CHAPTER 30

Strengths and weaknesses of the Endangered Species Act: Some insights from the Columbia Basin

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Introduction

During the 1990s various fish stocks in the Columbia Basin were listed as threatened or endangered under the US Endangered Species Act (ESA) (NMFS 1995, 2000, Lohr et al. 2001). These listings included sockeye, spring/summer chinook, fall chinook, steelhead and bull trout. My perspective on the ESA is a function of four sets of related experiences over the last decade, all of which have involved facilitating multi-agency efforts to recover fish populations at risk: 1) data analyses and modeling of listed Snake River chinook salmon to support ESA decisions (Marmorek and Peters 2001, Peters and Marmorek 2001, Deriso et al. 2001, Peters et al. 2001); 2) designing monitoring and evaluation approaches to determine the status of listed species and their responses to management actions (ESSA 2002, CBFWA 2002, ESSA 2001); 3) analyzing the factors limiting unlisted Okanagan sockeye populations that spawn in the Canadian portion of the Columbia Basin (Parnell et al. 2003) and 4) restoration efforts on listed and unlisted salmon populations in Northern California and British Columbia (Alexander et al. 2003, Marmorek and Parnell 2002). While these experiences have provided some interesting contrasts in processes some driven by ESA and some not, my subjective opinions are naturally sculpted by my particular set of experiences. In considering the strengths and weaknesses of the ESA, I also speak from a particular perspective - that of an aquatic ecologist and facilitator, not a lawyer, government regulator or direct user of water and fish resources.

Strengths and weaknesses are terms best judged in a relative manner, compared to some other standard. In this paper I am subjectively comparing the ESA to what I consider to be *the best possible application of scientific knowledge, human resources, laws and money towards conserving and recovering threatened or endangered species and the ecosystems on which they depend*. My judgments draw on experiences of preservation and restoration efforts with and without the ESA. I recognize that the ESA is only one tool in society's toolbox for preventing the extinction and accelerating the recovery of salmon stocks at risk.

I will focus on the application of the ESA to the operation of dams which form the Federal Columbia River Power System (FCRPS). To provide a foundation I will describe the FCRPS, the broader challenges in recovering Columbia Basin salmon, and the general process by which the ESA is applied to federal power projects. I will then delve into some of the specific history of ESA applications to the FCRPS, and conclude by posing some questions and perspectives, relying on comparisons with other processes to elucidate what I believe are the strengths and weaknesses of the ESA.

The Federal Columbia River Power System

The FCRPS consists of fourteen hydroelectric projects: four on the lower Snake River, four on the lower Columbia River and another six in the Upper Columbia River (Figure 30.1). Altogether there are 92 hydroelectric dams in the Columbia Basin, and 30% of the Basin's salmon habitat is permanently blocked from access by the Grand Coulee and Hells Canyon dams (Figure 30.2). The four Snake River projects (completed in the early 1970s) were the focus of much attention under the ESA during the last decade. Since the late 1960s, the number of returning spawners in the seven Snake River index stocks (Figure 30.1) have declined by about 70-80%, though with some strongly consistent fluctuations (Schaller et al. 1999). Currently, only about 10% of Snake River spring/summer chinook smolts migrate down through the eight reservoirs and dams; the remainder are transported in barges past all eight projects and then released below the last dam at Bonneville. One of the key issues facing fish management agencies during the last decade was whether to continue transporting fish or alternatively to breach or remove the four Snake River dams.

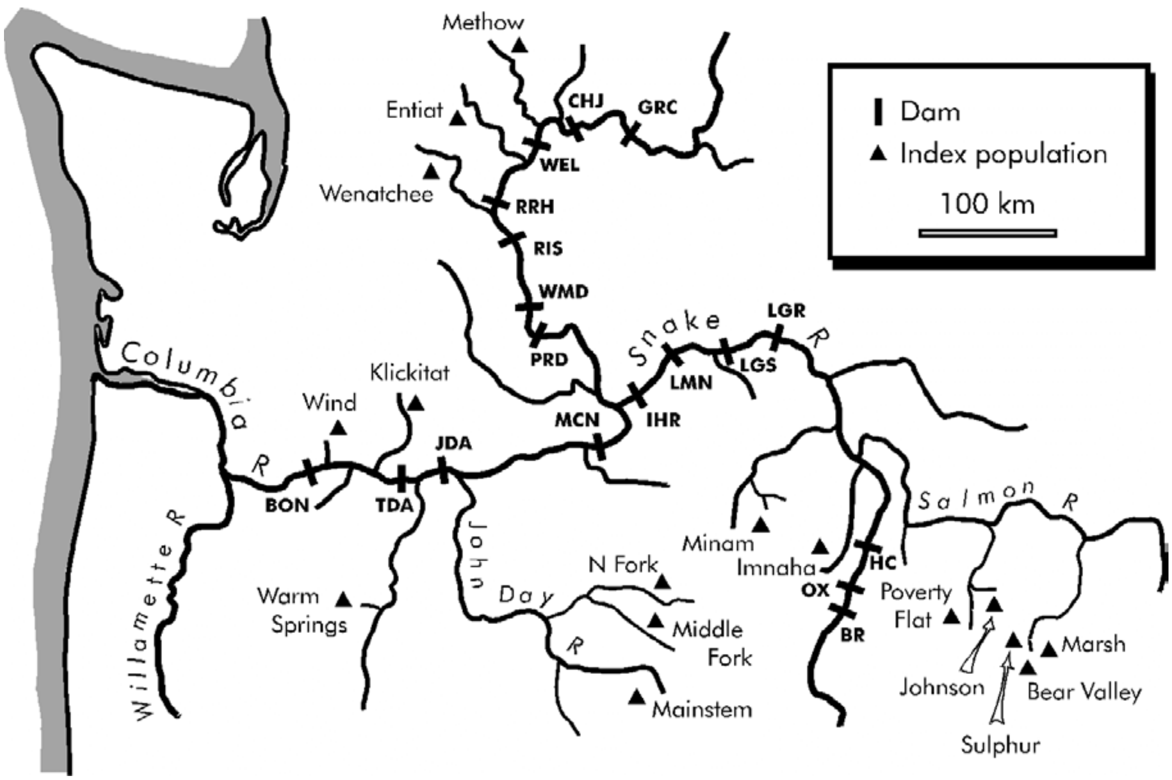

Figure 30.1. The Federal Columbia River Power System and monitored 'index populations' of spring/summer chinook, in both the Snake River basin and lower Columbia River (Schaller et al. 1999; reproduced with permission in Marmorek and Peters 2001).

Challenges in recovering Columbia Basin salmon

Among the many issues, I would highlight the following seven challenges:

1. The Columbia Basin covers an enormous area (Figure 30.2), with complex spatial linkages. For example, reservoir storage at its most northern hydroelectric project (the Mica Dam) affects conditions in the Columbia River estuary. The Alaska salmon harvest affects the abundance of fall chinook salmon in the Snake River (Peters et al. 2002).
2. Multiple stressors (harvesting, hatcheries, hydroelectric development, forestry, agriculture, urbanization, mining, pollution) have cumulative effects on salmon and their habitat.
3. There are both competing uses for the Columbia River, and differing goals for salmon populations (e.g. saving endangered species, increasing harvest, restoring ecosystems).

4. Jurisdictional complexities (2 national, 4 state, one provincial, and hundreds of First Nations/tribal/regional governments) make it difficult to coordinate salmon and habitat management policies to deal with these competing uses and goals and interacting stressors over this large area. Recent efforts have been made to develop a collaborative approach to monitoring and evaluation among federal, state, and tribal agencies (CBFWA 2002).
5. There are large scientific uncertainties regarding the relative importance of different factors on overall salmon survival, particularly since several factors (dams, hatcheries, transportation, ocean regime shifts) changed concurrently during the 1970s.
6. There are legal, technical and political constraints on implementing adaptive management experiments which might help to reduce these uncertainties (McConnaha and Paquet 1996).
7. There is a low level of trust, exacerbated by a history of hearings and court cases wherein modelers working for some agencies advocate transporting fish, and analysts with other agencies advocate dam breaching, thereby thoroughly confusing decision-makers who are seeking a single clear answer.

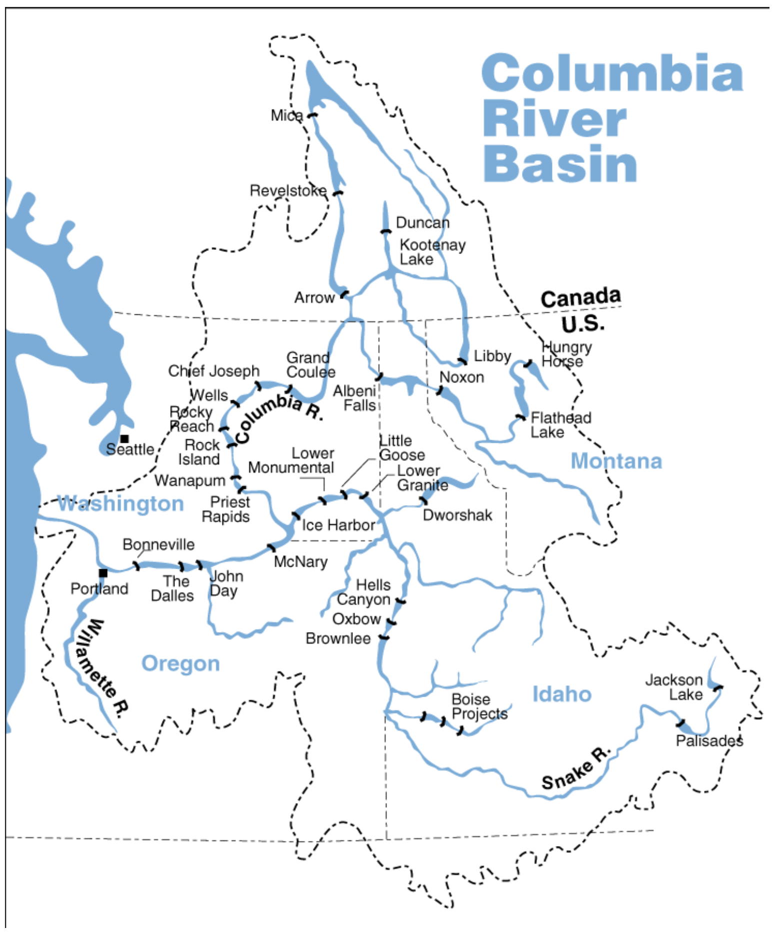

Figure 30.2. The Columbia Basin. Source: NMFS 2000.

The last two challenges deserve some elaboration. By adaptive management I refer to deliberate, well-designed, well-monitored contrasts in management over time and/or space to reduce key uncertainties. Fish agencies are understandably nervous about experimenting with endangered species. Unlisted species and hatchery fish provide the best opportunities for fail safe adaptive management experiments. In addition, risk-averse decision makers are loath to admit that they really do not know what actions are most likely to recover stocks. They would prefer that “scientific research and monitoring” resolve key uncertainties in the effectiveness of management actions. However, research and monitoring cannot significantly reduce these uncertainties without some spatial/temporal contrasts in management actions. Finally, an important technical challenge is that there is only one mainstem Columbia River, which makes it impossible to provide spatial contrasts in hydrosystem management actions, though temporal (i.e. year to year) contrasts are feasible. Spatial contrasts are possible at the level of reaches, tributaries and sub-basins for habitat management actions. The recent use of PIT-tag technology has provided insights into the effects of different factors (e.g. transported *versus* in-river passage, number of bypasses transited, wild *versus* hatchery, habitat conditions) on salmon smolt to adult survival rates (CSS 2002).

Building trust is a major challenge due to the adversarial nature of past interactions, and the frequently conflicting goals of different agencies. In the FCRPS salmon debates there have typically been three major groups of people involved: quantitative fishery scientists/modellers, field scientists and decision makers (the latter includes both regulatory agencies and the public). Each of these three groups have representatives from multiple agencies. A major challenge is moving from the standard defensive ‘within agency’ communication, where each agency buttresses its previous position to ‘interagency learning teams’. Such teams would ideally have open sharing of information and insights, leading to a consensus on what management experiments, research and monitoring is required to reduce remaining uncertainties in long-term management actions.

How the ESA is applied to the FCRPS and examples from the 1991 – 1995 period

The ESA is a complex piece of legislation and here I discuss only one important section (7(a) (2)), which directs what are commonly referred to as “Section 7 Consultations”. The federal agencies operating the dams propose various operations or actions in areas with listed species. They consult with National Oceanic and Atmospheric Agency (NOAA) fisheries for salmon and the United States Fish and Wildlife Service (USFWS) for bull trout. Those regulatory agencies assess if the proposed action would jeopardize the survival or recovery of the listed fish or adversely affect their habitat. If they conclude that the fish or their habitat might be jeopardized, they write a Biological Opinion. The Biological Opinion recommends a “Reasonable and Prudent Alternative” (RPA) to the original action that avoids jeopardizing the fish and recommends measures to minimize the impact on habitat. The RPA measures must be within the federal agency’s legal authority and jurisdiction, economically and technologically feasible, specific, and reasonably certain to occur. If those measures are accepted by the agencies operating the dams, they get what is called an “Incidental Take Statement” which means they can continue to kill some fish and continue to operate. The consultation may be re-opened if conditions change or the measures are not implemented.

There are three key issues in Biological Opinions: the survival and recovery standards used to assess jeopardy (are they too lenient or too stringent?); the analytical methods used to determine if actions meet the standards (are the key model assumptions that affect stock trajectories defensible?); and the enforceability of the RPA and associated measures (implementation uncertainty).

The first half of the 1990s was an interesting and intense period for the ESA and FCRPS. In 1991, Snake River sockeye was listed as *endangered*, the first species so designated in the Columbia Basin. In 1994 NMFS came out with a Biological Opinion which concluded that proposed dam operations did not jeopardize the survival or recovery of Snake River sockeye. They were promptly sued by the Idaho Department of Fish and Game and four tribes. The Judge agreed with the plaintiffs, stating:

> *The process is seriously, significantly flawed because it is too heavily geared towards a status quo that has allowed all forms of river activity to proceed in a deficit situation, i.e. relatively small steps, minor improvements and adjustments, when the situation literally cries out for a major overhaul...The Biological Opinion’s jeopardy standard and RPA are ‘arbitrary and capricious’ and* not *in accordance with the Endangered Species Act*

NMFS was sent back to the drawing board. The federal agencies, states and tribes worked together to revise the standards and, in 1995, a new Biological Opinion was issued. At that point Snake River spring, summer and fall chinook were also listed as *endangered*. The 1995 Biological Opinion included a lot more actions in its RPA, such as improving fish bypasses, spills, spring/summer flow, and transportation. It also specified a lot of research to evaluate the relative benefits of transportation *versus* dam breaching, including specifying a collaborative process to assess the evidence underlying the key hypothesis in different models (NMFS 1995; pg. 124, Rec. 17). Finally, and most importantly, NMFS said that by 1999 they would make a decision one way or another to either increase transportation or breach the Snake River dams.

PATH (1995 – 2000)

The new, collaborative process that was formed in response to the NMFS recommendations became known as the Plan for Analyzing and Testing Hypotheses (PATH). Since the process is described in detail in Marmorek and Peters (2001) I will only touch on a few highlights here that bear on processes by which the ESA can be applied to complex, controversial issues. PATH was assigned three specific objectives:

1. Determine the support for key alternative hypotheses from existing information, and propose other hypotheses and/or model improvements that are more consistent with these data (retrospective analyses).
2. Advise regulatory agencies on management actions to restore endangered salmon stocks to self-sustaining levels (prospective analyses).
3. Assess the ability to distinguish among competing hypotheses from future information, and advise institutions on research, monitoring, and adaptive management experiments to maximize learning.

One of the key lessons learned from the PATH process was that independent facilitation and peer review is essential to building both trust and rigour. PATH had four levels of peer review. First, the 25 scientists involved in PATH represented about a dozen agencies, and vigorously critiqued each others' analyses. A key feature of PATH was its collaborative structure; it was not simply one regulatory agency (e.g. NMFS) completing its analyses, and then receiving comments from others, which they could accept or reject. Second, there were three independent scientists involved in designing and implementing the analyses: Drs. Randall Peterman, Rick Deriso, and Lou Botsford. They rolled up their sleeves, sat at the table and called the shots as they saw them. That was an extremely helpful form of peer review, and raised the quality of work submitted by all participants. Third, all PATH reports went out to a Scientific Review Panel (SRP) that was not involved in designing or implementing any of the analyses: Drs. Carl Walters, Jeremy Collie, Saul Saila, Jim Kitchell and Steve Carpenter. In addition, the Independent Scientific Review Panel (ISRP), reviewed PATH funding proposals. Fourth, there were peer reviews of journal articles.

PATH's work on the first objective focused on restrospective analyses. In a conflict-ridden environment, it is extremely valuable to have extensive data and long time series to evaluate the relative probability of alternative hypotheses. One of the retrospective analyses completed by PATH was to compare the 40-year record of recruits per spawner for the seven Snake River stocks, which pass 8 dams, with the similarly long record for the six lower Columbia stocks that only pass 1-3 dams (Schaller et al. 1999; Deriso et al. 2001). Two interesting insights emerged (Figure 30.3). First, there were common year effects for all 13 stocks, with generally higher recruits per spawner before 1975, and generally lower recruits per spawner after 1975 (Figure 30.3 – upper graph). Second, after 1970 the Snake River stocks had on average about 67% more mortality than the lower Columbia River stocks (Figure 31.3 – bottom graph). Interestingly, in more recent brood years (1995 to 1997), better ocean survival has resulted in more positive year effects and generally higher returns coming back to both the lower Columbia and Snake River areas (Rich Hinrichsen, unpub. data). However, the Snake River stocks still have about the same level of incremental mortality over lower Columbia River stocks, in fact at the upper end of the range shown in the bottom graph of Figure 30.3. These results are consistent with significant negative impacts from dams and transportation. While other factors could also be partly responsible for this pattern (e.g. differential survival of the two stock groups in the ocean; effects of hatcheries), any such hypotheses must explain the observed patterns of change in recruits/spawner in both time and space. The collaborative effort at retrospective analyses made it clear to the group that certain hypotheses were indeed less tenable than others because they could not reasonably reproduce the observed pattern and magnitude of survival changes. This level of scientific consensus would not emerge through the standard ESA process in which the regulatory agency completes its own analyses and then sends them out for comment.

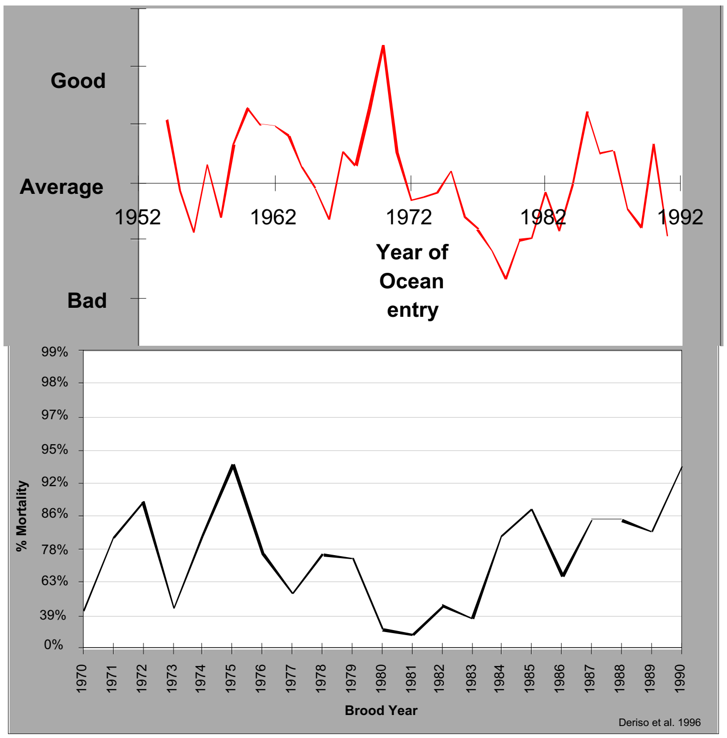

Figure 30.3. Upper graph: Common year effects (common changes in recruits per spawner) for 7 Snake River and 6 lower Columbia River spring summer chinook index stocks. Lower graph: Incremental mortality of Snake River stocks over lower Columbia River stocks (measured in terms of differences in recruits per spawner). Simplified from Deriso et al. 2001.

The PATH group systematically examined other factors: harvest, habitat and hatcheries (Marmorek and Peters 1996). Harvest was really not relevant to spring/summer chinook because the harvest rates were very low (less than 5%) during the post-1970 decline in abundance of Snake River spring/summer chinook. Habitat change also cannot explain the decline of these stocks, since stocks in pristine habitat in the Snake subbasin showed about the same rate of decline as stocks in degraded habitat. There is also a consistent recruitment curve of smolts *versus* spawners since the 1960s, which suggests no significant change in survival during the freshwater spawning and rearing stage (Petrosky et al. 2001). When it comes to hatcheries, there are certainly possible effects but they are hopelessly confounded with changes in the transportation program (see Figure 2 in Marmorek and Peters 2001). The only way to tease apart these competing hypotheses would be to vary either transportation and/or hatchery releases to improve the contrasts in these actions. A lesson drawn from this experience is that mitigation actions should be carefully planned through an experimental design that will reveal their effectiveness (or lack thereof) with high statistical power (e.g. an ON-OFF-ON-OFF sequence over several years).

Collaboration on objective 2 (prospective analyses) was made easier by a decision analysis framework which permitted open exploration of the consequences of alternative hypotheses for changing the relative value of different management actions (Peters and Marmorek 2001, Peters et al. 2001). There were many sets of alternative hypotheses, and people would argue about each one of them for weeks at a time. We found it helpful to critically examine the evidence for each proposed hypothesis and then look at how each of the three alternative actions (i.e. continue current operations, maximize barging, or breach four Snake River dams) performed across *all* of the combinations of about 15 different hypotheses. For the breaching action, this resulted in about 2,000 combinations of hypotheses, each of which were simulated 3,000 times to cover all of the uncertainty in stock recruitment parameters. After all of this sensitivity analysis, we found that only 3 of the 15 sets of uncertainties (i.e. transportation assumptions, stock productivity and extra mortality) really made any difference to the ranking of alternative actions. Other assumptions just scaled survival up or down, but did so equally for all actions. This allowed the group to focus their discussions on uncertainties which really made a difference to decisions. This effort made a significant difference to subsequent work completed by NMFS for the 2000 Biological Opinion, even though NMFS did not conduct as detailed a decision analysis.

PATH's initial decision and sensitivity analyses were helpful but were criticized on the grounds that all hypotheses were weighted equally. Decision analyses can be manipulated by including unreasonable hypotheses or probabilities that tilt expected outcomes in a desired direction. To avoid this, we conducted an intensive process to compile all of the available evidence for and against the critical hypotheses. This formal Weight of Evidence Process was concluded with an independent weighting of the probability of alternative competing hypotheses by each SRP member, after reviewing a detailed Weight of Evidence report. We then took each of the panel's independent weights and applied them to determine if they yielded a different outcome to the results from weighting all hypotheses equally. With all of the SRP members' weights, breaching was consistently the better action for recovering Snake River spring/summer chinook, even more so than with all hypotheses weighted equally (Figure 30.4). The SRP strongly recommended that PATH pursue experimental management actions to resolve key uncertainties, which we subsequently did.

In summary, PATH's retrospective analyses narrowed the range of tenable hypotheses and focused both the debate and future research priorities. A decision analysis clarified the effects of both alternative decisions and alternative hypotheses. PATH's analyses of experimental management actions demonstrated tradeoffs between learning and conservation for a number of alternative approaches. Finally, a lot of mutual respect and trust evolved among PATH scientists. The main weaknesses of the process were that it was slower than what would occur with a single agency conducting their own analyses, and that it was difficult to explain to non-technical audiences (Marmorek and Peters 2001).

ESA and the FCRPS during the 2000 – 2003 period

NMFS (2000) completed its own analyses for their 2000 Biological Opinion, although they did extensively reference PATH. One of the reasons for this separate analyses is that by the year 2000, there were 9 more populations of salmon and steelhead listed under the Endangered Species Act. These stocks were found in areas such as the Upper and Mid-Columbia regions, which PATH had not analyzed.

Nine federal agencies were brought together and developed a Basinwide Recovery Strategy, which embraced an "all-H" approach, with hydro, harvest, habitat and hatchery actions. The 2000 Biological Opinion presented an RPA with a lot of "off-site" habitat mitigation for hydrosystem mortality. The RPA proposed detailed monitoring and evaluation, and "check-ins" after 3, 5 and 8 years. If the stocks were not doing well during these check-ins, NMFS would reconsider breaching and other kinds of actions. Like PATH, NMFS found that breaching was the most certain way to recover Snake River stocks, but the 'all-H' approach was considered by NMFS to generate sufficient survival improvements to avoid jeopardy.

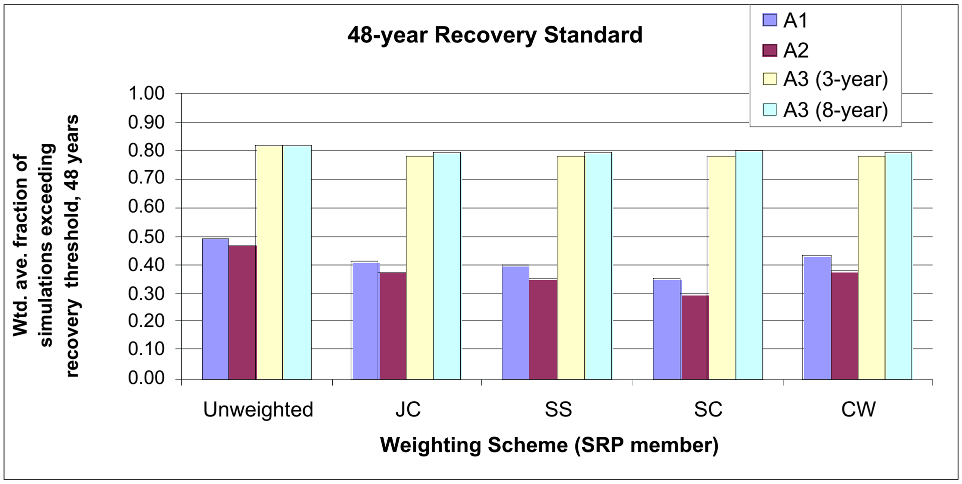

Figure 30.4. Results of independent weighting of alternative hypotheses by four Scientific Review Panel members on the probability of recovery of Snake River spring/summer chinook, compared to the unweighted case (all hypotheses equally probable). Actions: A1=current transportation; A2=increased transportation; A3 (3-year) = dam breaching with 3-year delay for Congressional Approval; A3 (5-year) = dam breaching with 3-year delay for Congressional Approval.

In 2001, a lawsuit was initiated against the 2000 Biological Opinion by 12 environmental and fish groups, the State of Oregon and 4 tribes. In 2003, Judge Redden rejected most scientific criticisms as inadmissible, but sided with the plaintiffs on the implementation uncertainty of the proposed RPA:

> *NMFS improperly relied on range-wide off-site federal mitigation actions that have* not *undergone Section 7 consultation, and non-federal mitigation actions that are* not *reasonably certain to occur in order to reach the no-jeopardy conclusion.*

NMFS was asked again to rework their Biological Opinion.

Insights and Questions

What kinds of insights and questions can we draw from the above history? I believe that the ESA and its associated court decisions have both strengths and weaknesses. Some of the strengths include: the judge is a neutral party and does not work for any of the entities involved; the ruling has the force of law and is not just a scientific 'opinion'; legal decisions can force collaboration to occur among parties (e.g. PATH was created by the 1995 Biological Opinion, interagency Recovery Teams were created out of the 2000 Biological Opinion); and legal decisions can force beneficial mitigative actions to occur.

There are also some weaknesses to court decisions about ESA matters. As a scientist, I find it frustrating that the court's focus is almost entirely on administrative procedure (i.e. did the regulatory agency follow the law?) and not on science. As a result many key issues are ignored. There is also a deference to the regulatory agency's science, rather than a rigorous examination of alternative hypotheses as occurred in PATH. Finally, the judge tends to rule on as little of the complaint as necessary, and these rulings vary with the wisdom of the judge. A huge amount of scientific brainpower ends up being focussed on a legal process that often does not deal with the critical issues affecting the future of salmon.

The strengths probably outweigh the weaknesses. ESA has forced valuable improvements in fish passage, habitat, recovery plans and monitoring, which otherwise would never have occurred. For example, at Rocky Reach dam the Chelan Public Utility District recently spent $112 million on a smolt bypass, with significant survival improvements. Some may say that this is just a techno-fix. However, without those techno-fixes, the cumulative effect of an Okanagan sockeye smolt going through 9 dams really starts to hit hard. If you reduce the mortality at each of 9 projects, it can make a big difference to overall survival.

Do court cases erode trust among scientists from different agencies and undermine collaboration? The answer to that question will depend on the people involved, but I would answer "yes". Courts are inherently adversarial, and tend to be hard on the people as well as the problem. Lawyers on all sides put pressure on scientists to state their case as strongly as possible, beyond their comfort level. My experience in talking to people from NMFS is that while ESA is a useful hammer, court cases make the agency very defensive. This can lead to a 'crisis response' atmosphere rather than an open 'interagency learning' atmosphere. I suspect that the trust built up during PATH has been somewhat eroded with recent court cases.

What about stocks that are not yet listed? Does the ESA, perhaps not intentionally but nevertheless incidentally, lead to too much money being spent on listed stocks and not enough on unlisted stocks? Okanagan sockeye is a good example (Parnell et al. 2003). These salmon spawn in Canada in the Okanagan River above Osoyoos Lake, and the fry rear in Osoyoos Lake. Once grown to migrating size, the smolts move down the Okanagan River, and then through the Columbia River and its 9 dams to the ocean, returning as adults two years later (Figure 30.5). That stock has varied in spawner abundance from about 2,000 in the lowest year to as high as 80,000 (measured at Wells Dam Figure 30.6).

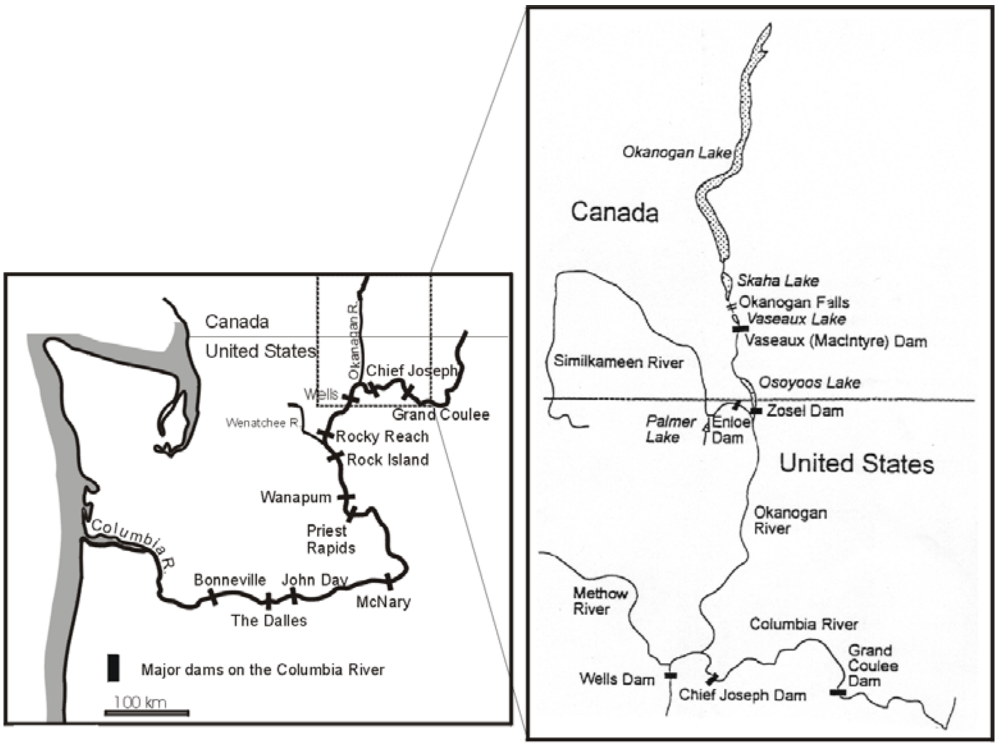

Figure 30.5. Time series of spawner abundance of Okanagan sockeye, and migratory route. Source: Parnell et al. 2003.

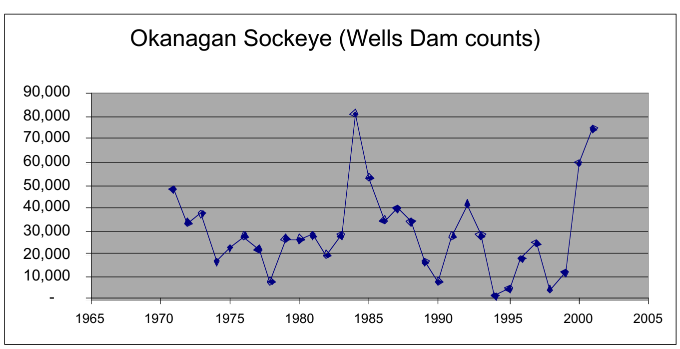

Figure 30.6 Abundance of Okanagan sockeye (Wells Dam counts) from 1970-2002.

Okanagan sockeye are not listed as *threatened* or *endangered*; over the last decade the Bonneville Power Administration (BPA) has spent about $0.5 million on this stock. By comparison, BPA has spent about $12.5 million on a captive brood stock program for *endangered* Red Fish Lake wild sockeye in Idaho. In 1992 Redfish Lake had one returning spawner (named 'Lonesome Larry'); it is a bad sign when individual fish are named. Does it make ecological and societal sense to spend 25 times as much money on Redfish Lake sockeye as on Okanagan sockeye? Unlisted stocks provide opportunities for implementing Adaptive Management experiments to reduce key uncertainties. The lessons learned can then be applied to listed stocks.

Is the ESA too species-centric? Williams et al. (1999) wrote an innovative report, "Return to the River", which recommended a more 'normative' river for the Columbia, increasing natural ecosystem processes and functions. The ESA is by definition focused on species, and Biological Opinions do not tend to talk much about ecosystem processes. I think the structure of the ESA generally gets in the way of adopting an ecosystem perspective, although Recovery Plans do consider meta-populations and other ecosystem processes. Restoration efforts on the Trinity River in northern California, which are driven by tribal fishing rights rather than the ESA, have adopted more of a normative river approach. On the plus side for ESA, the numbers of animals are still a measurable and enforceable metric, whereas ecosystem integrity is a much less well-defined concept.

How can we build on the strengths of the Endangered Species Act and overcome its weaknesses? I think it is important to keep the hammer represented by the ESA, but to also add other tools to the toolbox. In particular, we need to improve methods of interagency collaboration on science, and learn from successful stakeholder-scientist processes. This would include the Water Use Planning processes being used in British Columbia for reviewing operations at hydroelectric facilities, and the Grand Canyon Restoration Program. We need to focus a larger fraction of the total dollars spent on unlisted stocks, investing in Conservation Plans to maintain these stocks before they decline to the point where they are *threatened* or *endangered*. Finally, we need to develop metrics for ecosystems that help create more of an ecosystem approach.

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