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AMERICAN ASSOCIATION OF STATE CLIMATOLOGISTS EXECUTIVE COMMITTEE

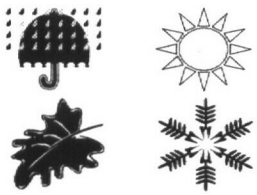
President, AASC
Allen Dutcher
HPCC / Climate Services
15 L.W. Chase Hall
University of Nebraska-Lincoln
Lincoln, NE 68583-0728
T: (402) 472-5206
E: adutcher@hpccsun.unl.edu

Past-President, AASC
Pamela Naber Knox
Sabbatical Address:
523 West 112th St., #1
New York, NY 10025-1619
T: (212) 678-2773
E: stclim@macc.wisc.edu

President-Elect
George Taylor
Oregon Climate Service
Oregon State University
316 Strand Ag Hall
Corvallis, OR 97331-2209
T: (541) 737-5705
E: oregon@ats.orst.edu

Secretary-Treasurer, AASC
Mary Knapp
State Climatologist
Weather Data Library
211 Umberger Hall
Kansas State University
Manhattan, KS 66506-3402
T: (913) 532-7019
E: mknapp@oz.oznet.ksu.edu

Ex-Officio, AASC
John P. Hughes
National Climatic Data Center
Room 557-G, Federal Building
151 Patton Avenue
Asheville, NC 28801-5001
T: (704) 271-4475
E: jhughes@ncdc.noaa.gov



Long-term Climate Trends and Salmon Population

There is increasing evidence that salmon populations in the northeast Pacific are significantly influenced by long-term climate changes. In the Northwest, temperature and precipitation data go back about 100 years. During that time there have been four relatively distinct climatic periods. These are illustrated in Figure 1, which shows annual precipitation (departures from the long-term average) for the Oregon Coast. All stations west of the crest of the Coast Range were averaged together to get a single value each year, and every year's value compared with the long-term average. The Water Year (October through September) was used so that all months from a single winter remained in the same data set.

The four climatic periods were:

1 1896-1914 Generally wet (and cool)

2 1915-1946 Generally dry (and warm)

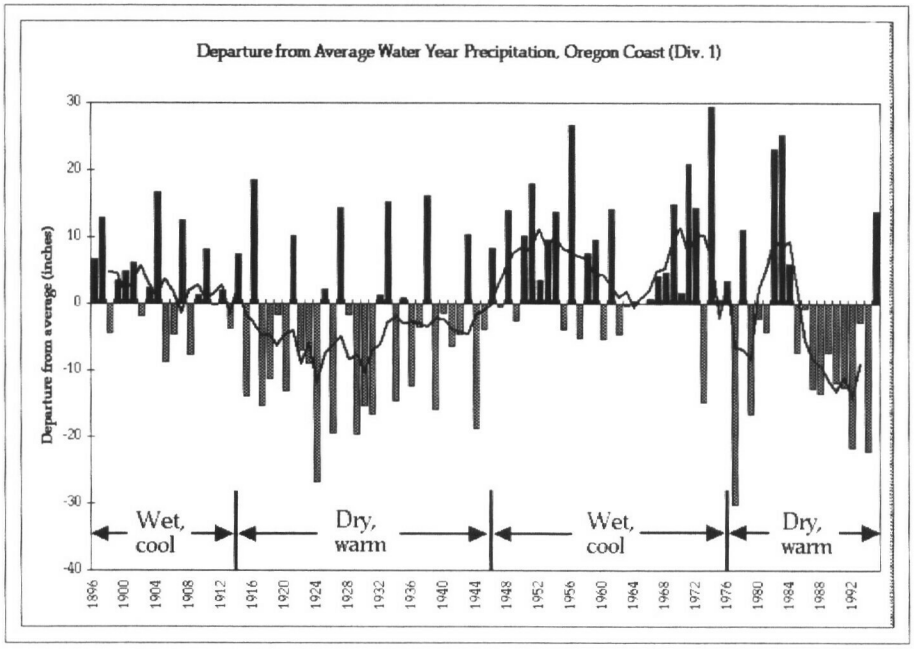


Figure 1. Annual precipitation for the Oregon Coast.

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3 1947-1975 Generally wet (and cool)

4 1976-1994 Generally dry (and warm)

Note that in any given period, not all the years are dry or wet, but that a high percentage follows that pattern. For example, in the 1915-1946 period there were 22 dry years and only 10 wet ones. Consecutive dry years were common (indicating drought periods). The wet period immediately following had 21 wet years versus 7 dry ones, and consecutive dry years never occurred. Droughts were nonexistent during the latter period, although there were several major floods.

Recently, scientists have found that salmon returns in the Northwest show long-term behavior which closely follows the climate cycles. Figure 2 was reproduced from a 1995 report to Washington entitled "Oyster Condition and Climate: Evidence from Willapa Bay" prepared by Curt Ebbesmeyer of Seattle. Curt used the "Pacific Northwest Index" (PNI) to distinguish cool, wet periods from warm, dry ones; note the similarity of PNI to the graph in Figure 1. Curt then compared PNI with Columbia River spring Chinook salmon return going back to 1940

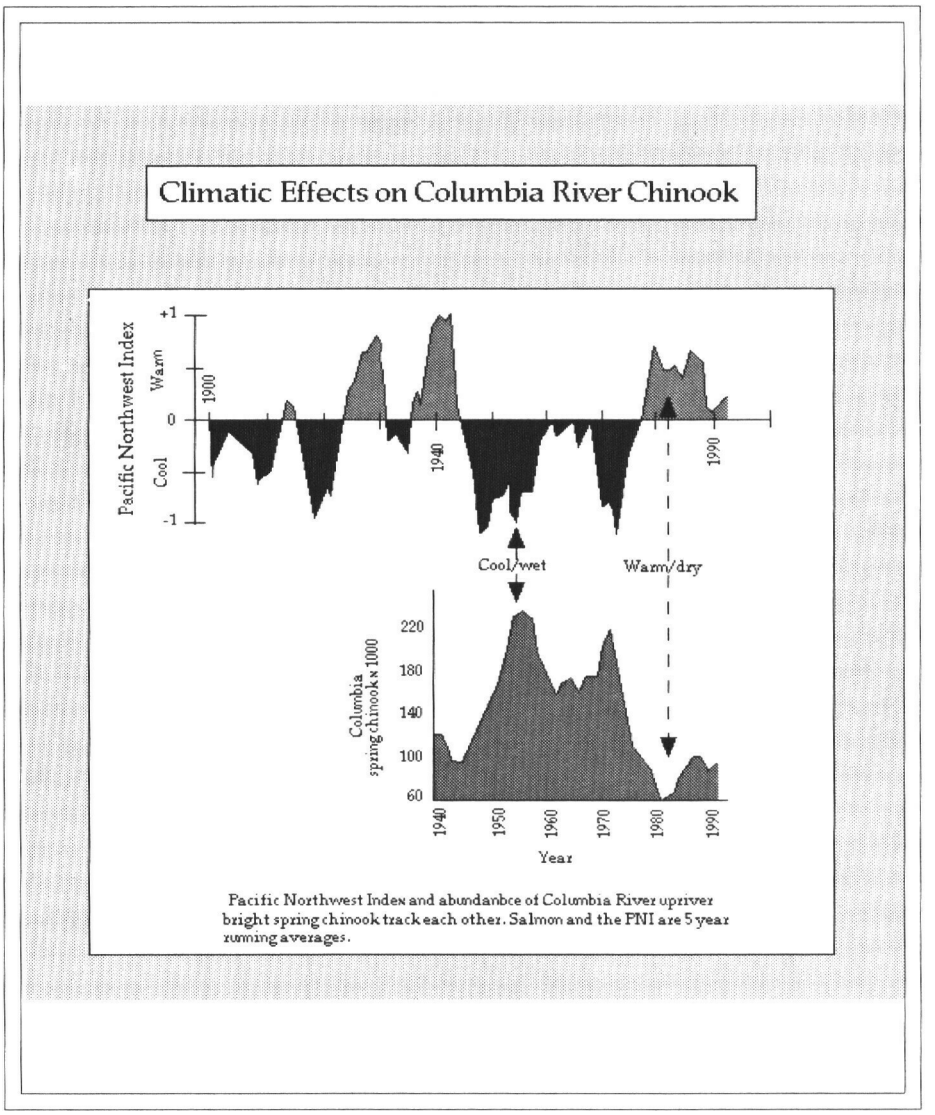

Figure 2.

(earlier data are not available). The correlation between spring Chinook and PNI is very strong, as indicates that salmon return increase during cool, wet periods and decline during warm, dry ones. While there are undoubtedly human-induced effects on the fish (including dam construction and habitat destruction), Figure 2 indicates that natural variability may be a very significant influence as well, and should be considered in any salmon restoration plan (such as the Oregon plan currently being implemented).

While stocks in the Northwest have shown low numbers in recent decades, Alaska salmon have had a tremendous boom period. Climatologists have known for many years that weather patterns in Alaska and the Northwest are out-of-phase: wet periods in the

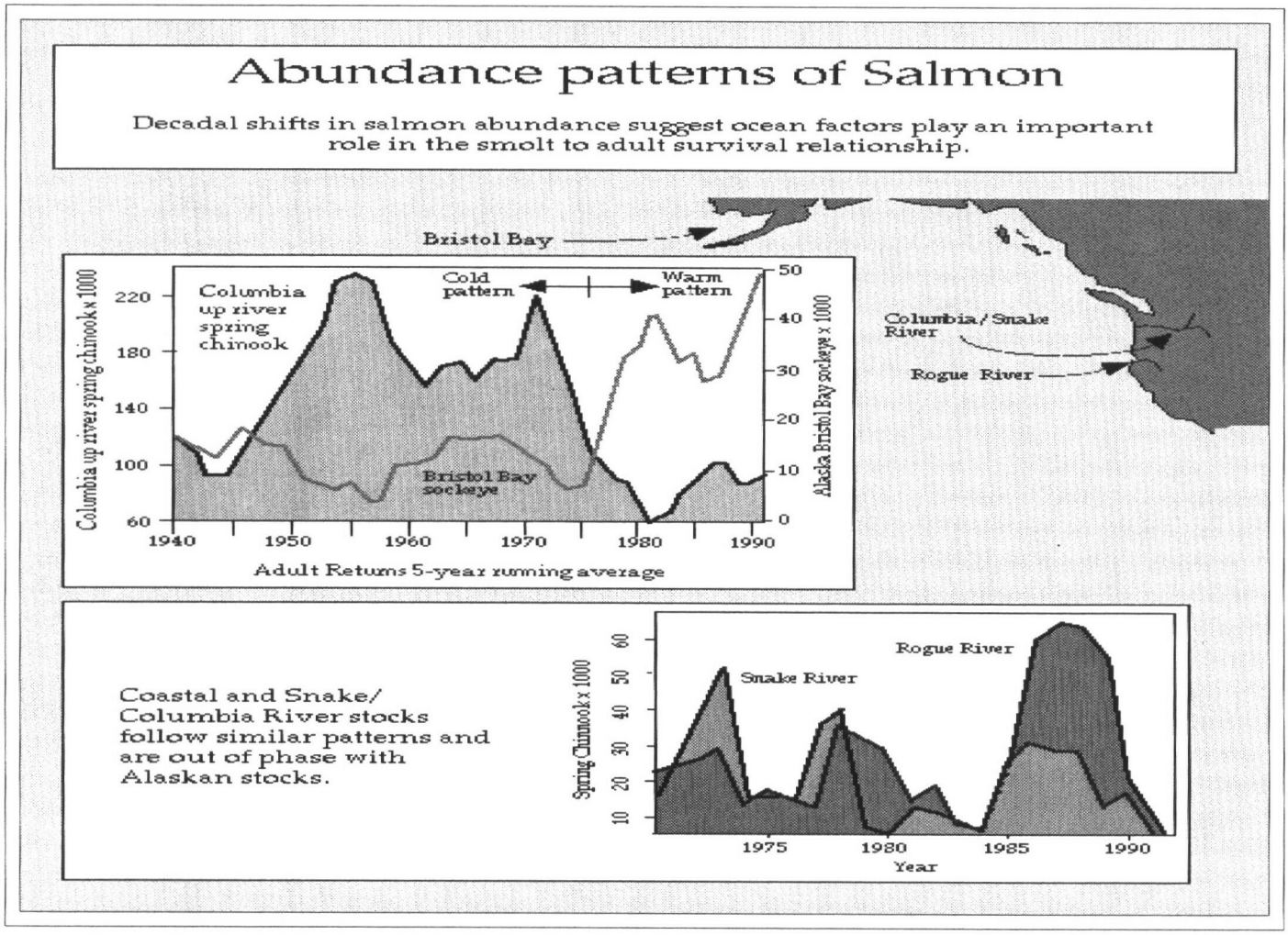

Figure 3.

(Continued from page 3)

Northwest tend to be dry in Alaska, and vice-versa. The El Nino-Southern Oscillation appears to be the major reason for this flip-flop. Interestingly (and perhaps not surprisingly), salmon returns in the Northwest and Alaska are similarly out of phase. Figure 3 shows that Chinook returns in the Rogue and Columbia/Snake behave similarly over time. The upper figure, however, shows that Columbia and Alaska salmon are out of phase, with the abundant 1950-1975 period in the Northwest corresponding with a very poor salmon period in Alaska. When Northwest stocks declined in the 1970's, Alaska's were soaring.

An excellent article by Mantua, Hare, Zhang, Wallace and Francis (1996) entitled "A Pacific Interdecadal Climate Oscillation with Impacts on Salmon Production" presents a very thorough overview of the Alaska/PNW differences. It is fascinating to see how trends change, and how Alaskan and Northwest fish fortunes have continually been out of phase. The authors quote various issues of *Pacific Fisherman*:

(Continued from page 4)

September 1915 (*Pacific Fisherman* 1915); wet in Northwest

> Never before have the Bristol Bay [Alaska] salmon packers returned to port after the season's operations so early.
>
> The spring [Chinook salmon] fishing season on the Columbia River [Washington and Oregon] closed at noon on August 25, and proved to be one of the best for some years.

1939 Yearbook (*Pacific Fisherman* 1939); dry in Northwest

> The Bristol Bay [Alaska] Red [sockeye salmon] run was regarded as the greatest in history.
>
> The [May, June and July Chinook] catch this year is one of the lowest in the history of the Columbia [Washington and Oregon].

August/September 1972 (*Pacific Fisherman* 1972); wet in Northwest

> Bristol Bay [Alaska] salmon run a disaster.
>
> Gillnetters in the Lower Columbia [Washington and Oregon] received an unexpected bonus when the largest run of spring Chinook since counting began in 1938 entered the river.

1995 Yearbook (*Pacific Fishing* 1995); dry in Northwest

> Alaska set a new record for its salmon harvest in 1994, breaking the record set the year before.
>
> Columbia [Washington and Oregon] spring Chinook fishery shut down; west coast troll coho fishing banned.

There are indications that global ocean and atmosphere conditions are the cause of the long-term climate variations shown in Figure 1. There is also evidence that a switch in regimes occurred in late 1994, and that we have returned to the conditions which tend to yield wet, cool winters in the Northwest. If so, it would appear that environmental conditions may be very favorable for a resurgence of Northwest salmon stocks (and unfavorable in Alaska). While I do not disagree with the emphasis in the Oregon Salmon Plan on restoring salmon habitat, it appears clear that natural variations play an important role in fish survival and reproduction, and that these variations should be considered in drafting the Plan.

Recent evidence suggests that a rebound may already be occurring. On April 28, 1997, Oregon Department of Fish & Wildlife issued a statement that the number of Chinook salmon redds in the Upper John Day River last summer were the second highest since 1959. Jim Myron of Oregon Trout said "It's good news for everybody concerned, whether it's rancher, environmentalist or state employee - and it's especially good news for the fish." Maybe there **IS** a silver lining in all those gray rain clouds!

George H. Taylor,
Oregon State Climatologist
Chad Southards,
Undergraduate Assistant
Oregon State University

April, 1997

United States Climatological Chronology

1644 - 1645 In the United States the earliest weather diary was kept by the Chaplain of the Swedish colonization force in what is now Wilmington, Delaware (Landsberg, 1981). Weather diaries were the primary source of weather information in our country through the War of 1812. Weather diaries were kept by well known Americans: Benjamin franklin and presidents George Washington and Thomas Jefferson, — the latter from early July 1776 to near his death on July 4, 1826.

1814 The first government directive to gather weather data was issued by the US Army Surgeon General to the medical corps at forts and barracks.

1838 Pennsylvania was the first of about three states to appropriate funding for a climatological network. The program lasted a relatively short time.

1847 The Smithsonian Institution began gathering climatological data nationwide.

1870 The National Weather Service (NWS) was created to be administered by the US Army Signal Corps.

1875 The first successful state weather service was established in Iowa by Professor Gustavus Hinrichs. Other states followed suit with Missouri the second in 1877.

1881 General William B. Hazen, US Army Signal Corps, sent letters to all the state governors encouraging the creation and development of state weather services.

1880s The "little ice age" came to an end according to

(Continued from page 6)
some paleoclimatologists.

1890 The national weather program was transferred to the US Department of Agriculture.

1892 The first annual meeting of the American Association of Weather Services cooperating with the USDA Weather Bureau held at Rochester, NY, Aug. 15-16. Meetings were also held in 1893, 1894 and 1895.

1895 Decision to standardize state networks and publications under USDA Weather Bureau. State weather programs generally declined or ceased, but a few survived including Iowa and Michigan programs.

1930s The new WB aviation program grew rapidly. Climatology declined.

1941 Weather Bureau transferred into the US Department of Commerce.

1940s The climatic warm-up since the 1890s shifted into a three decade cool-off.

1952 WRPC (Weather Records Processing Center) moved in January to Asheville, North Carolina.

1954 Weather Bureau Climatological Services Division headed up by Dr., Helmut Landsberg. His first Climatological Services Memorandum No. 45 announced the discontinuance of the Section Centers and the creation of the State Climatologist and the Area Climatologist program. Incidentally, this era was also that of the creation of the National Hurricane Center and the National Severe Storms Center.

1955-56 The state Climatology program put in place.

1965 Environmental Science Services Administration (ESSA) created, which included the National Weather Service.

1967 Dr. Landsberg returned to appointment at the University of Maryland as the director of their meteorology program.

1970 NOAA created.

1973 The State Climatology program was terminated effective April 16, 1973.

1973 (late March) NOAA Administrator Robert M. White sent a letter to all state governors asking that they establish their own state climate program.

1975 & 1976 National Climatic Center (NCC) sponsored informational meetings at Asheville for the State Climatologists (32 SCs in 1974; about 40 in 1978).

1976 The American Association of State Climatologists organized (Oct. 6, 1976).

1977 The State Climatologist quarterly begun 1/1/77. NCC also provided other state support in the form of NCC products and later, SC internships at NCC.

1978 The National Climate Program Act was signed into Public Law 95-367 on September 17, 1978 by President Carter.

1980s Regional Climate Offices established. climatic warming period reported.

1997 (July) President Clinton announced "a White House conference in early October on worldwide climate change, part of an effort to get the American people interested in the issue." (Washington, DC [AP])

Paul Waite
Former State Climatologist of Iowa

A moment in climatological history. . . (from left) Gerald Barger, former NCDC Director; Helmut Landsberg, the "father" of modern climatology; and Ernest Rodney, Chief Meteorologist for the Asheville Airport, at the Asheville Airport mid-1950's.

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FEDERAL BUILDING
151 PATTON AVENUE, ROOM 120
ASHEVILLE, NORTH CAROLINA 28801-5001

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