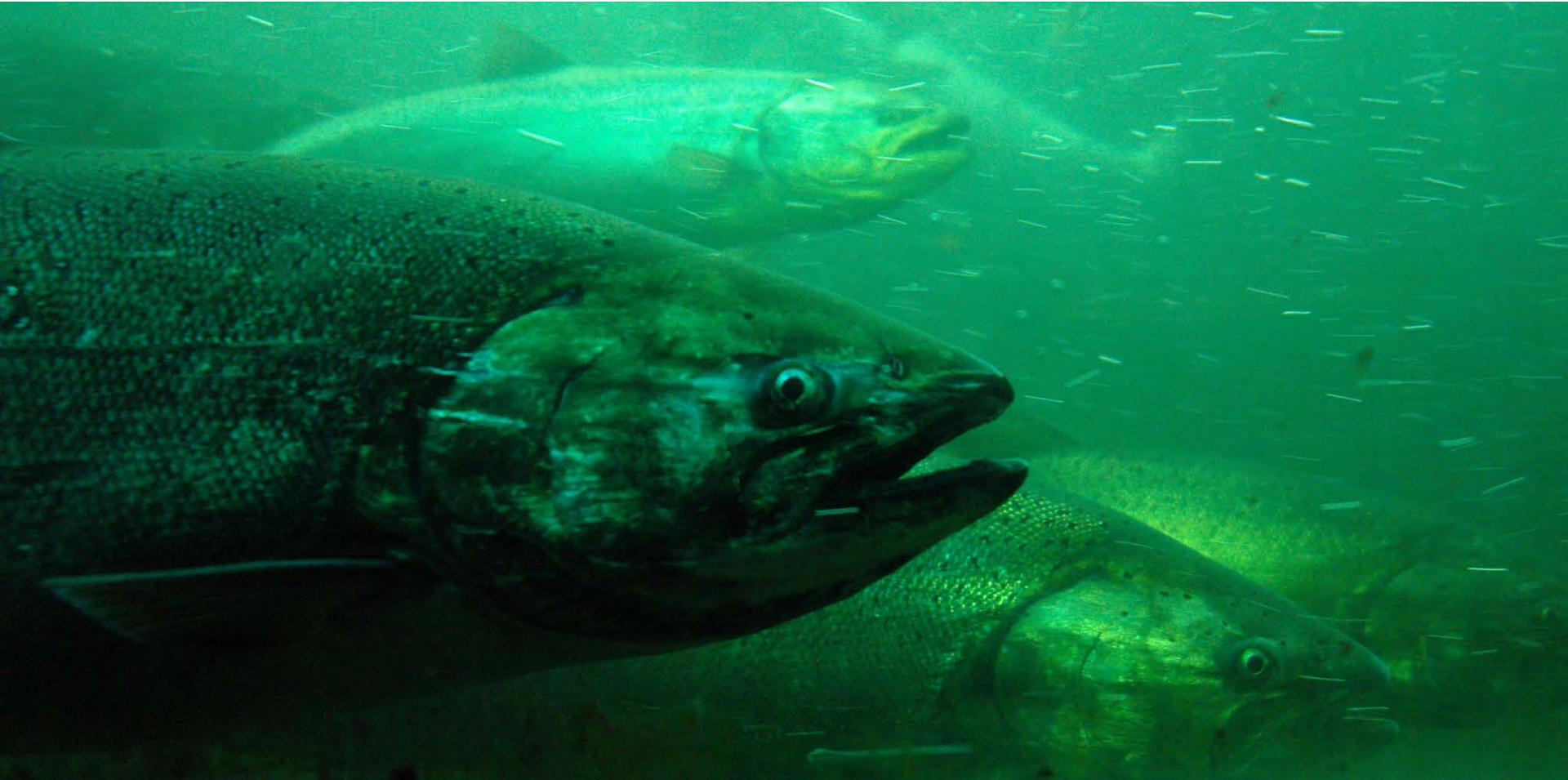


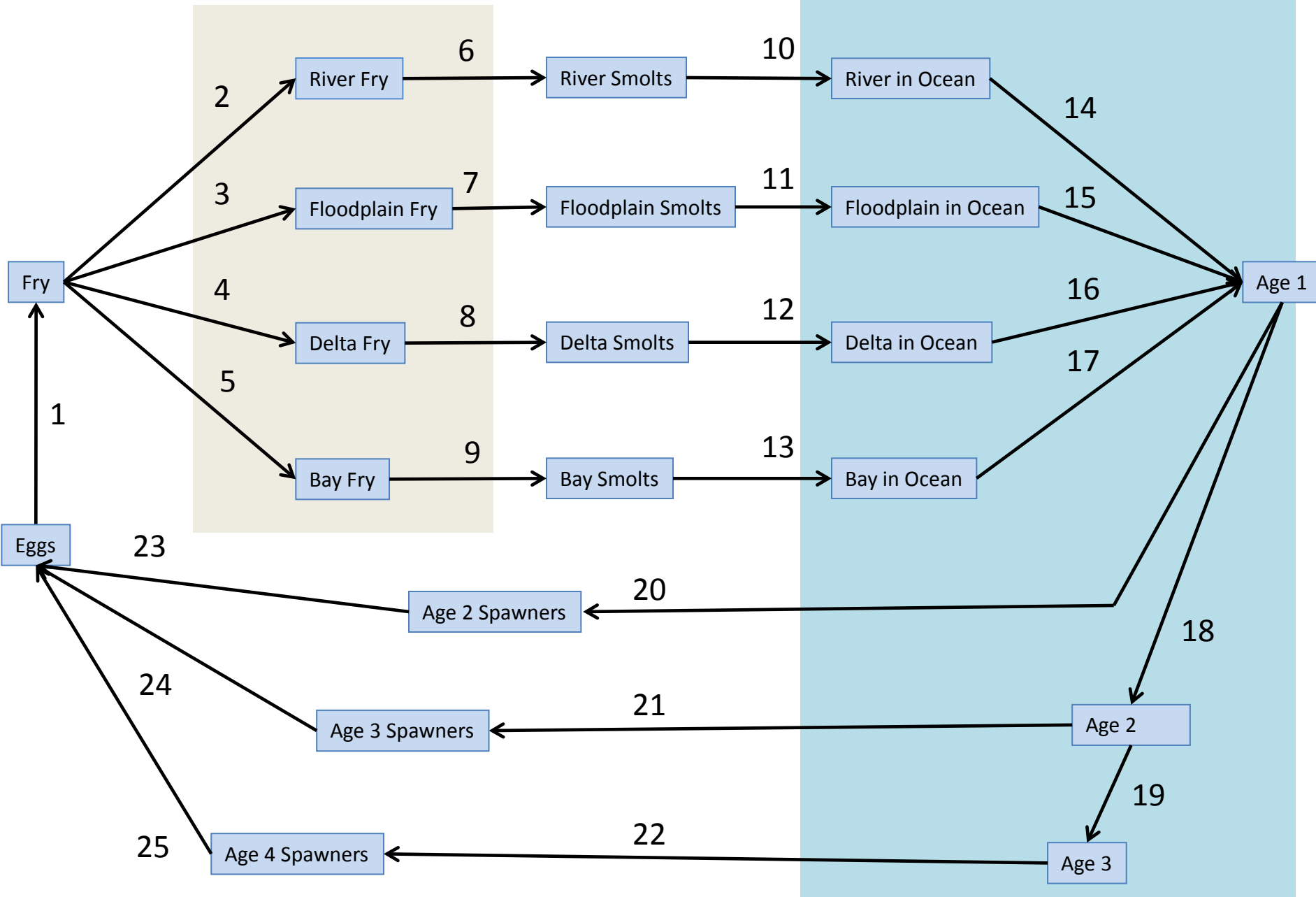
NMFS Chinook Life Cycle Model

Steve Lindley and Doug Jackson, NMFS SWFSC, UCSC IMS



Freshwater Rearing

Ocean Rearing



Mortality

- λ = mean free path length of prey
- ω = mean squared random encounter speed of prey and predators
- x = distance
- t = time
- S = prey survival probability

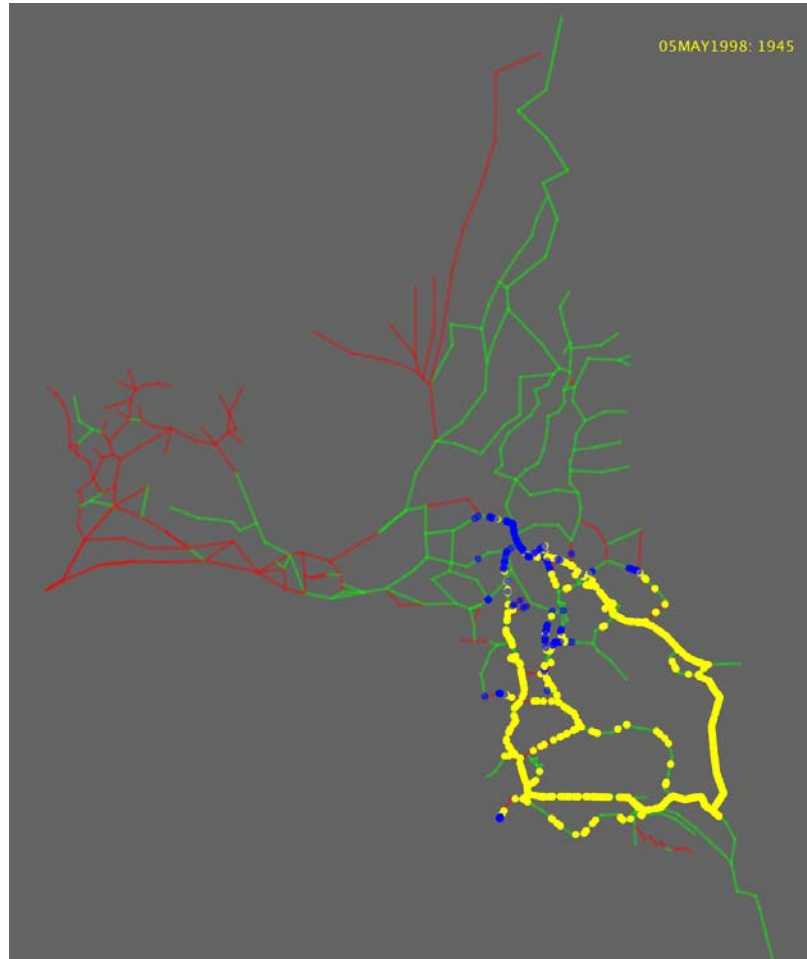
$$S = \exp\left(-\frac{1}{\lambda} \sqrt{x^2 + \omega^2 t^2}\right)$$

Particle modifications

- Behaviors:
 - Swim along channel
 - Drift
 - Hold position
- Cues
 - Direction
 - Flow
 - Tidal phase
 - Salinity
 - Day/night
 - Turbidity

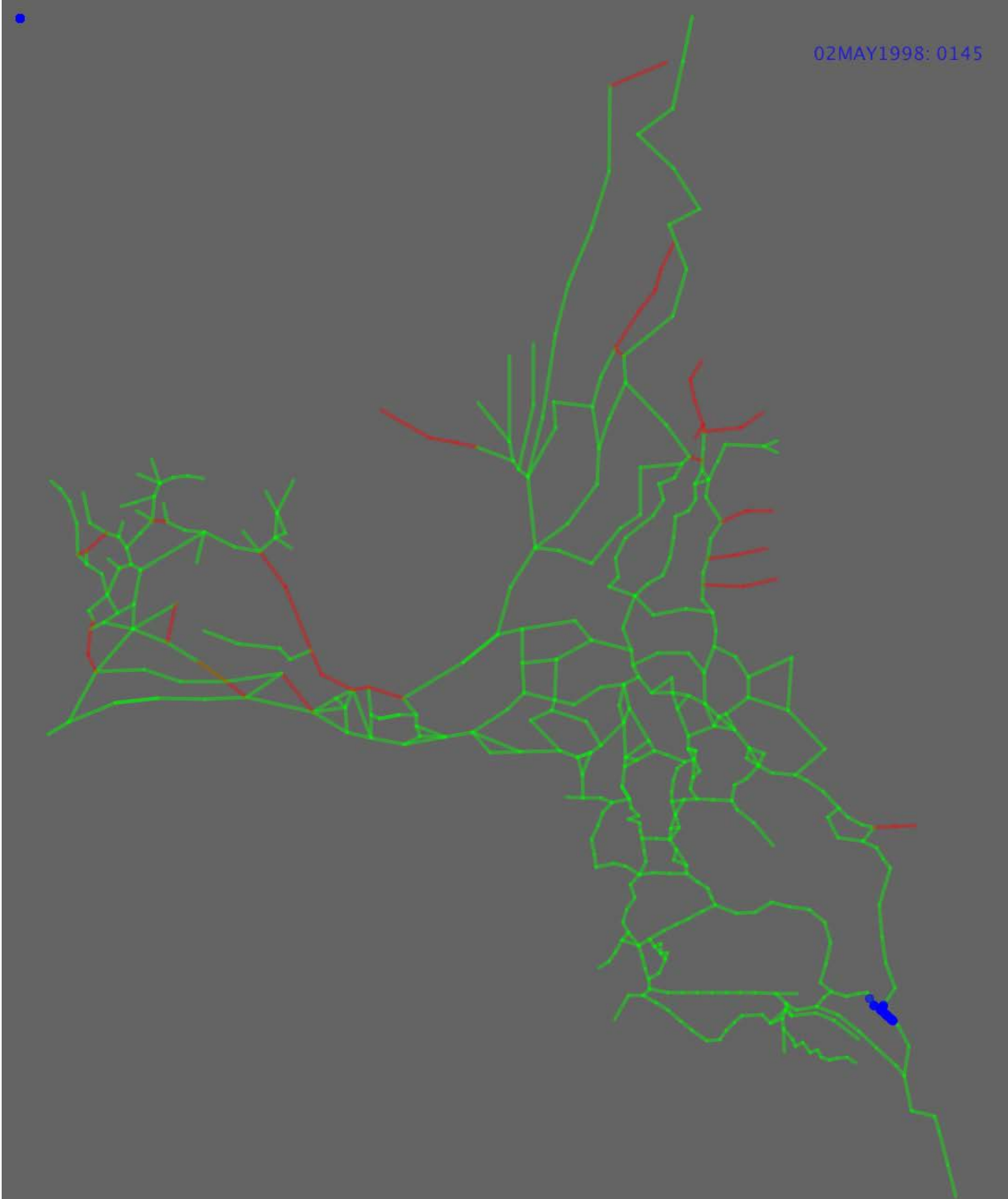
Legend

- alive
- dead
- downstream flow
- upstream flow



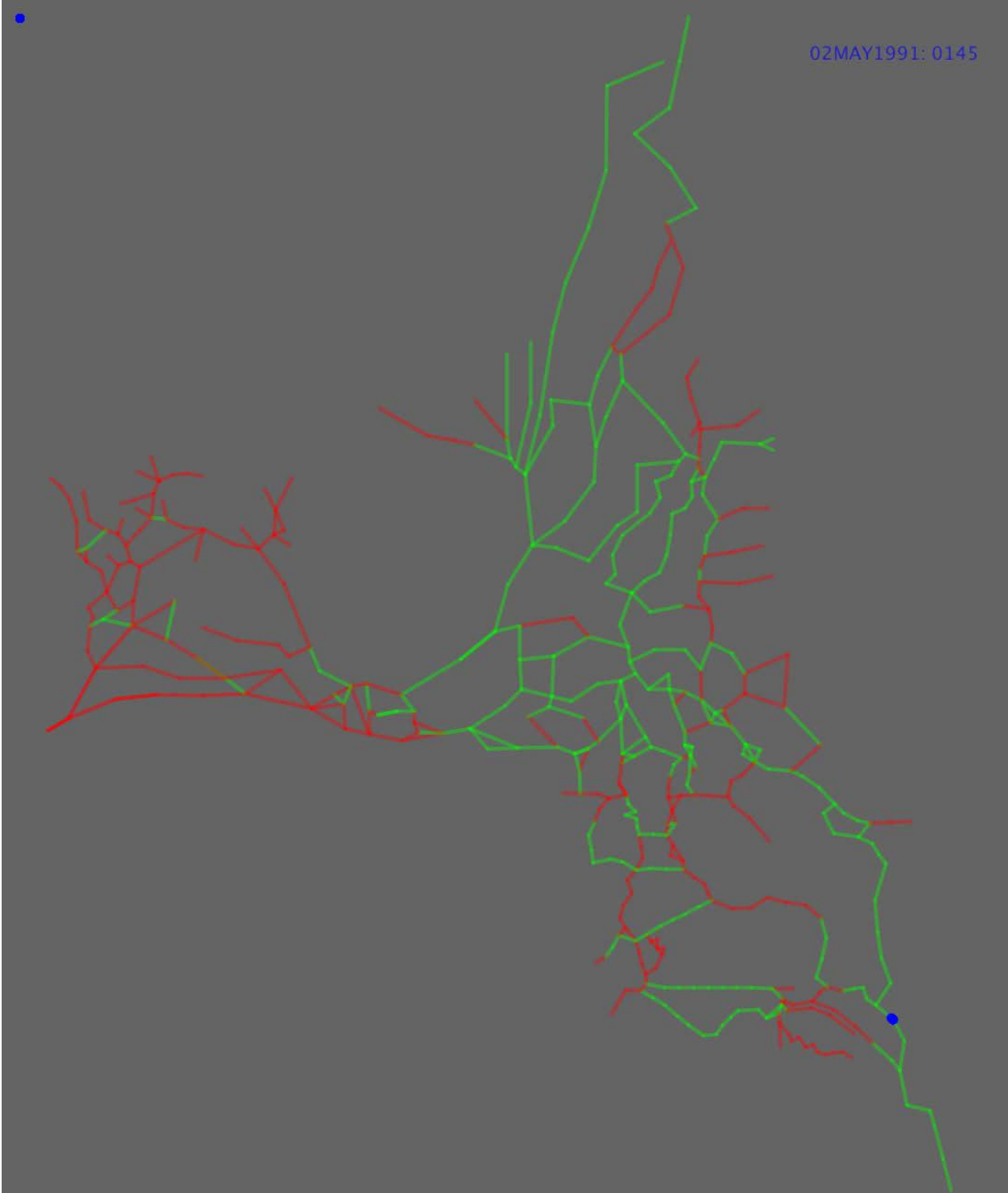
Passive particles with mortality

02MAY1998: 0145

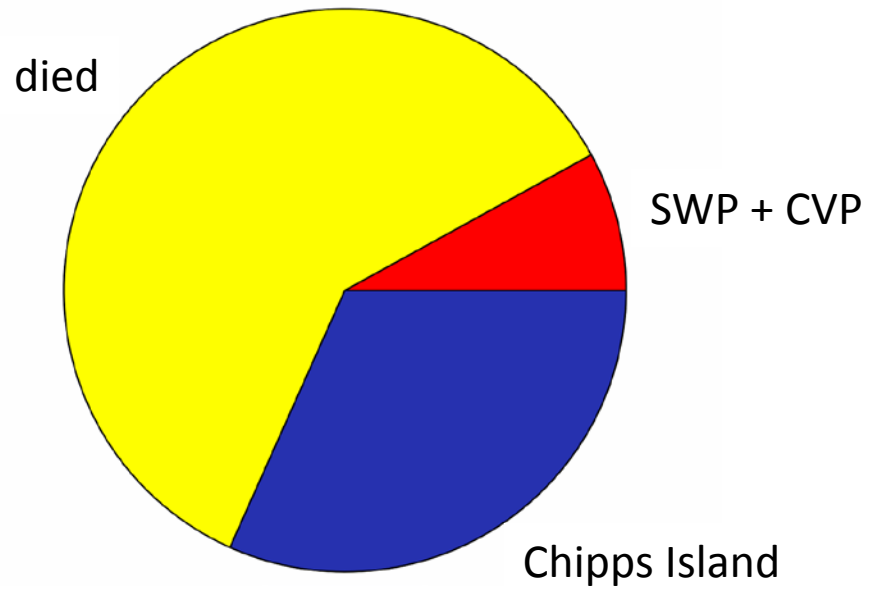


Particles swim with flow on falling tide; otherwise hold

02MAY1991: 0145



Legend



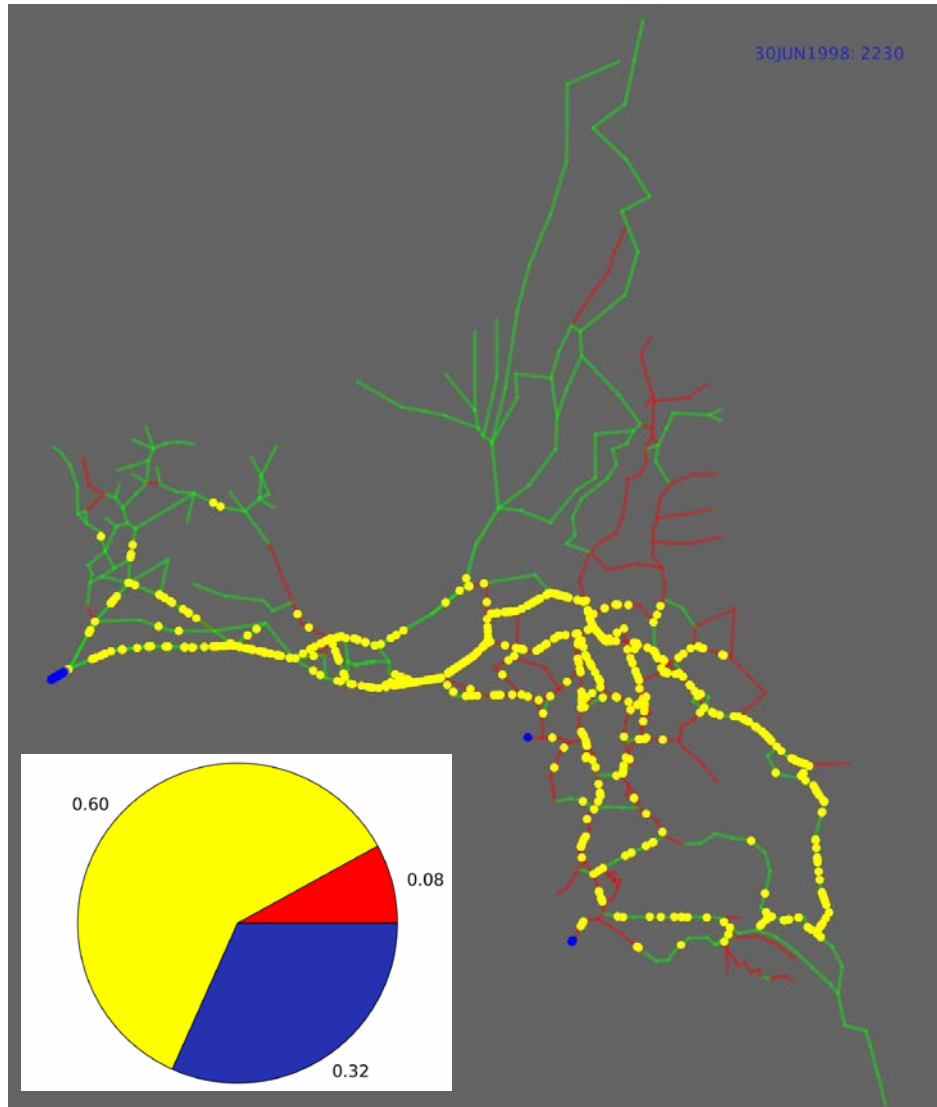
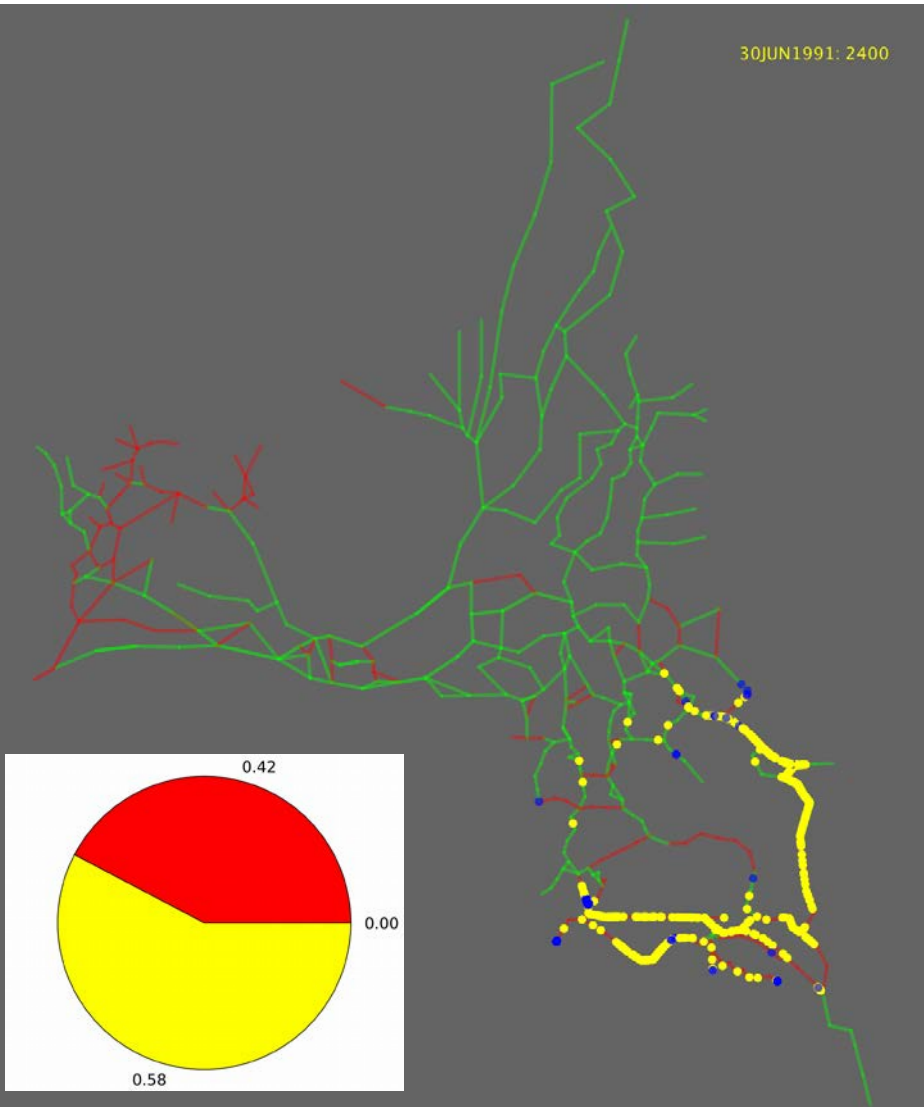
Low predation, passive particles

May-June 1991

May-June 1998

30JUN1991: 2400

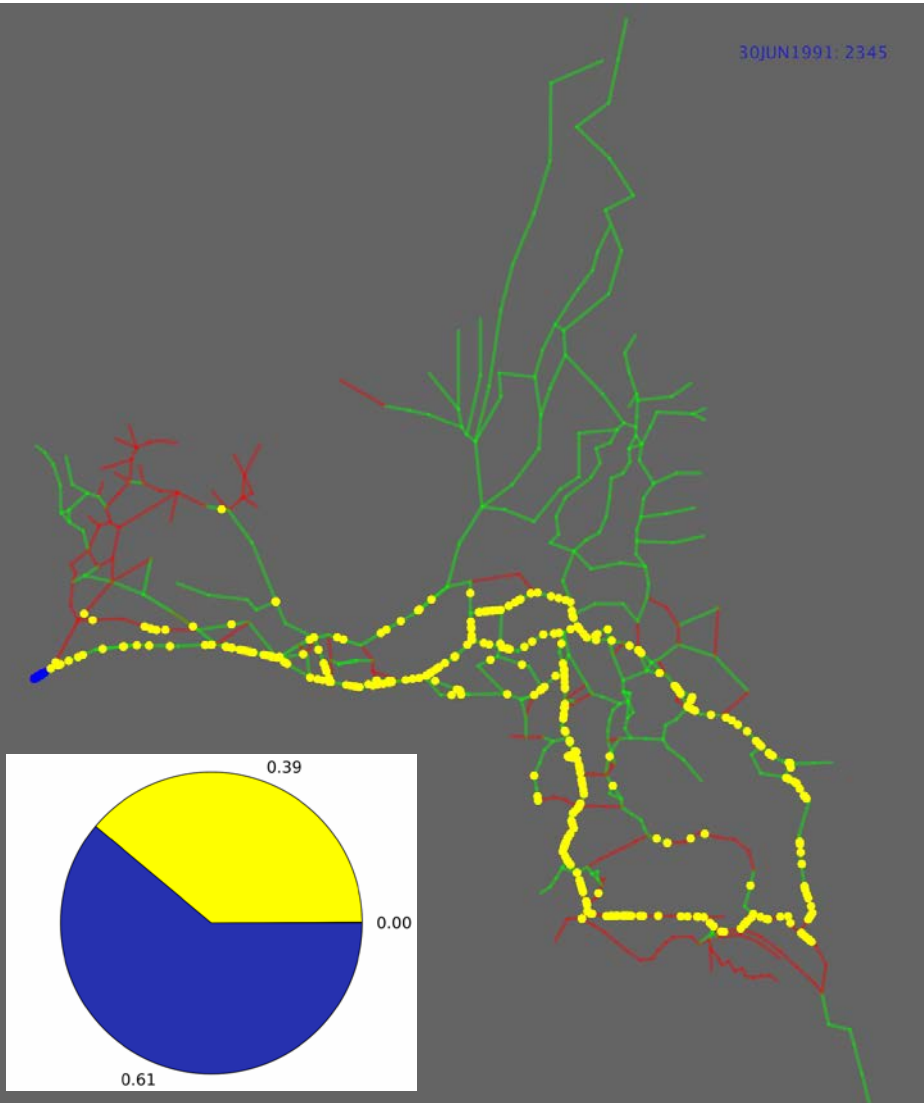
30JUN1998: 2230



Low predation; particles swim towards Bay

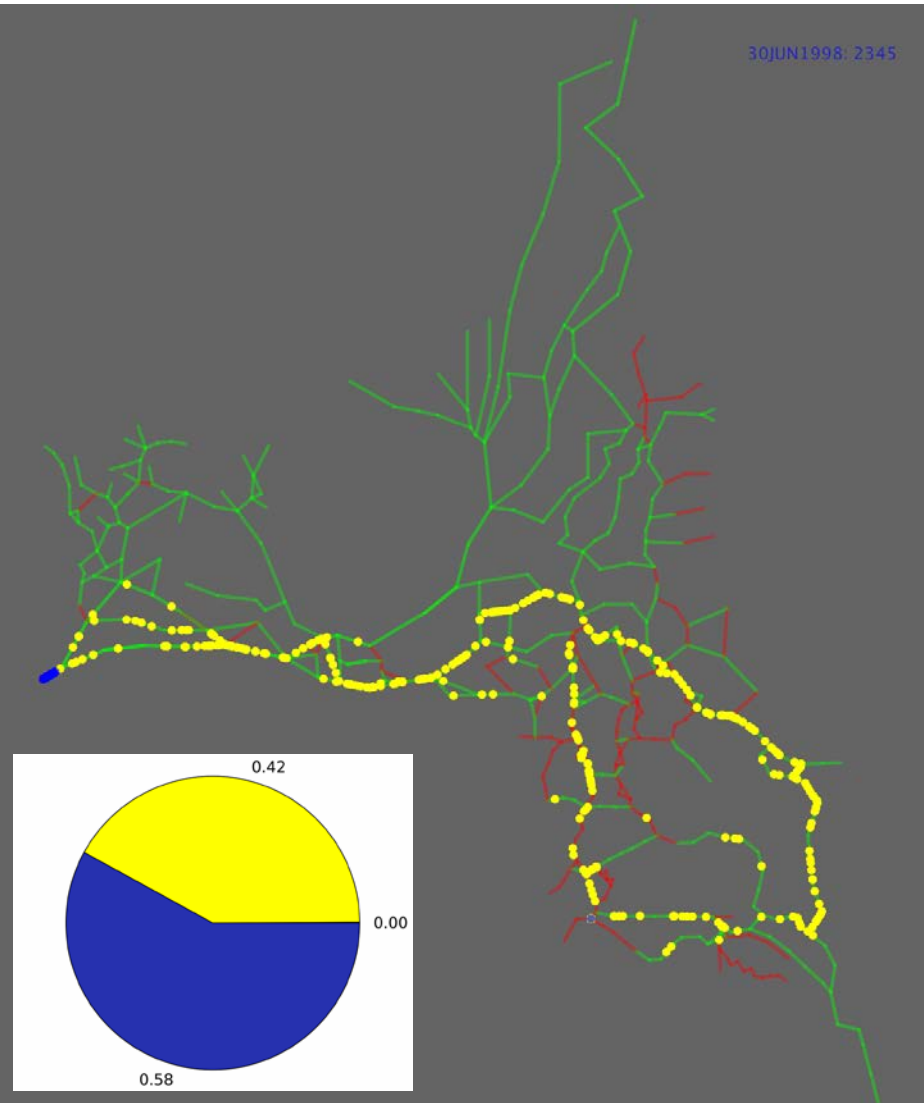
May-June 1991

30JUN1991: 2345



May-June 1998

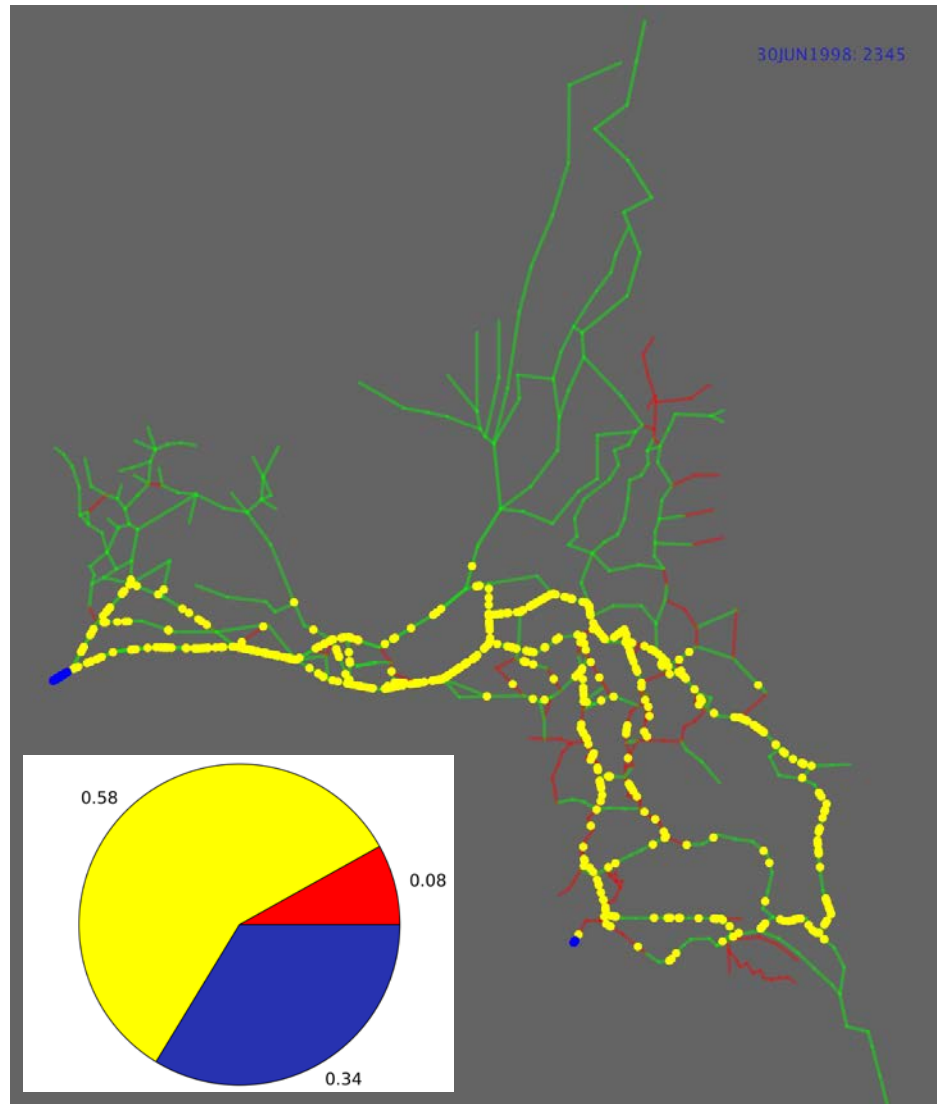
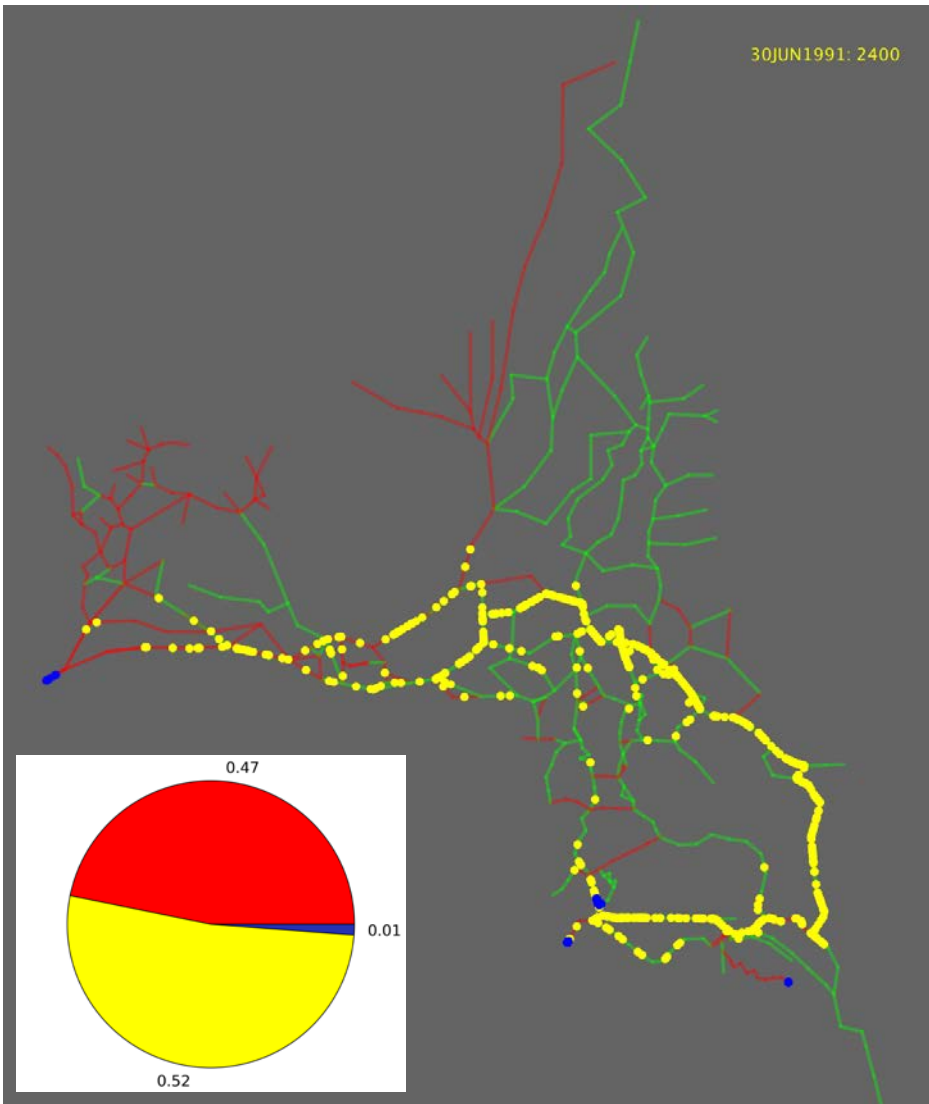
30JUN1998: 2345



Low predation, particles swim with flow
on falling tide

May-June 1991

May-June 1998



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Contributors:

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Pat Brandes (USFWS)

DWR DSM2 Team

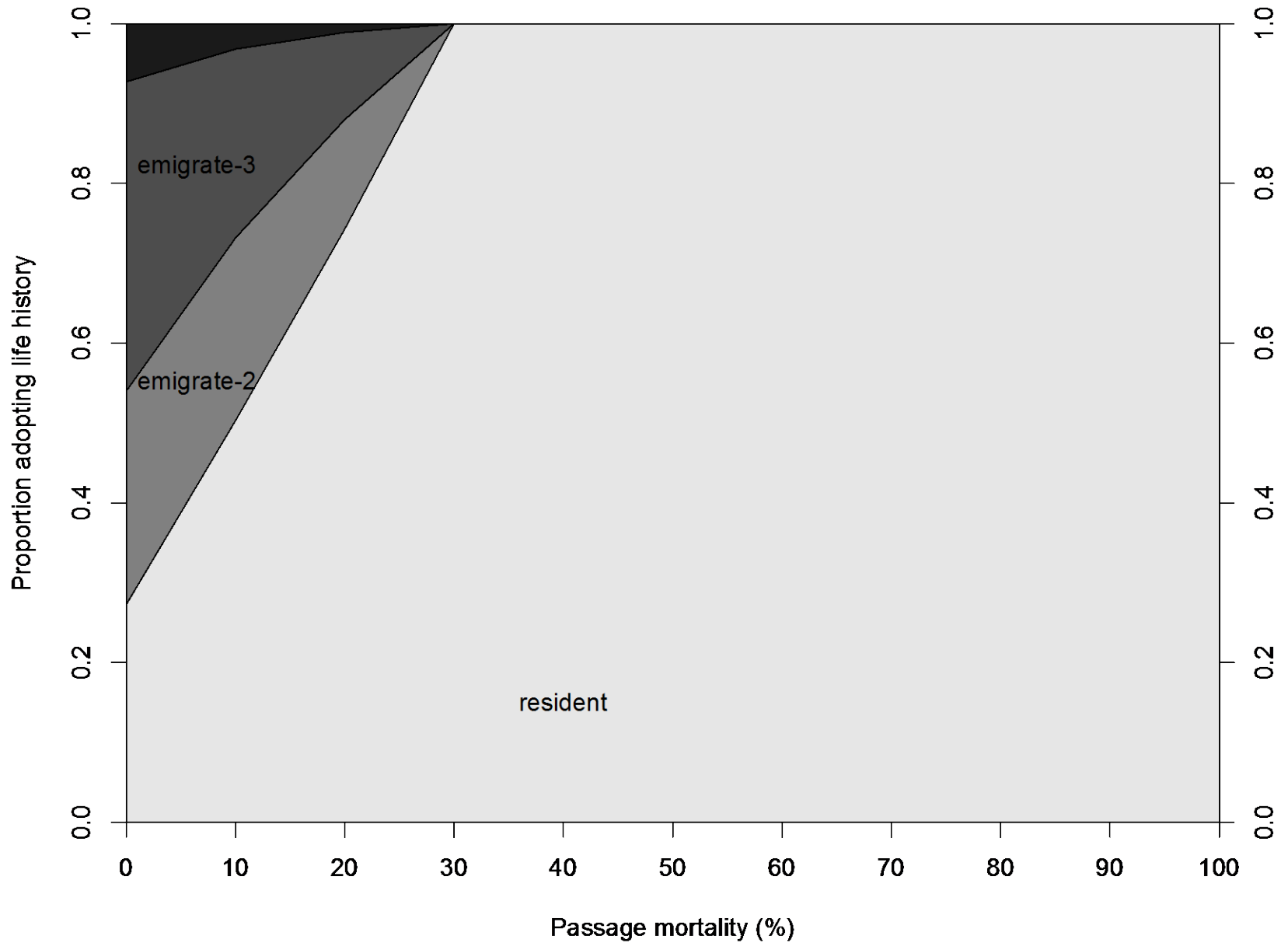
Funding:

USBR

NMFS SWRO

NMFS SWFSC

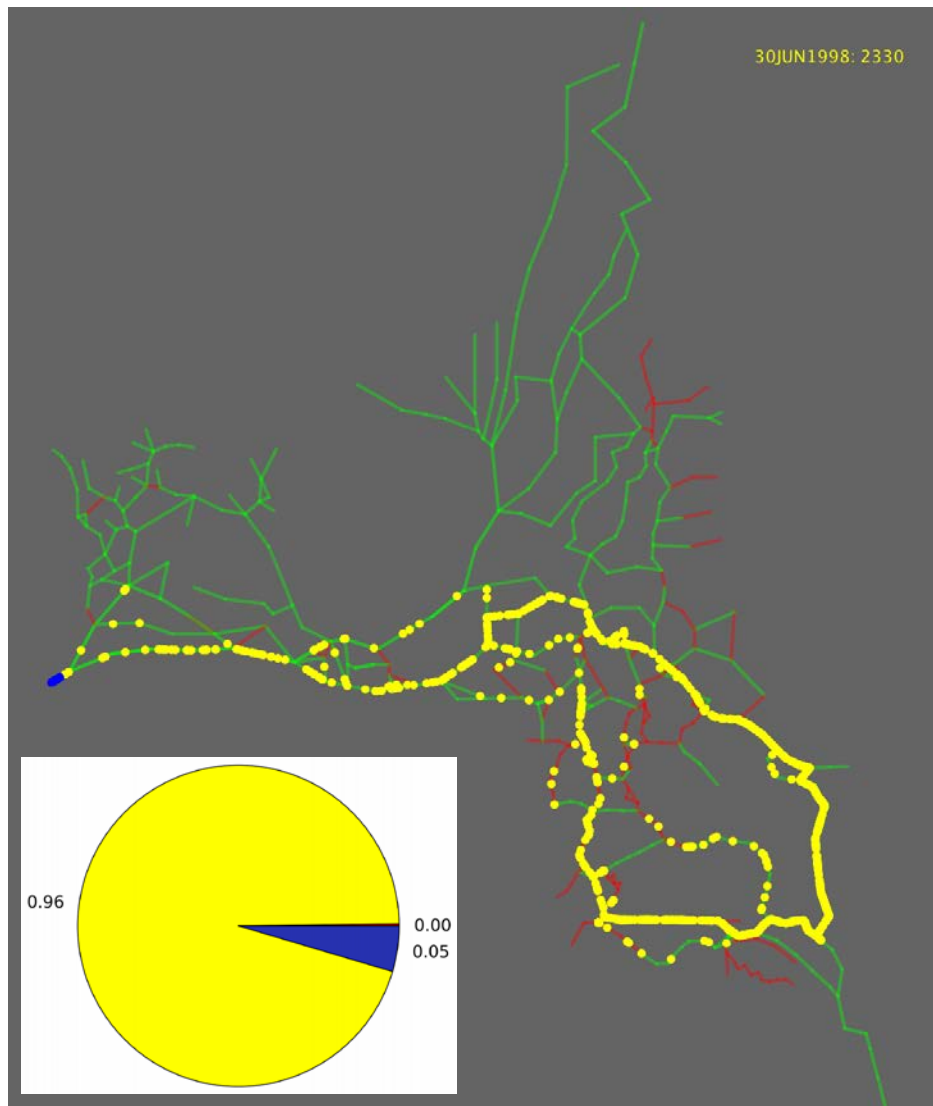
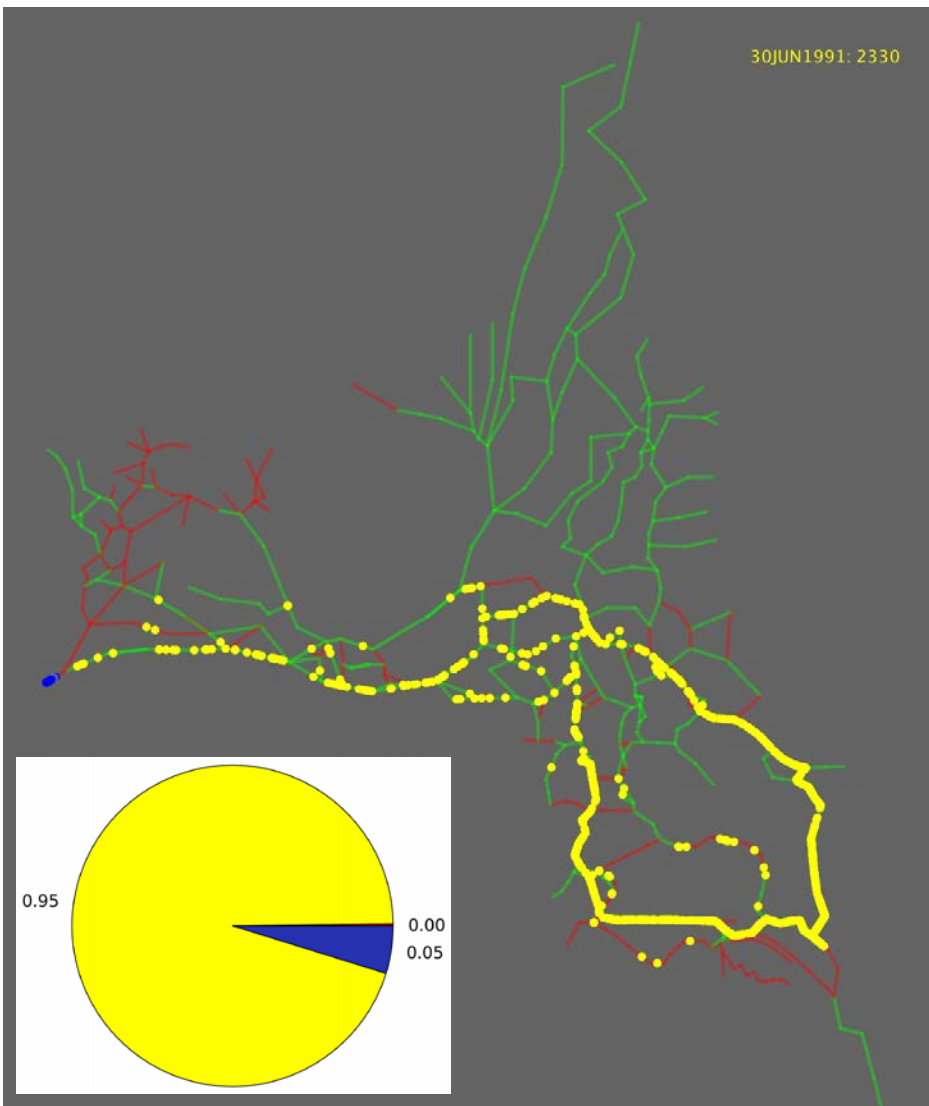
Steelhead Life History Model



$\lambda=50\text{km}$, $\omega=12.0\text{ cm/sec}$
swimCode=4, nodeDecision={0, 1}

May-June 1991

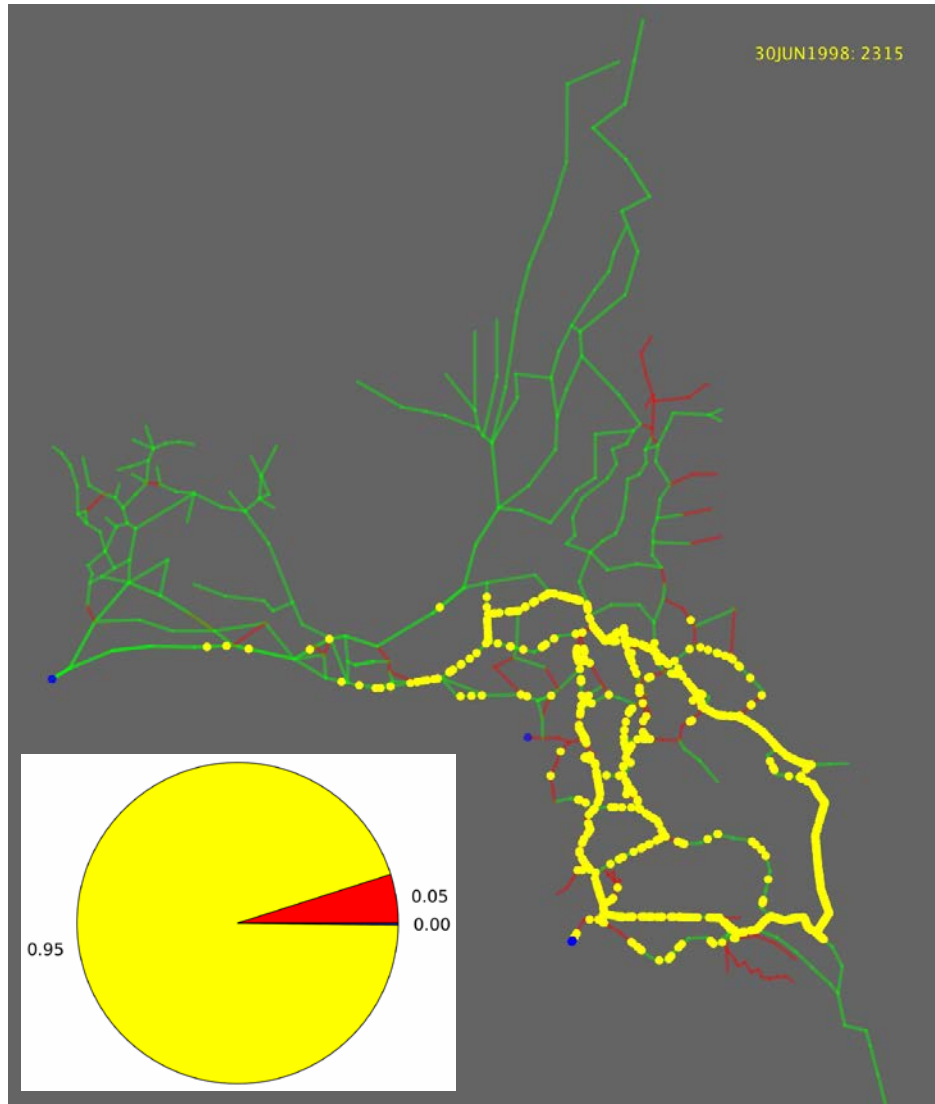
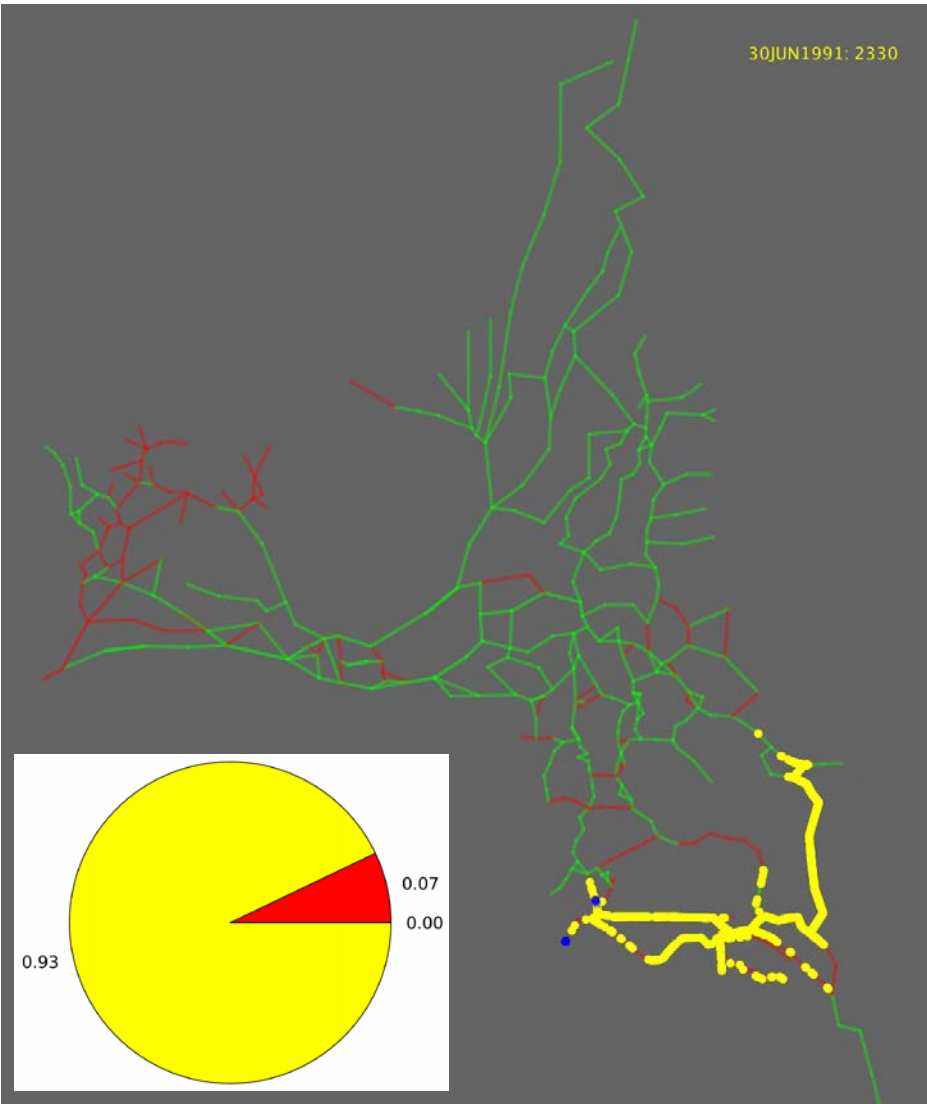
May-June 1998



$\lambda=50$ km, $\omega=12.0$ cm/sec
swimCode=1, nodeDecision=0

May-June 1991

May-June 1998



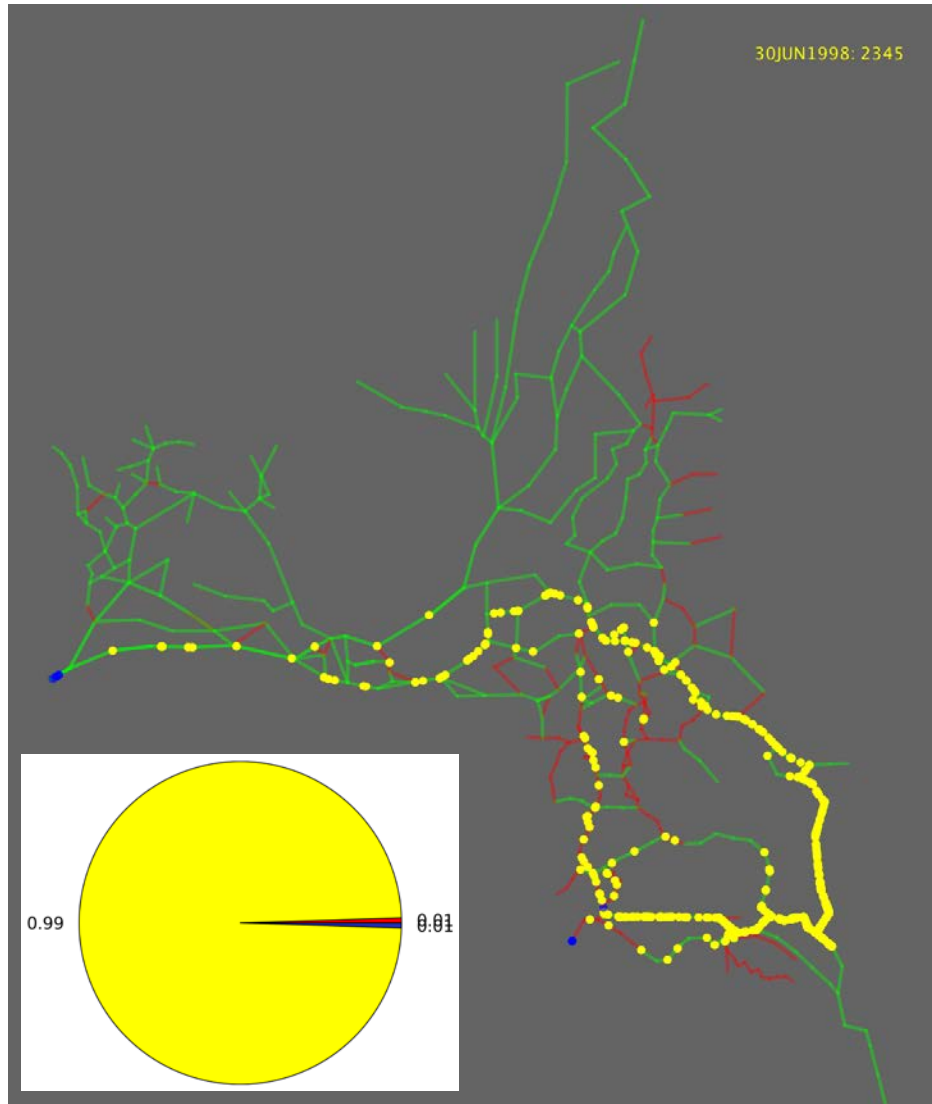
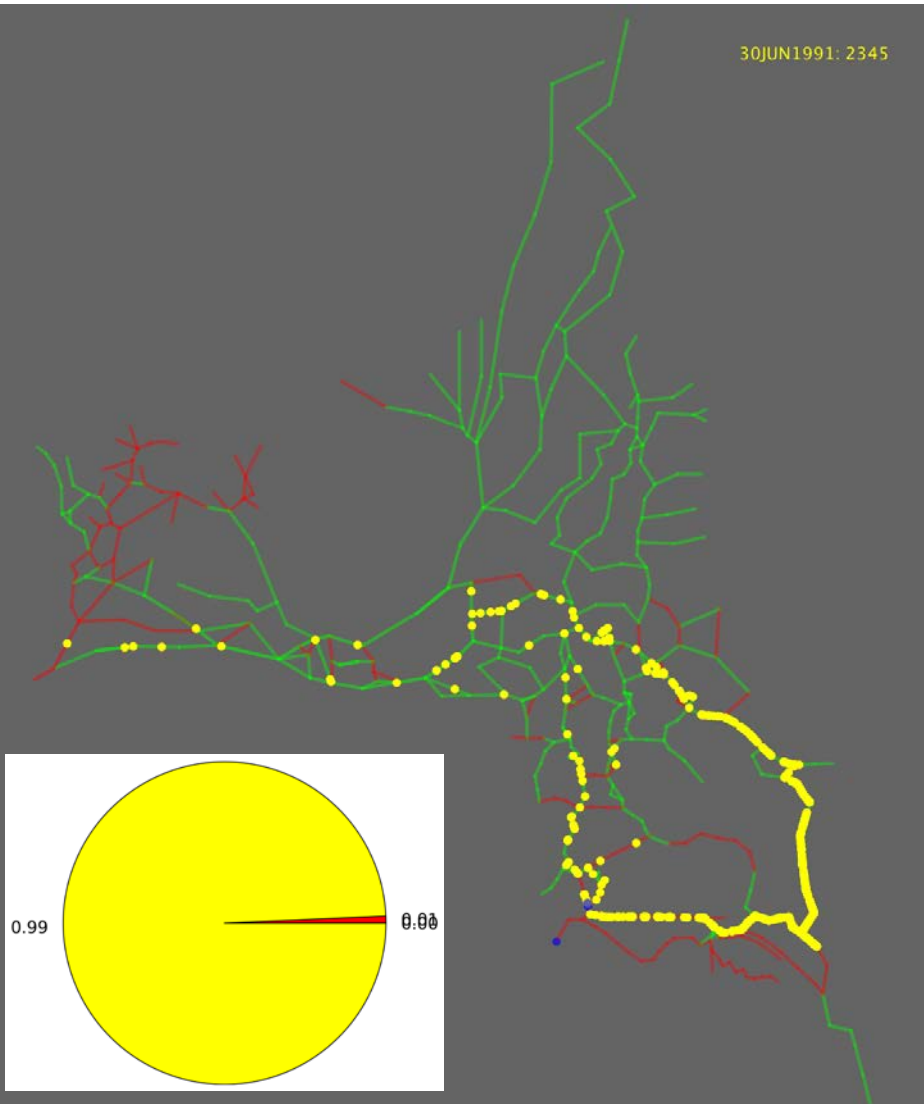
$\lambda=50$ km, $\omega=12.0$ cm/sec
swimCode=6, nodeDecision=0

May-June 1991

May-June 1998

30JUN1991: 2345

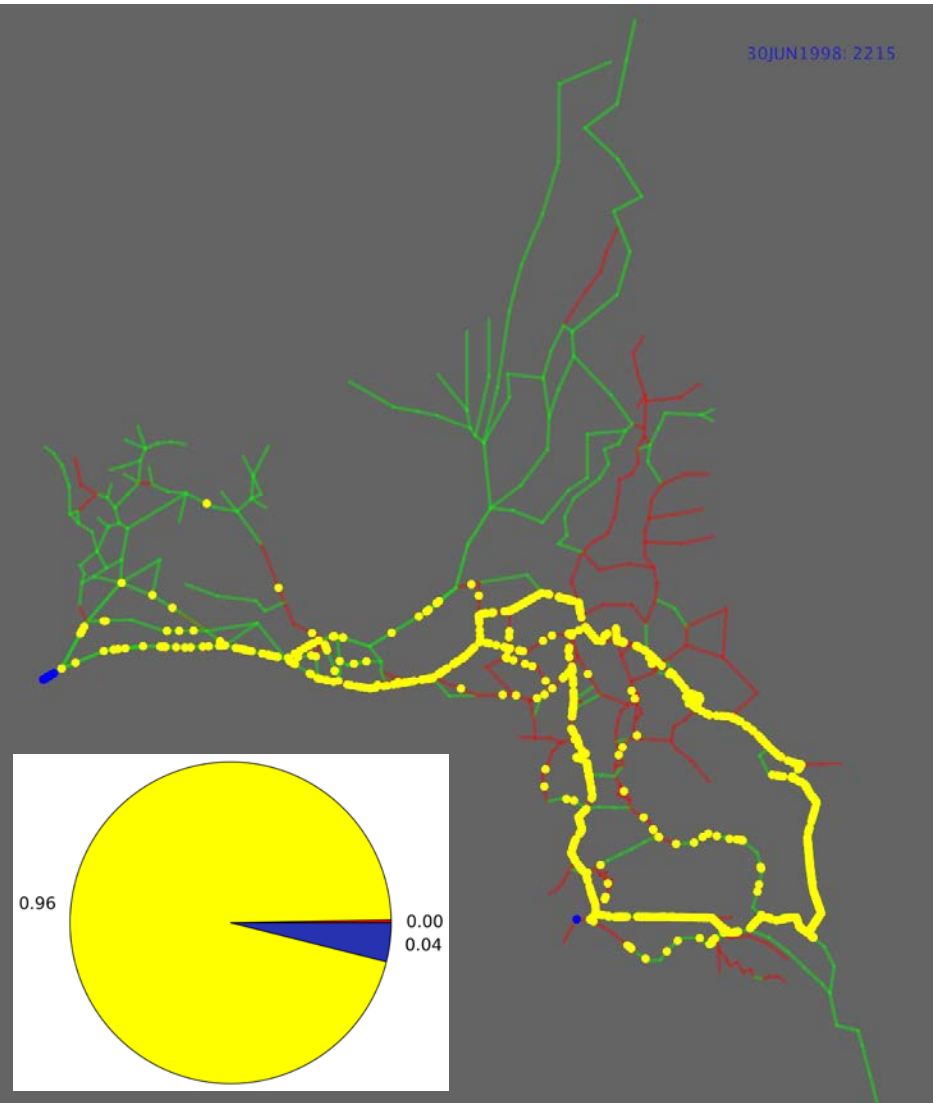
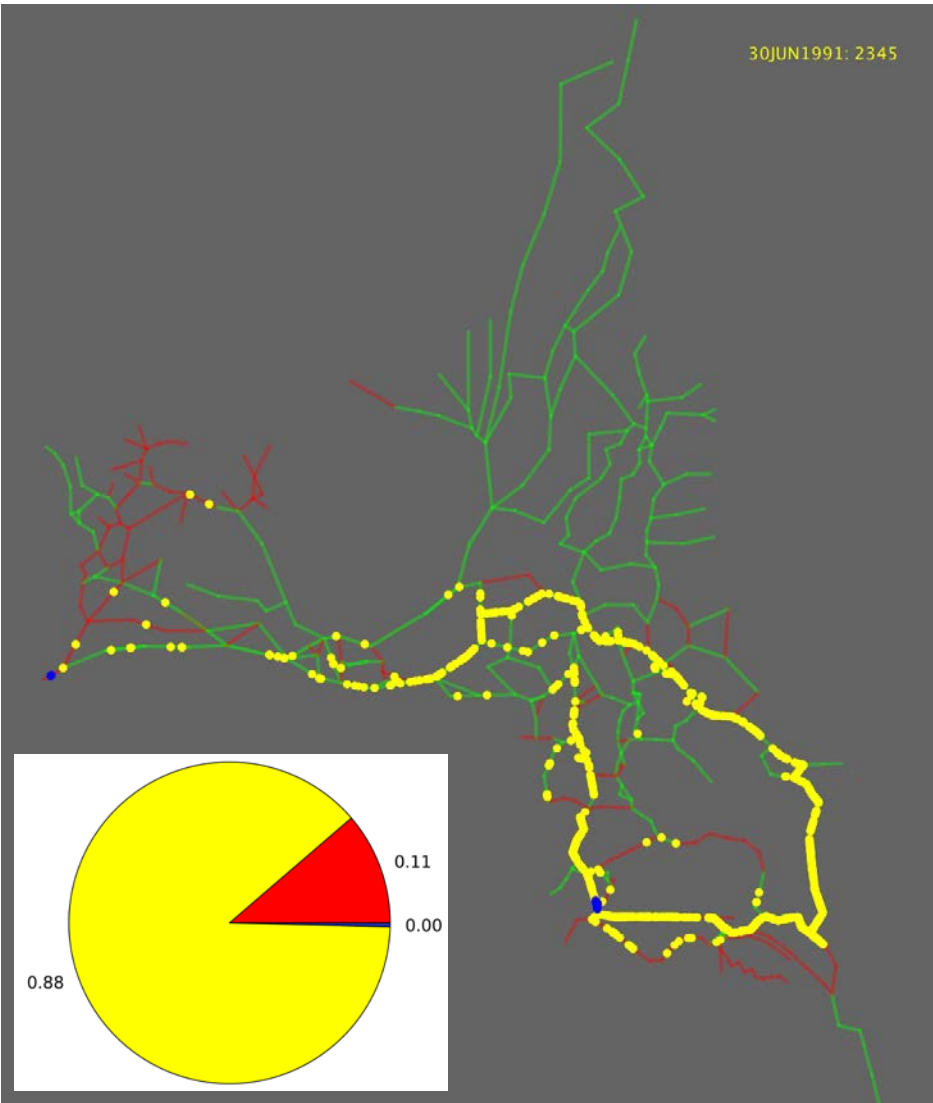
30JUN1998: 2345



$\lambda=50$ km, $\omega=12.0$ cm/sec
swimCode=2, nodeDecision=0

May-June 1991

May-June 1998



Scenario

- 1000 individuals released from node 7
- dry date range: May-June 1991
- wet date range: May-June 1998

Behaviors

- behavior 1:
 - swimCode = 4
 - advection if flow is downstream; hold if flow is upstream
 - swim with downstream flow; don't swim if flow is upstream
 - nodeDecision = {0, 1}
 - favor highest flow, then favor widest channel
- behavior 2:
 - swimCode = 1
 - passive, neutrally-buoyant particles
 - nodeDecision = 0
 - favor highest flow

Behaviors, contd.

- behavior 3:
 - swimCode = 6
 - swim with the flow when tide falls, otherwise hold still
 - nodeDecision = 0
 - favor highest flow
- behavior 4:
 - swimCode = 5
 - swim with the flow when tide falls, otherwise drift
 - nodeDecision = 0
 - favor highest flow
- behavior 5:
 - swimCode = 2
 - swim downstream at all times
 - nodeDecision = 0
 - favor highest flow

PTM mortality scenarios

Doug Jackson

19-jul-2013