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An Overview of the Okanagan Watershed Fish-and-Water Management Tools (FWMT) Project.

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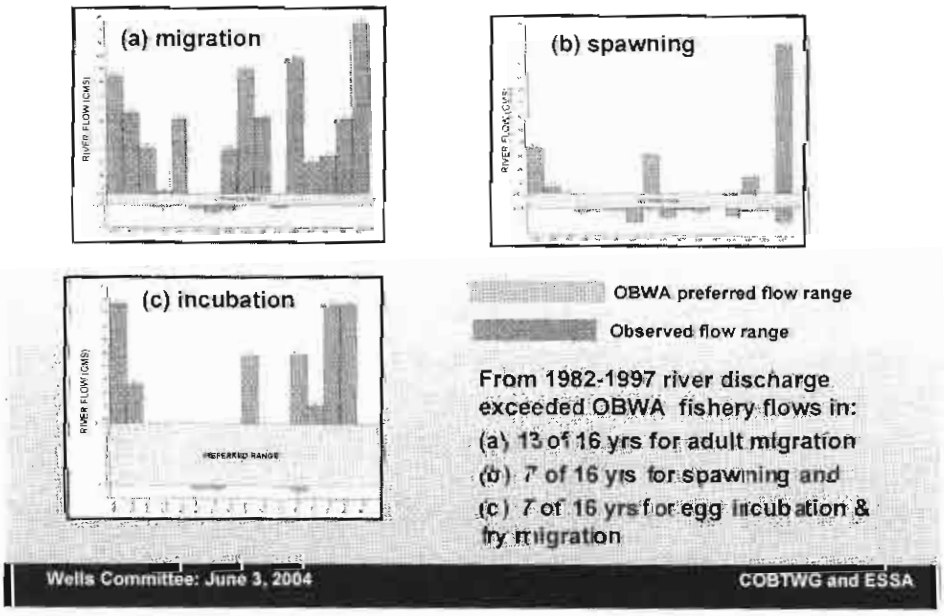
In the Okanagan River and its associated valley bottom lakes, resident and anadromous fishes have been the focus of important harvest activities by human populations for thousands of years. However, after little more than a century of intensive agriculture and urban development, sockeye salmon (*Oncorhynchus nerka*) are the last remaining population of several species of sea-going salmonids (sockeye, chinook, coho, chum and steelhead) that once supported seasonal food-fisheries (e.g. at Okanagan Falls) by aboriginal peoples in the Okanagan valley. Although not currently listed as endangered, annual returns of sockeye to the Okanagan River are frequently insufficient to support even modest levels of harvest by aboriginal peoples (Hyatt and Rankin 1999). Similarly, until their recent dramatic decline (1980's), "landlocked" kokanee (*O. nerka*) in Okanagan Lake supported an important sport fishery (Ashley et al 1998) valued at more than a million dollars annually. Given their biological, social, economic and cultural significance, Okanagan L. kokanee and Okanagan R. sockeye salmon are the subjects of several significant stock and habitat restoration initiatives.

Annual production variations for both Okanagan Lake kokanee and Okanagan River sockeye salmon are influenced significantly by water regulation decisions at a series of low head dams built and operated to meet flood control, fisheries and other water use objectives (Anon. 1954). The Canada-BC, Okanagan Basin Water Agreement (OBWA) of the early 1970's recognized that water management decisions influence fish production because of their effects on: (1) seasonal water level variations at Okanagan Lake beaches where kokanee spawn, (2) discharge, water level and flows downstream in both natural and channelized sections of the Okanagan River where sockeye salmon spawn and (3) water quality of the lake rearing-habitats of both sockeye and kokanee. Consequently, specific provisions of the OBWA focused on the maintenance of lake and river discharge levels that were adjusted seasonally to protect the productive capacity of various life history stages of sockeye and kokanee salmon throughout the system. A review by Bull (1999) suggested that between 1983-1998 water management decisions frequently departed from compliance with seasonal lake elevation and river discharge levels recommended by the OBWA (Figure 1).

Figure 1. Deviations from Okanagan Basin Water Agreement (OBWA) flows for fish (Bull 1999).



Discussions with "front-line" fisheries and water managers indicated that difficulties in maintaining compliance were related to the complexity of balancing fisheries, flood control and water allocation benefits throughout the year, given large uncertainties in:

- annual and seasonal water supplies,
- the exact timing of sockeye and kokanee life history events (spawning, egg incubation etc...) that control their vulnerability in a particular year to losses from flood-and-scour or drought-and-desiccation processes,
- the magnitude of fisheries losses associated with deviations from recommended lake level or river flow ranges (e.g. during flood or drought conditions),
- risk of "significant property" losses associated with seasonal maintenance of "fish friendly" lake elevation and river discharge levels.

During 2001, the Canadian Okanagan Basin Technical Working Group (COBTWG) initiated a fish and water management tools (FWMT) project (Hyatt et al 2001) to develop a set of quantitative, decision-support models to reduce uncertainties and improve the basis for water management decisions that influence annual production variations of fish. The resultant FWMT System provides a multi-user, gaming environment based on a set of five, coupled, "state-of-the-science," biophysical models (Figure 2). FWMT is accessed through standard web-browser technology from a common server at several locations by a consortium of natural resource managers representing private industry, First Nations, federal and provincial interests. The FWMT System operates in either retrospective mode on historical data sets or in prospective mode on real time data to allow resource managers to identify optimal solutions to complex water management decisions.

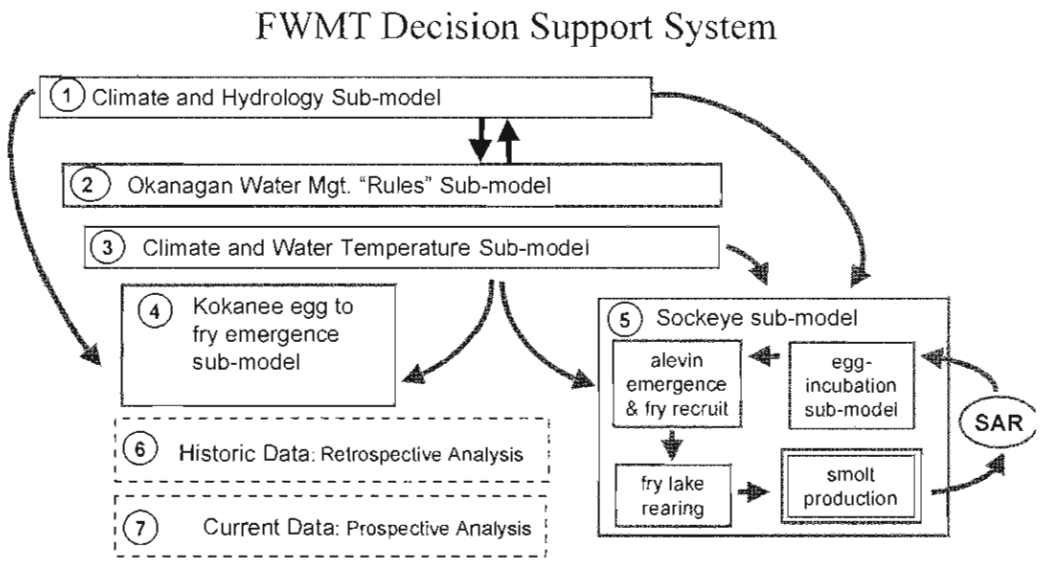


Figure 2. The FWMT System is a coupled set of 5 biophysical models of key relationships (among climate, water, fish & property) used to predict the consequences of water mgt. decisions for fish & other water users. FWMT may be used to explore water management decision impacts in a prospective-mode going forward or in a retrospective-mode looking back on historic water supply, climate & fish years.

During the winter of 2004, a formal retrospective analysis was completed to identify potential fish production benefits associated with future deployment of the FWMT System. This involved:

- training three "apprentice" fish-and-water managers to use the FWMT System in making water management decisions,
- applying the FWMT System to 25 unidentified, historic water supply years to make "simulated" water management decisions and to identify associated salmon production outcomes suggested by FWMT,

- applying the actual, seasonal water storage and release decisions within FWMT to identify salmon production outcomes likely to have occurred when historic water management decisions were not informed by access to FWMT,
- comparing salmon production outcomes associated with simulated management decisions assisted by FWMT versus historic management decisions made without the benefit of FWMT use.

Although preliminary, these results suggest that **routine operational use of the FWMT System by fish-and-water managers could result in an average annual increase in Okanagan sockeye salmon juveniles by as much as 50 %** without significantly increasing socioeconomic losses associated with other water use interests.

In prospective mode, the FWMT system accesses "real-time" data on Okanagan Lake and River elevations, water temperature and discharge that are automatically entered into an FWMT database through satellite links on a daily basis. Given its ease of use, and the promising results noted above, fisheries and water managers have enthusiastically adopted FWMT. During 2003-04 FWMT was applied to predict the consequences of seasonal water management decisions under conditions of continuing drought for:

- kokanee production outcomes in the upper watershed (Okanagan Lake),
- sockeye production outcomes in the lower watershed (Okanagan River, Osoyoos Lake) and,
- damage and economic losses associated with urban and agricultural "property" under flood or drought conditions.

The ultimate success of the FWMT project will be determined by whether its long-term use contributes significantly to maintenance of the productive capacity of aquatic habitats and the restoration of resident and anadromous salmon in the Okanagan watershed. However, even at this early date, there is a consensus among participants that the project has already achieved a large measure of success by:

- applying leading-edge science and technology to provide fish-and-water managers with a new generation of user-friendly tools to satisfy conflicting resource management objectives (e.g. sustain or increase fish production without significantly increasing the risk of "property" losses under conditions of flood or drought),
- implementing FWMT as a truly ecosystem-based element of the existing fish and water management framework in the Okanagan (i.e. FWMT integrates biophysical processes, deals with multiple species and geographic locations, anticipates socioeconomic outcomes of decisions), and,
- establishing increased cooperation among government agencies, industry and local communities for conservation and restoration of two fish populations at risk (i.e. Okanagan kokanee and sockeye salmon).