Coho Salmon Conservation in the Central California Coast ESU

- Captive broodstock programs for Russian River and Scott Creek population established.
- Inbreeding high in program due to limited founders, even with genetically determined breeding matrices.

Russian River
Salmon Creek
Lagunitas Creek
Coho salmon populations in coastal watersheds of central California

Central California
Coast Coho
Salmon ESU

Russian River - very low
Salmon Creek - absent
Walker Creek - absent

Lagunitas/Olema Creek - low, persistent
Release of captively-raised maturing adult coho salmon as a novel strategy for restoration and recovery - Walker Ck

Released into Walker Creek:

- 8 young-of-year (YOY) of BY03 -- 7 of these, sampled in one location, are offspring of hatchery-reared adults released in December 2003

- 2 YOY and 2 jacks of BY04 -- 3 of these are offspring of at least one Olema Creek parent released in December 2004

- 17 YOY of BY06 assign strongly to Olema Creek but parents unknown - offspring of adults entering naturally to spawn
Release of captively-raised maturing adult coho salmon as a novel strategy for restoration and recovery-Salmon Ck

- Salmon Ck. - no coho salmon since ~1980

- Adults from Lagunitas Creek (N=152) and from the Russian River (N=158) released in December 2008

- Juveniles confirmed and sampled in two creeks, Fay Creek (N=105) and Finley Creek (N=105) in July 2009.

### Origin of coho salmon in Salmon Creek

#### No. of individuals

<table>
<thead>
<tr>
<th></th>
<th>Russian x</th>
<th>Lagunitas x</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fay Ck</td>
<td>8</td>
<td>35</td>
<td>62</td>
</tr>
<tr>
<td>Finley Ck</td>
<td>0</td>
<td>14</td>
<td>90</td>
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#### No. of Matings

<table>
<thead>
<tr>
<th></th>
<th>Russian x</th>
<th>Lagunitas x</th>
<th>Hybrid</th>
</tr>
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<tbody>
<tr>
<td>Fay Ck</td>
<td>1</td>
<td>2</td>
<td>5 or 6</td>
</tr>
<tr>
<td>Finley Ck</td>
<td>0</td>
<td>1</td>
<td>2</td>
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</table>

NewHybrids posterior probabilities had mean of 0.99 to assigned genealogical class.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate ± SE</th>
<th>p-value</th>
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</thead>
<tbody>
<tr>
<td>Female Stream Origin [DBC]</td>
<td>0.022 ± 0.015</td>
<td>0.128</td>
</tr>
<tr>
<td>Male Stream Origin [DBC]</td>
<td>0.005 ± 0.011</td>
<td>0.612</td>
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<tr>
<td>Female Ovulation Rate</td>
<td>0.02 ± 0.031</td>
<td>0.516</td>
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<tr>
<td>Relatedness Coefficient Rxy</td>
<td>0.162 ± 0.057</td>
<td>0.004</td>
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<tr>
<td>Female Internal Hz</td>
<td>0.021 ± 0.07</td>
<td>0.760</td>
</tr>
<tr>
<td>Male Internal Hz</td>
<td>0.056 ± 0.059</td>
<td>0.345</td>
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</tbody>
</table>

A generalized linear model analyzing the effects of six potential predictor variables on deformity rate reveals a significant relationship between relatedness ($R_{xy}$) of parent pairs and alevin deformity rate in juvenile coho salmon at Warm Springs Hatchery.
Coho salmon Outcrossing Experiment

Instream Survival Results

Overwinter survival rate of F1 of Russian River broodstock (RR) outcrossed with Lagunitas/Olema Creek (OL) coho

Oversummer survival rate of F1 of Russian River broodstock (RR) outcrossed with Lagunitas/Olema Creek (OL) coho

Data from UC Cooperative Extension
Coho salmon Outcrossing Experiment

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Outcrossed coho salmon survive better at all juvenile life stages

Data from UC Cooperative Extension
Conclusions

• Endangered coho salmon raised entirely in freshwater reproduce naturally in streams when released at maturity

• In Salmon Creek, majority of surviving offspring are RR x OC hybrids, result of spontaneous outbreeding

• Coho salmon in Salmon Ck do not avoid hybridization and may prefer it.

• Experimental outbreeding has a direct, positive effect on survival in natural areas of hatchery-bred juveniles

• Genetic analysis (parentage, model-based) confirms juveniles observed in Walker and Salmon Creeks are the offspring of adults released the previous winter

• Adult release projects now occurring in streams in Sonoma, Marin and Santa Cruz counties.
We recognize the sustained efforts and collaboration of dozens of people from NOAA Fisheries Service, California Department of Fish & Game, University of California Cooperative Extension, Pacific States Marine Fisheries Commission and U.S. Army Corps of Engineers and in particular we recognize Louise Conrad, Ben White, Manfred Kittel, Mariska Obedzinski, Brett Wilson, Pete La Civita, Vanessa Apkenas, Edith Martinez, and Hilary Starks for their contributions to this project.

Funded by U.S. Army Corps of Engineers, NOAA and California Department of Fish and Game.