DNA that vary from one person to another) in pairs of siblings—987 people in all—from 105 families. By identifying markers shared by alcoholic siblings, the researchers found "highly suggestive" evidence that chromosomes 1 and 7 carry alcoholism susceptibility genes, "modest" evidence for such genes on chromosome 2, and "suggestive" evidence for chromosome 4, said Reich.

A similar study by Jeffrey Long and David Goldman of the National Institute on Alcohol Abuse and Alcoholism (NIAAA) on an entirely different population—a community of alcoholism-prone Southwest American Indians—confirmed that chromosome 4 may contain alcoholism susceptibility genes. The study also produced what Long called "strong suggestive evidence" of involvement by chromosome 11.

The DNA stretches implicated are already known to carry genes that could influence behavior, including pleasure seeking and compulsive overindulgence. The chromosome 2 region, for example, carries one gene related to the control of endogenous opioids and another that controls production of leptin, a peptide involved in appetite and obesity. The chromosome 11 area includes many genes that direct the production and metabolism of various brain chemicals.

Psychiatrist Henri Begleiter of the College of Medicine at the State University of New York Health Science Center at Brooklyn, COGA's principal investigator, noted that "it's a very long road from genes to behavior." But he reported progress in identifying what may be one point along that road: a genetically influenced brain wave, called the P3 wave. Visual or auditory stimuli evoke this oscillation in the brain's electrical activity, which is associated with recognition and attention, and Begleiter found deficits in the wave in alcoholics and in many close relatives of alcoholics. He also said that recent, soon-to-be-published research with adolescents by psychologist William Iacono of the University of Minnesota, Minneapolis, has shown that P3 deficits go not only with alcoholism and drug addiction but also with antisocial behavior and learning disorders. Begleiter says, "We have evidence that [P3 deficit] is a good index of central nervous system disinhibition," which characterizes all those conditions.

NIAAA director Enoch Gordis emphasized that we are far from the day when alcoholism genes could be useful as predictors for individual risk. The gene search is infinitely more difficult than that in a single-gene disease, he said: Alcoholism genes are multiple, they interact in unknown ways, and they have incomplete penetrance, which means you can have the genes but not be an alcoholic. As Gordis puts it, "these genes are for risk, not for destiny."

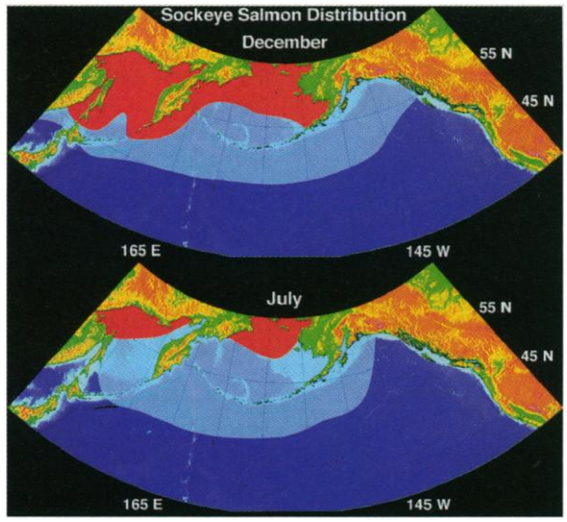
–Constance Holden

MARINE SCIENCE

Temperature Rise Could Squeeze Salmon

Modest rises in sea surface temperatures, in line with predictions of global warming over the next half-century, could make salmon disappear from much of the North Pacific Ocean. That possibility is suggested by a new review of a 40-year database that examines how fluctuating water temperatures affect the distribution of this commercially important fish. "This is a major study of enormous importance highlighting the need to study fish throughout their natural environments," says fisheries biologist John Everett, head of research at the U.S. National Marine Fisheries Service in Silver Spring, Maryland.

The study of sockeye salmon (*Oncorhynchus nerka*) appears in the April edition of the *Canadian Journal of Fisheries and Aquatic Science*. In it, David Welch of Canada's Department of Fisheries and Oceans in British Columbia and Japanese colleagues at the National Research Institute of Far Seas Fisheries in Shimizu in central Honshu mine data from major salmon surveys and sea-temperature measurements taken by the Japanese, Canadian, and U.S. governments going back to the mid-1950s. These data are equivalent to "29.1 years of continuous ship survey time," says Welch.



SOURCE: DAVID WELCH

In hot water. Warmer temperatures caused by a projected doubling of atmospheric carbon dioxide would shrink the current range of sockeye salmon (area north of the dark blue region) to the red zone.

Although laboratory experiments have shown that sockeye salmon are capable of surviving in waters warmer than 20 degrees Celsius, the study found that from November to March, the fish are only found in regions where the surface temperature is below 7 degrees Celsius. The maximum temperature rises to 15 degrees by August before dropping back to 7 degrees by November, the team finds. Such "sharp thermal limits," says Welch, are evident in all months (except October, for which data are lacking) and in all regions where sampling extended into sufficiently warm ocean regions. "Lethal limits for Pacific salmon are generally well above 20 degrees Celsius, so the remarkably low thermal limits observed result in sockeye salmon being excluded from vast areas of the North Pacific that are otherwise potentially habitable," says Welch.

These findings have led the authors to speculate that water temperatures interact with another factor—the need to minimize basic metabolic rates when food supplies are low—in shaping where the fish live. Laboratory studies have found that basal metabolic rates for cold-blooded animals rise exponentially with temperature. In other words, the fish may be avoiding warmer water because food supplies are insufficient to maintain such high metabolic rates.

The new studies also suggest a potentially devastating impact on salmon populations from predicted patterns of global warming caused by increasing concentrations of atmospheric CO_2. "A rise of 1 to 2 degrees Celsius in sea surface temperature in the Northern Pacific by the middle of the next century is a real possibility," says climate modeler Simon Tett at the Hadley Centre for Climate Change in Bracknell, U.K. Such a change could shrink the range of the salmon dramatically, largely restricting it to the Bering Sea. "Although much attention has been paid to the possibility that some stocks of salmon near the southern end of their range may be adversely affected by climate warming in fresh water, events happening in the marine phase could be even more disruptive," says Welch. In addition, he says, a northern shift in their ocean habitat would force the salmon to travel farther to reach their breeding rivers, resulting in smaller fish with fewer eggs.

The next step is to see whether other cold-blooded organisms display a similarly clear response to temperature variations. "So few studies have been done," says Everett. "We need urgently to know more about the effect of environmental temperatures on aquatic ecosytems."

–Nigel Williams