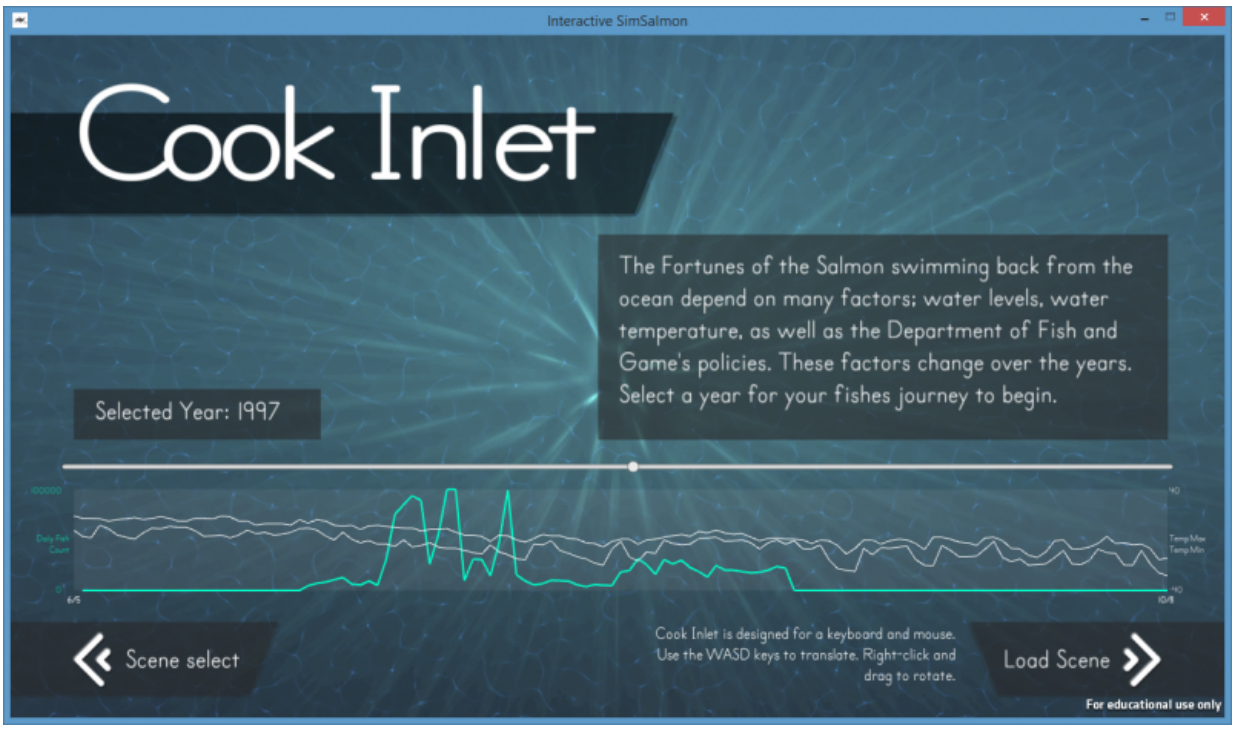
Highlighting deeper questions in education, decision making and ecology through simulation

March 2 2016, by Jens Hegg



The start screen of the Cooks Inlet section of the Salmon Sim where users can select the year of historical salmon returns to simulate. Credit: Roger Lew

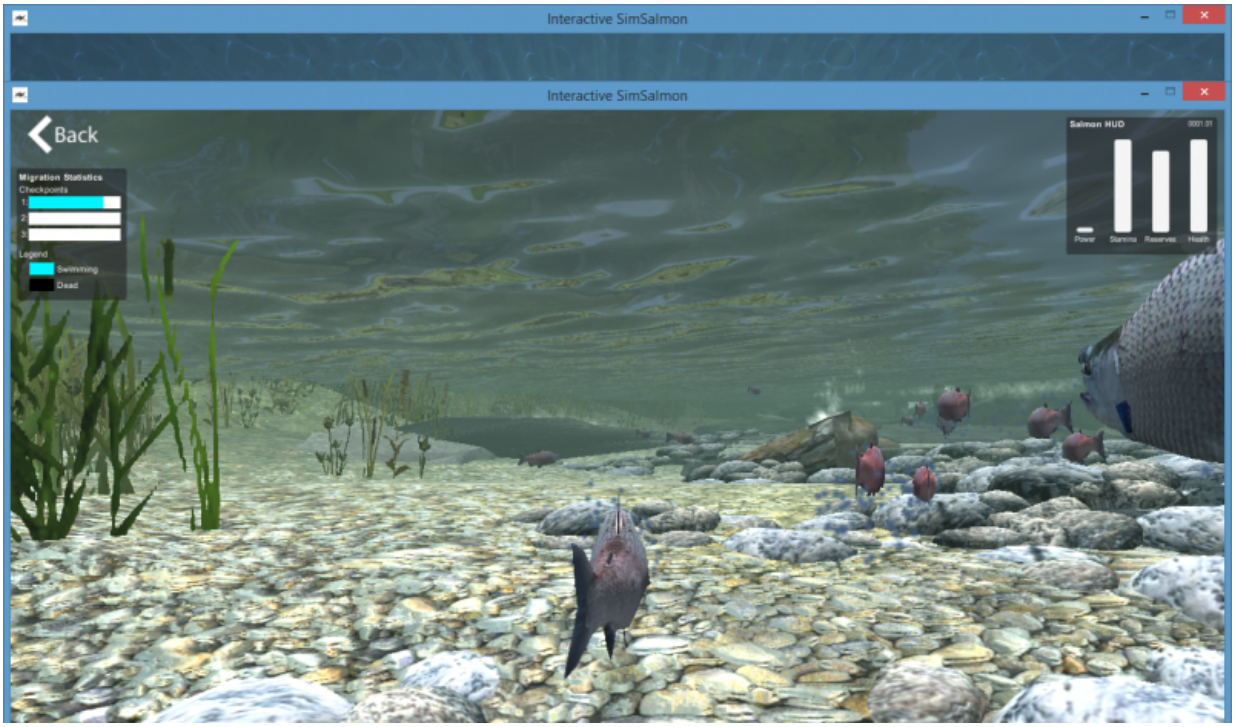
Water bubbles and the distant rumble-swoosh of rapids can be heard upstream. On shore the occasional bird calls from the surrounding forest. Under the water you are fighting your way upstream, acutely aware of

your waning strength as the water continually pushes you downstream. You are looking for a seam in the current, that path where turbulence and intersecting currents allow you to slip upstream without draining the limited reserves of energy you still have. You will need those to surmount the falls and find a mate, you can't waste them in the rapids. You try once again to slip past beyond the sheltering rock and make headway upstream only to be stymied again, barely managing to hold ground against the current.

This is the reality of becoming a salmon, and it is surprisingly difficult. Still, after we leave the Virtual Technology and Design lab at University of Idaho, my 10 year old son yells from the backseat, "Dad, when they release that game for Xbox you HAVE to buy it!" There must be something to this idea, I think.

This was a sneak peak at the Salmon Sim, an interactive virtualization of the spawning ecology of salmon in the Russian River of Alaska. The tour came about through my role as an advisor on salmon biology and ecology to the group. The simulation takes users through an interactive reconstruction of the return of salmon to Cook Inlet at the mouth of the river, leading to taking on the role of an individual salmon who must swim upstream to spawn on limited energy reserves. Users can also explore the life stages of a sockeye salmon in an aquarium mode to better visualize the effects of age and conditions on a salmon.

The simulation can be explored in immersive 3D throughout, and conditions like temperature can be changed to systematically explore what affect they have on the salmons ability to complete it's journey. The year-to-year fluctuations in salmon abundance and return timing can also be explored, the simulation includes re-creations of historical returns to Cook Inlet. In fact the entire simulation is underpinned by real scientific data, even the landforms are accurately mapped from GIS elevation data and vegetation is created based on imaging of the basin.



Users of the Salmon Sim take on the challenge of ascending the Russian river as a salmon (foreground). Visual and audio cues guide the journey while physical reserves are tracked and affect the ability to swim, requiring strategic rests and planning to succeed. Credit: Roger Lew

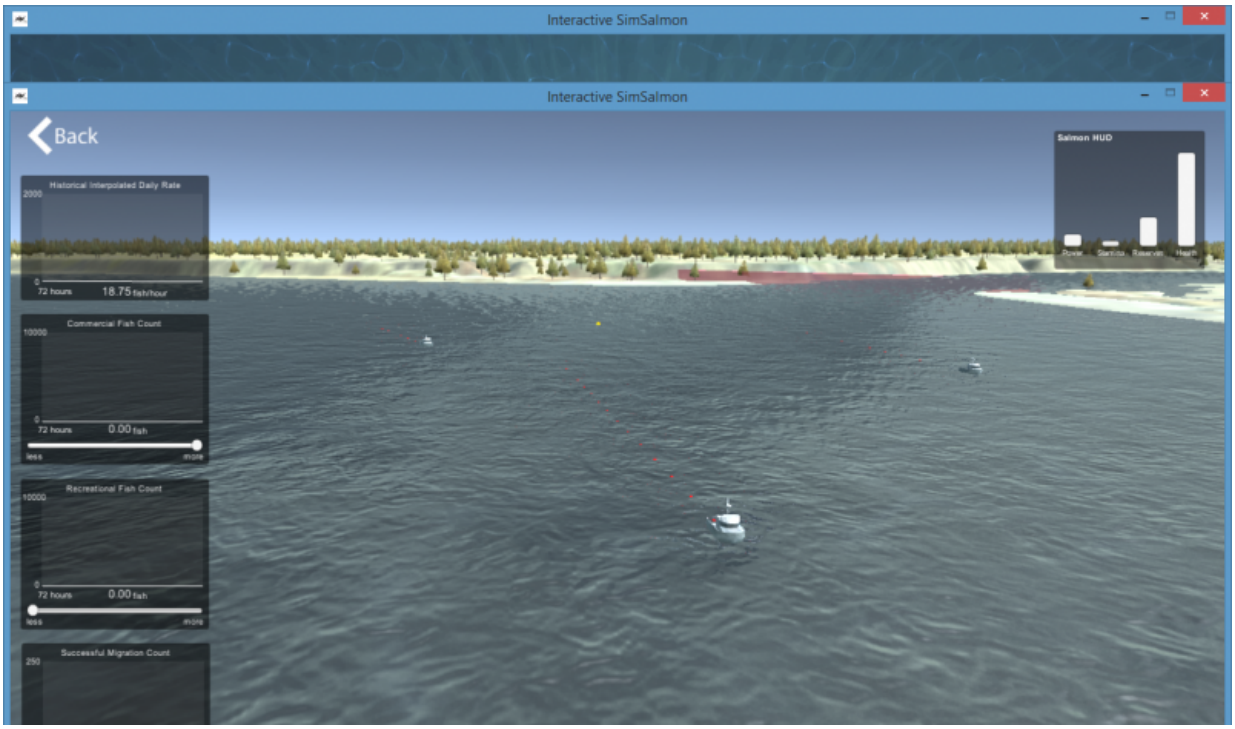
While the Salmon Sim is, in some ways, a computer game (it is controlled via Xbox controller for instance) the vision behind it is much deeper when you begin to talk with the projects creator Dr. John W Anderson about it's implications.

"How do we communicate through storytelling," begins Anderson. "We're stuck in a paradigm of ecosystem management that we can only it through a certain lens. These simulation tools are useful because now we can pose alternate management scenarios that reflect cultures."

Anderson explains that the process of exploring the sometimes contentious issue of salmon through the lens of a salmon allows people the space to reflect on the implications of management actions from a perspective that isn't their own. The immersive element allows learning through play, letting people see things in ways they hadn't before.

'Traditional Western management doesn't think that way. It's usually based on economics and that is eventually tied to some kind of value." But, Anderson points out, "People tend to have a higher level of empathy immediately within these [simulated] worlds," and begin to back away a little bit from their preconceived notions."

This empathetic response is important for the three goals of the project; decision making, education and scientific visualization. One future goal of these simulations is a tool to communicate real science and to help stakeholders and communities grapple with management scenarios. These diverse stakeholders are often at odds and the empathic response can be a benefit in helping break down barriers in decision making. It potentially helps people to look at management scenarios, rather than causes, argues Anderson.



A view from above in the Cook Inlet virtualization. Users can move throughout the scene, both above and below water, to explore the salmon run. Credit: Roger Lew

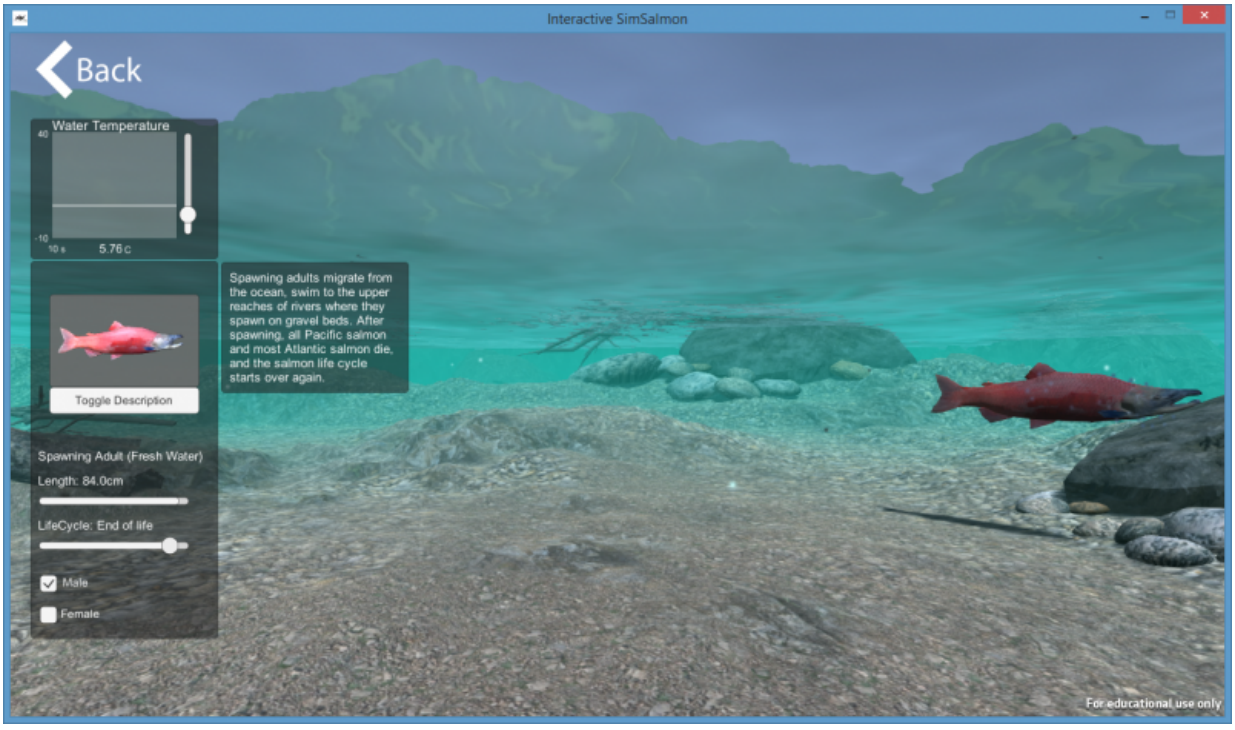
A second goal is to develop the simulator as an educational tool. This is currently is a major part of the work being done on the Salmon Sim, with collaborators at University of Alaska Fairbanks, Anchorage and Juneau actively working to create curriculum based around Salmon Sim for K-12 children.

"Just like any video game they are immediately intrigued by the visuals and they are intrigued to jump into this world…It's feeding right into their preferred way of consuming information, which the other side of this which is critical…the content they are seeing needs to be aligned with science and educational goals," says Anderson.

To that end the team is hopeful for upcoming NSF support that will allow them to develop this project into a full fledged curriculum.

The goal would be to, "design a curriculum for a 7 year journey, so a kid could essentially start in junior high and follow a salmon all the way through highschool, understanding all the complexities along the way." This would be tied to local data collection and also to other classes following the same curriculum as a way to highlight that local conditions are different, and these differences inform management and policy. And while simulation might be visually catchy, Anderson is quick to point out that it isn't all about flash, which is why Salmon Sim is built on real data.

"It's one thing to catch the kids' attention. It's another to be sure we are informing them correctly, and that they are informing themselves correctly. Science, when you see it in action, makes perfect sense."



View of the “Aquarium” portion of the Salmon Sim where users can see the changes in salmon bodies with age, sex and condition. Credit: Roger Lew

As for the use of the Salmon Sim as a scientific visualization tool, those days are far off but scientists are eager to help build these tools according to Anderson and postdoc Roger Lew. "Building these tool libraries is necessary for the future," says Lew.

As data analysis and processing becomes more integrated the tools and processes that underlie Salmon Sim are being built with scientific visualization and modelling in mind. Eventually, the researchers muse, scientists can use these and as-yet-unimagined visualization tools to explore their models more directly.

"This is exciting, but imagine what will be possible 20 years from now," says Anderson.

Talking with Anderson it is hard not to come away with the impression that he could have a career as a futurist. The line between where current simulations end and future plans begin is fluid, both because the technology is moving fast and because Anderson has big plans. Often, answers come back much deeper than you might expect from a conversation about what looks, on the outside, like a video game. No doubt this has helped Anderson win over critics, mostly in the sciences, who wonder what the real utility of these virtualization tools are. "But, as people use them they see the strengths," and often become firm believers he says.

The philosophical questions don't end there. Anderson ends the conversation with a question to ponder:

"A question that is kindof profound is, can these simulated worlds [and presumably the empathy they engender] help individuals to potentially make decisions against their own self interest, but for the common good?"

Regarding the problem of salmon Anderson continues, "So, if you were to see that in seven generations, that the actions and management I'm making currently will give me financial benefit, but I realize [through the simulation] that I've collapsed the economy further ahead, will I make sacrifices in this generation to secure a healthy one for the next?"

Anderson isn't sure of the answer. Either way, he believes that having tools that cross societal boundaries and allow us to visualize multiple management scenarios are important. Developing these tools, he believes, are important for a realistic discussion of the costs and benefits inherent in ecological decision making.

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