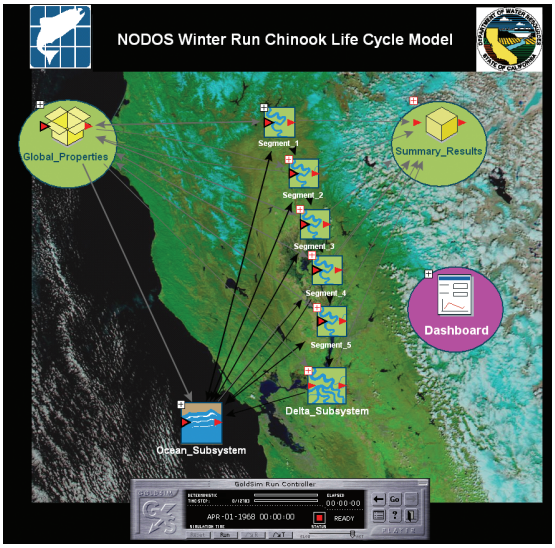
A DELICATE ECOSYSTEM:

The Impact of California's Water Management on Salmon Populations

Advanced simulation software helps minimize threat to struggling species

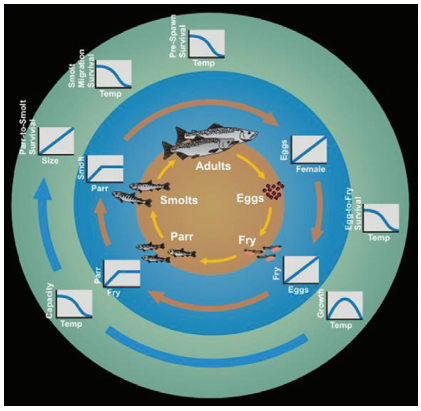
California's salmon population has plummeted more than 88 percent since its all-time high five years ago, reaching a near-record low. Such unprecedented collapse is coupled with an increasingly arid environment and dwindling water resources, burdening the state with exceedingly complex water management issues that affect humans and wildlife alike. As in any ecosystem, critical (and sometimes unexpected) cause-and-effect relationships exist; one small fluctuation in water flow or temperature, for example, can have a profound, long-term impact on salmon. Accordingly, it was imperative that California's water management strategies not only met state-wide water needs but also helped recover and sustain its troubled fish populations.



Fishery scientists use GoldSim to simulate the life cycle of salmon throughout the state. The relationships between and behavior of freshwater, ocean water and delta water are vastly different yet inextricably intertwined.

That was easier said than done. Storing and delivering water while minimizing disturbance to the natural environment was—and continues to be—a very delicate balance. To compound the complexity further, scientists and decision-makers needed to ensure their strategies were based on sound quantitative—not just qualitative—research. (While scientists have worked to model and quantify such cause-effect relationships in the past, the methods used were cumbersome and based on old technology. Excel spreadsheets were the tools of choice yet had limited capacity and were difficult to explain to scientists, state officials, and the public.)

To help in this monumental task, California tapped two key partners: Cramer Fish Sciences (Cramer), a Sacramento fisheries and environmental consultancy, and GoldSim Technology Group (GoldSim), whose sophisticated simulation software technology helps mitigate the risk inherent in such intricate, large-scale projects. Using GoldSim, Cramer developed a salmon life cycle model that analyzed how each of four proposed water management strategies would impact the state's salmon populations.



Dynamic Graphics

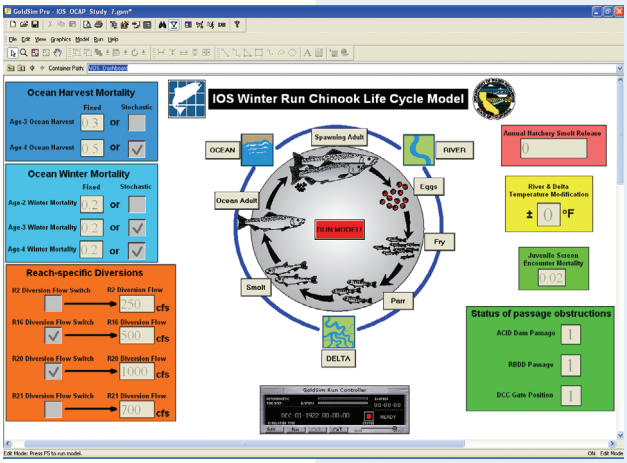
The salmon life cycle model developed using GoldSim is graphic-rich and user-friendly. The model makes logical connections between elements rather than relying on programming with code, which greatly enhances model transparency, user understanding and, ultimately, management decisions.

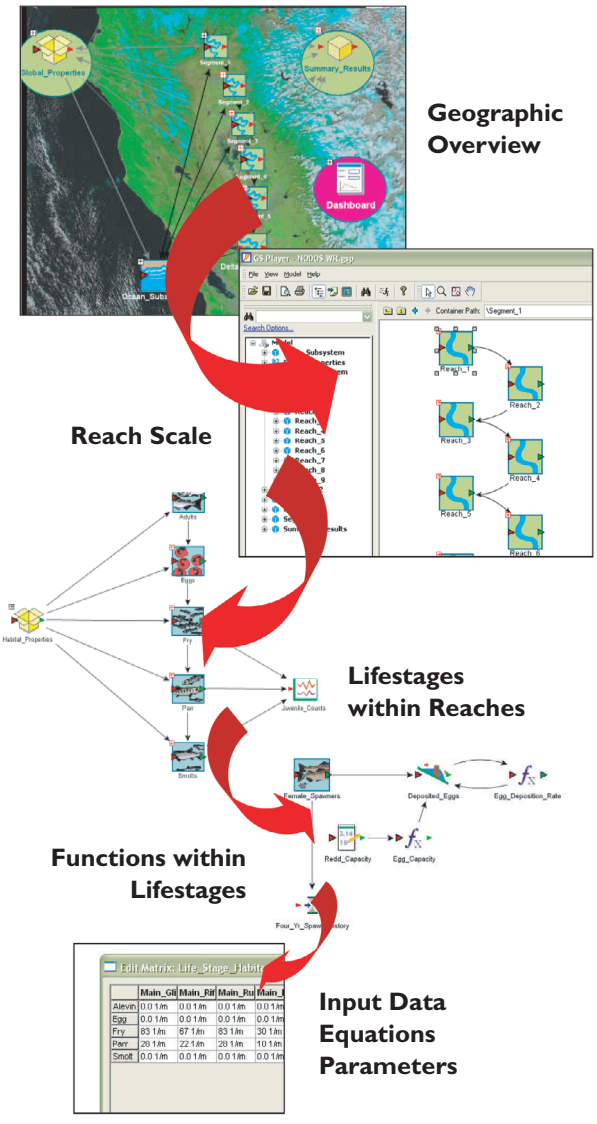
> *"Previously, our research was more about what we* think *the relationships are. Using GoldSim, however, we can computationally show the likely outcomes of alternative water project operations, habitat improvement actions, and fishery management strategies."*
>
> – Brad Cavallo, fisheries scientist

Interactive User Dashboards

The image to the right represents a sample dashboard created using GoldSim. Dashboards serve as models' "front ends" and are easily customized to provide the user with everything needed to understand and operate simulations.

The figure below demonstrates the model's hierarchical organization. Intuitive, conceptual elements are near the top while more complex information, such as functional relationships, equations and data input values, is revealed as the user drills further down into specific model elements.





The model was a resounding success. It forecasted how small changes in various water projects would affect current and future salmon populations. Through GoldSim, Cramer was able to identify the most viable, environmentally-friendly water management strategy for our nation's most populous state.

The GoldSim model empowered Cramer with a level of scientific confidence and detailed modeling that had theretofore been unattainable. "That's hugely important," said Brad Cavallo, a fisheries scientist at Cramer. "Previously, our research was more about what we think the relationships are. Using GoldSim, however, we can computationally show the likely outcomes of alternative water project operations, habitat improvement actions, and fishery management strategies."

Equally important, the modeling results were no longer limited to mathematically-inclined scientists. GoldSim's user interface translated the complex computations into an understandable, more layman-friendly format that not only resonated with scientists across the field but also state decision-makers.

Salmon life cycle modeling through GoldSim has inspired many possibilities for better evaluating the state's water management strategies. California is currently using GoldSim to identify new facilities to reliably deliver water while helping recover salmon and the Sacramento-San Joaquin Delta ecosystem, and is developing a model to project how alternative water diversion structures and operations will affect the area's salmon runs.

Thanks to powerful modeling tools like GoldSim's and scientific dedication to the cause, water management projects and salmon recovery programs need not be mutually exclusive.

GoldSim Technology Group LLC
300 NE Gilman Blvd, Suite 100
Issaquah, Washington 98027-2941
USA

Web: http://www.goldsim.com
Email: software@goldsim.com
Phone: +1 425-295-6985
Fax: +1 425-642-8073