A Hydrodynamic Simulation of a Conservative Tracer to Evaluate Dispersion of Out-Migrating Salmon in Sinclair Inlet, Puget Sound, Washington

Sinclair Inlet

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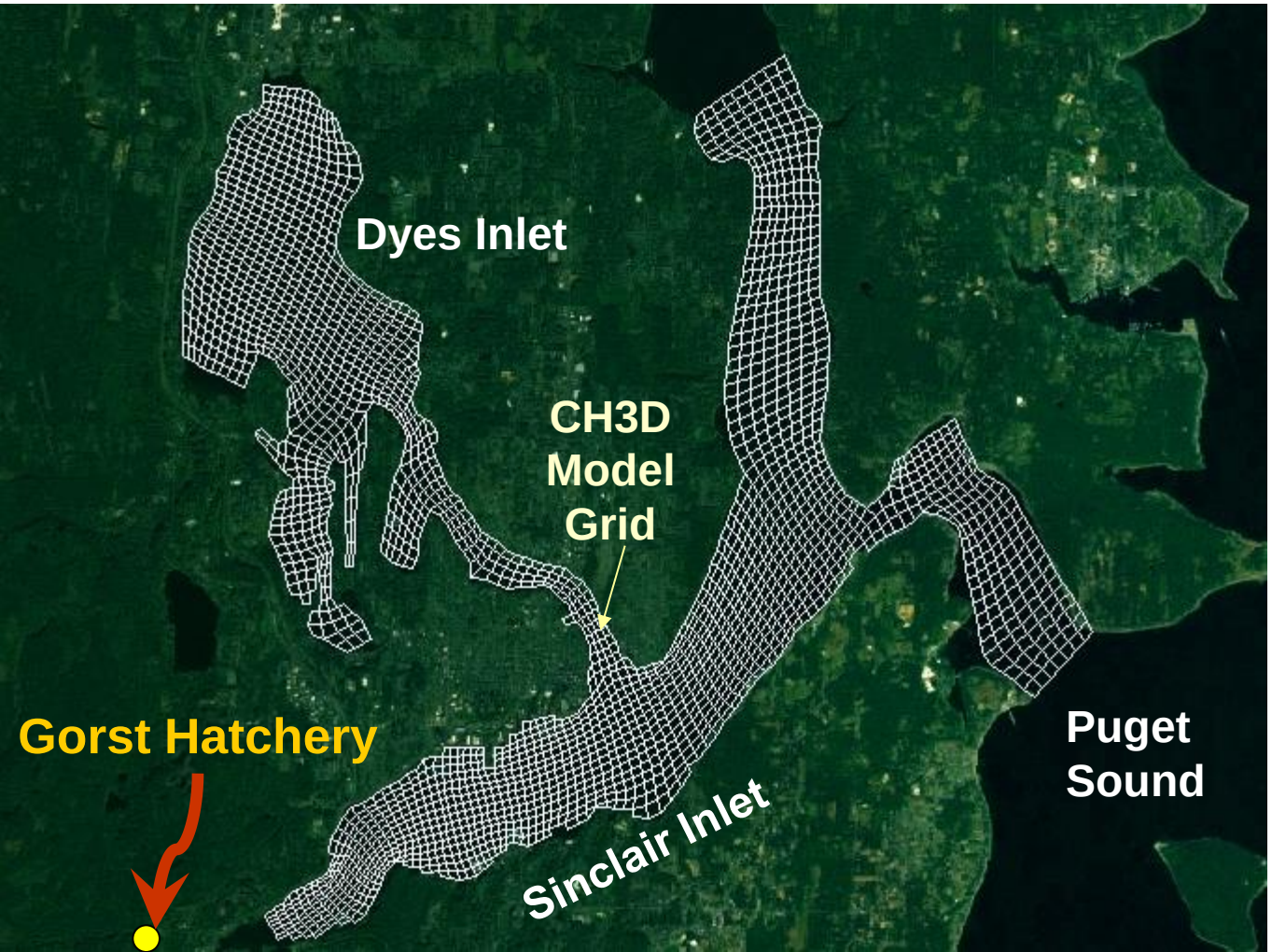
Introduction

A high resolution curvilinear 3-dimensional hydrodynamic model (CH3D) for Sinclair and Dyes Inlets, Puget Sound, WA was set up to simulate the hydrological and tidal conditions present during the release of hatchery-reared, juvenile Chinook salmon from the Gorst Creek Hatchery (May 19 - Jun 30, 2002).



The model was used to simulate the salinity distribution and currents that occurred during a mark and recapture out-migration study conducted by the Washington State Department of Fish and Wildlife (WDFW) in Sinclair Inlet.

Marking Juvenile Chinook

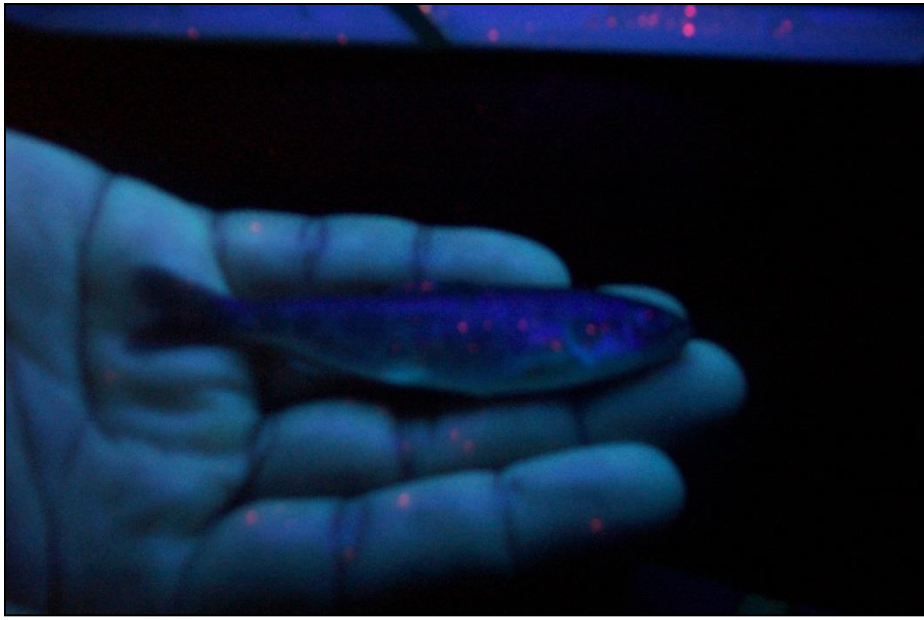
Juvenile Chinook (top) and juvenile chum (bottom) captured in Sinclair Inlet April 2002.

A portable marking system was used to mark juvenile Chinook with fluorescent pigment, providing a readily visible mark, with little or no damage at low cost. Additional fish were marked with coded wire tags (CWT) with a code specific to the Gorst Hatchery.

(Photos courtesy of WDFW)

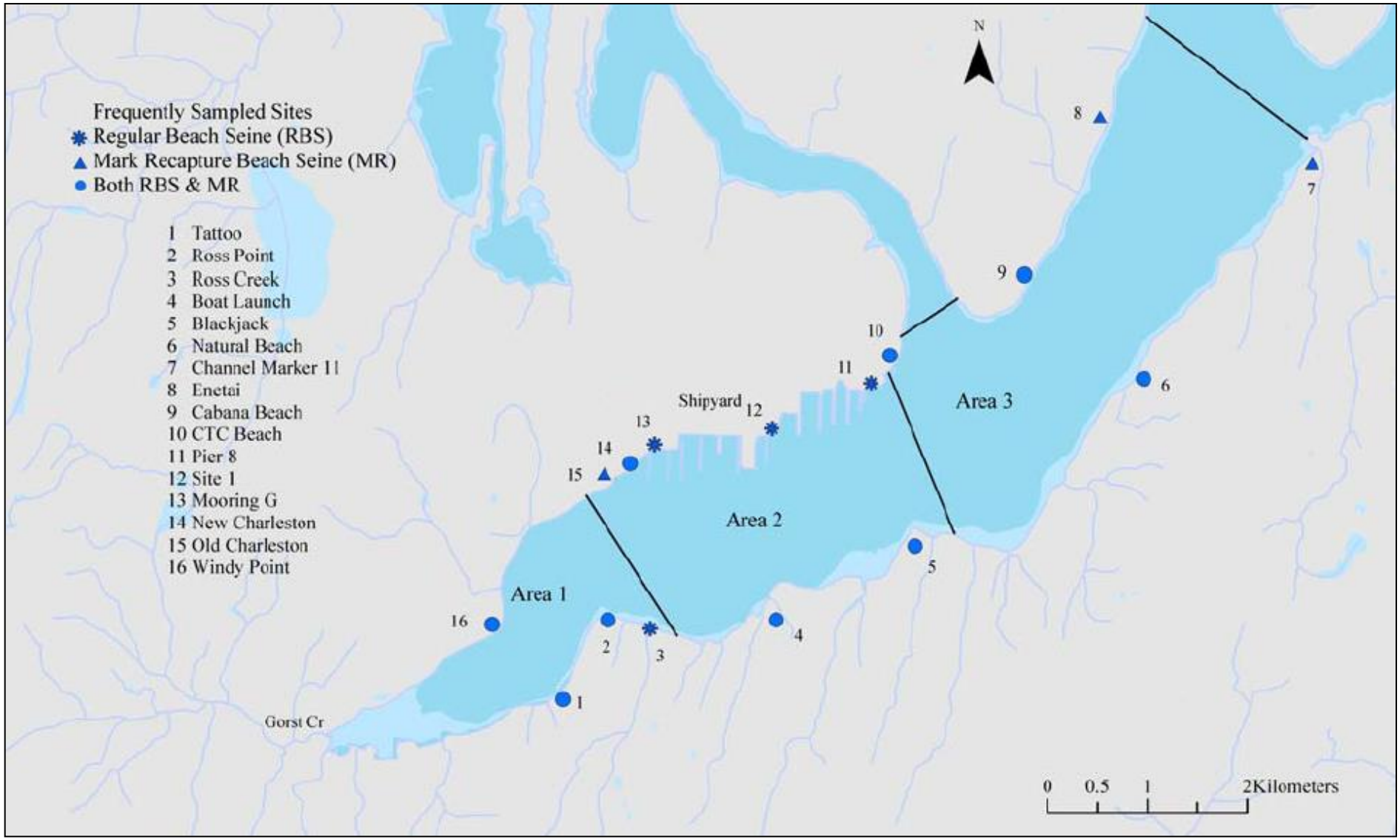
Recapture Sampling

Marked juvenile Chinook salmon were recaptured in Sinclair Inlet by beach seining or two boat surface trawls. Captured fish were exposed to black light within a dark box and tested with a CWT detector to determine if fish were marked.



(Photos courtesy of WDFW)

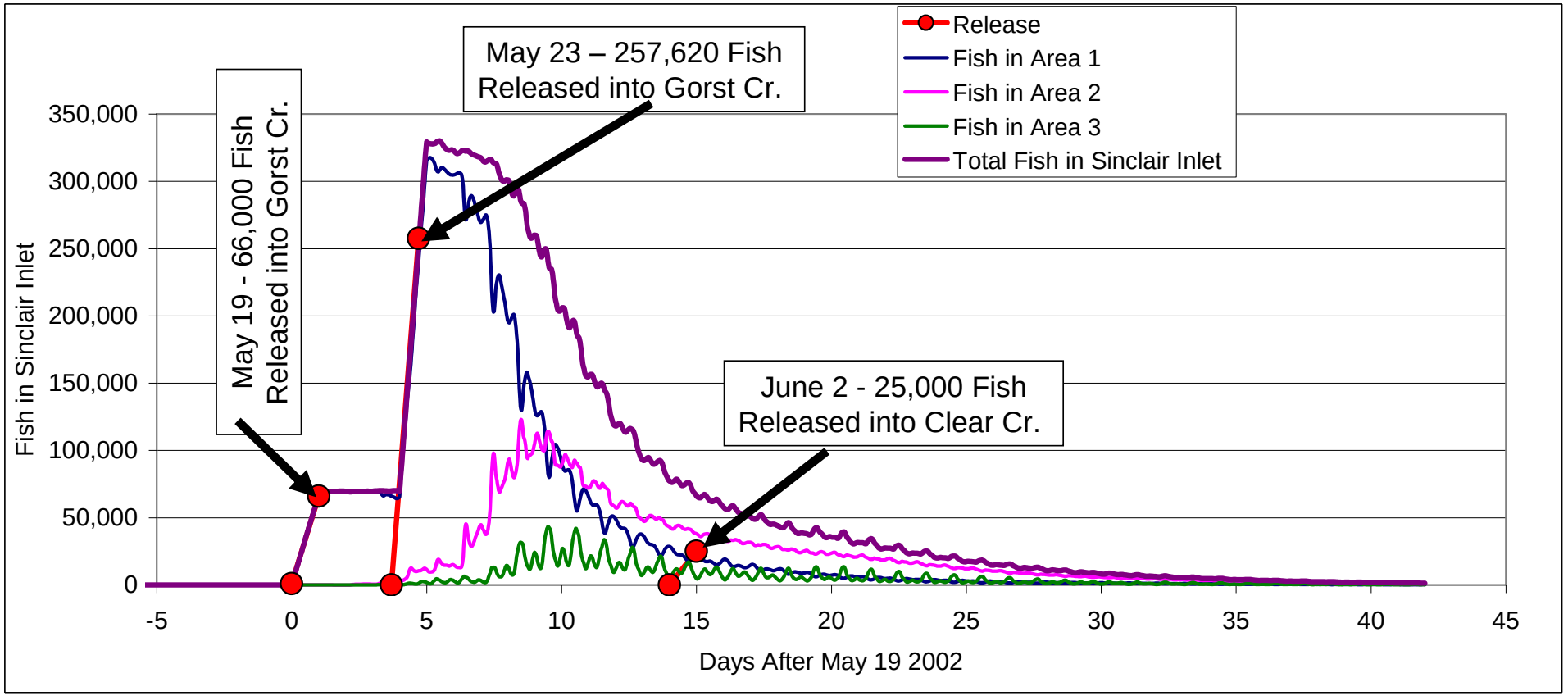
Recapture Sampling Stations in Sinclair Inlet



Simulated Release

The CH3D model was set up to recreate the tide, wind, and fresh water flow during the release period. The tracer was scaled to represent the number of marked fish released:

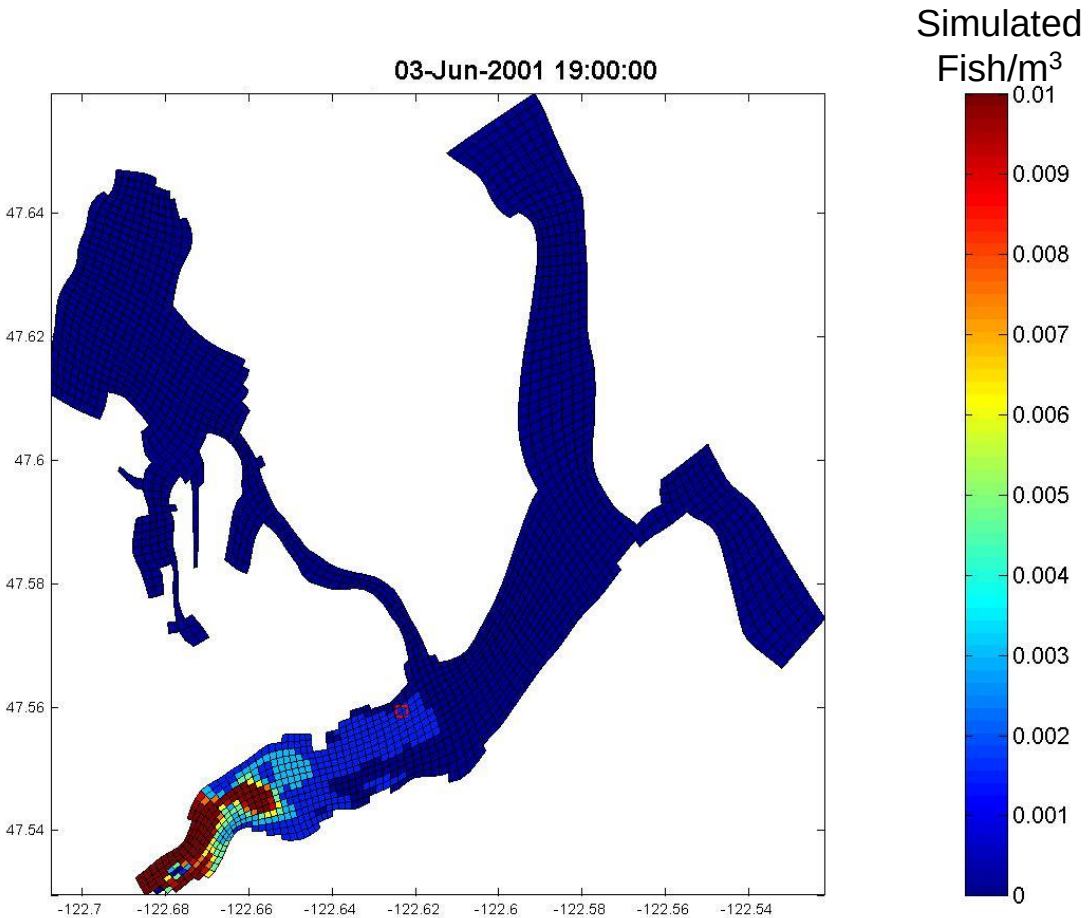
- May 19: 66,000 Fish released into Gorst Creek
- May 23: 257,620 Fish released into Gorst Creek
- Jun 2: 25,000 Fish released into Clear Creek



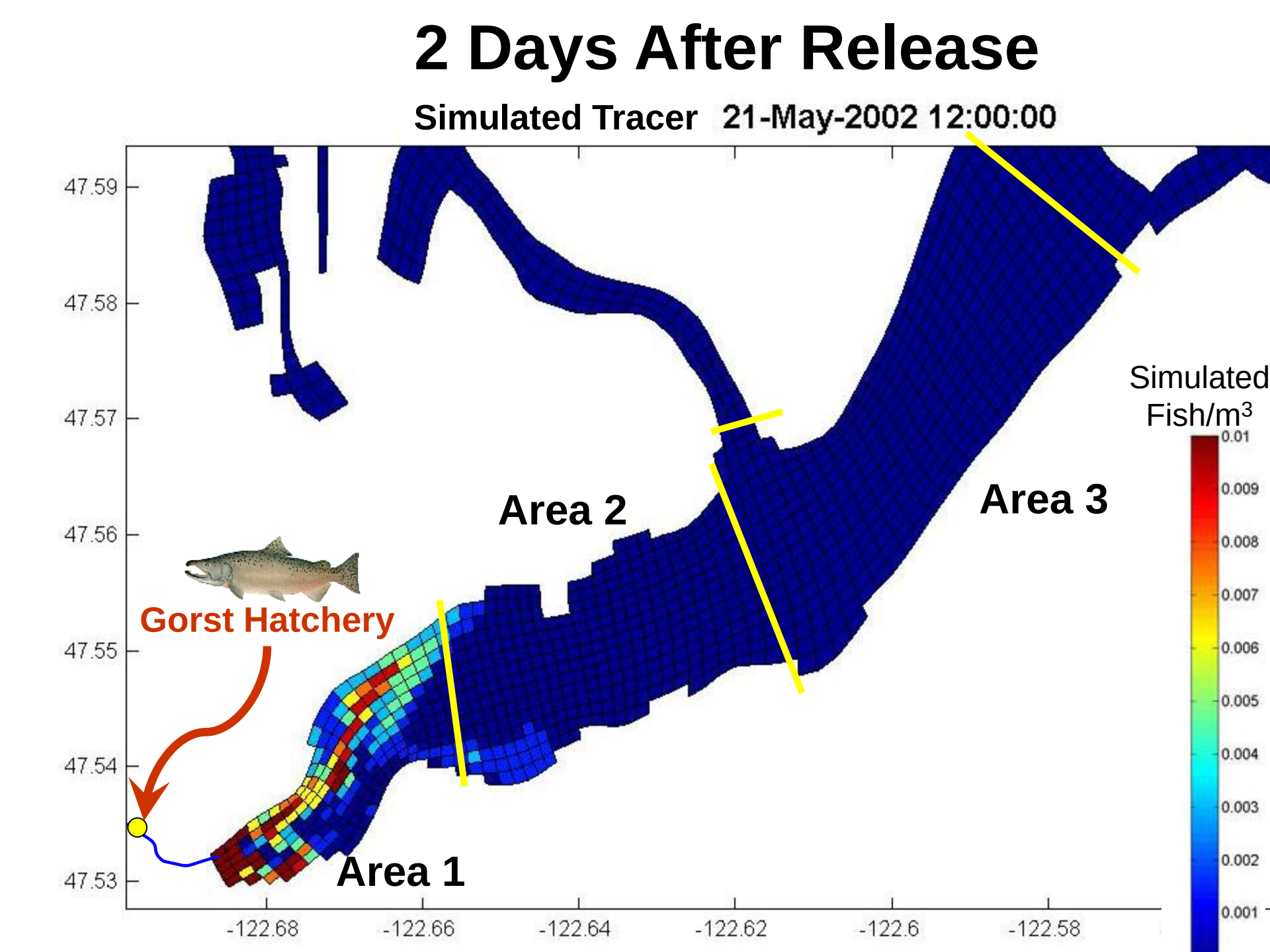
Results

The model simulated the release of a conservative “tracer” that corresponded to when the majority of the marked fish were released into Gorst Creek. The model simulated dispersal of the “tracer” plume as a function of tide and wind-driven currents and fresh water inflow without any biological interactions.

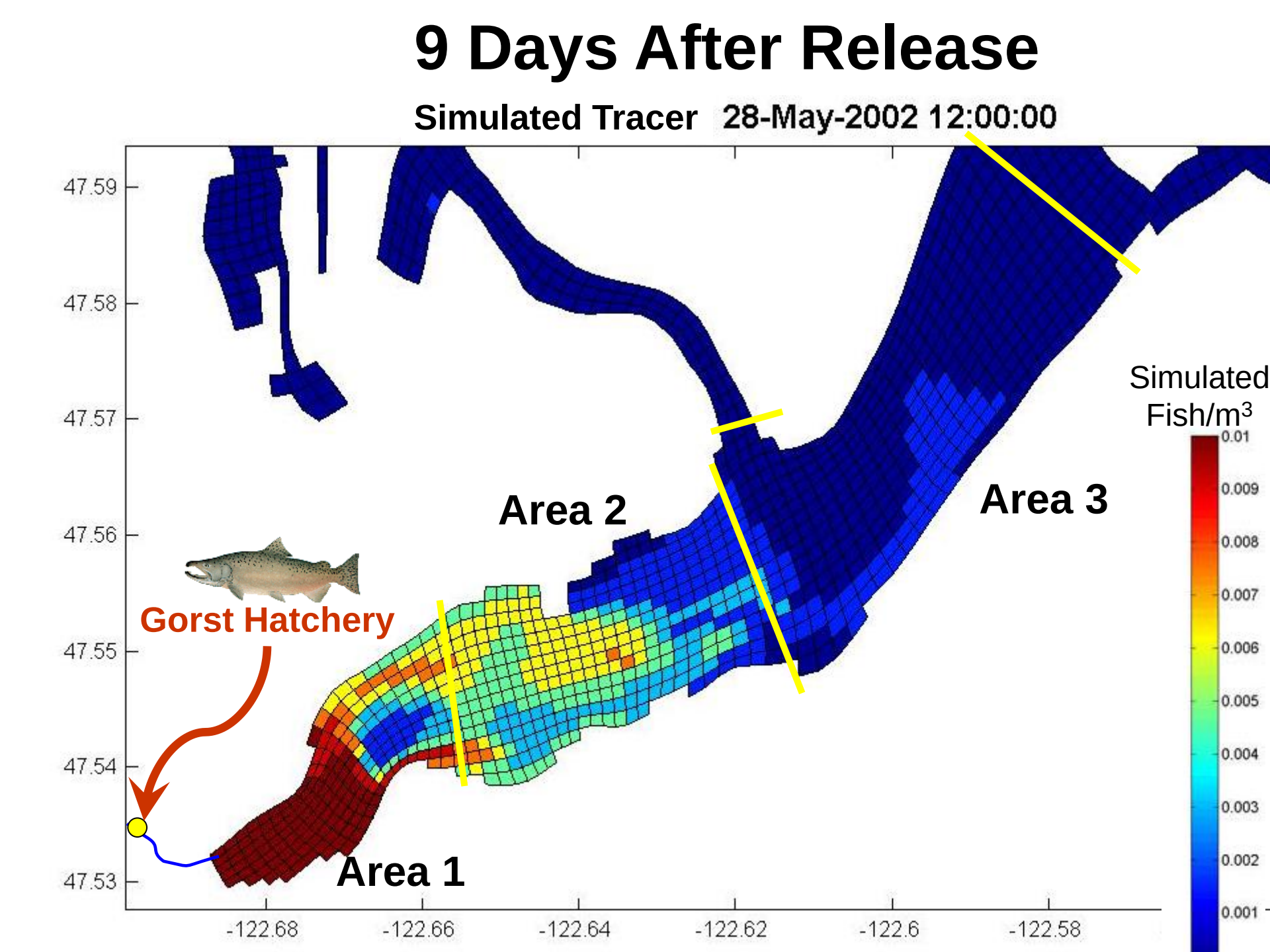
The model produced a time series of tracer concentrations in areas of the Inlet that were sampled during WDFW’s out-migration study. The model results were compared to fish recapture rates to evaluate differences between fish density and the tracer concentrations predicted by the model.



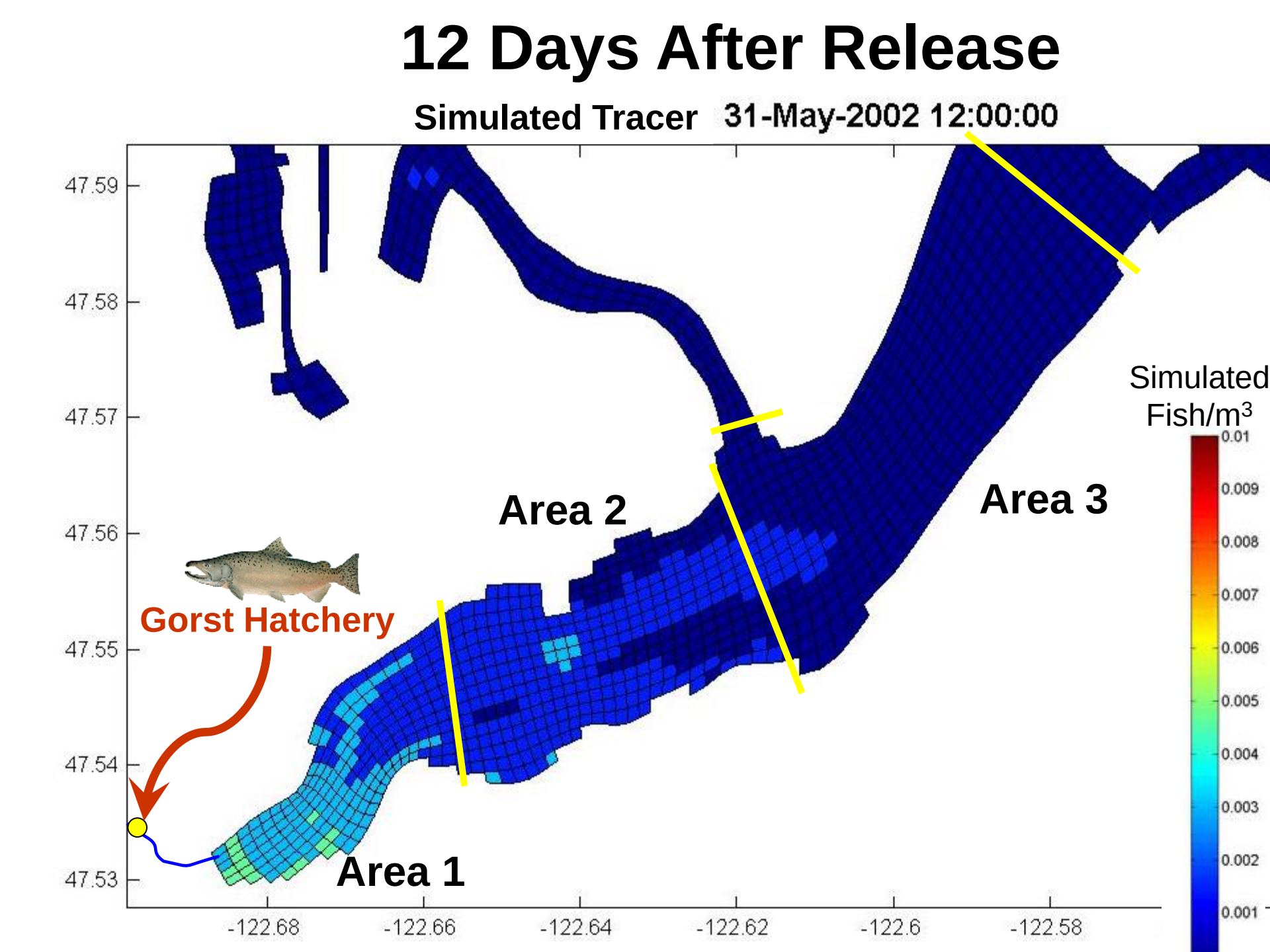
2 Days After Release



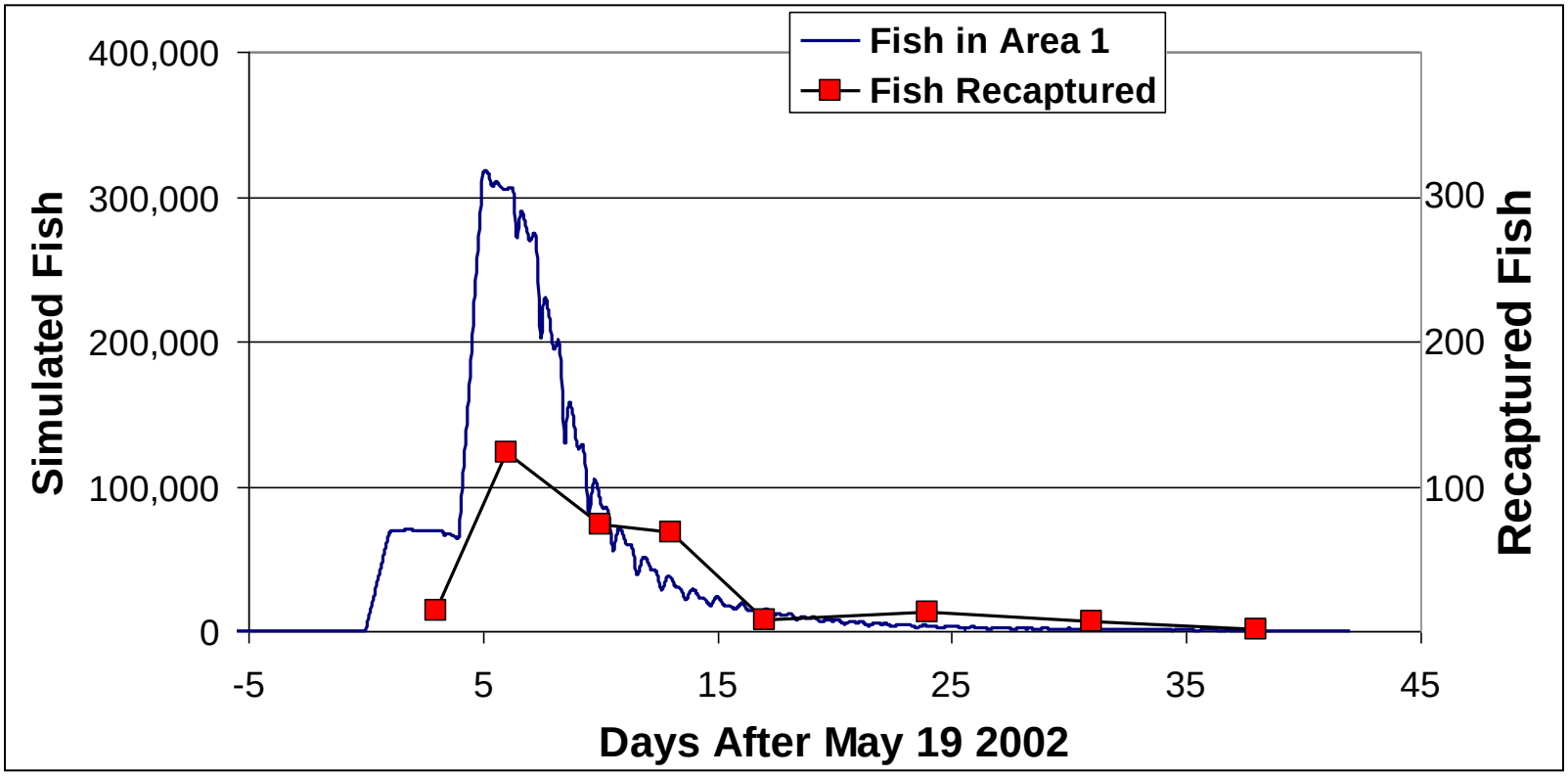
9 Days After Release



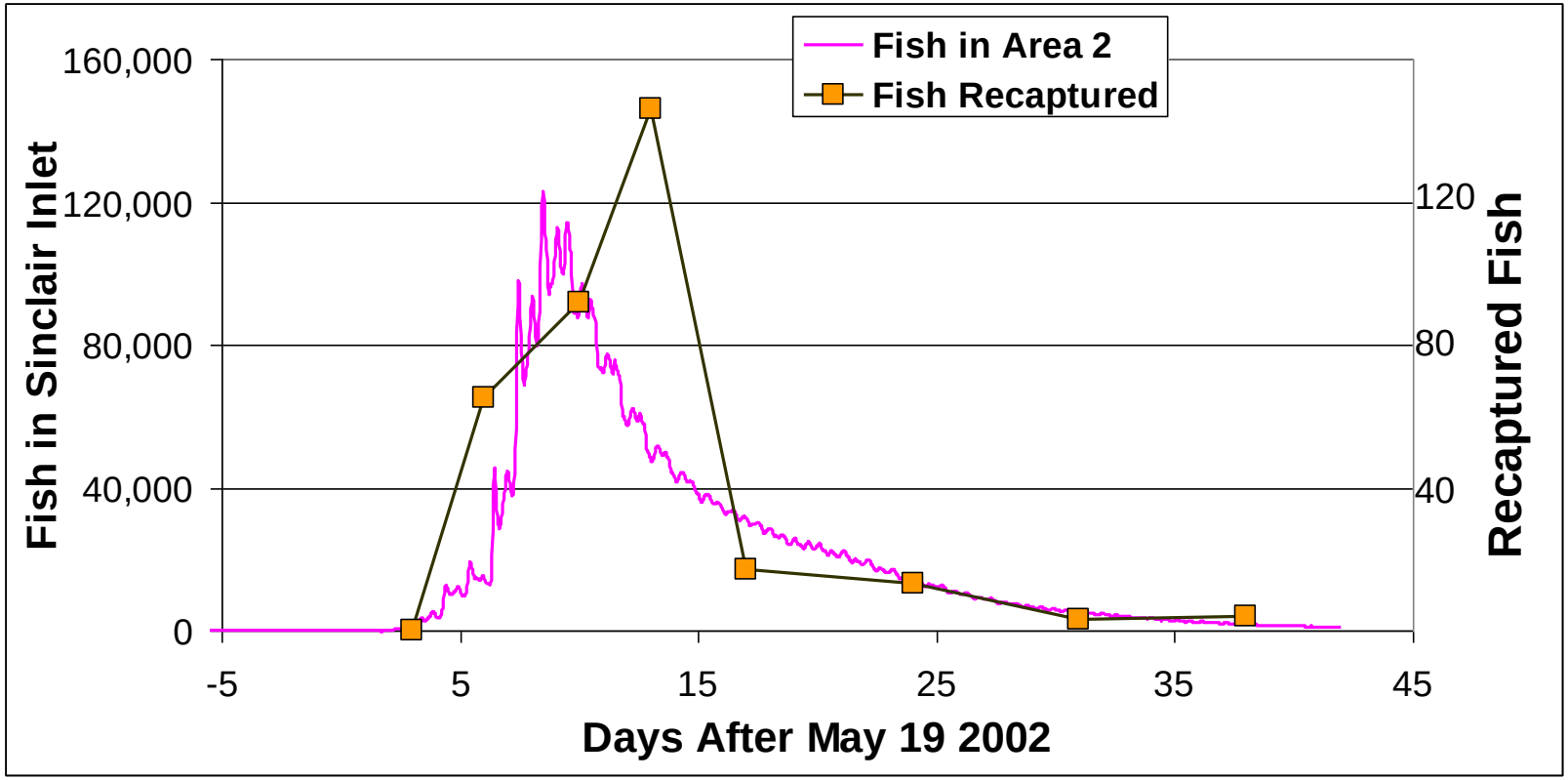
12 Days After Release



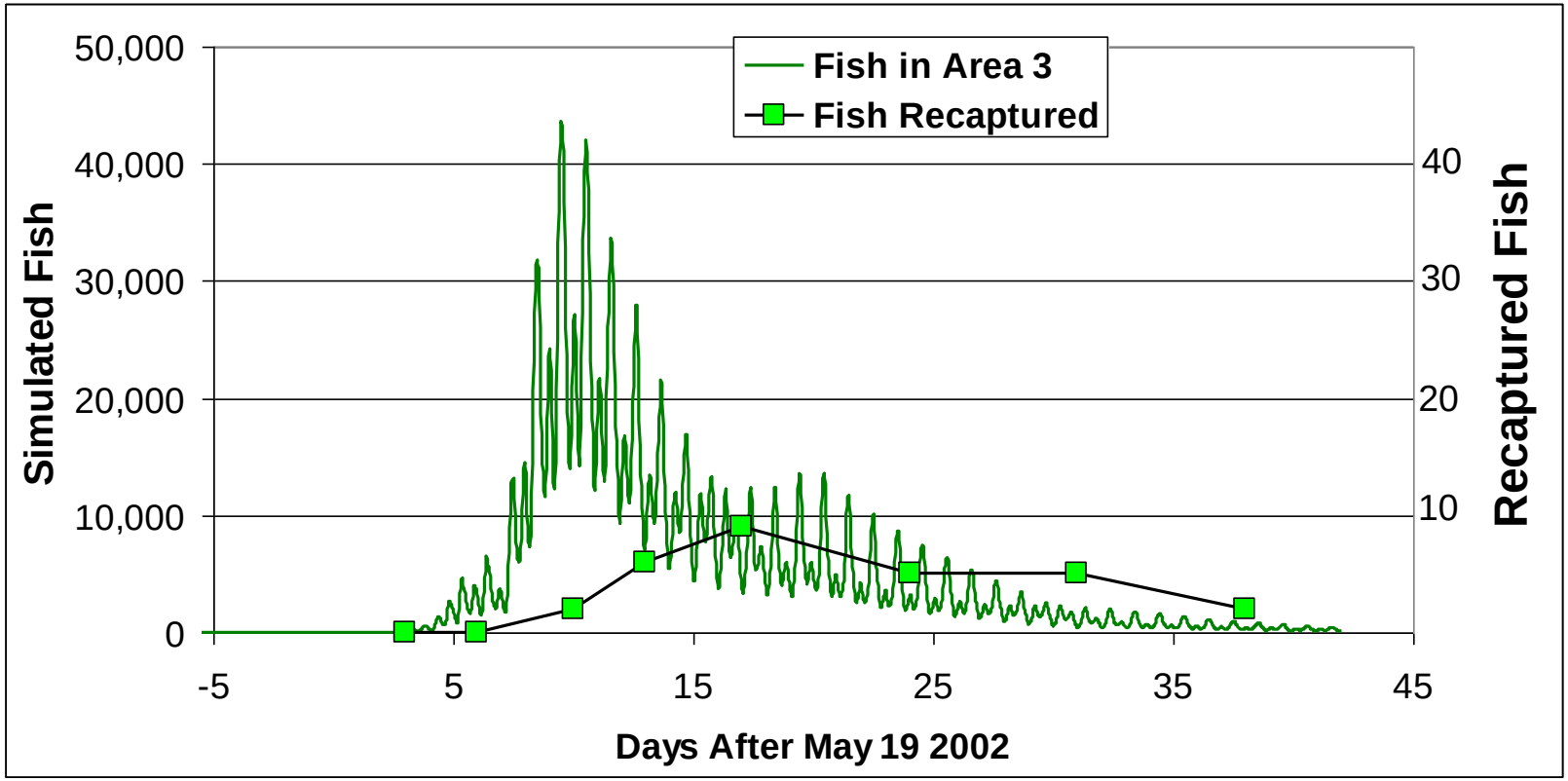
Simulated and Recaptured Fish in Area 1

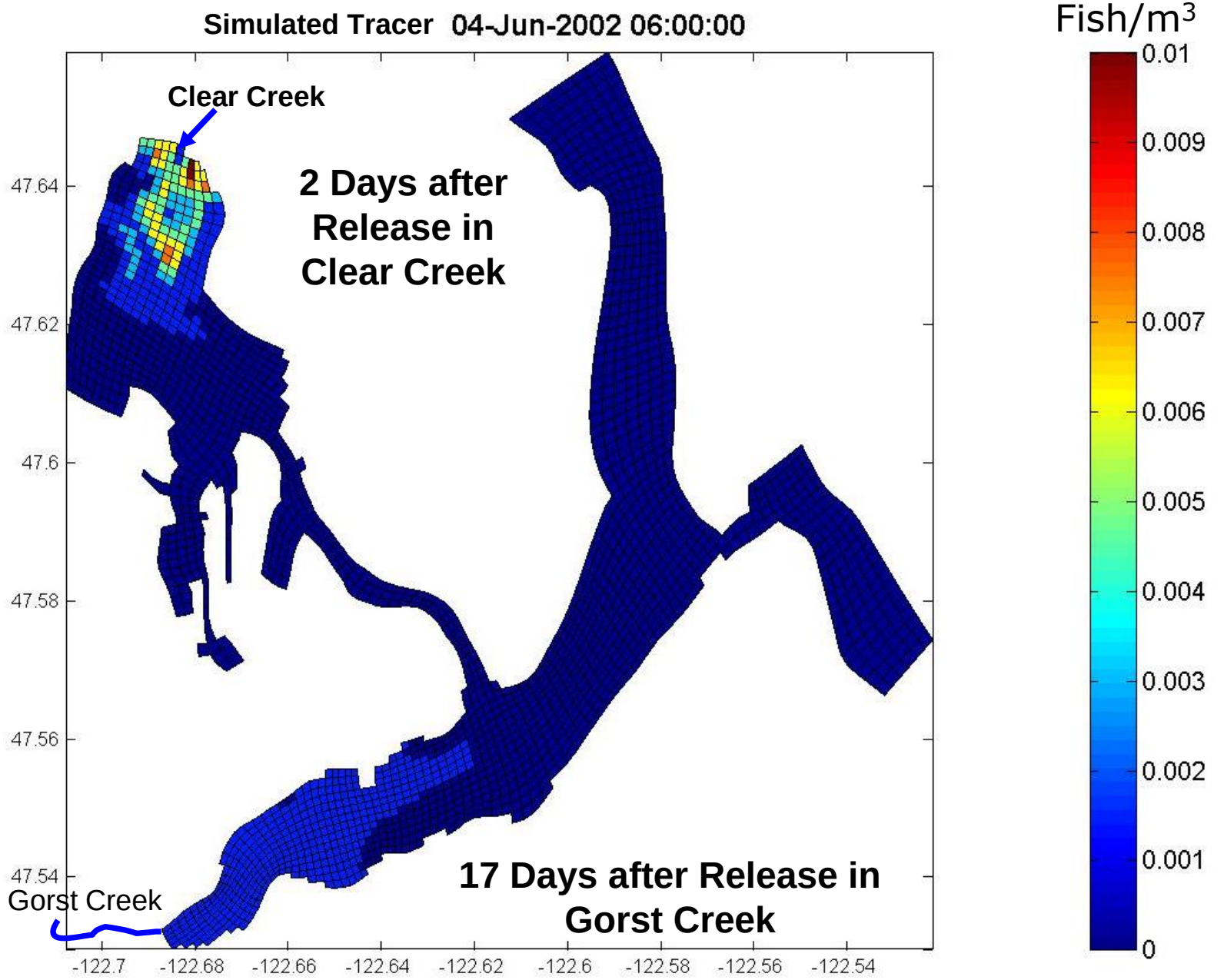


Simulated and Recaptured Fish in Area 2

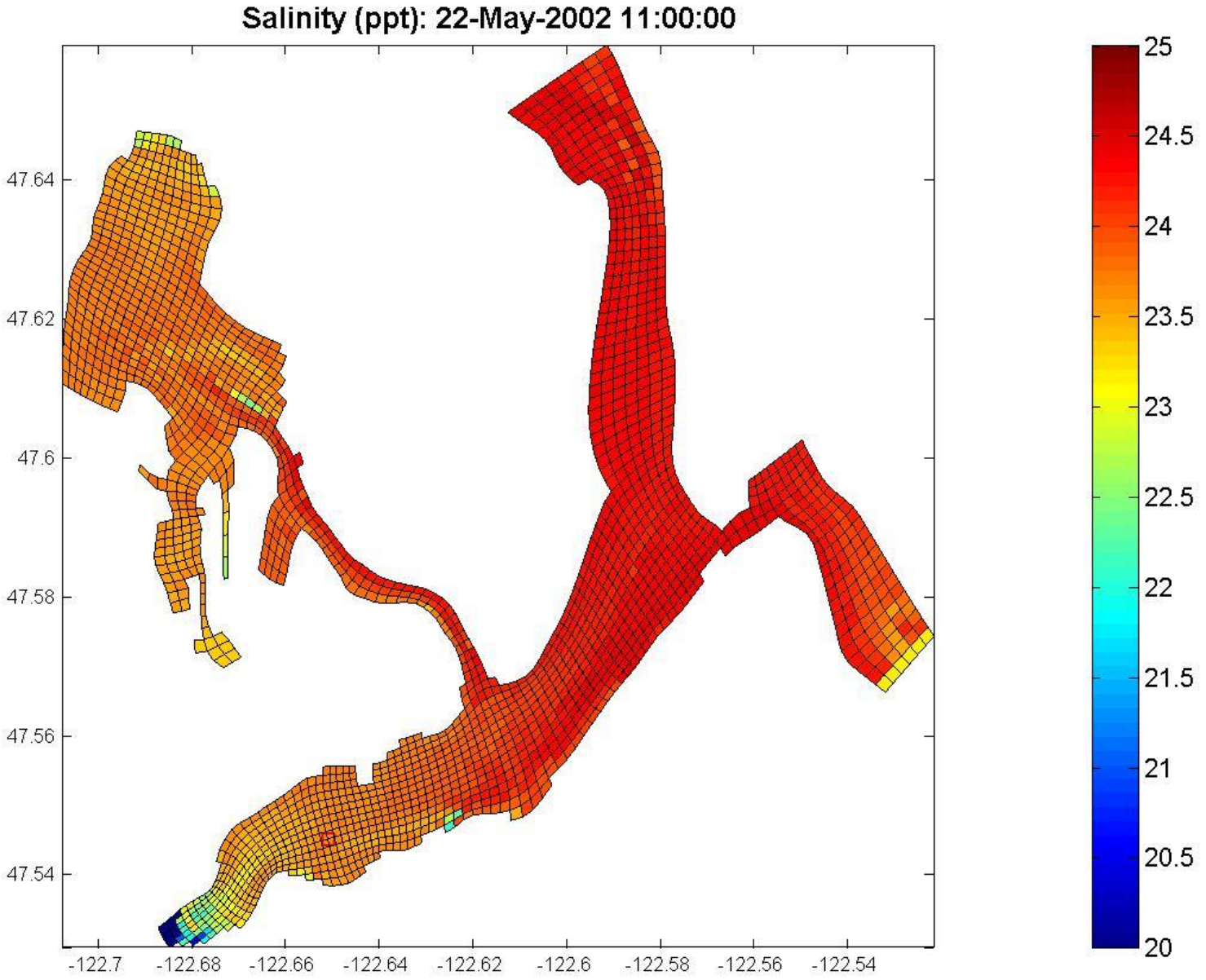


Simulated and Recaptured Fish in Area 3

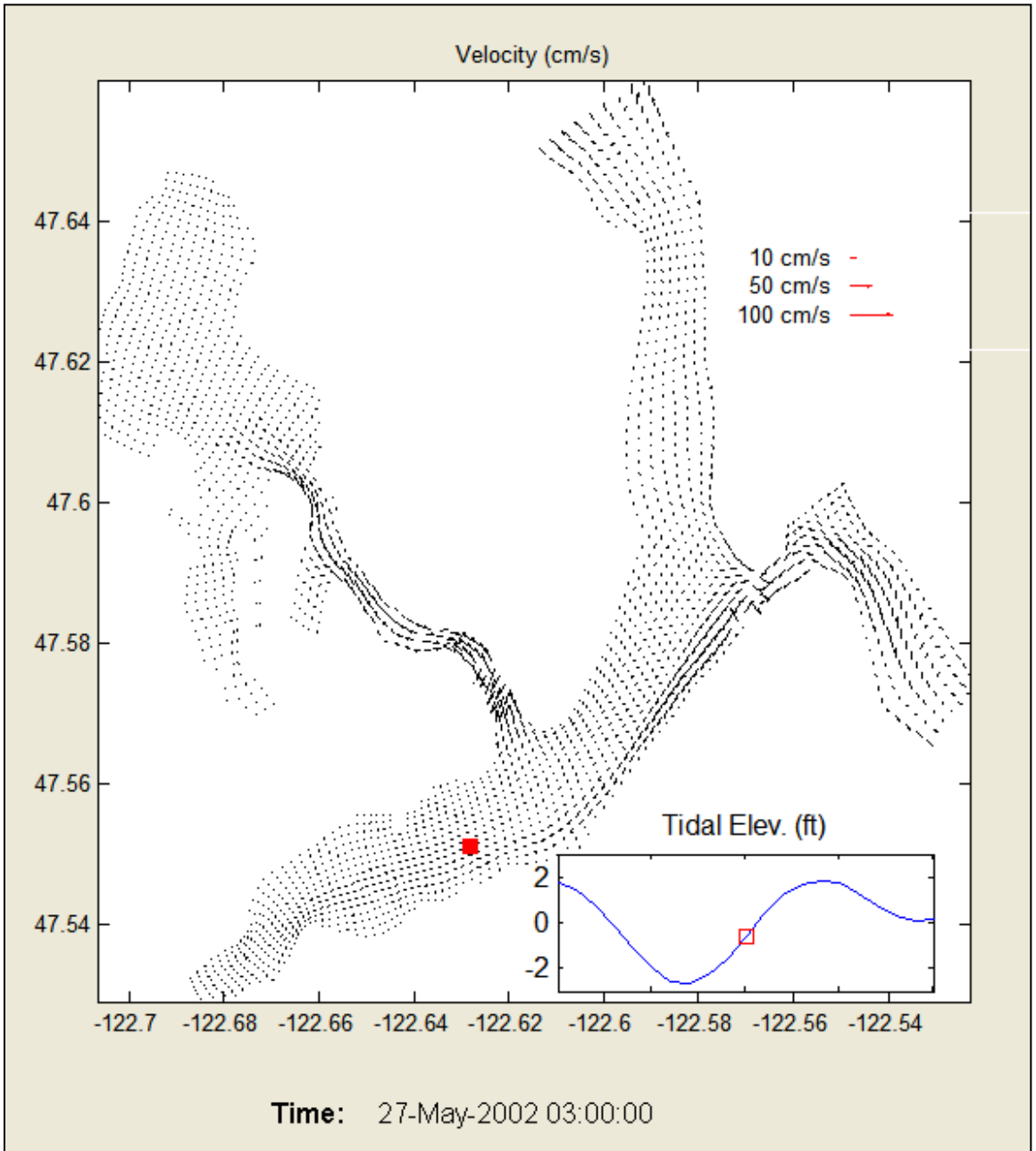



Simulated Tracer 04-Jun-2002 06:00:00
Clear Creek
2 Days after Release in Clear Creek
17 Days after Release in Gorst Creek
Gorst Creek
47.64
47.62
47.6
47.58
47.56
47.54
-122.7
-122.68
-122.66
-122.64
-122.62
-122.6
-122.58
-122.56
-122.54
Simulated Fish/m3
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0

Simulated Salinity Distribution



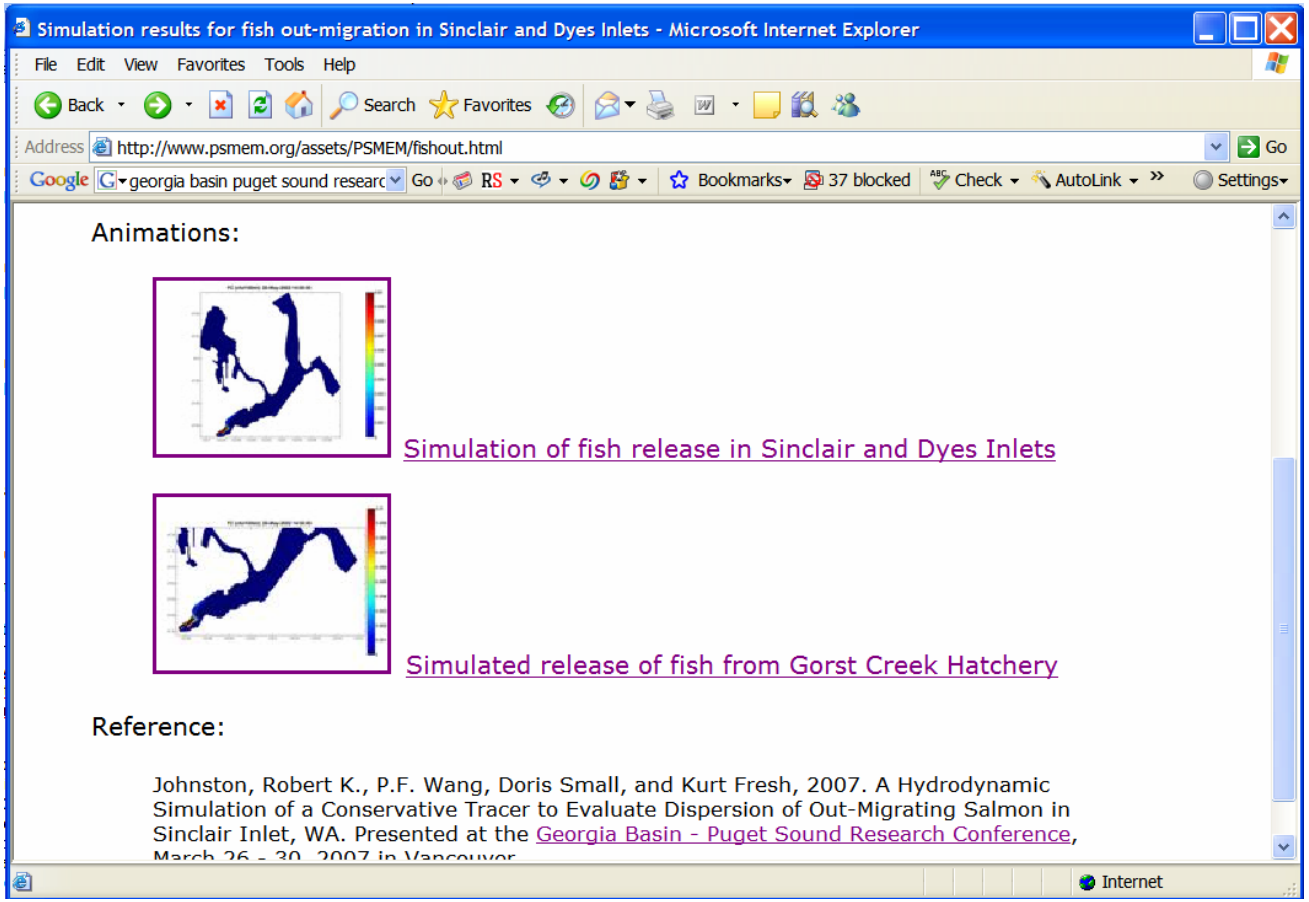
Simulated Currents



Link to Animations

Click link to load page with animation of simulation results:

http://www.mesodat.org/Public/Envvest/Docs/psmem/



Conclusions

- The hydrological and tidal conditions from 19 May - 30 Jun 2002 were simulated to recreate the currents and salinity distribution during the study.

- The tracer dispersion was determined by mixing.

- The out-migrating juvenile salmon remained in the Inlet about 3 to 7 days longer than expected from dispersion due to mixing alone.

References:

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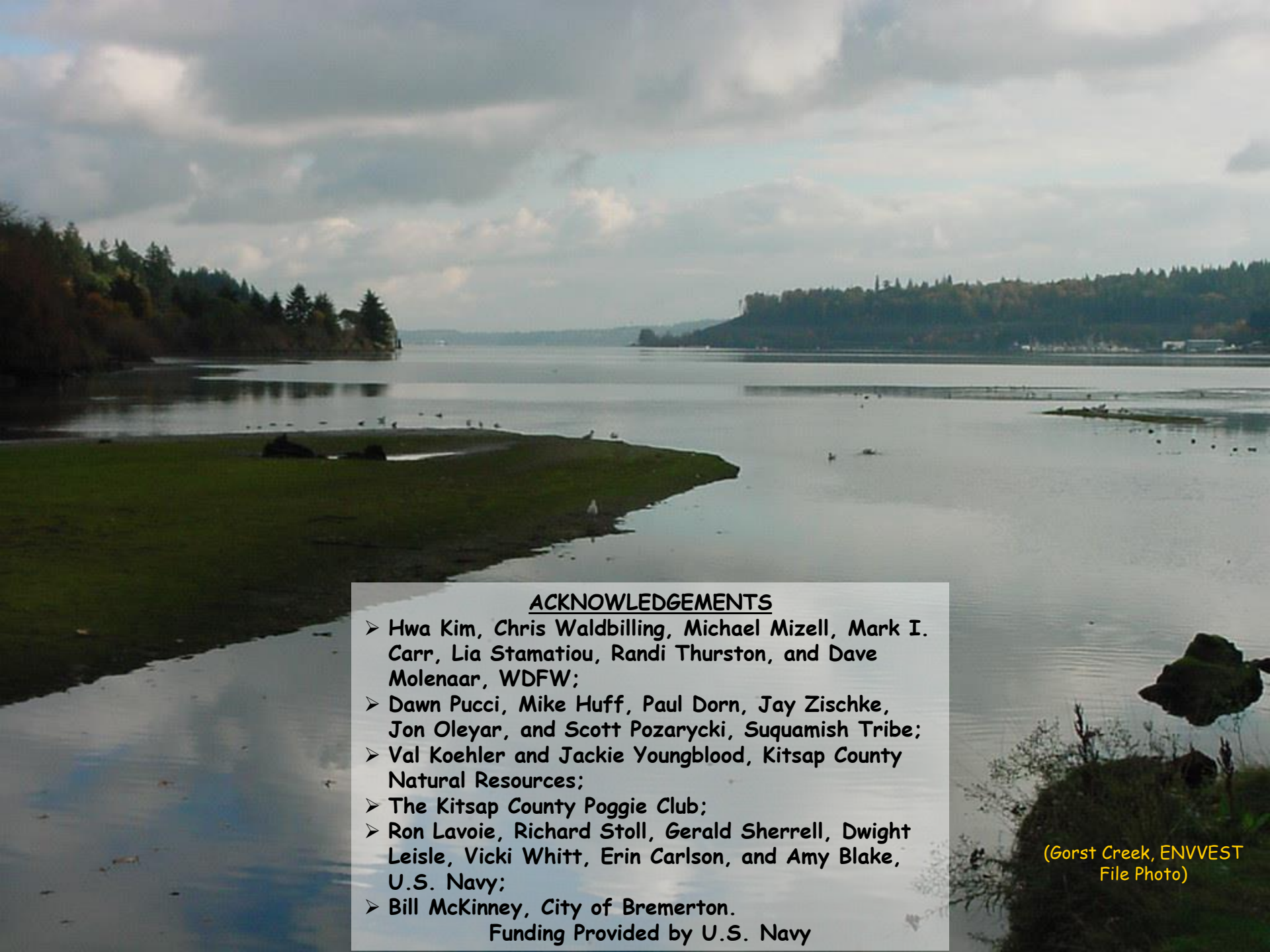

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(Gorst Creek, ENVVEST File Photo)