Adapting the Ok-FWMT Decision Support System to Protect an Expanded Range of Sensitive Species.

Osoyoos Lake Water Science Forum, Osoyoos, Sept. 19, 2011.

Douglas County Public Utility District

Fisheries and Oceans Canada / Pêches et Océans Canada

Department of Fisheries and Oceans Canada

BC Ministry of Water Land and Air Protection

Okanagan Nation Alliance

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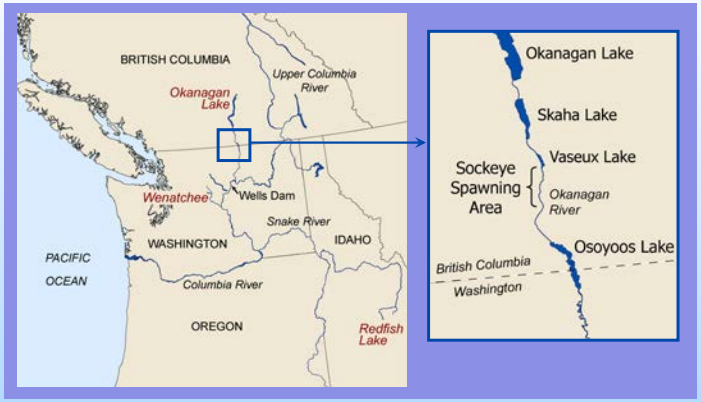
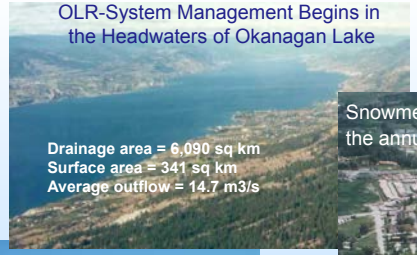
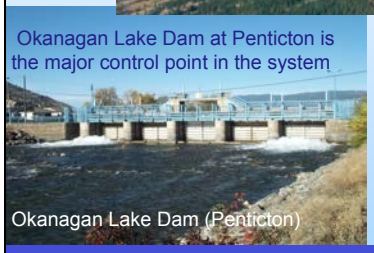
Outline for This Talk

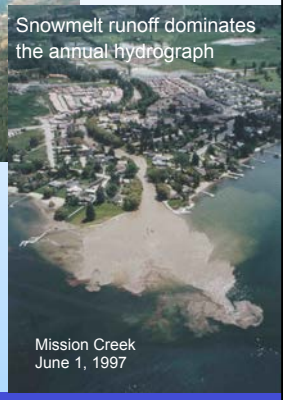
- Identify context, process , objectives and decision support tools (FWMT) for managing fish-and-water in the Okanagan Lake and River System (OLRS).
- Define adaptive management (AM) plus the how and why for its application in the Okanagan.
- Round-1 of the AM cycle (1950-2000): the 1974 Okanagan Basin Agreement and its implementation.
- Round-2 of the AM cycle (2001-2011): creation of the Fish-and-Water Management Tools (FWMT) decision support system and its implementation
- Identify potential for expanding FWMT as a risk assessment tool for protection of sensitive species.

Okanagan Lake and River System Study Location

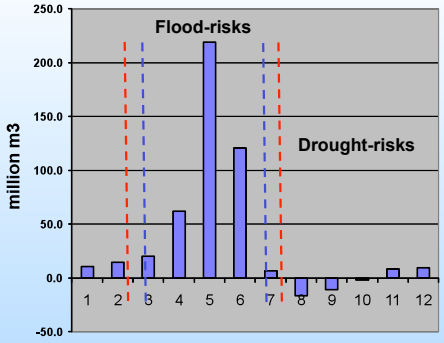








Mean monthly inflows to Okanagan L. (85 % of inflow from Apr-Jun)



Annual inflow hydrograph dominated by snowmelt runoff; range of annual inflows: 78 million to 1.4 billion m^3 ; 0.23 m to 4.12 m stage change

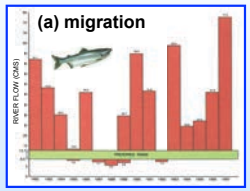
OLRS OPERATIONS

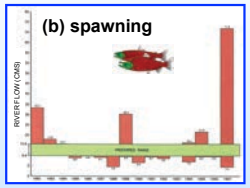
- 1974 Canada-BC Okanagan Basin Agreement (OBA) rules specify seasonal lake levels and flows.
- Operating plans/decisions reflect climate variations inflow forecasts.
- Decisions address competing objectives to satisfy: flood control, fisheries values, water storage/extraction, navigation, tourism, international agreements, etc.

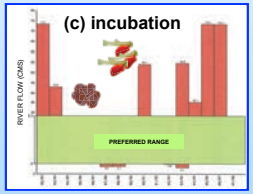
OPERATOR CHALLENGES

- Forecast uncertainty re: freshet inflow volumes and capacity to match lake spill or storage to spring inflows ("bathtub" analogy).
- Effects of environmental variability (water levels, flow, temp.) on risk assessments given competing economic, social & environmental demands of multiple "parties" & authorities.
- **OLRS decisions re: water storage or release based on rules of thumb, past experience & incomplete information.**

Compliance with OBA Fishery Flows was low prior to 1997.





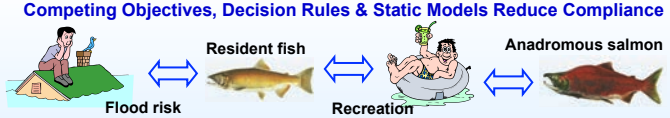


OBA preferred flow range

Observed flow range

From 1982-1997 river discharge exceeded OBA fishery flows in:
(a) 13 of 16 yrs for adult migration
(b) 7 of 16 yrs for spawning and
(c) 7 of 16 yrs for egg incubation & fry migration (Glenfir 1998)

Competing Objectives, Decision Rules & Static Models Reduce Compliance



Rule 1: Don't fill Okanagan Lake above 342.56 meters (i.e. 10 cm rise above 342.56 incurs $5-$10 million in "property" losses !)

Rule 2: Try to avoid drafting to lake levels below 341.50 meters. (i.e. problems with docks, water intakes & vessel navigation become severe).

Rule 3: Minimize draw-down of Okanagan L. between the time of kokanee spawning and 100% fry emergence (i.e. minimize dewatering kokanee eggs & fry but don't risk violatin of "rules" 1 or 6,7,8, & 9)

Rule 4: Minimize the number of buildings flooded at Penticton

Rule 5: Provide summer flows for recreation if possible

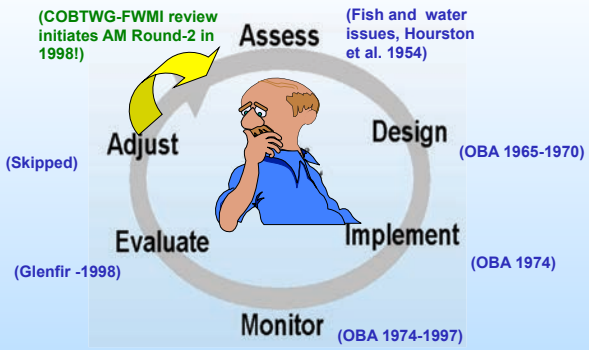
Rule 6: Sox. Migration – maintain flows (@ Oliver) between 8.5 & 12.7 cms during Aug 1 to Sept 15 to allow "easy" passage of VDS.

Rule 7: Sox. Spawning – maintain flows between 9.9- 15.6 cms during Sept 16- Oct 31 to maximize "good" spawning habitat.

Rule 8: Sox Incubation- flows at 5.0- 28.3 cms during Nov 1- Feb 15 i.e. egg incubation flows greater than or equal to 50 % of spawning flows & must not exceed 28.3 cms to avoid redd desiccation & scouring.

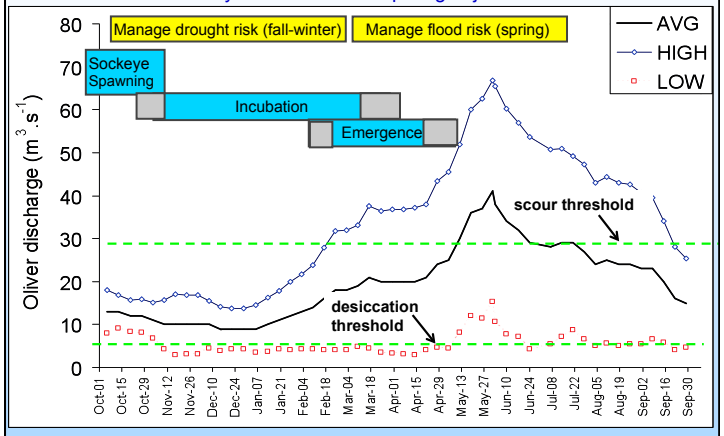
Rule 9: Sox. Fry emergence-migration- flows during Feb16- Apr 30 at 5.0- 28.3 cms.

Round-1 of "Adaptive Mgt." Cycle (50 yrs, 1950-1998) ?



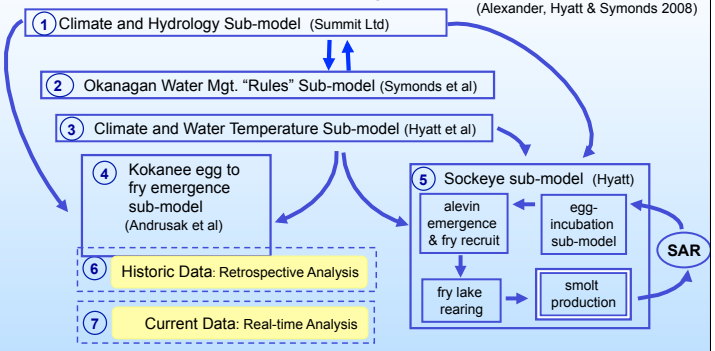
Adaptive management is a structured process of learning by doing that involves more than simply better ecological monitoring & response to unexpected management impacts. **It should begin with a concerted effort to integrate existing interdisciplinary experience & scientific information into models that attempt to make predictions about the impacts of alternative policies (Walters 1997).**

Event timing & natural variations determine whether fish-and-water managers satisfy OBA rules & competing objectives



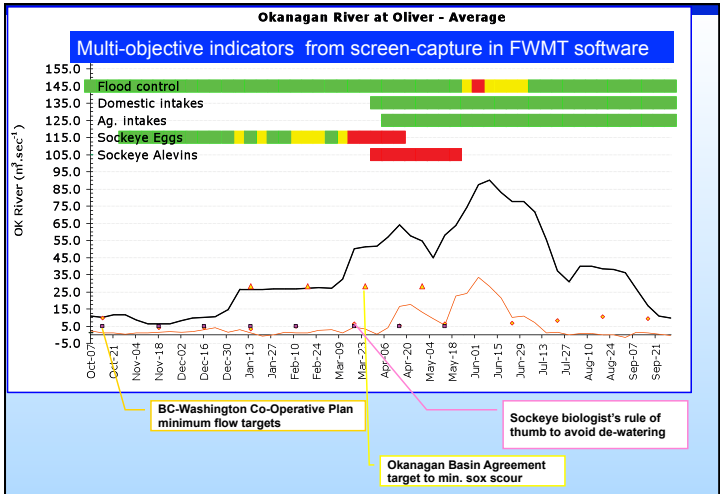
FWMT Decision Support System Version 2.1.000

(Alexander, Hyatt & Symonds 2008)

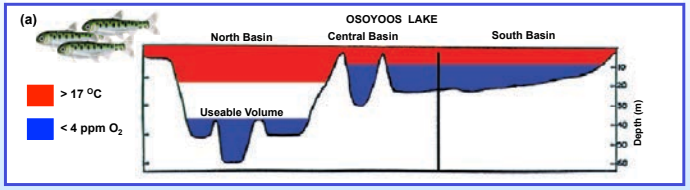


The FWMT System is a coupled set of biophysical models of key relationships (among climate, water, fish & property) used to predict the consequences of water mgt. decisions for fish & other water users.

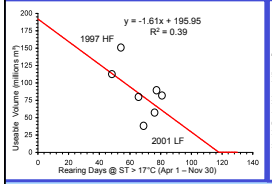
FWMT may be used to explore water management decision impacts in an operational mode employing real-time data, a prospective-mode going forward or in a retrospective-mode looking back on historic water supply, climate & fish years.



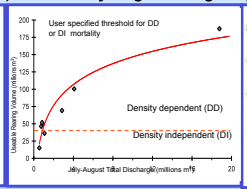
The FWMT-DSS allows "front-line" fish-and-water managers to rapidly assess impacts of alternative management decisions (*e.g.* summer-09 temp-O2 "squeeze" issue in Osoyoos Lake).



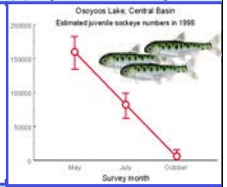
(b) URV vs days > 17oC



(c) URV vs July-Aug discharge



(d) Fry #s vs URV days at 0



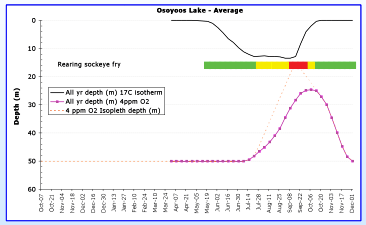
FWMT scenario development provided a risk assessment report card re: fish-and-water management options to deal with threats from a temp-O2 'squeeze" on URV.

Table 1. A summary by location & issue of consequences associated with adoption of three alternate flow scenarios (FWMT-569, 561,568) during Aug-Sept, 2009.

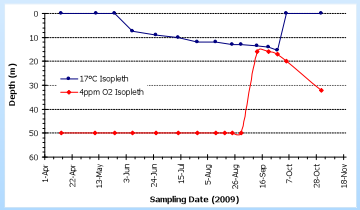
Location/Issue [1.] **August 2009 FWMT Scenario Options**	FWMT-569 Current (10.7 cms)	FWMT-561 OBA max (12.7 cms)	FWMT-568 Mitigate squeeze (18.3 cms)
Ok Lk levels predicted (Sept 30, 2009) [2.]	341.76	341.72	341.69
Domestic intakes [3.]			
Agricultural intakes [3.]			
Navigation boats [4.]			
Navigation docks [4.]			
Kokanee spawn/survival [5.]			
Ok Lk levels expected by Oct 14, 2009 [5.]	341.72	341.66	341.64
Okanagan River			
Recreation at Penticton [6.]			
Domestic intakes-Oliver [7.]			
Agricultural intakes-Oliver [8.]			
Osoyoos Lake			
Juvenile sockeye rearing [9.]			
Adult sockeye holding [9.]			
Ok Lk levels expected by April 1, 2010 [10.]	341.48	341.42	341.40

FWMT Fish-and-Water YEAR 2008 - 2009

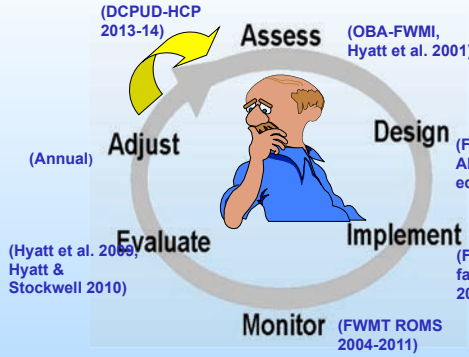
Predicted Temp-O2 "Squeeze"



Observed Temp-O2 "Squeeze"

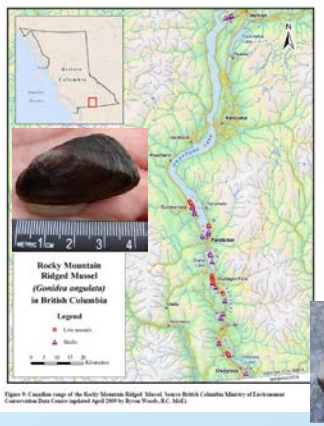


Round-2 of Adaptive Management Cycle (12 yrs, 1998-2010)



Post FWMT deployment, more adult spawners clearly lead to more smolt production as per Hyatt & Rankin (1996) analysis of carrying capacity of river and lake habitats.

Adapting FWMT to Other Sensitive Aquatic Species

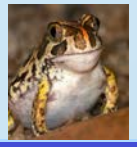


Rocky Mountain Ridged Mussell :

- in Canada, found only in the Okanagan as isolated shallow water colonies.
- recently reclassified by COSEWIC from threatened to endangered.
- given shallow shoreline habitats, vulnerable to lake level variations (and water mgt decisions???)
- FWMT predicts risk of salmon egg or alevin loss due to seasonal lake level variations or riverine flow & scour.
- mussel risk of desiccation could be readily included within FWMT to alert mgrs.

Adapting FWMT to Other Sentinel Species

- FWMT sub-models deal with climate factors (seasonal changes in temp., precipitation, runoff), that determine elevation changes in lakes, flow changes in rivers and temperatures in both on a daily basis.
- Daily to seasonal changes in physical conditions support predictions of risk of habitat disturbance, habitat loss and associated mortality of several life history stages of aquatic animals.
- Conclusion: Ok-FWMT is flexible and robust enough to be adapted as a risk assessment tool for virtually any sensitive aquatic species (e.g. mussels, spadefoot toad) or life history stage (eggs, tadpoles, fry etc…).
- Given impacts of river hydrology on riparian habitat, it may also be adapted to predict risk of habitat losses to even some terrestrial species (yellow chat)



FWMT-AM Check List & Conclusions

- [X] FWMT integrates interdisciplinary experience and science information,
- [X] Models identify & explore limiting conditions (stage, flow, temperature),
- [X] Models are dynamic and predict impacts of alternate policies,
- [X] Observed events are routinely used to validate/test model results,
- [X] Model uncertainties & sensitivities are identified and documented.
- [X] Actions and policies may be treated as experiments (escapement manipulations, pulsed water releases to mitigate “squeeze” events).
- [X] FWMT-DSS allows transparent communication with fish-and-water mgrs.
- [X] FWMT provides (1) a “deep and durable” representation of key issues for management of Okanagan fish-and-water and (2) a flexible platform for future rounds of rigorous adaptive management.

Questions ?

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