Nutrient Addition to Restore Salmon Runs: Considerations for Developing Environmental Protection Policies and Regulations

Robert T. Lackey*

**Department of Fisheries and Wildlife*
Oregon State University
Corvallis, Oregon 97331

Citation: Lackey, Robert T. 2003. Nutrient addition to restore salmon runs: considerations for developing environmental protection policies and regulations. pp. 283-285. In: *Nutrients in Salmonid Ecosystems: Sustaining Production and Biodiversity*, John G. Stockner, Editor, American Fisheries Society, Symposium 34, Bethesda, Maryland, 285 pp.

Email: Robert.Lackey@oregonstate.edu
Phone: (541) 737-0569

American Fisheries Society Symposium 34:283–285, 2003

Nutrient Addition to Restore Salmon Runs: Considerations for Developing Environmental Protection Policies and Regulations

ROBERT T. LACKEY

National Health and Environmental Effects Research Laboratory
USEPA, 200 SW 35th Street, Corvallis, Oregon 97333, USA

One scheme to help restore salmon to the Pacific Northwest is the addition of nutrients (i.e., raw or processed salmon carcasses and commercially-produced organic or inorganic fertilizers) to headwaters (e.g., lake or stream salmon spawning and rearing habitat) that are now nutrient deficient because of inadequate replenishment from oceanic or other sources. The rationale is as follows:

> Salmon are a vector by which marine nutrients are captured and conveyed against the force of gravity into freshwater ecosystems. Especially in the upper reaches of watersheds where salmon are able to spawn and their offspring spend their early lives, these nutrients, in both organic and inorganic forms, play an important, perhaps essential, role in maintaining viable salmon runs along with numerous other ecosystem components. For example, a substantial proportion of the nitrogen in plants and animals in streams where salmon are abundant is undoubtedly derived from decomposed spawned salmon. This "anadromous nutrient pump" has been attenuated considerably because salmon runs have been reduced substantially in the Pacific Northwest for decades and, in some places, for more than a century. Thus, the addition of nutrients to watersheds, lakes, or streams where salmon runs are now much reduced would replace, at least partially, the "missing" marine-derived nutrients and would likely enhance salmon runs and overall aquatic productivity.

There are many scientific uncertainties with assessing the efficacy of nutrient addition. For example, is it *possible* for salmon runs in the Pacific Northwest to be restored without somehow compensating for diminished nutrient inputs? When and where is it most effective to add nutrients to improve spawning and rearing success, thus enhancing salmon runs? Is it feasible to add nutrients to nutrient-poor headwater streams without degrading downstream water quality where nutrient levels already are too high due to agricultural or other land/human activities? What form of nutrient addition is the most effective? Is there any significant difference in how organic and inorganic forms of nutrients perform in salmon enhancement? If salmon carcasses are used, what is the risk associated with disease transmission? How important is the carcass substrate, itself, as compared with the role of the nutrients themselves? How important is the effect of spawning *activity* on the physical attributes of channels compared with the biological effect of elevated *nutrients* from salmon runs? Are there ecological consequences from spawning fish (e.g., aerating gravel) that are not realized with carcasses or other forms of nutrient addition? What is the contribution of salmon eggs as a nutrient source, or as food for other animals? How do human-caused changes in stream hydrology and riparian habitat interact with nutri-

ent addition to influence salmon runs? To what extent do salmon accumulate toxins in marine waters and then transport them to fresh waters? Apart from potential effects on salmon populations, what are the broader ecological consequences of nutrient addition on streams, rivers, riparian zones, and estuaries? Perhaps the most crucial scientific uncertainty hindering salmon recovery is answering the century old question of knowing the *relative* contribution of nutrient shortages, fishing, dams, water withdrawal, forest and agricultural practices, pollution, hatchery operations, predators, competitors, ocean conditions, and climatic changes.

Answers to these and similar questions *can* be addressed with a comprehensive, sustained research effort.

However, equally important are the many important questions *not* amenable to scientific evaluation. For example, is the use of nutrients just the latest techno-fix in attempts to restore salmon and will it fail, as have the others, because it does not address the root cause of the decline? Because it is a relatively painless way for society to address the salmon decline issue, will nutrient addition become the tool of choice to avoid the important societal actions that must be implemented if salmon are to be restored? What criteria should regulatory agencies use to decide which proposals for nutrient addition to approve? How should a government agency justify forcing some members of society (i.e., farmers, ranchers, forest managers, golf course owners, and suburbanites) to reduce their addition of nutrients to streams and lakes, while simultaneously condoning requests from fisheries managers to add nutrients?

The specific policy questions that should be answered, at least implicitly, by the relevant regulatory agencies are

- Fundamentally, even assuming that rigorous field tests demonstrate that nutrient addition has the capability of restoring wild salmon runs, is it an appropriate tool for restoration?
- Is there an inherent policy conflict between adding nutrients to watersheds to enhance salmon runs and other societal values such as protecting or enhancing water quality, given that society wants both?
- Intended or not, will fisheries technocrats lead society again down the track of a quick-fix solution rather than addressing the fundamental causes of the salmon decline?
- Is there a regulatory bias toward achieving "distilled water" in lakes and streams such that the important beneficial role of waterborne nutrients will not be appropriately understood and considered?
- Should regulatory agencies categorically reject large-scale requests for nutrient addition until its efficacy is adequately documented in scientifically validated field tests?
- How should regulatory agencies balance the universally supported but apparently conflicting goals of enhancing water quality and restoring salmon through nutrient addition?
- If nutrient additions are approved, what level of monitoring should be required to evaluate effects on water quality, and which agency or organization should be responsible for the stipulated monitoring and evaluation?
- How much latitude will various levels of government (and society) be granted in deciding to what extent nutrient addition will be permitted, given that local, state provincial, and national environmental and natural resources priorities often differ markedly?

Beyond the relatively narrow constraints of restoring *salmon* runs and maintaining water quality, there are other important policy and scientific issues to consider. For example, is it desirable (perhaps even essential) to add nutrients specifically to rehabilitate key wildlife species (e.g., bears and eagles), vegetation (e.g., to restore the growth rates of trees), and scavengers (e.g., aquatic invertebrates and small mammals). Although policy and scientific assessments of the desirability of nutrient addition are generally limited to concerns about restoring salmon runs, concurrent with maintaining water quality, other ecological considerations are also important.

There are many concerns that need to be evaluated carefully before environmental protection agencies develop general policies or promulgate specific regulations on granting requests for permits to add salmon carcasses, processed fish products, or inorganic fertilizers to rivers and lakes in the Pacific Northwest. It is easy to be diverted with arguments of the scientific merits of proposals to add nutrients, but there remains, even with *complete* scientific knowledge, explicit

policy choices and clashes of competing values that society will adjudicate through the bureaucracy of the regulatory agencies or the courts.

Given the intense public commitment to restore runs of wild salmon and the likelihood that nutrient addition of some sort will be seriously considered in recovery efforts, the policy challenge for environmental protection agencies will be to craft policies that carefully balance the apparent need for nutrient *removal* (at some locations) to enhance water quality with nutrient *addition* (at other locations) to help restore salmon runs.

Acknowledgements

Summary of a panel and audience discussion at the International Conference on Restoring Nutrients to Salmonid Ecosystems, Eugene, Oregon, 24–26 April 2001. Special thanks are due to panelists Xan Augerot, Don Dodds, Dave Peeler, and Mitch Wolgamott for presenting and defending their personal views on this contentious issue. The views and opinions expressed here, however, are those of the author and do not necessarily reflect those of the panelists or any organization.