WSP

Strategy 3 Implementation Approach

Operations Committee

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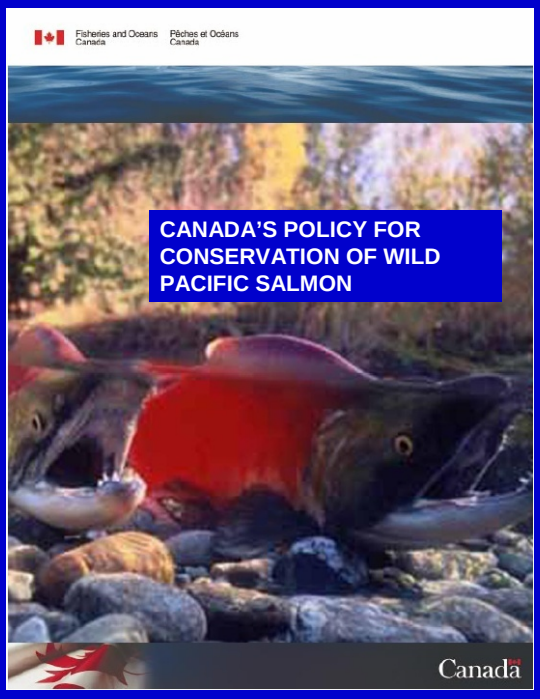
Oct. 8, 2009



Presentation provides an overview of our approach to refining the content and identifying practical steps to initiate implementation of Strategy-3 that deals with ecosystem based objectives and values of Canada's Policy for the Conservation of Wild Pacific Salmon (WSP).

Presentation Objectives

- **Identify origins and intent of ecosystem-based management (EBM) elements under Strategy-3 of Canada's Wild Salmon Policy (WSP).**
- **Identify general approach and progress in defining Strategy-3 content.**
- **Identify next steps for EBM development and implementation under WSP.**

Presentation Outline

1. **Background on WSP directions for Strategy-3**
2. **Elements of a proposed implementation approach**
3. **Next steps**

My presentation is arranged in three parts:

1. Cover…
2. Describe…
3. Provide summary of … to move Strategy-3 implementation forward.

Strategy 3 Background: General guidance.

Salmon play a key role in natural ecosystems, nourishing a complex web of interconnected species.

Salmon & Diversity: Protecting diversity[2] is the most prudent policy for the future of wild salmon & the ecological processes that depend on them (WSP, p. 2).

Maintenance of "habitat and ecosystem integrity[3] " Serves as one of three fundamental objectives that "must be fulfilled" "to achieve the outcome expressed in the policy goal for wild salmon" (WSP, p. 9).

WSP Ecosystem "Values" include the biodiversity of wild salmon, the species that depend on them and the "integrity[3]" of the ecosystems they rely on.

DFO's Commitment is to "progressively consider ecosystem values in salmon management." Strategy-3 will "provide the scientific understanding and technical capacity to include ecosystem values over time" (WSP, p.23).

1. An ecosystem is defined as "a community of organisms and their physical environment acting as an ecological unit " (WSP 2005 p. 38).

2. Defined as per the 1992 UN Convention on Biodiversity.*

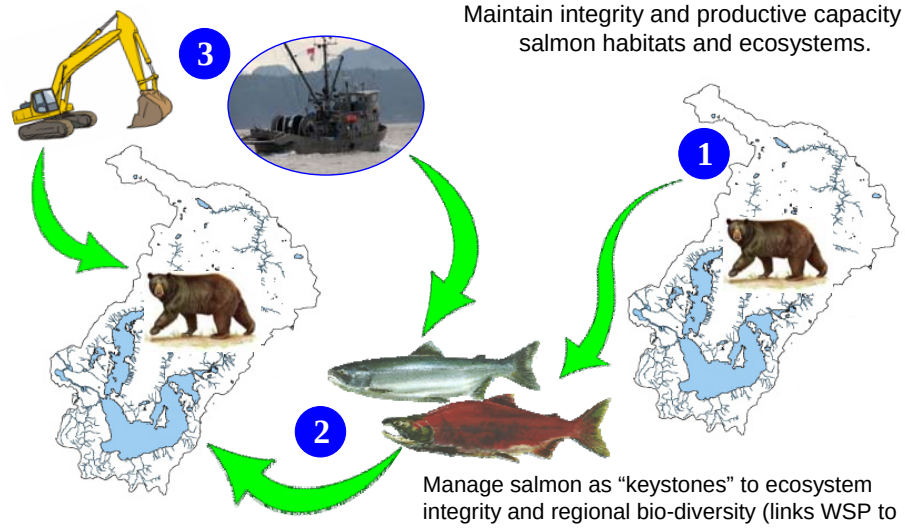
3. Ecosystem "integrity" is undefined in the policy but involves physical, chemical and biological elements along with the processes that link them.

*1992 UN Convention on Biological Diversity, and Noss (1990), "Indicators for monitoring biodiversity."

Strategy-3 of the WSP directs us to immediate consideration of EBM from a natural sciences perspective and eventual consideration (principally when dealing with Strategy-4) from a social sciences perspective.

WSP Strategy-3 includes several statements that make the importance of EBM of wild salmon clear at a general conceptual level. It starts with the observation that salmon play a key role etc…

EBM under WSP-S3 acknowledges that: (1) ecosystems influence salmon, (2) salmon influence ecosystems and (3) DFO sectoral activities influence both salmon and ecosystems.



EBM of salmon within the WSP requires recognition that (1) ecosystem variations and change affect wild salmon , (2) that wild salmon are "keystone species" that influence ecosystems, and (3) DFO has full to partial authority to manage sectoral activities that influence both wild salmon and their ecosystems.

Sectoral Links to WSP Strategy-3:

Although we talk about managing wild salmon and ecosystems, our principal role is one of managing human influences on ecosystems and wild salmon within the context of natural influences that affect both. DFO has either sole or shared authority for several sectoral activities that influence wild salmon. These include salmon harvest, salmon culture in hatcheries, salmon aquaculture and salmon habitat alteration.

Consequently, EBM values, objectives, indicators (and eventually benchmarks) need to be developed within a sector-specific context.

Strategy 3 Background: Specific guidance.

Step 3.1 of WSP: Identify indicators to monitor status of freshwater ecosystems.[1]

- Identify key indicators (physical, chemical, biological) of the current and potential state of lake and stream ecosystems (diversity of organisms, productivity etc.).
- Integrate content and assessment frameworks for WSP Strategies 2 (habitat) and 3 (ecosystem values and indicators).
- Implicitly, integrate monitoring under Steps: 1.3 (CU status), 2.3 (habitat), 3.1(freshwater ecosystem status) and 3.2 (marine conditions).

Step 3.2 of WSP: Integrate climate and ocean ecosystem information into annual salmon management processes. [2]

- Integrate the freshwater monitoring program from 3.1 "with programs investigating variability in climate and ocean conditions to understand the consequences (*of variations in freshwater and marine ecosystems*) for salmon production".
- Identify knowledge gaps requiring further research.[3]

The WSP provides some specific guidance regarding the scope of EBM considerations and some high priority objectives which include Step 3.1 etc… (*i.e.* rest of comments from slide).

1. This requires identification of objectives and indicators to monitor status and trends regarding (a) impact of ecosystems on wild salmon & (b) impacts of wild salmon on ecosystems (i.e. manage habitats and salmon to maintain important ecological linkages and biodiversity).
2. This requires partitioning freshwater and marine production contributions to annual variations in salmon returns.
3. Although there are numerous knowledge gaps, three identified explicitly under Strategy 3 (WSP 2005, pp. 22-23) are:

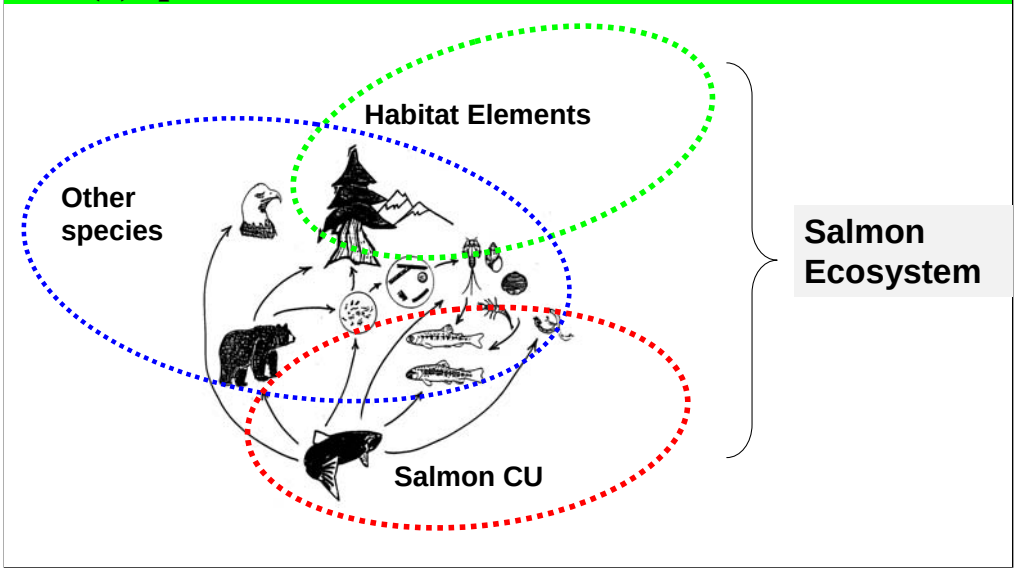
- Provide advice on the numbers of salmon necessary for healthy freshwater ecosystems;
- Link (*knowledge about*) freshwater ecosystems with changes in climate and marine conditions that affect survival and production of salmon;
- Develop a more comprehensive view of salmon production and its determinants, from egg to spawning adult to direct management activities more accurately and effectively conserve Pacific salmon resources in an uncertain future.

Approach to developing ecosystem objectives and indicators

1. Define operational ecosystem units
2. Determine reference state
3. Identify sector specific EBM objectives with Sectors, FN & other Stakeholders
4. Develop Indicators
5. Develop Monitoring plan

Although specific guidance in the WSP, noted above, is helpful, it remains largely uninformative about several key considerations that must be clarified for a viable approach to operationalizing EBM of wild salmon. These include: defining just what a salmon-centric ecosystem is, identifying the difference between salmon-habitat and salmonid-ecosystems (since we're directed to integrate elements of the former (from Strategy-2) with the latter(under Strategy-3), breaking the ecosystem into operational units for applied management, identifying the reference state(s) that EBM is meant to maintain or achieve, identifying DFOs sector-specific responsibilities for EBM, specifying informative and affordable indicators to assess DFO progress in meeting EBM objectives and finally development of a monitoring plan.

<u>Definition</u> : Ecosystems are groups of organisms and their environment , so a salmonid ecosystem, under WSP, consists of (1) a salmon CU, (2) associated habitat elements and (3) species that salmon interact with.

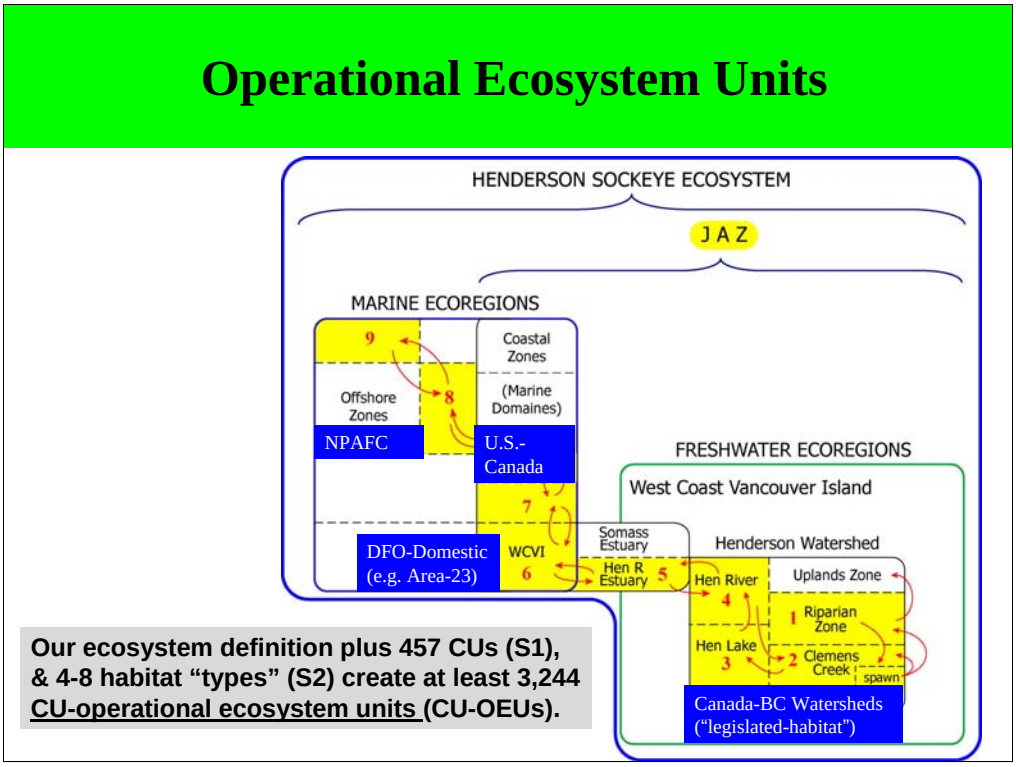


Given the definition provided here, EBM under Strategy-3 involves integrating wild salmon management objectives and indicator approaches developed for WSP Strategies 1 and 2. Thus, pressure, status or trend indicators associated with WSP-1 and WSP-2 are important precursors that will help inform the Strategy-3 general objective of maintaining & monitoring ecosystem integrity (i.e. ecosystem <u>structure</u> and associated <u>processes</u>).

Note that under Strategy-1 a few simple attributes of CUs were identified to monitor their status without reference to either habitat or ecosystem objectives. Next the Strategy-2 HWG defined habitat objectives and indicators for traditional habitat units <u>virtually entirely in terms of physical and chemical elements</u> while excluding consideration of biotic indicators (e.g. properties of the CUs themselves or other biota). **Thus, Strategy-3 integrates consideration of CUs, habitat elements and other biota to define a salmon-centric ecosystem as directed by language in the WSP.**

Even with this definition, the salmon ecosystem remains a vague conceptual construct that lacks either spatial or process boundaries that may be used to implement the overarching WSP objective of maintaining ecosystem integrity. This requires further consideration of practical approaches to defining operational ecosystem units (OEUs) for “on the ground” delivery of WSP Strategy-3 objectives.

Operational Ecosystem Units



Holtby & Cirunna (2008) provide evidence that the biodiversity of salmon CUs reflects evolutionary adaptation to conditions in some 39 joint adaptive zones (**JAZ**) covering marine and freshwater domains utilized by salmon . DFO has a long history of splitting these adaptive zones into operational spatial units that reflect international, bilateral, national & regional mgt mandates over salmon & the ecosystems they occupy (e.g. offshore zone of **NPAFC**, bilateral coastal zone of the US-Canada **PST**, domestic fisheries in Canadian shelf or terminal inlet waters, watersheds for which Canada and BC share authority). Further, under WSP Strategy-2 a series of familiar habitat units (spawning areas, riparian zones, lake and stream rearing areas etc…) have been confirmed as focal points for consideration of sectoral activities that are subject to both legislated and policy objectives for wild salmon (e.g. under the **Fisheries Act**, the **National Habitat Policy**, **BC FRPC** etc…).

By definition, a salmon CU's ecosystem includes the JAZ (Strategy-1), underlying habitat units (Strategy-2) plus dependent biota (Strategy-3). Thus a Cu + Habitat unit(s) + Other Biota = an Operational Ecosystem Unit (OEU). Given this definition , the 457 CUs (Strat-1) and 4-8 habitat elements (Strat-2) create at least 3,244 CU operational ecosystem units (CU-OEUs) at multiple spatial scales. Although this spatial complexity makes it impractical to continuously monitor status and trends for indicators within each OEU, we can use end-to-end assessments within representative CU-OEU combinations to define (1) desirable baseline reference states of CU-OEU integrity, (2) management guidelines for their maintenance and then (3) development of status and trend indicators for a representative sub-set of CU-OUEs for auditing/tracking purposes (e.g. DFOs use of Carnation Creek research to define Forest Practices Act elements pertaining to management of fish and forest sector interactions).

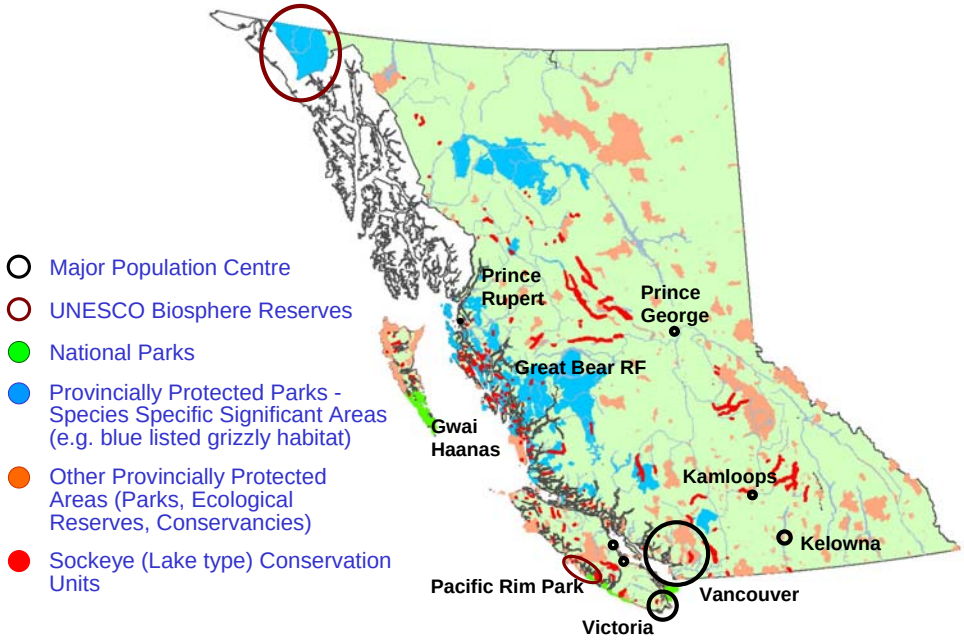
Reference state(s) for maintenance of "ecosystem integrity"* and associated indicators.

- **Historic, "natural" ecosystem**: state characterized by "unimpaired," pre-industrialized conditions (< 1900s, *e.g*. Gwaii Haanas National Park).
- **Current, but altered, ecosystem**: a current state exhibiting an acceptable range of desirable conditions (*e.g*. Barkley Sound ecosystem).
- **Future, altered ecosystem**: state reflecting movement towards a more desirable range of conditions than the current state (*e.g.* Okanagan sub-basin).

EBM of wild salmon requires specification of a reference state(s) for ecosystem integrity as a pre-condition for developing a suite of useable EBM indicators. Managing for ecosystem integrity is not restricted to managing human activities to maintain just a single reference state. There is high interest among the general public as well as scientific value in knowing what the natural, undisturbed state of an ecosystem was and how it compares to what exists there today so the primordial, undisturbed ecosystem is an important reference state to consider under Strategy-3. However, ecosystem states that depart from their prehistoric or historic configurations may be desirable from a human values perspective. Thus we may choose to manage for either a current altered state or some future altered state as the reference frame for maintenance of ecosystem integrity under the WSP.

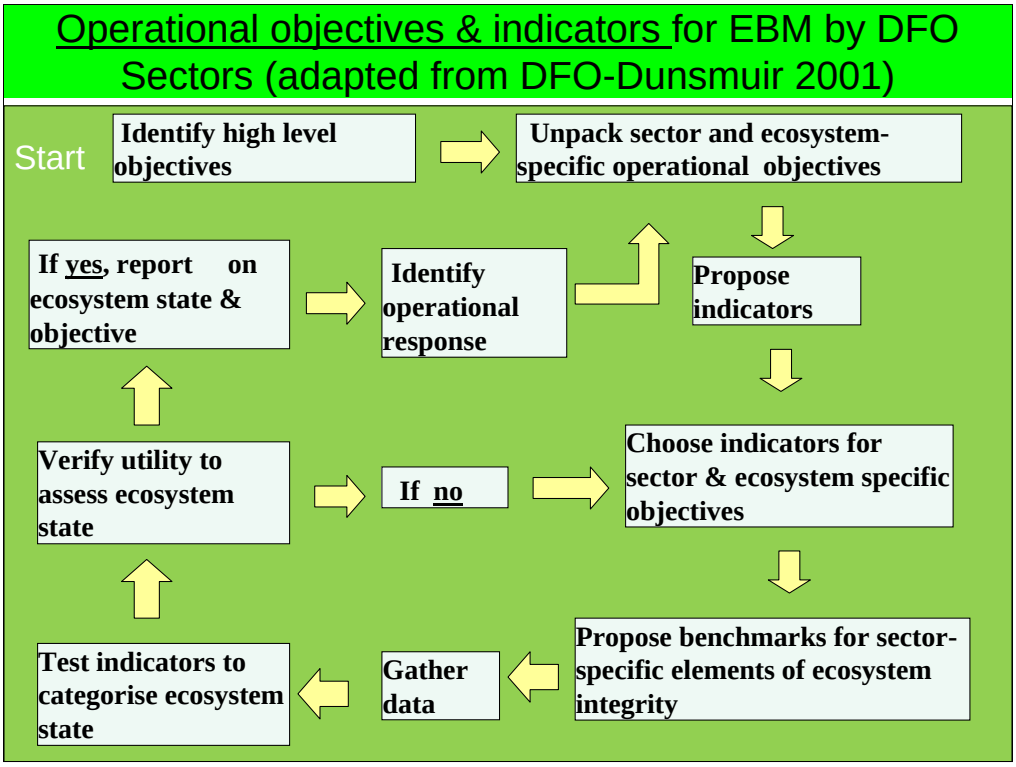
* The overarching EBM objective of Strategy-3 is to "maintain ecosystem integrity" (WSP 2005, p. 9). Ecosystem integrity may be defined as the maintenance of an ecosystem's structure (physical, chemical and biotic components) and ecological processes within a specified reference range.

De facto management zones & variable reference states.



Strategy 3 commits DFO to "progressively consider ecosystem values, and implicitly, ecosystem reference states, in salmon management." However, it is not up to DFO but rather society at large to specify the ecosystem reference state and associated conditions we're expected to manage for.

There is already a *de facto* set of ecosystem reference states specified by statute (Fish Act, National Parks Act), policy (WSP, BC-GBRF) or practice (Urban Centers) over significant areas of British Columbia. Consequently, DFO will be required to consider these during the process of implementing WSP Strategy-3 (*e.g.* **a.** National Parks commitment to manage ecosystems in an "untrammeled state of nature" for future generations under plans approved by the House of Commons, **b.** the Great Bear Rain Forest-PNCIMA region has been targeted under recent BC legislation for mandatory EBM of forest and other resources, and **c.** urban areas reflect states where societal tradeoffs have sacrificed pristine conditions for highly engineered landscapes that are less than salmon friendly).



The overarching EBM objective of Strategy-3 is to "maintain ecosystem integrity" * (WSP 2005, p. 9).

High level objectives such as maintain ecosystem integrity are conceptual and too general to permit implementation so must be broken down into practical operational objectives that are specific to sectoral activities within a given CU-OEU.

DFO has total or shared authority over several classes of activities that influence the maintenance of salmon biodiversity and the integrity of salmon-associated ecosystems. These include salmon harvest, salmon culture in hatcheries, salmon aquaculture and salmon habitat alteration.

The Strategy-3 WG has used the Dunsmuir "unpacking process" to tabulate potential operational objectives and indicators across sectoral activities and ecosystem(s). Describe Figure steps !

DFO national experience (Dunsmuir 2001) in developing EBM objectives (www.dfo-mpo.gc.ca/csas/Csas/proceeedings/2001 / Pro2001 _09e.pdf) recommends use of an "unpacking process" to identify operational objectives and effective indicators for sector-based management.

Generic Conceptual Objective: Maintain integrity of ecosystems supporting wild salmon and associated biota.	
Hatchery Operational Objectives	**Potential Indicators**
1.0 Conserve ecosystem structure by managing distribution, abundance and production of hatchery-origin salmon so structure & processes of associated OEU's remain within a specified * (i.e. "preferred") reference range.	1.0 No. & locations of hatchery facilities, adult salmon taken for brood-stock (vs wild returns) & no's of juvenile salmon released (vs wild juvenile salmon no's). Used as pressure and response indicators.
2.0 Conserve ecosystem biophysical and biochemical structure by managing hatchery activities and practises so hydrologic and water quality conditions supporting wild salmon near a given hatchery site remain within a desirable reference range.	2.0.1 Diversions/withdrawals of water relative to mean annual discharge and base-flow for hatchery-associated stream(s). 2.0.2 Hatchery effluent quality (temperature, nutrient content, pathogen titre) relative to upstream and downstream surface water conditions (BACI design).

Hatchery culture of salmon is used here to illustrate the application of this "unpacking" process to move from a non-executable conceptual objective down to operational EBM objectives that may then be used to identify practical indicators to track progress in achieving specific objectives.

Refer to figure details here !

As noted above, the Strategy-3 WG has used this process to develop a first version of EBM objectives for several DFO Sectors. One not very surprising outcome of this unpacking process is that there are scores of potential sector-specific EBM objectives that resource managers will need to consider. Consequently sectoral consultations will be required to identify Strategy-3 objectives that are practical from those that are not.

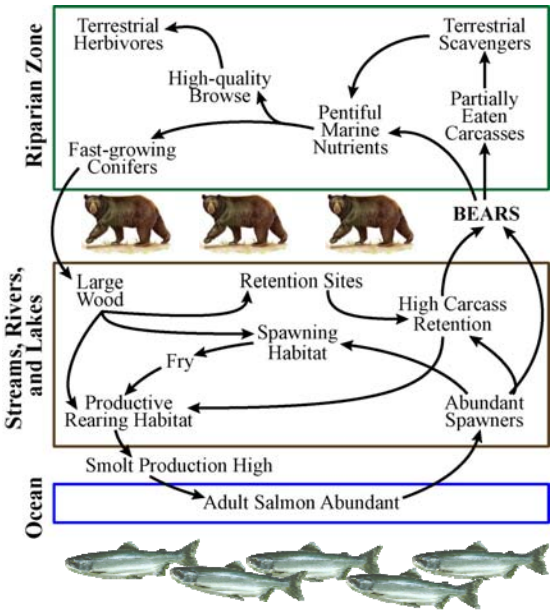
I note here that during initial discussions with OHEB staff it became apparent that sectoral consultations on EBM objectives are a special case of the more general requirement for Sectors to develop logic models and objective based management plans as part of a larger National initiative within DFO.

Process complexity also creates challenges for Strategy-3

"Ecosystems are not more complicated than we think ! "

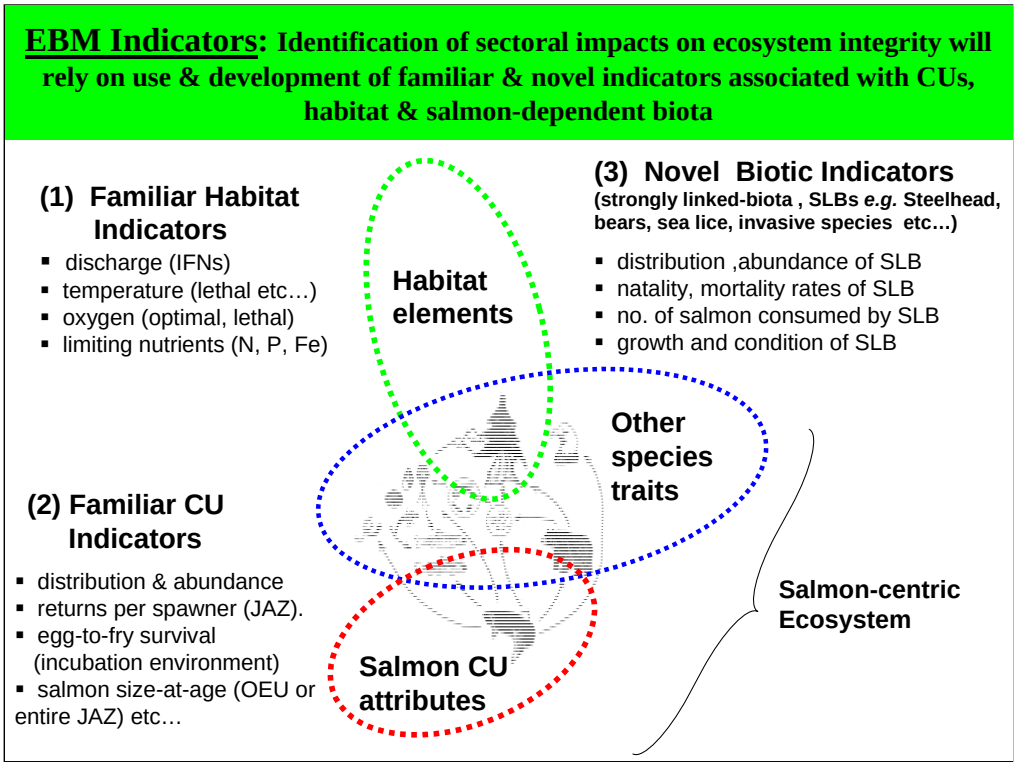
"Ecosystems are more complicated than we can think !"

It's impossible to explicitly manage for countless interactions among salmon-mediated processes & all of the dependent species in ecosystems or OEUs.



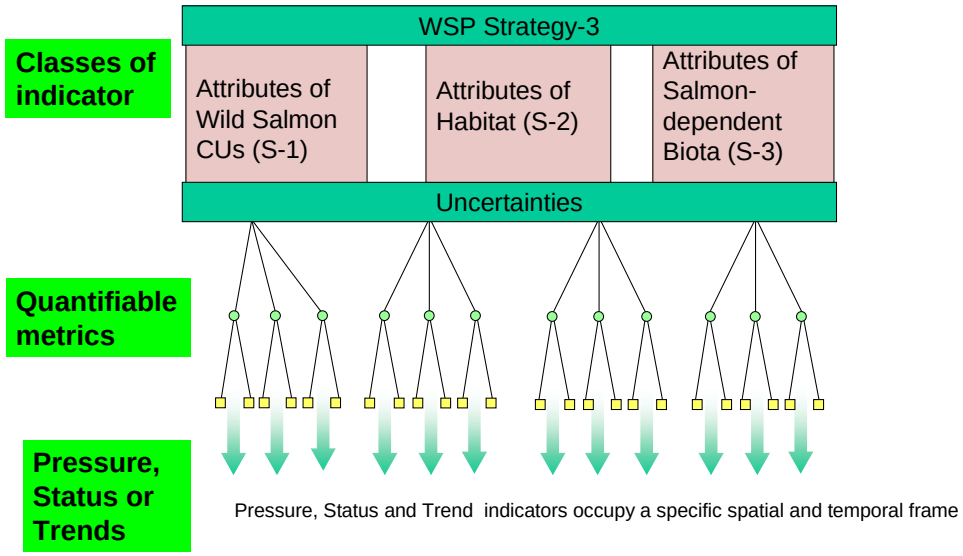
Wild salmon CUs have complex life histories completed within OEUs distributed from headwater streams to the high seas and back. Consequently, combinations of sector-specific objectives and spatially dependent CUs generate very high levels of information needs to support EBM of salmon which may be dealt with, in part, through detailed end-to-end studies of representative CU-OEU combinations. Ecological process interactions between wild salmon, their habitat, other species also poses a challenge for Strategy-3 given that both impacts of natural or man-induced disturbance events or regimes on wild salmon and their ecosystems are highly variable and often poorly understood. Its been said that ecosystems are not more complex than we think, rather they're more complex than we can think.

However, under WSP Strategy 3, identification of complex ecosystem processes involving salmon may also be simplified by focusing on just 3 process categories when considering sectoral impacts and associated indicators. These are (1) **Bottom-up processes** that emerge from a production perspective where activities of concern are those that alter the base of food-webs resulting in trophic-cascade effects (*e.g.* from anthropogenic disruptions to energy or nutrient flux), (2) **Lateral processes** that emerge from a competition perspective where human-induced changes in species numbers alter competition of wild salmon for food and space (e.g. hatchery releases, invasive species impacts) or that alter exposures to parasites & disease. **Top-down processes** that emerge from a predator-prey perspective where human-induced salmon losses (*e.g.* from fisheries) may affect culturally important (*e.g.* killer whales) or ecologically important "umbrella" species (*e.g.* bears) and ecosystem integrity.



Given: (1) our definition of salmon-centric ecosystems, (2) the identification of spatially bounded OEUs and (3) three main classes of ecological processes a "analytical filters", consideration of sector-specific impacts on ecosystem (i.e. OEU) integrity may be used to identify indicators with which to track DFO progress in meeting EBM objective(s). Under WSP Strategy-3, identification of sectoral (vs natural) impacts on ecosystem integrity will involve use and development of combinations of familiar and novel indicators associated with CUs, their habitat and biota that are strongly linked to salmon. Familiar habitat indicators include discharge etc…

Interdependencies: WSP Strategy-3 integrates and extends wild salmon management objectives & indicators developed for Strategies 1 & 2



As an aside, its important to emphasize again that WSP Strategies 1-3 are highly interdependent. Because salmon-centric ecosystems involve interactions among salmon CUs, their habitat elements and other salmon-dependent biota, indicators developed under both strategies 1 and 2 will be integrated and then supplemented during Strategy-3 implementation with additional indicators for the CUs themselves, habitat elements and especially salmon-linked biota to determine ecosystem status and trends.

EBM Indicators: Suites of specific indicators may be used for status & trend "report cards" or for aggregate-indices of OEU integrity (*e.g.* IBI) that reflect impacts of either natural or anthropogenic events/activities.

Sea Entry Year	98	99	00	01	02	03	04	05	06	07	08
Pacific Decadal Oscillation											
December–March	10	4	1	7	3	11	6	9	8	5	2
May–September	5	2	4	3	6	10	9	11	7	8	1
Multivariate El Niño Southern Oscillation Index											
MEI Annual	11	1	3	5	10	9	7	8	6	4	2
MEI Jan–Jun	11	2	3	5	7	9	6	10	4	8	1
Sea surface temperature											
Buoy 46050 (May–Sep mean)	9	2	4	5	1	7	11	8	6	10	2
NH 05 (May–Sep mean)	8	2	1	4	7	6	11	10	5	9	3
Winter prior to ocean entry	11	6	4	5	3	7	10	9	8	2	1
Physical spring transition (Logerwell)	7	6	2	1	4	9	8	11	9	3	5
Coastal upwelling April–May	6	1	10	3	5	9	8	11	6	2	4
Deep water at NH 05 (May–Sep)											
Temperature	11	4	6	2	2	7	8	10	9	5	1
Salinity	11	3	3	5	8	9	10	7	6	1	1
Upwelling season length (d)	7	4	3	9	1	10	8	11	6	5	2
Copepod biodiversity	11	2	1	5	3	8	7	10	9	6	4
N Copepod anomalies	11	8	3	5	2	9	6	10	7	4	1
Biol. spring transition	11	6	3	5	4	9	7	10	8	2	1
Spring Chinook (Jun)	10	2	3	8	5	7	9	11	6	4	1
Coho (Sep)	9	2	1	4	3	5	10	11	7	8	6
Overall Ranking											
Mean of ranks	9.5	3.5	3.2	4.6	4.3	8.6	8.0	9.7	6.9	5.1	2.4
Rank of mean ranks	10	3	2	5	4	9	8	11	7	6	1

Employing our ecosystem definition along with analytical "filters dealing with spatial (OEU) and ecosystem process considerations will allow us to identify suites of indicators that may be used to compile status and trend "report cards" or aggregate-indices of OEU integrity (e.g. IBI) that reflect impacts of either natural or anthropogenic events/activities.

Ecosystem status and trend "report cards" are well developed for some continental shelf OEUs *e.g.* the Northern California Current system which is assessed along the "Newport Line" with a suite of biophysical indicators relevant to salmon survival.

Analogous status and trend report cards that summarize or integrate indicators associated with salmon CUs, habitat and salmon dependent biota can be developed for priority OEUs (e.g. streams, lakes, riparian-zone areas) from existing information or from new research results that identify important CU-OEU associations.

Next Steps for WSP Strategy-3

To engage DFO in "progressively considering ecosystem values in salmon management" & in "providing the scientific understanding plus technical capacity to include ecosystem values over time" we will:

- ❑ Complete EBM paper & a peer review workshop (Jan. 2010).
- ❑ Develop/test/refine WSP-EBM **concepts*** in "pilot" areas to focus on area-specific, sectoral objectives and priority freshwater OEUs (e.g. Barkley Sound Pilot, sockeye and Chinook CUs).
- ❑ Identify suites of simple or aggregate indices as informative and affordable indicators of progress in meeting EBM objectives in priority CU-OEUs (*e.g.* in the Barkley Sound WSP Pilot)
- ❑ Organize a DFO workshop early in 2010 to examine ocean climate factors and salmon survival predictions.
- ❑ Identify information gaps impeding effective EBM and prioritize research required to fill these gaps.

***Concepts Include:**

- **defining area-specific reference states and associated management zones,**
- **unpacking sector-specific objectives and defining associated indicators,**
- **utility of CU-OEUs to deal with spatial complexity,**
- **utility of a 3-class approach to deal with process complexity,**
- **use of SL-biota or "umbrella" species such as bears & their attributes as integrating indicators of ecosystem structural & process integrity,**
- **options for developing suites of simple indicators into status and trend report cards or more complex combinations (IBIs, IBPCI etc…) for practical assessments of ecosystem status and trends etc…**

Strategic Considerations

- **WSP Strategy-3 is "evolutionary not revolutionary" but will require a shift of DFO staff thinking *.**
- **Our approach builds on existing stock & habitat monitoring and EAF management within DFO.**
- **Approach is consistent with evolving requirements of BC NR-Ministries & DFO interest in MSC processes.**
- **Approach has First Nation and NGO support based on consultations to date (Richmond 2008, NTC 2009 …).**
- **Future indicator assessment frameworks will be multi-scalar & must be informative, affordable & accessible.**
- **Additional opportunities may arise to implement EBM and watershed governance with outside funding (*e.g.* Skeena, PNCIMA-GBRF).**

* i.e. (1) a shift from considering salmon harvest and retail value as the principal focus for applied management given "shadow pricing" of relative values argument about what we actually manage salmon for (i.e. as indicators of ecosystem health).

An Oct. 4, 2009 article in the Times Colonist indicates NGOs (*e.g.* Raincoast Conservation Society) have begun to campaign for "full protection" of salmon runs in some areas of the coast (*e.g.* the GBRF) while at the same time praising the WSP because it "identifies the need for management to transcend salmon production" and a sole focus on harvest management by "explicitly seeking information on how much salmon is required to sustain key terrestrial species."

(2) Requires that DFO shift information gathering "tactics" from an insistence on more "boots on the ground" to "value added" functions for the boots already on the ground where we supplement scarce, increasingly expensive expertise with advanced technologies to improve productivity of "mission specialists". Need to move towards automated and semi-automated data and information retrieval systems of all types including remote sensing devices (satellite imagery, semi-autonomous cameras and sensors, drones etc…).

Questions or Comments ?

Maintain as speaking points on paper version but drop from distributed version !

Guidance ? Guidance is required regarding which of several competing process needs we should focus our limited implementation capacity on. These include:

- Implementation of WSP-pilots in DFO areas,
- Internal sectoral consultations to integrate EBM objectives from "unpacking" with logic model and objective based management initiatives,
- Federal-provincial engagement required to integrate CU-habitat-ecosystem assessment and management objectives.

Offering full support to any one of these process lines could consume all Implementation Team resources for months to years.