

# Genetic Status of Atlantic Salmon in Maine

## Interim Report from the Committee on Atlantic Salmon in Maine

Committee on Atlantic Salmon in Maine

Board on Environmental Studies and Toxicology

Ocean Studies Board

Division on Earth and Life Studies

National Research Council

NATIONAL ACADEMY PRESS  
Washington, D.C.

**NATIONAL ACADEMY PRESS 2101 Constitution Ave., N.W. Washington, D.C. 20418**

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This project was supported by Grant No. 01-0008 between the National Academy of Sciences and the National Fish and Wildlife Foundation. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the organizations or agencies that provided support for this project.

International Standard Book Number: 0-309-08311-7

Cover: design by Van Nguyen; salmon illustration by Walter H. Rich  
from *Fishes of New England: The Salmon*, plate 4

Additional copies of this report are available from:

National Academy Press  
2101 Constitution Ave., NW  
Box 285  
Washington, DC 20055

800-624-6242  
202-334-3313 (in the Washington metropolitan area)  
<http://www.nap.edu>

Copyright 2002 by the National Academy of Sciences. All rights reserved.

Printed in the United States of America

# THE NATIONAL ACADEMIES

National Academy of Sciences  
National Academy of Engineering  
Institute of Medicine  
National Research Council

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Bruce M. Alberts is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Wm. A. Wulf is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Kenneth I. Shine is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Bruce M. Alberts and Dr. Wm. A. Wulf are chairman and vice chairman, respectively, of the National Research Council.

*Conclusions* 47

Stocking clearly has not been completely effective, as shown by declining run sizes over the last 30 years. Whether today's genetic differences represent a remnant of salmon population structure that predates human intervention, following thousands of years of natural selection and genetic drift, typical of salmon occupying different habitats with a variety of environmental circumstances, or whether they represent five to six generations of genetic drift, exacerbated by an increasingly serious population collapse over a short period, is a question that we cannot answer by genetic characterization of neutral genetic markers alone. Any conclusions we draw about the selection/drift dichotomy will necessarily be circumstantial. Suffice it to say that the patterns of variation we see are typical of wild salmon exhibiting the effects of both selection and drift.

Maine Governor Angus King, in his presentation to the committee on June 12, 2001, asked whether we are dealing with Maine salmon or merely salmon in Maine. The distinctiveness of Maine salmon is important, but it is not the whole question, which we consider to have two parts. For the first part, the genetic evidence available for review indicates that wild salmon swimming in Maine's DPS-designated rivers are genetically distinct from salmon swimming in Europe, from those in Canada, and from those used in the Maine aquaculture industry. Collectively, the data are persuasive on these points, from which we conclude that the natural salmon spawning in Maine's DPS-designated rivers are "Maine salmon," not just "salmon in Maine."

The second part of the question is whether these Maine salmon are mainly hatchery-created mixtures or the results of natural processes—including migration, colonization, natural selection, and genetic drift—that occur in network-connected watersheds. More specifically, the issue concerns the relative importance of natural selection over long periods, which influenced the differentiation of Maine's original salmon populations, versus recent genetic drift or a sampling effect related to small populations. Hatchery supplementation—including the movement and mixing of multiple stocks, adaptation to hatchery husbandry practice, and genetic drift—has the potential to alter the gene pool of wild populations. If salmon in Maine are merely the local "farm crop," rather than largely the result of natural processes, they might not be "Maine salmon." We do not have data to answer this question completely.

We can, however, draw some inference from comparisons of the watershed-specific samples of the current DPS rivers. If Maine salmon are an artificial construct of non-river-specific hatchery supplementation, then the separate watershed-specific populations should be genetically indistinguishable. The genetic evidence available for review indicates that the natural populations

48            *Genetic Status of Atlantic Salmon in Maine*

are distinguishable from each other. Moreover, their degree of distinctiveness is typical of that found throughout the remaining world distribution of wild Atlantic salmon. The data suggest that current Maine salmon in the DPS rivers are not mainly hatchery mixtures but rather show the typical metapopulation structure that characterizes wild populations of salmon and their relatives in places where stocking has been absent or insignificant. Maine has wild salmon populations in the eight DPS rivers that are as divergent from Canadian populations and from each other as expected among wild salmon populations elsewhere in the Northern Hemisphere.