The similarity of the Democratic and Republican platforms in the U.S. presidential race might be "because a highly integrated political economy ensures that any policy will have mediocre outcomes," an idea based on a model that simulates complex systems with large numbers of conflicting interactions. Further discussion is presented about the National Marine Fisheries Service's plan for saving endangered salmon in the Columbia River. One source of the compound SF_5CF_3 that was recently identified and reported in *Science* as a potent greenhouse gas is described. And another explanation is offerred for results from an international survey that suggest marital satisfaction is associated with moderate husband dominance.

Presidential Politics: Constrained by Complexity?

During the U.S. presidential campaign, there has been considerable discussion about the degree of similarity between the platforms of the Democratic and Republican candidates (*1*). Mallaby sees the "irrelevant election" as a consequence of globalization, noting that "the next U.S. president will find his ideals on a wide range of foreign policy issues boxed in by new systemic constraints" (*2*).

This boxing in of the executive office is reminiscent of the complexity catastrophe described by Kauffman in his NK model of rugged fitness landscapes (*3*) used to simulate evolutionary patterns in biological systems. In this model, networks are constructed randomly to simulate the large number of conflicting interactions found in complicated systems. Each of the N components is randomly assigned an initial state, is randomly connected to K other components, and exerts at random favorable or unfavorable interactions on each of its K neighbors. Despite these random assignments, systems having moderate amounts of interconnectivity (lower values of K) can be readily configured to achieve primarily favorable interactions. However, in systems with higher amounts of interconnectivity (higher values of K), a nagging load of unfavorable interactions becomes unavoidable. In the limit of maximum interconnectedness ($K = N - 1$), configurations have, on average, as many favorable as unfavorable interactions, and a given configuration contains no information about neighboring configurations. Hence, overly connected, highly frustrated networks guarantee that (i) a search for better configurations can do no better than a random selection, and (ii) highly favorable configurations simply do not exist. The complexity of the interactions ensures a catastrophic loss of the potential to improve beyond mediocrity.

Despite their best efforts to distinguish themselves, perhaps Mr. Bush and Mr. Gore appear similar because large-scale communication, transportation, and economic networks have resulted in a globally integrated political economy, with many conflicting interactions. Globalization is equivalent to increasing the "K parameter" of economic networks, resulting in an uncorrelated landscape of mediocre compromises among political, environmental, and cultural systems. Differences in principle and means become irrelevant as each candidate faces the fact that acceptable solutions to large-scale political problems are, at best, hard to find, and, at worst, nonexistent. Although the platforms of Bush and Gore differ in detail, any policy decision concerning large domestic or foreign programs, such as urban housing (*4*) or free trade agreements (*5*), will necessarily result in as much harm or risk as benefit (*6*). Their platforms seem similar because a highly integrated political economy ensures that any policy will have mediocre outcomes. A Kauffmanian complexity catastrophe also implies that a random casting of votes would, paradoxically, do as well as costly lobbying and political analysis in directing national affairs.

SOURCE: ASSOCIATED PRESS

Is complexity in the form of globalization confounding distinctions between political platforms?

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Of Salmon and Dams

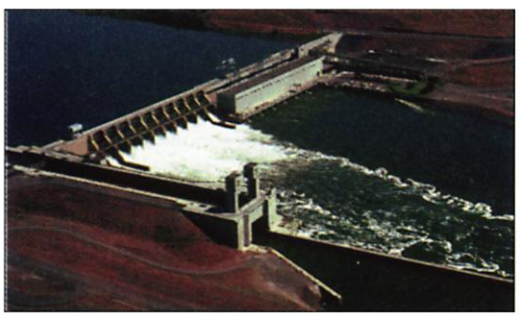
Charles Mann and Mark Plummer's News Focus article "Can science rescue salmon?" (4 Aug., p. 716) on the Snake River salmon is well informed but does not adequately characterize the Plan for Analyzing and Testing Hypotheses (PATH) or the plight of the endangered salmon stocks. As members of the Scientific Review Panel of PATH, we have reviewed thousands of pages of PATH reports. PATH was a network of fishery scientists, including North American experts in fish population dynamics. The core group of 25 scientists represented six federal entities, three state fishery agencies, one tribal organization, and two regional entities. PATH sought consensus by evaluating all plausible hypotheses (hydropower dams, harvesting, habitat degradation, hatchery misuse, and climate) for the decline of Snake River Chinook salmon. Historical data were essential because they allow comparisons to be made with conditions before the construction of the dams. For example, the survival rate of upriver spring-spawning Chinook remained high during the 1940s, even though this appears to have been a period of lower ocean productivity, similar to the ocean conditions since 1976 (*1*).

The life-cycle model PATH used to predict future population levels for spring/summer Chinook is described as a "super model" in the article, but this is a misnomer; it is an extension of the classic Ricker model in which the stage-specific survival terms are described in more detail to allow comparison of competing hypotheses. The price of this inclusiveness was that the life-cycle model be-

came very complicated. The PATH was successful in that it distilled the uncertainty about causes of the decline of Snake River Chinook salmon to a small set of management decisions.

The Cumulative Risk Initiative (CRI), created by the National Marine Fisheries Service (NMFS), diverted attention away from the impact of dams to mortality at other life-cycle stages. Taking spring/summer Chinook as an example, the CRI team identified the first year of freshwater residence as a promising stage for decreasing mortality, as Mann and Plummer note. However, first-year survival rates (before migration down river) have not declined since the construction of the Snake River dams; hence, there is little scope for increasing survival during this stage (*2*).

The real losers in this process are the salmon. Most of the incremental solutions



To breach or not to breach: that is—or is it?—the question.

to increasing dam-passage survival have been implemented, but they cannot provide sufficient increases in survival to meet standards determined to be necessary for survival and recovery of the species (jeopardy standards), which were specified by the NMFS in 1995. For this reason, the essential decision is reduced to choosing between dam breaching and the status quo. By deferring action for 8 years, the NMFS plan increases the extinction risk and the cost of recovery. The life-cycle model shows that delaying action decreases the probability of meeting the jeopardy standards. On the basis of the most recent escapement counts, a 7.5-fold increase in survival is necessary to meet the 24-year survival standard (one of the jeopardy standards). The only measure with any chance of success is to eliminate mortality of the smolts in the reservoirs and mortality downstream of the last dam, which may be related to the presence of dams and/or transportation effects.

We agree that the debate and decision on how to recover depleted stocks of Columbia River salmon has become political and legal. In reference to global warming, Vice President Al Gore wrote, "Research in lieu of action is unconscionable....[A] choice to 'do nothing' in response to the mounting evidence is actually a choice to continue and even accelerate the reckless environmental destruction that is creating the catastrophe at hand" (*3*). Can science rescue salmon? No, but scientists can study salmon to death.

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Response

In their letter, Collie and the other members of the Scientific Review Panel say that PATH "distilled the uncertainty about causes of the decline of Snake River Chinook salmon to a small set of management decisions." Indeed, "the essential decision [for saving Snake River salmon] is reduced to choosing between dam breaching and the status quo."

As the report by Kareiva *et al.* in this issue (p. 977) makes clear, however, the decision to save Snake River Chinook is more complicated than a simple choice between breaching the dams and the status quo. And in recent scientific documents, some members of the Scientific Review Panel themselves drew strikingly different conclusions. During his tenure on the panel, Walters wrote, "I no longer trust your [that is, the PATH] assessments about the range of uncertainty in recovery predictions under alternative policies, [and] in particular I do not trust your finding that there is a very high long-term recovery probability under the dam removal options (where the passage models become the dominant factor causing differences among policies in predicted performance). I suspect that after some reflection, you are going to have to admit considerably greater uncertainty about whether even these extreme measures will do the job" (*1*).

Saila and Carpenter expressed similar reservations during their tenure on the panel. Indeed, Saila criticized PATH for paying "insufficient attention" to "the treatment of uncertainties associated with model inputs" (*2*)—that is, failing to recognize how uncertainties in the data would affect the validity of its predictions. (The panel's reviews can be found at http://www.efw.bpa.gov/Environment/PATH)

In researching our article, every scientist we spoke with viewed PATH as a valued component of the scientific work that supports salmon policy-making in the Pacific Northwest. But many researchers do not believe that the PATH work conclusively narrows the policy questions to dam breaching. Nor would it be accurate to characterize the contrasting CRI results, as Collie *et al.* do, as simply "divert[ing] attention away from the impact of dams." By bringing a different scientific perspective to the problem, the CRI work, also produced by a blue-ribbon group, focuses attention on the magnitude of that impact, in absolute terms and relative to other recovery measures. The debate over these measures may be "political and legal," as Collie *et al.* note, but it is also scientific.

It is possible to "study the salmon to death," as Collie *et al.* put it. But the argument of the scientists who disagree with them is that it is also possible to advocate the fish to death, if that advocacy forecloses options that are just as beneficial as those from dam breaching—and more easily attained.

Charles C. Mann
Mark L. Plummer

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No Longer a Source of Dioxin

In the News of the Week article "Just how bad is dioxin?" (16 June, p. 1941) about the Environmental Protection Agency's (EPA) reassessment of the risks of dioxin, Jocelyn Kaiser suggests that one of the major sources of this toxic chemical is the paper bleaching process.

Paper bleaching with elemental chlorine did generate small amounts of dioxin as a by-product. The discovery of this relation, which was the result of an industry-EPA cooperative sampling effort in the mid-1980s, prompted responsible companies in the industry to change their bleaching processes, well before EPA's recent "cluster" regulations. These regulations require no detection of dioxin at levels of parts per quadrillion measured in the bleach plant. In addition, research suggests that dioxin (tetracholordibenzodioxin) is not generated from alternative bleaching technologies now in use (*1*). Today, little if any dioxin is generated. Bleached paper mills are no longer a significant source as suggested in the article.

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