

Straying, stress, and performance on the spawning grounds by hatchery-produced chum salmon in Southeast Alaska*

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* In review. Email me if interested in advanced copy





What do we *know* about straying?

- A biological phenomenon, not an aberration (Quinn 2005)
- Facilitates (re)colonization (Hendry et al. 2004)
- Differs among species, populations, and life history types (Westley et al. 2013)
- Is influenced by climate, water temperature, and population density (social interactions?) (Westley et al. 2015, Berdahl et al. 2016)
- Can be elevated by human disturbance (Keefer et al. 2008, Bond et al. 2017)
- Mediates hatchery wild interactions on spawning grounds



What we do not know?



C. Takeda

- A failure to home or a choice to stray?
- At what point in the life history is the 'choice' determined?
- Why are some sites attractive to strays while others are not?
- What about wild fish?
- What are key proximate factors of influence?
- Very little known about pink or chum salmon straying

Towards a better understanding



C. Takeda

- A failure to home or a choice to stray?
- At what point in the life history is the 'choice' determined?
- Why are some sites attractive to strays while others are not?
- What about wild fish?
- **What are key proximate factors?**
- **Comparably nothing known about pink or chum salmon straying**

Driving questions

Is stress associated with 'choice' to home or stray?

Is stress associated with performance (stream-life and egg retention) on the spawning grounds?



Why stress?

Plasma surges of cortisol are associated with olfactory imprinting by juveniles and memory recall of odors by migrating adults (Hasler and Scholz 1983, Dickhoff et al. 1990, Carruth et al. 2002)



R. Bell

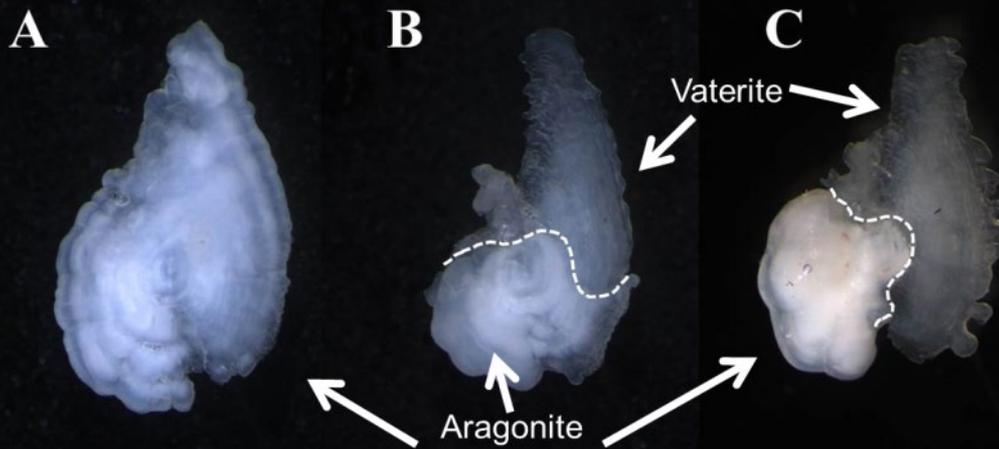


P. Vecsei

Our approach (stress and straying)

Compare two proxies of stress, vateritic otoliths and blood plasma cortisol concentrations between:

1. Wild-born fish on the spawning grounds (presumed home)
2. Hatchery-born fish on the spawning grounds (strays)
3. Hatchery-born fish returned to hatchery (home)



Our approach (stress and performance)

Compare two proxies of reproductive performance, stream life and egg retention between:

1. Wild-born fish on the spawning grounds (presumed home)
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Study sites and sample collection

Sawmill Creek ca. 40 km north of Juneau
~500m of spawning habitat



Wild-born vs. hatchery-born fish on
spawning grounds (vaterite,
cortisol, performance)

Macaulay Salmon Hatchery



Hatchery-born fish that returned
home (vaterite)

Salmon Creek (adjacent to hatchery)



Hatchery-born fish that
returned home (cortisol)

Sampling methods

step 1: catch fish entering creek



McConnell et al. 2018. Aquaculture
Environment Interactions 10: 99-113

Sampling methods

step 2: blood draw



McConnell et al. 2018. Aquaculture
Environment Interactions 10: 99-113

Sampling methods

step 3: tag and measure



McConnell et al. 2018. Aquaculture
Environment Interactions 10: 99-113

Sampling methods

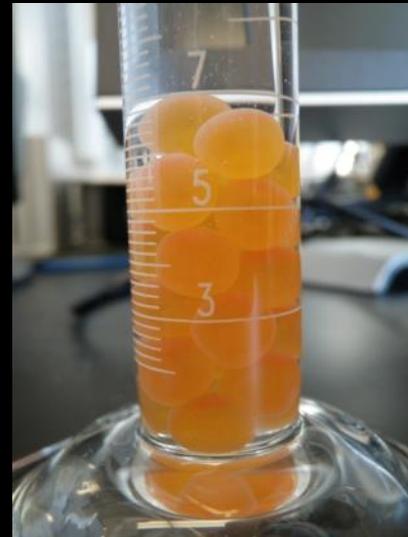
step 4: track and recover fish and otoliths



McConnell et al. 2018. Aquaculture
Environment Interactions 10: 99-113

Sampling methods

step 5: quantify egg retention

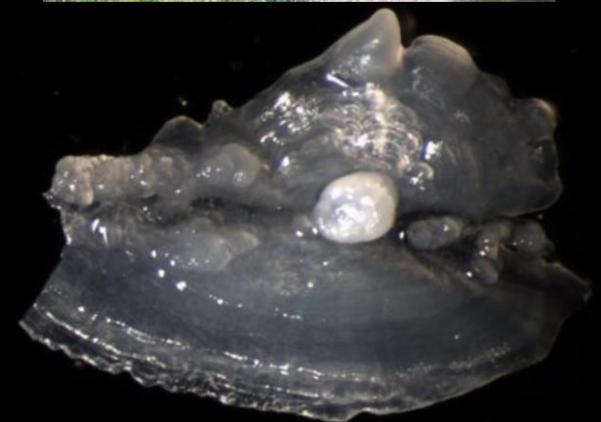


McConnell et al. 2018. Aquaculture
Environment Interactions 10: 99-113

Results

Is stress associated with 'choice' to home or stray?

- Vaterite levels and straying
 - Hatchery home: 45% vaterite (n=181)
 - Hatchery Strays: 40% vaterite (n=191)



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} p= 0.22



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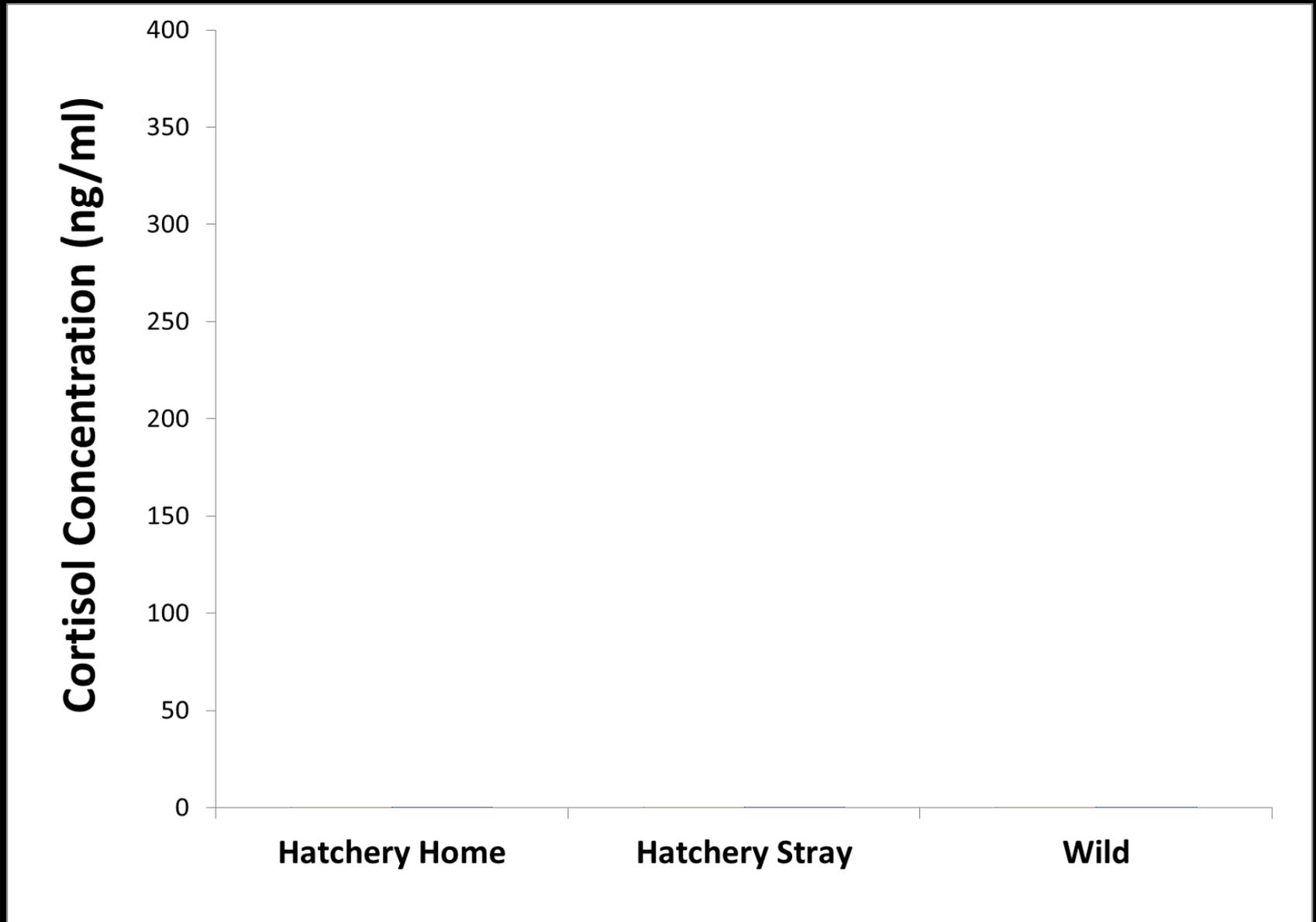
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- Vaterite levels and straying
 - Hatchery home: 45% vaterite (n=181)
 - Hatchery Strays: 40% vaterite (n=191)
 - Wild : 24% vaterite (n=220)



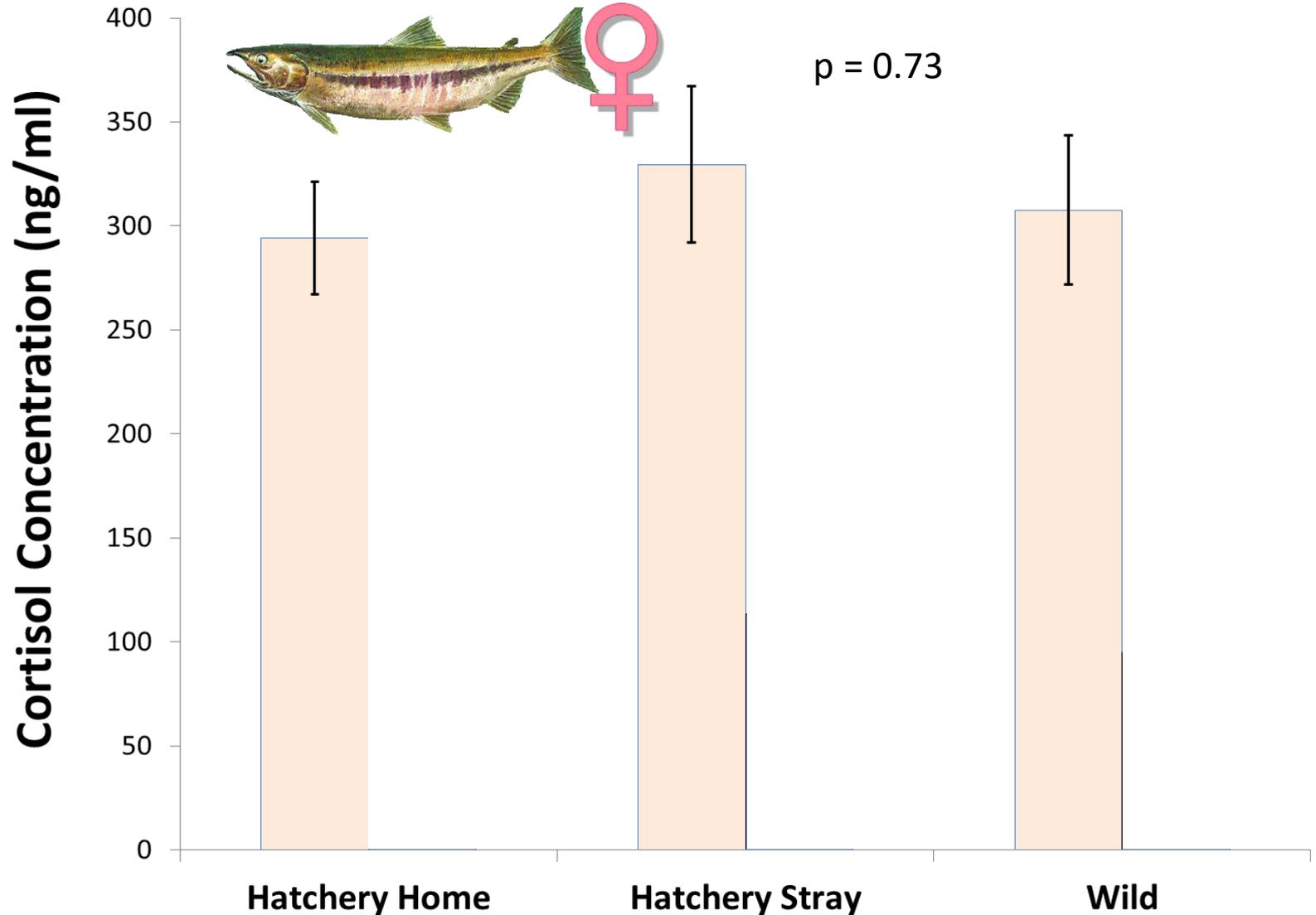
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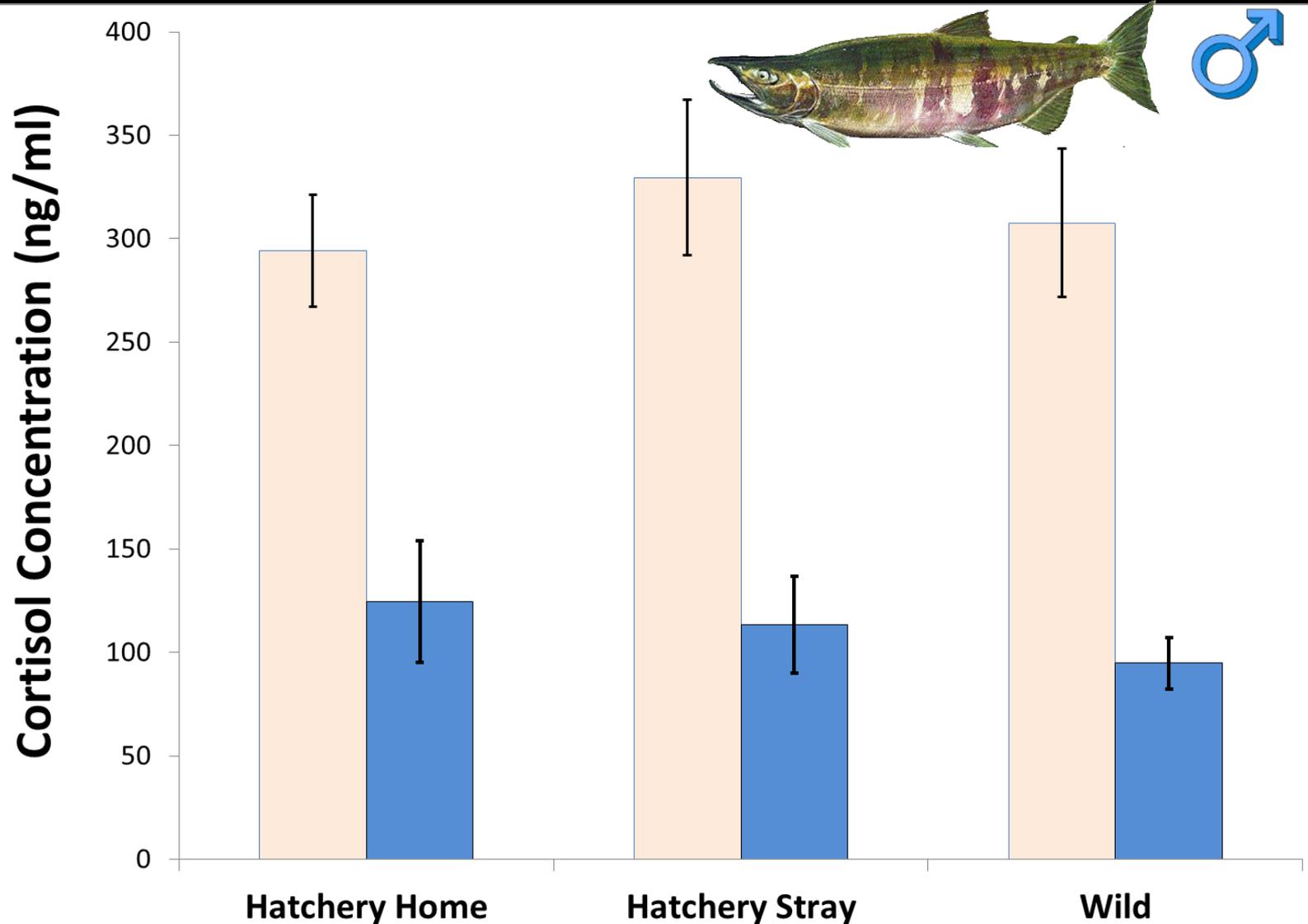
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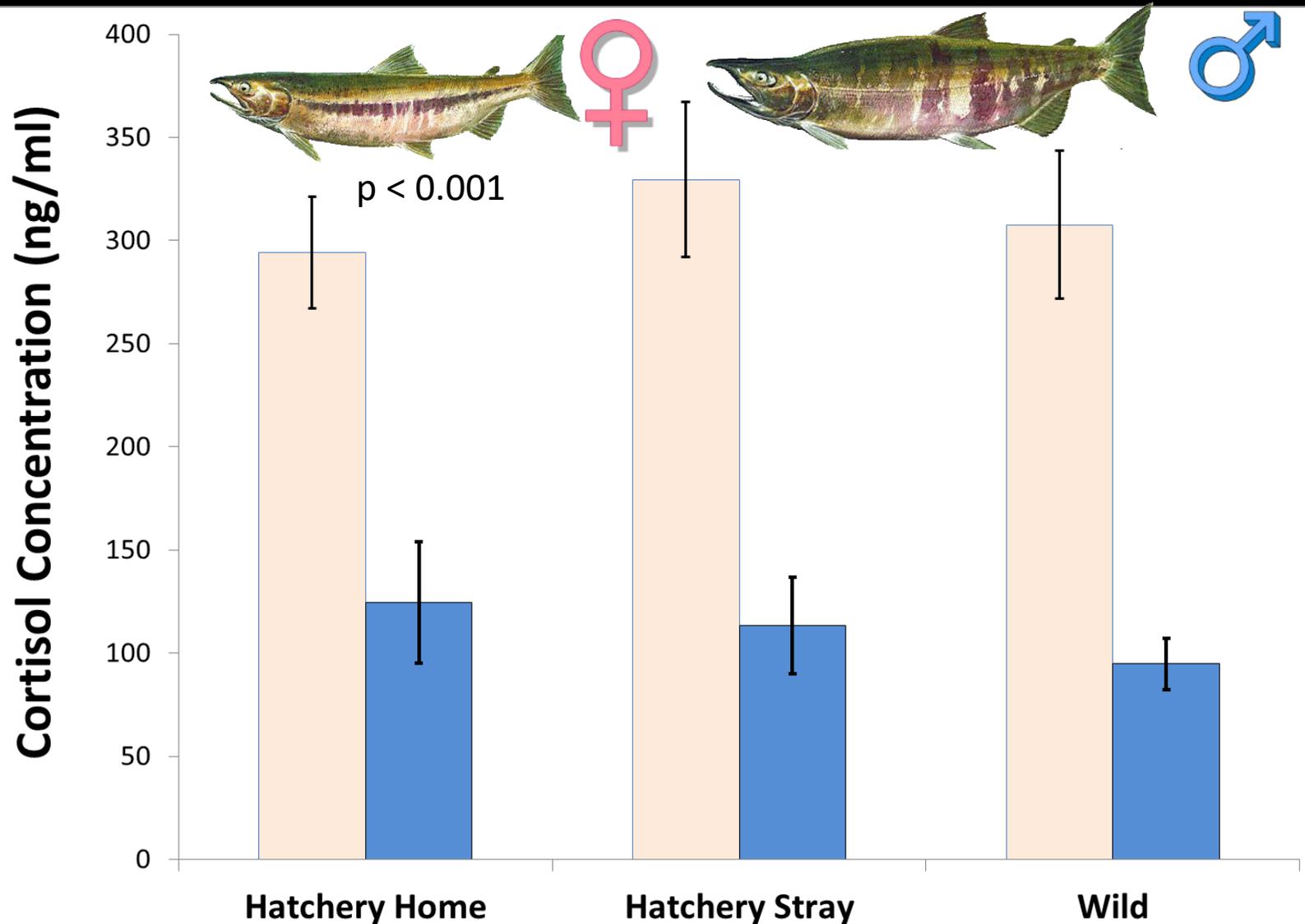
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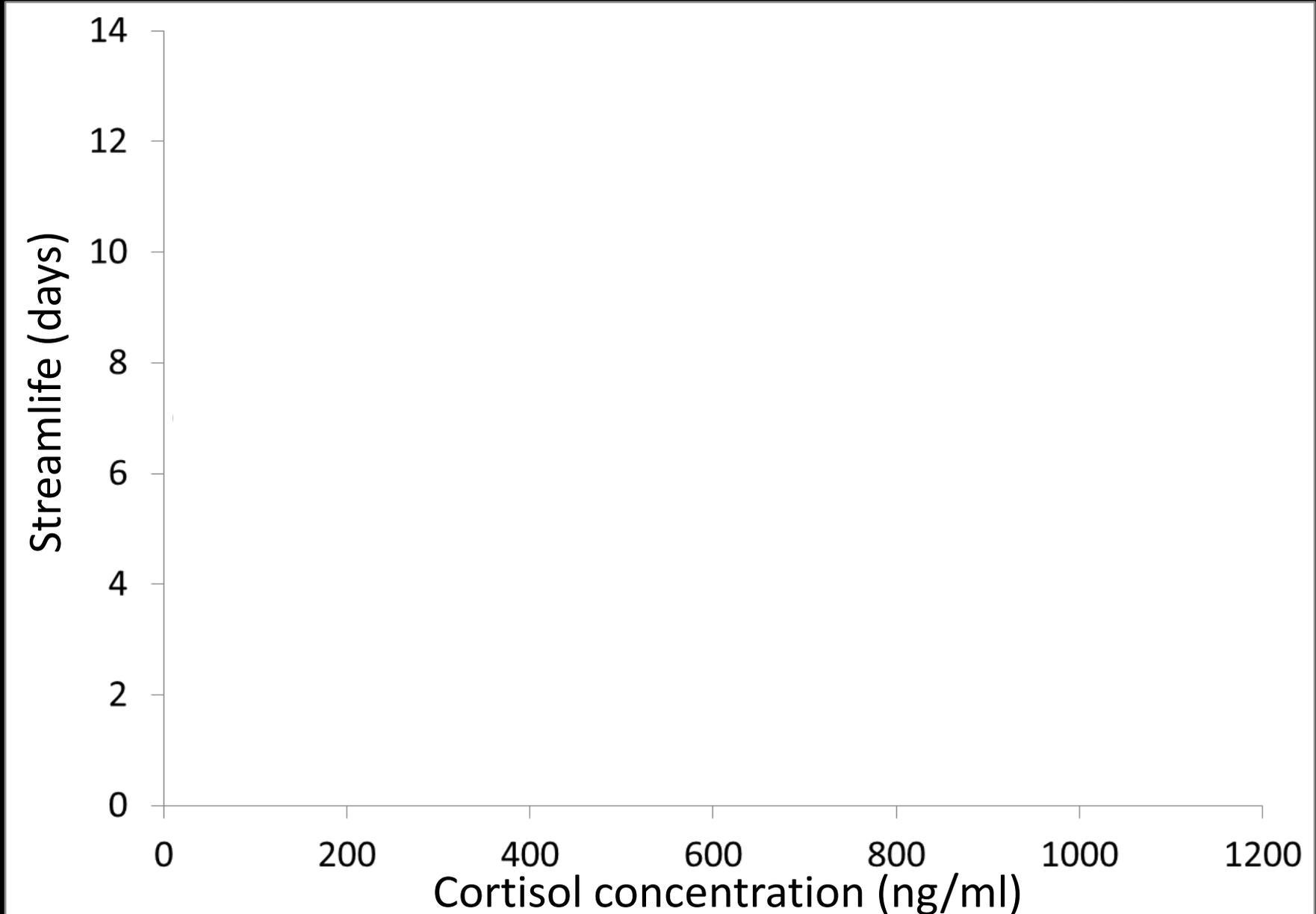
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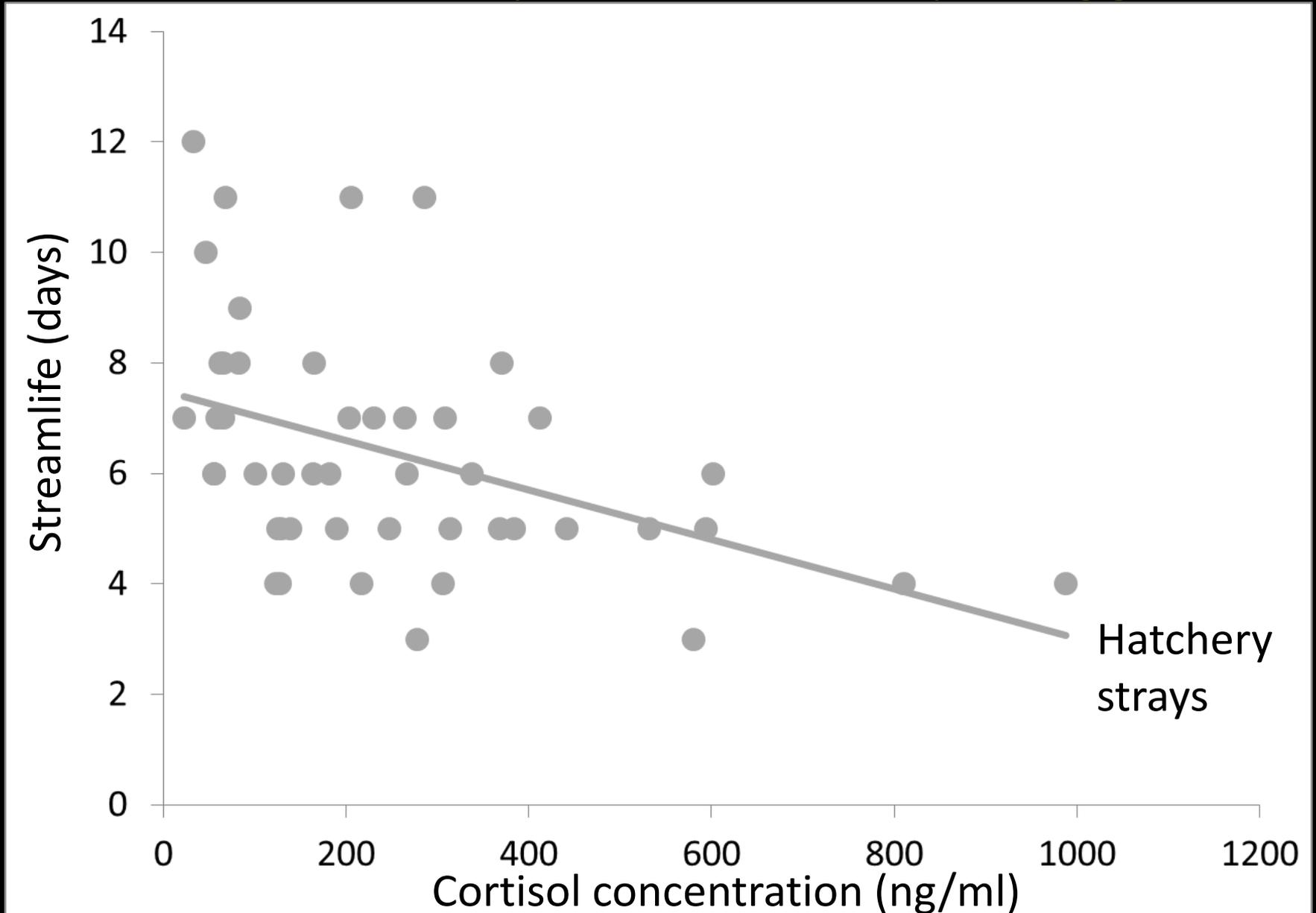
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Is stress associated with performance on the spawning grounds?



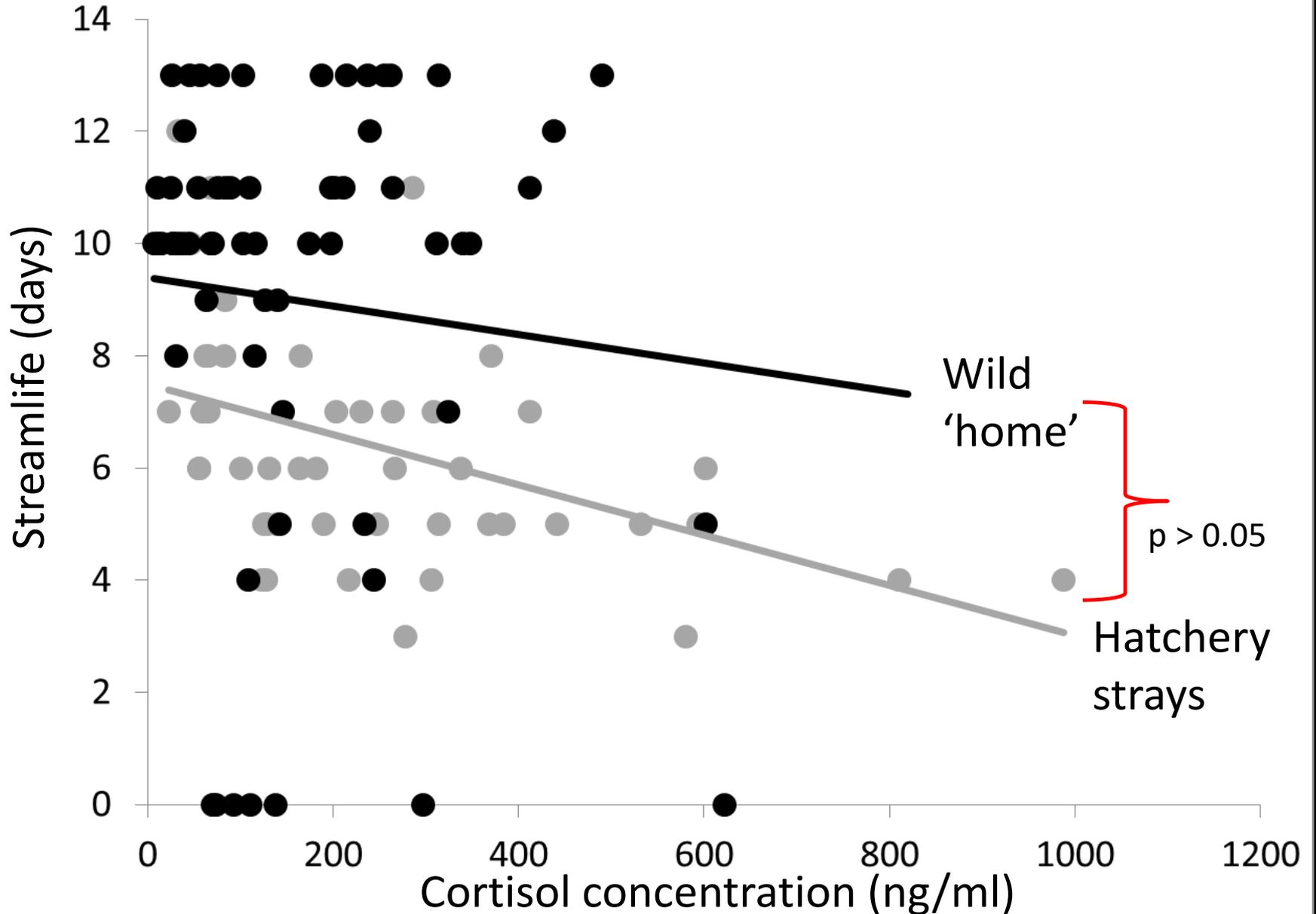
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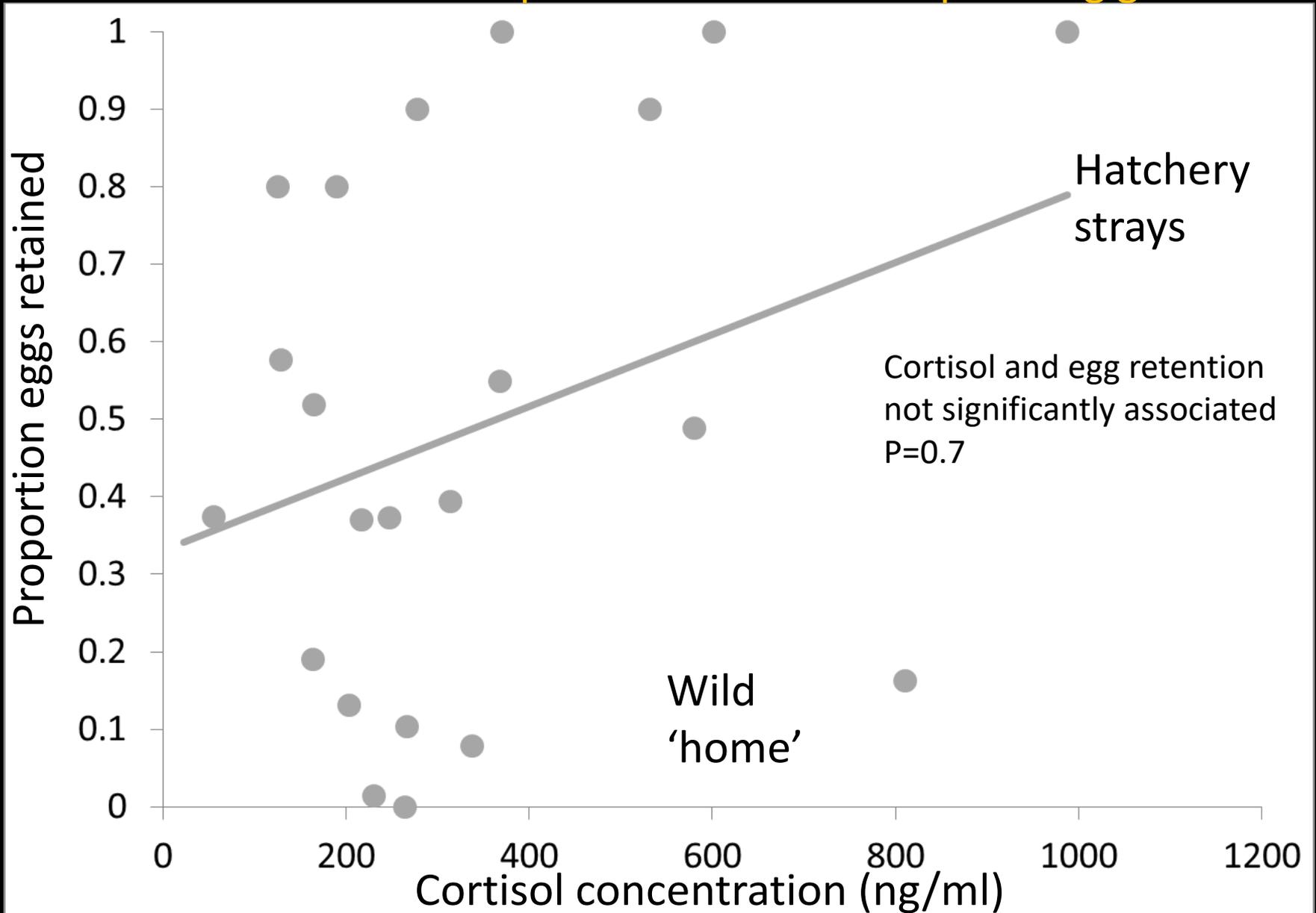
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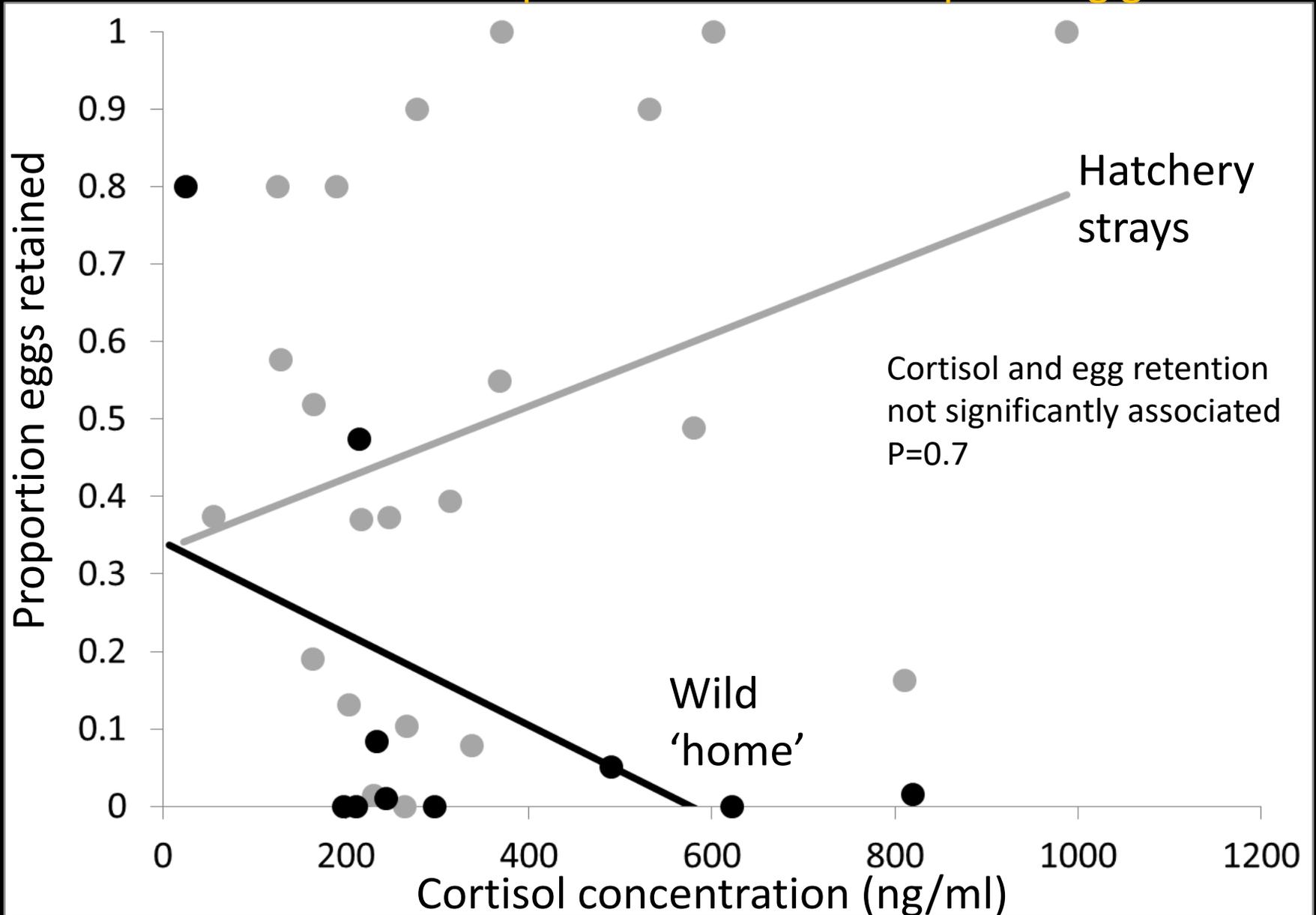
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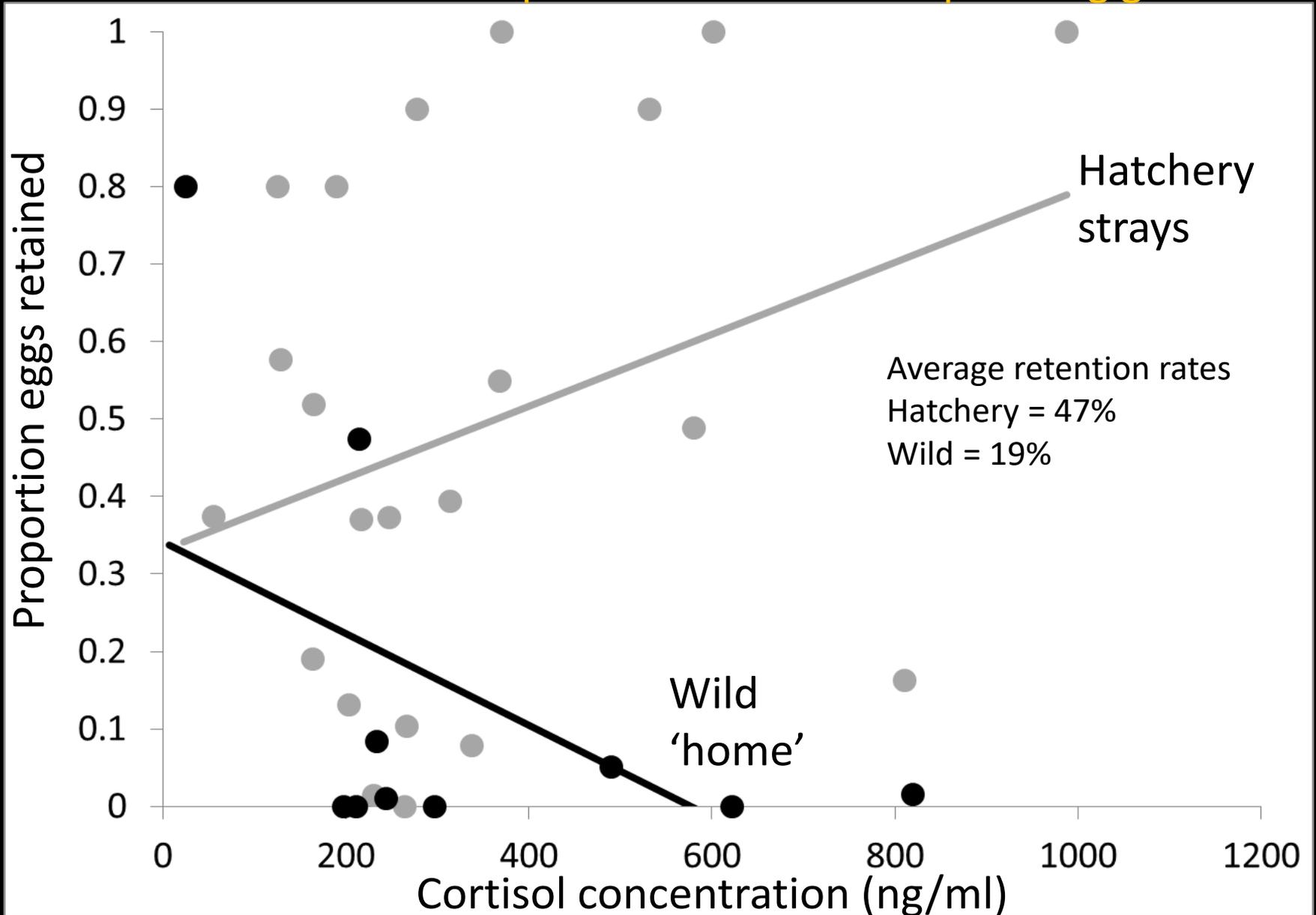
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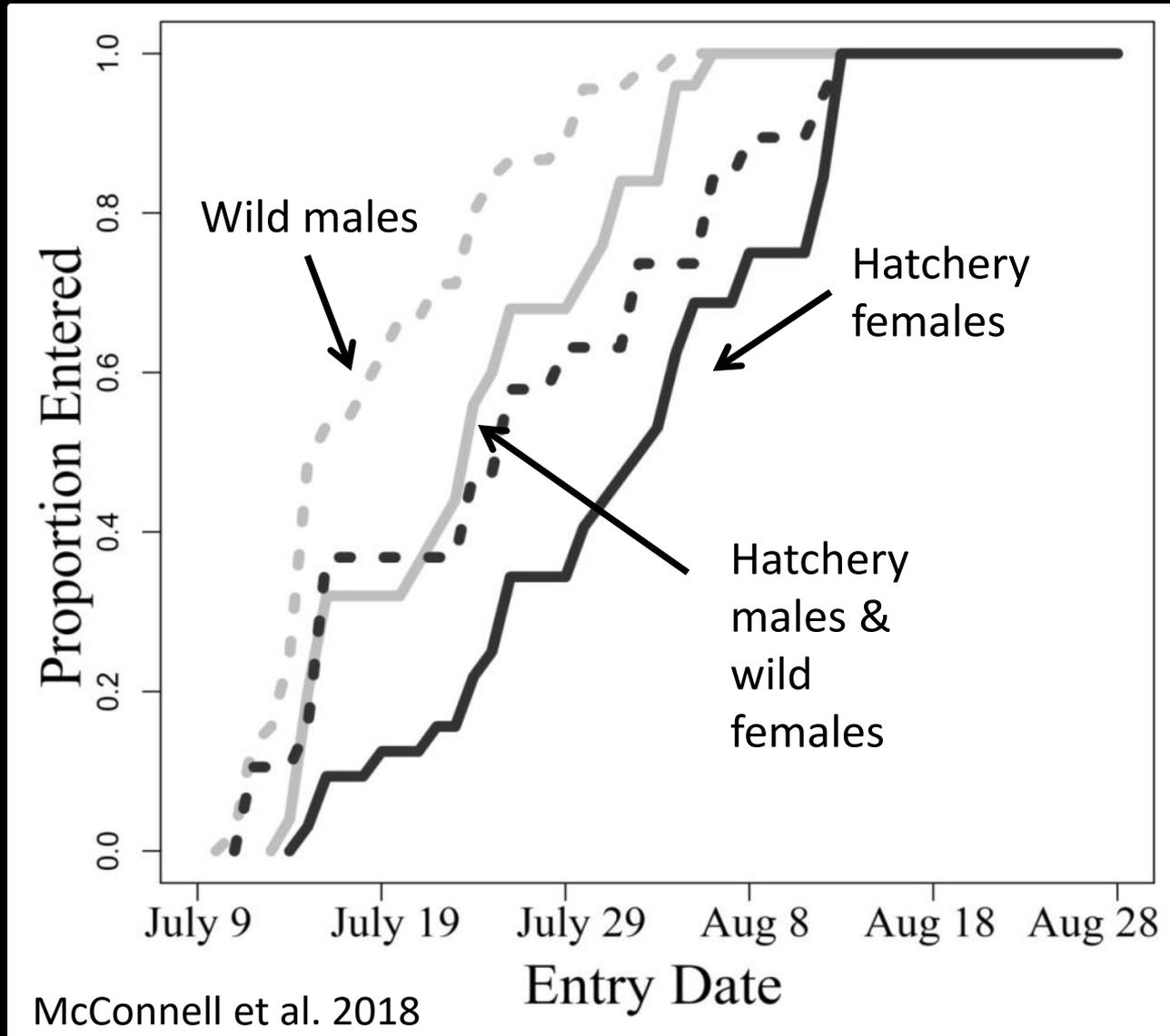


Results

Is stress associated with performance on the spawning grounds?



Why might hatchery fish retain more eggs?



Summing it up

Is stress (cortisol & vaterite) associated with 'choice' to home or stray?

No evidence: Hatchery home, hatchery stray, and wild fish had similar cortisol concentrations.

but, Females appeared more stressed than males (both wild and hatchery strays)

Wild fish had 50% less occurrence of vaterite than hatchery fish, but vaterite (or intensity of thermal marking) not associated with straying



Summing it up

Is stress associated with performance (stream-life and egg retention) on the spawning grounds?

Yes and no. Stream life declined in individuals with higher cortisol concentrations irrespective of whether they were hatchery or wild.

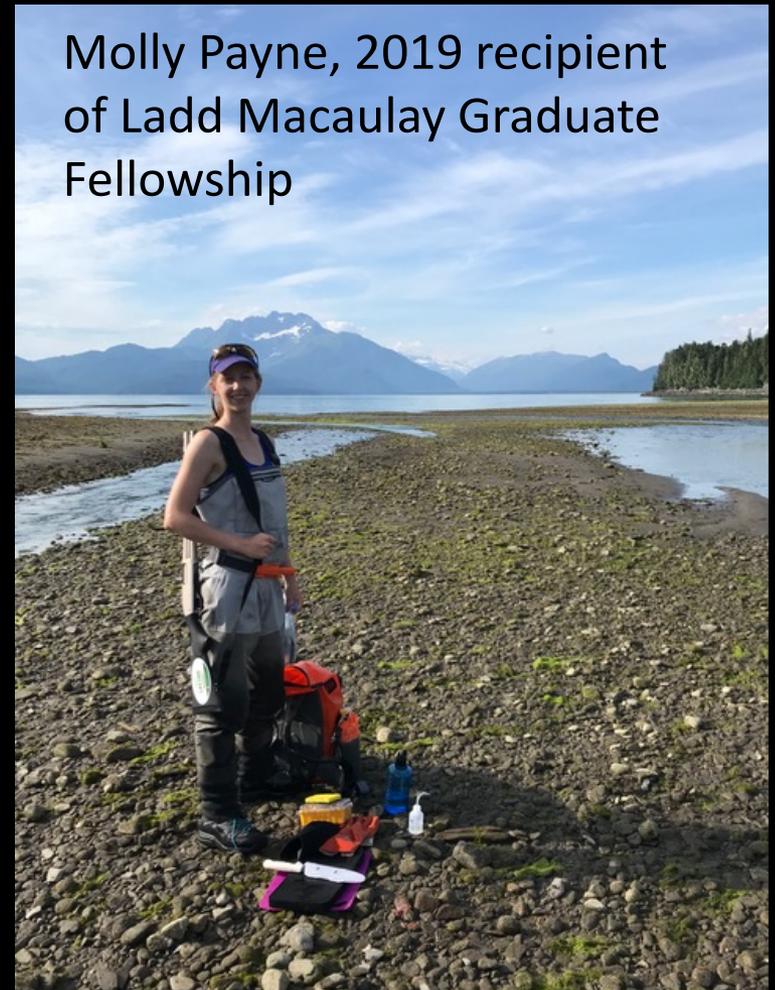
Rates of egg retention were not associated with cortisol, though hatchery fish retained ca. $\frac{1}{2}$ of their eggs while wild fish $\frac{1}{5}$.



P. Vecsei

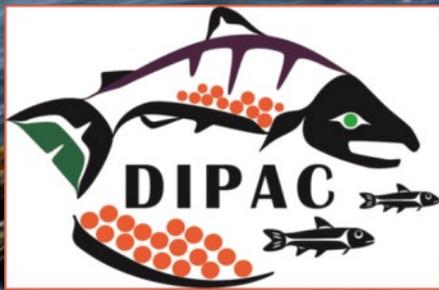
Where to from here?

- Causes and consequences of higher vaterite in hatchery fish?
- Where are the strays coming from? And do they go first to release sites and then stray? Or choose to stray without ever going 'home'?
- What makes sites attractive to strays?



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