express and maintain its full suite of life history strategies (Bottom et al. 2011).

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