NOAA REPORT

Vol. III, No. 2 February 1994

Global Warming on Hold: Surface temperatures in 1993 remained unchanged from 1992 levels, said Thomas R. Karl, senior scientist at NOAA's National Climatic Data Center in Asheville, N.C.

In a presentation last month at the American Meteorological Society's annual meeting in Nashville, Tenn., Karl confirmed an earlier NOAA report that global surface temperatures remain about 0.2 degrees Celsius above the 30-year average ending in 1980. He said, however, that the century-long 0.5 degree Celsius warming trend could resume, now that the effects of Mt. Pinatubo's 1991 eruption in the Philippines are largely behind us. Karl and many scientists believe global warming is caused primarily by increases of greenhouse gases worldwide.

NEWS BRIEFS

In addition to surface temperatures, Karl also reported on temperatures in the troposphere (4,500 to 31,000 feet above the Earth's surface) and the stratosphere (50,000 to 80,000 feet above the surface), using data gathered by James Angell of NOAA's Office of Oceanic and Atmospheric Research. Tropospheric temperatures have cooled .05 degrees Celsius per decade and stratospheric temperatures have decreased dramatically, with the lower stratosphere experiencing record low levels in 1993.

Satellite Moves to Florida for Launch: The National Weather Service passed a milestone in its modernization program last month when a sophisticated GOES satellite was rolled out by its manufacturer, Space Systems/Loral at Palo Alto, Calif., for shipment to a launch site at Cape

continued on page 8

West Alton, Mo., on the banks of the Mississippi River, seen here on July 20, during the worst of the Midwest Floods of 1993. Events like the floods caused NOAA climate researchers to call 1993 'The Year of Water.' This aerial photograph was taken by NOAA researchers 2,700 feet above ground.

Droughts, Floods Rampant; El Niño Holds On

Climate Researchers Call 1993 'The Year of Water'

NOAA meteorologists have dubbed 1993 "The Year of Water," marked by floods, drought, ozone depletion, El Niño, and other climatological developments across the United States and globally.

In the western United States, water was in plentiful supply after some six years of drought. Torrential rains and epic flooding affected much of the Midwest. On the East Coast, the "Storm of the Century" deposited snow over one-third of the United States.

continued on page 2

NOAA Researchers Call 1993 'The Year of Water'

continued from page 1

Later in the year, the Southeast was hit with drought conditions.

NOAA climate researchers reviewed important climate events over North America in their annual summary of factors including ozone depletion, global warming, floods and droughts. The results were announced last month.

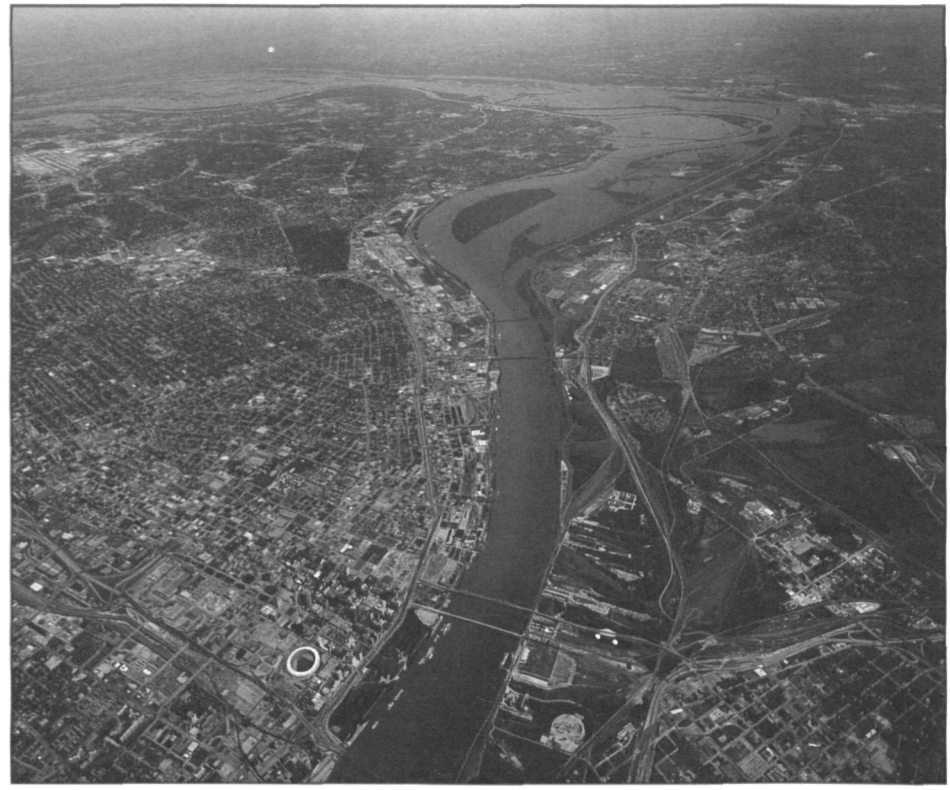
Ozone Layer Thin in North

The ozone layer outside the polar regions registered about 10 percent lower at the end of 1992 and into 1993 than in past years. Closer examination revealed that the major portion of the 1992-1993 ozone changes occurred in the mid-latitude region of the Northern Hemisphere, including much of North America, Europe and Asia. By the end of 1993, ozone levels returned to values of the previous year, but a long-term trend of decreasing ozone continues.

Ozone measured at an altitude of eight to 12 miles over the Antarctic region reached record low levels during September and October of 1993. On Oct. 12, 1993, total ozone fell in the atmospheric column to a new low, well below the previous minimum established in 1992.

During 1993, there was a continuation of warmer-than-normal temperatures worldwide. The 1993 estimated global surface temperature anomaly of plus 0.18 degrees Celsius (0.32 degrees Fahrenheit) sustained the warming trend that began in 1985. The normal used for comparison comes from the 30-year average derived from data gathered between 1951 and 1980.

Satellite Ground Stations Open: Two new ground stations have been added to the U.S. network of satellite search and rescue facilities designed to help bring emergency assistance to mariners and pilots in distress. Located in Guam and Puerto Rico, they are the last of six new fully automated installations.



Aerial photo (alt. 14,000 ft.) of downtown St. Louis (foreground, left), looking north on the Mississippi River to the confluence with the Missouri River, during the worst of the Midwest Floods of 1993. Busch Stadium and the Gateway Arch can be seen along the river at the bottom of the photo. Flood waters cover much of St. Charles County, Mo., in the upper portion of the photo.

However, in the United States, cooler temperatures in 1993 followed a string of three much-warmer-than-normal years between 1990 and 1992. Last year ranked as the 13th coldest year on record for the contiguous United States since 1895, according to the National Climatic Data Center.

Longest El Niño in 50 Years

The current extended period of El Niño conditions is the longest stretch of above-normal sea-surface temperature conditions in half a century. But it is not unprecedented, said Vernon Kousky, a meteorologist with the National Weather Service's Climate Analysis Center. El Niño is an effect characterized by warmer waters in the tropical Pacific Ocean, which researchers have linked to a worldwide chain of ocean events. These warm episode conditions, present since 1991, redeveloped in early 1993, and may have contributed to excessive rainfall that occurred over the Midwest during late spring and summer.

The Midwest floods in July and August were the major national weather-related event of 1993. The floods accounted for nearly fifty deaths and caused damages of as much as $15-20 billion over a nine-state area.

Moist soils in flood-stricken areas of the Midwest, coupled with normal amounts of precipitation in the coming months, could lead to more flooding in some areas affected in 1993, said Frank Richards, a hydrometeorologist with the NWS's Office of Hydrology.

Excessive rainfall observed during early 1993 over California and parts of the southwest helped end lengthy droughts, but brought record flooding of the Gila and Salt Rivers from Phoenix to Yuma, Ariz. The excessive rain was, in part, attributed to the continued El Niño effect.

'Breakthrough' Checks on Harm From Ozone Depletion

Sea Life's Solar Radiation Damage Measured

NOAA scientists in La Jolla, Calif., have developed a method of monitoring the effects of ultraviolet sunlight rays (UV-B) on marine organisms that permits researchers to measure molecular damage within cells of fish eggs and larvae smaller than one millimeter in diameter.

The breakthrough enables NMFS scientists to measure and observe precisely the level of UV-B damage to sea life at various times of the year and depths in the ocean. That allows scientists to determine and predict how sensitive and adaptable different species are to increases in UV-B exposure caused by depletion of the earth's protective ozone layer.

The work was supported by NOAA's Climate and Global Change Program and carried out at the Southwest Fisheries Science Center in La Jolla in collaboration with the University of California at Santa Barbara. It is part of NOAA's effort to quantify and predict what impact increased doses of the sun's ultraviolet rays may have on sea life.

Eggs, Larvae Sensitive

Fish eggs and larvae are particularly sensitive to UV-B because they float at the ocean surface where irradiance is highest. Many eggs and larvae, like the northern anchovy studied, are mostly transparent, allowing the damaging radiation to penetrate deeply into vital tissues.

"We now have a method that can be used in field tests to determine whether fish eggs and larvae in the upper ocean are undergoing cellular DNA damage specifically caused by UV-B exposure," said Russell Vetter, leader of the genetics and physiology program at the La Jolla facility.

Prior to the study, scientists could measure only indirect effects of UV exposure under controlled laboratory conditions, drawing conclusions mainly from responses of fish to different levels of exposure.

The new method detects a special deformity in the chemical arrangement of the DNA molecule inside the fish's cells that occurs after exposure to UV-B light. The deformity, called a thymine dimer, is an abnormal "spot weld" on the rungs of the DNA ladder.

Human Procedure Adapted

The deformity is detected by adapting a special immunological procedure and antibody originally developed by Japanese scientists for use in detecting UV-B damage in human cells.

In laboratory experiments, scientists also found a cycle in UV-B damage to fish over the course of a day and evidence that there is daily, partial repair of the damage, called photorepair, which takes place primarily in the late afternoon.

"We knew that photorepair occurs in animals, plants and bacteria, but we were surprised to learn the extent to which larval fish depend on this type of repair to keep their DNA healthy," Vetter said. However, if the DNA damage rate exceeds the repair rate, larval growth may slow and death may result, he added.

Running field tests at sea, fisheries service scientists found DNA damage from UV-B in eggs and larvae of northern anchovy and Pacific sardines. The damage decreased with water depth and followed the same daily photorepair cycle observed in the laboratory exposures. The anchovy and sardine species are important food sources for many fishes, seabirds and marine mammals off the West Coast.

Observed primarily at the earth's poles in the past, ozone depletion and increased UV-B radiation has recently been seen at mid-latitudes of the Northern Hemisphere, including the shores of the United States.

Hawaii, Alabama Programs Eyed

NOAA evaluation teams were scheduled to visit Hawaii and Alabama this month to assess the progress of both states' coastal zone management programs and gather local views on the program's operation and management.

NOAA's Office of Ocean and Coastal Resource Management provides approximately $700,000 annually in federal funds to Hawaii for its coastal management programs, and more than $500,000 in matching funds to Alabama.

The federal grant program was established under the Coastal Zone Management Act of 1972, which sets forth specific national guidelines and objectives for program participation. The evaluation will assess Hawaii's success in addressing these national coastal management objectives, implementing and enforcing the Hawaii Coastal Zone Management Program, and adhering to the terms and conditions of the grants received during the review period, January 1991 through January 1994. The team will also assess the program's implementation of beach management practices, the efforts made in public education and outreach, and the effects that budget reductions have on the ability of the Office of State Planning to implement the program.

Focus On...

NOAA's FY 1995 Budget

1995 Budget to Advance Environmental Research and Stewardship Responsibilities

NOAA's FY 1995 budget request of $1.964 billion will ensure the continuation of weather service modernization efforts and includes significant programmatic increases for fisheries management.

The FY 1995 budget request is reduced slightly from the FY 1994 level. However, significant increases are proposed in NOAA's operating programs. For example, the largest NOAA account, Operations, Research and Facilities, has requested $1.897 billion, an increase of 8.3 percent over last year.

'Promotes Economic Prosperity'

"This budget promotes economic prosperity in many areas, and has been restructured to support the Administration's strong environmental concerns and priorities, such as programs that promote healthy ecosystems and encourage managing resources through sustainable development," said D. James Baker, Commerce Department's Under Secretary for Oceans and Atmosphere.

The budget request closely follows NOAA's recently developed Strategic Plan that has charted a course for the agency to reach its vision for 2005. The FY 1995 budget request is driven by the Strategic Plan's focus on world-class research and development to integrate approaches to environmental manage-

continued on page 5

Total Request for FY 1995

(dollars in millions)

Account	*Budget*	*Percent*
Advanced Short-Term Warning	1091.3	55
Build Sustainable Fisheries	258.7	13
Recover Species	50.5	3
Coastal Health	158.5	8
Improve Seasonal Forecasts	94.4	5
Environmental Technologies	14.4	1
Modernize Navigation	76.4	4
Education	11.3	1
Decadal to Centennial Change	94.1	5
Environmental Information	15.4	1
Non-ORF	66.8	3
Other	57.3	3

continued from page 4

ment and coastal resource development and to significantly improve environmental assessments and prediction.

NOAA will significantly improve short-term warning and forecast services for the environment, in particular, to maintain ongoing NWS operation and modernization efforts with the requested amount of $1.1 billion.

NOAA's budget request will build sustainable fisheries, recover protected resources and promote proper habitat management. Investing in proper fisheries management will, over the long run, lead to an estimated $2.9 billion increase in net revenues to fishermen, an $8 billion increase in the Gross Domestic Product and the creation of about 300,000 new jobs. A total of $309.4 million is requested for these efforts in FY 1995, including increases of $62 million over last year in the National Marine Fisheries Service budget.

Global Change Program

In FY 1995, NOAA will continue to play a major role in advancing the President's high-priority agenda items by participating in the U.S. Global Change Research Program, the High Performance Computing and Communications Program, and by serving as host agency for the Vice President's Global Learning and Observation to Benefit the Environment (GLOBE) Program. NOAA has requested $106.5 million for these efforts in 1995, an increase of $42.4 million from 1994.

The FY 1995 funding request maintains or increases funding for legislatively authorized programs, such as the Coastal Zone Management Act ($41.6), the Marine Mammal Protection Act ($30.1 million), the Endangered Species Act ($20.4 million), the Magnuson Act ($142.5), the National Sea Grant College Program ($43.2) and funds for environmental compliance. NOAA requested an increase of $3 million for sanctuaries.

NOAA is also proposing to increase fee revenues to be deposited into a special fund in the Treasury Department to help offset the costs of our programs in several areas: aeronautical charts, marine sanctuaries and living marine programs. The specific details of these fees are being developed in close consultation with the community and Congress.

Statistics Come to Life at National Climatic Data Center

Federal staffers at NOAA's National Climatic Data Center in Asheville, N.C., help solve problems ranging from the mundane to the mysterious.

NCDC has provided information to investigators in a murder trial, furnished insight into a mysterious disease, and helped a construction company decide whether to build a new wharf.

NCDC, which maintains more than a hundred years' worth of climate data for the country, provides information to numerous customers in the public and private sectors.

NCDC was recently contacted by a Michigan lawyer representing a defendant in a murder case. The center provided him with rainfall statistics for Florida towns along the route the victim had traveled on the day of his death.

Clues to Cuban Disease

In another unusual request, NCDC provided the Center for Disease Control with Guantanamo Bay, Cuba's daily maximum and minimum temperatures and precipitation for the past four years. The NCDC is cooperating with the Cuban government to help find the cause of a mysterious disease called optic neuropathy, which has affected some 50,000 people in Pinardel Rio, Cuba.

A New Orleans construction company asked NCDC for statistics on precipitation and storms to help it decide whether to build a new wharf or repair an old one. The existing wharf was believed to be damaged in a recent severe storm and flooding episode.

NCDC officials say the legal community is a major customer, representing about 30 percent of the center's users. The insurance, engineering and business sectors also represent a large segment of customers. The largest user groups are scientists from government agencies and foreign customers who rely on NCDC data. NCDC derives its information from many sources, including NOAA satellites.

—Patricia Viets

Decreased Snow Cover Aiding Warming

NOAA researchers have shown that reduced spring snow cover over North America and Asia has significantly contributed to warmer air temperatures.

Dr. Pavel Groisman, a visiting scientist from Russia, and Thomas Karl and Richard Knight of NOAA's National Climatic Data Center in Asheville, N.C., reported their findings in the Jan. 14 issue of *Science* magazine. The research helps explain why the increase of global surface air temperatures, almost 1 degree Fahrenheit (0.5 degree Celsius) since the latter 19th century, has been most evident during the spring.

Effects on Marine Mammals Studied

Navy Shock Tests to Be Monitored

In an effort to protect marine mammals, the U.S. Navy will be granted a permit under the Federal Marine Mammal Protection Act that will for the first time allow independent monitoring of its mandatory underwater explosives testing of ships off California.

"Although the Navy has tested ships this way for many years, this is the first time it has asked for our help in developing a strategy to minimize harm to marine mammals," said Rolland Schmitten, NMFS director. "We are pleased to be of assistance in providing additional monitoring and checkpoints so that our obligation to provide environmental protection for marine mammals is carried out appropriately while balancing our national defense obligations."

The permit, valid for five years, stipulates the Navy must observe strict rules and procedures devised by the fisheries service to ensure that both maximum protection and minimum harm come to marine mammals located in the Navy's outer-sea test range of the Pt. Mugu Naval Air Warfare Center, 65 miles off the coast of Ventura County, Calif. As an added safeguard, the permit requires the Navy to renew the testing authorization each year with the fisheries service.

'Maximum Possible Safety'

The Navy applied to the fisheries service for the five-year permit in May 1993. The Marine Mammal Protection Act allows such permits to be issued for activities that may result in marine mammals possibly being harmed, provided the "take" will have a negligible impact on any species or its habitat.

"Our biologists have conducted research to make certain that the maximum possible safeguards are in place during testing," Schmitten added.

Special protective provisions in the Navy's permit include a two-nautical-mile safety range that will be surveyed by 10 to 15 fisheries service biologists located in five aircraft and the test ship itself. The aerial and surface monitoring will start more than two hours before detonation time and continue for more than two hours following the test. Testing will be postponed if marine mammals are observed within the testing zone or if weather and sea conditions prevent adequate monitoring.

Fisheries service biologists have spent more than a year surveying the Navy's test range to pinpoint three detonation sites where marine mammals are least likely to live.

Test Simulates Torpedoes, Mines

Under the National Defense Authorization Act, each new class of Navy ship must undergo a series of underwater explosive shocks before the ship can be released to the fleet. The detonations simulate near misses from mines, torpedoes and projectiles to determine the structural integrity of the ship and its vital components, such as electrical systems.

This testing helps the Navy identify and correct weaknesses in ship design early in the construction of a new class of vessel and thereby improve the chances for the crew's survival.

Two Agencies to Study Atlantic Salmon for Possible Endangered Species Listing

NMFS and the U.S. Fish and Wildlife Service are beginning a joint study to determine whether populations of anadromous Atlantic salmon in New England should be listed as threatened or endangered under the Endangered Species Act.

The action comes after a 90-day review of a petition submitted to the Fish and Wildlife Service last October and to NMFS in November. The petition, filed by the Biodiversity Legal Foundation, RESTORE: The North Woods, and Jeffrey Elliott, seeks listing of the species throughout its U.S. range--from the Connecticut River to the St. Croix River on the New Brunswick border.

Threats to Be Identified

The petition introduces information on current and historical Atlantic salmon populations, identifies possible threats, and cites numerous scientific articles. Based on the review of the petition and other available data, the agencies believe listing may be warranted and will now review all pertinent information. A decision on whether to initiate listing procedures will be made by October 1994.

"We have been working cooperatively with the U.S. Fish and Wildlife Service in the Northeast for the restoration of self-sustaining populations of Atlantic salmon for years," said NMFS director Rolland Schmitten. "Work on this petition will set precedent for the two agencies to combine resources, assess progress and plan strategies together."

'Wonders of our Rivers'

"Atlantic salmon are one of the wonders of our northeastern rivers," said Mollie Beattie, director of the Fish and Wildlife Service. "We will seek information from all those who care about the salmon before we decide whether this species should be proposed for protection under the Endangered Species Act."

Compu-sneaks Foiled by Alert Staffer

NMC Hacks the Hackers

They had done it before. Why, no one knew. A group of computer hackers--hobbyists with a potentially destructive streak--had broken into the computer system at NOAA's National Meteorological Center in Camp Springs, Md., in September, by contacting it from their computers through other systems, and trying a few passwords. Although they hadn't damaged anything or compromised any information, the potential for damage was great. If a hacker wanted to, he or she could change or delete enough information to wreak havoc with weather forecasts, putting lives and property at risk. They had to be caught. But how?

John Ward, National Meteorological Center staffer, aided the FBI in the apprehension of Danish computer hackers who had broken into NMC's computers.

After consulting with the FBI's National Computer Crime Squad, NMC staffer John Ward decided the best action was...no action. Or at least let it look like that to the hackers. So Ward, rather than changing the entire system and possibly giving the hackers more of a challenge, instead provided easy access to the NMC computer system. If the hackers did any damage, however, or attempted to use any part of the NMC weather forecast system, they'd be locked out.

But he also put into operation the computer equivalent of a video security camera--special monitoring programs which kept a log of who was using the computer system, and from where. If any of the hackers' special patterns were detected, Ward would be alerted. He could then alert the FBI, who would begin to trace the activity back to its origins, wherever that might lead. The whole process could take as little as two minutes. But it had to be done quickly, since the hackers usually stayed on the system for only a short time. NMC staff covered the system 24 hours a day, seven days a week.

They're Heeeere...

On a Sunday in December, the alarm went out--the hackers had come back. Within two minutes, the FBI had traced the connection to a house in Denmark, and on December 8, Danish authorities arrested three men, aged 17 to 20. A fourth was arrested two days later. The 17-year old was charged with disrupting the day-to-day operation of the data handling system; his maximum penalty is four years. The others were released pending further investigation. According to Danish reports, the hackers gained access to 32 computer systems in the U.S. and 36 in Denmark, through computer networks such as Datapac, the Danish telephone system, and the Internet.

"Working at NMC can be exciting," Ward said, "especially during hurricanes and major winter storms. But nothing can compare with the adrenaline levels I felt when the intrusion alarm sounded and I scrambled to find a phone to call the FBI while watching the hackers on my computer screen. The result made all the late nights and long weekends worth it."

—Jerry Slaff

New Mission Means New Name for Lab

A "renewed commitment to...environmental technology" has led one of NOAA's 11 Environmental Research Laboratories in Boulder, Colo. to change its name to more accurately reflect its new mission.

The Wave Propagation Laboratory became the Environmental Technology Laboratory (ETL) late last year. The new name better describes the breadth of ETL's mission to improve the Nation's geophysical research and services through creating, assessing, and applying cost-effective remote-sensing measurement systems, said Dr. Steven F. Clifford, ETL's director.

continued on page 8

continued from page 1

Canaveral, Fla.

The new Geostationary Operational Environmental Satellite, or GOES-I, is the first of a series of five meteorological satellites *that will assure dual-satellite coverage for* the United States into the next century. It will be designated as GOES-8 after its launch, scheduled for mid-April.

The United States now has only one operational meteorological satellite in geostationary orbit, GOES-7. A companion satellite was lost during a launch failure in 1986.

Since then the United States has been serviced by a single GOES and a borrowed European satellite. Another satellite, GOES-J, is set for launch in 1995.

Jet Ski Ruling to Be Appealed: NOAA will appeal a district court ruling that strikes down a regulation limiting the use of jet skis and other motorized personal watercraft within the Monterey Bay National Marine Sanctuary off California's coast. The regulation was intended to reduce the use of motorized personal watercraft, which are reported to have caused at least one collision with a sea otter and are considered a threat within the sanctuary's areas of high marine mammal and seabird concentrations and kelp forests.

NEWS BRIEFS

New Appointments: Among the newcomers to top NOAA positions this month are:

- Derek Winstanley, Deputy Chief Scientist, former director of the National Acid Precipitation Assessment Program;
- Lori Arguelles, director of Public Affairs, former Congressional press secretary and news director of the GEM Group radio stations in Santa Barbara, Calif.;
- Sally Yozell, director of Congressional Affairs, former aide to Sen. John Kerry;
- Jeffrey Benoit, director of NOS's Office of Ocean and Coastal Resource Management, former head of the Massachusetts Coastal Zone Management Office.

Few Klamath R. Salmon Return to Spawn; Drought, Severe Habitat Loss Blamed

The 1993 fall run of nearly 21,000 chinook salmon in California's and Oregon's Klamath River basin, although the strongest since 1989, did not reach Federal preseason goals.

Fisheries scientists from NOAA's National Marine Fisheries Service point to severe loss of habitat and the recent extended drought as possible causes of historically low numbers of returning Klamath chinook salmon. Tight restrictions on ocean and river fishing for Klamath salmon have been required so sufficient numbers of fish can return to spawn.

Only 20,880 naturally spawning fall chinook salmon escaped ocean fishermen and river fishing last fall to return to the spawning grounds of the Klamath and Trinity rivers, according to figures released by the California Department of Fish and Game.

The spawning escapement fell far short of the goal set by the Secretary of Commerce and marked the fourth consecutive year that the run failed to meet the minimum spawning escapement goal of 35,000 naturally spawning adults.

The minimum escapement goal, or floor, is specified by the Pacific Salmon Fishery Management Plan and is regarded as the minimum number of spawners needed to protect the productive potential of the natural stock. The Secretary of Commerce, in an emergency regulation last April, set the 1993 spawning escapement goal at 38,000 with the hope of avoiding a fourth year of sub-floor escapement.

Fisheries scientists had predicted that under the Secretary's fishery management measures, 72,600 salmon would return to the Klamath River, of which 21,200 were allocated to sport and Native American net fishers.

The river run of two-year-olds, which predicts the strength of the next year's ocean three-year-old population, was the fourth lowest since 1978; only 7,576 returned, compared to the run of 13,688 in 1992.

Lab's New Name

continued from page 7

"The Wave Propagation Laboratory was a leader in developing the new technology of remote sensing over the past 25 years," Clifford added. "The name change to the Environmental Technology Laboratory manifests our renewed commitment to the development and transfer of environmental technology."

ETL is regarded as an international leader in developing ground-based remote-sensing instruments (such as Doppler radars, wind profilers, and radiometers) that use radio, light, and acoustic waves for atmospheric and oceanic observation. With these instruments, ETL scientists have obtained unique measurements of a huge range of environmental phenomena, ranging from the dynamics of air pollution to the velocity structure of tornadoes.

—Janet Amber

NOAA Report is a monthly publication for NOAA employees from the NOAA Office of Public Affairs, Washington.
Address comments to:
Editor
NOAA Report
NOAA Office of Public Affairs
6013 Herbert C. Hoover Building
Washington, DC 20230
202-482-6090 *(voice)*
202-482-3154 *(fax)*
Banyan E-Mail: JerryS@pa@noaa
Internet: jslaff@hq.noaa.gov
CompuServe: 70762,3151
Lori Arguelles ..... Director, Public Affairs
Jerry Slaff ..... Editor

National Oceanic and Atmospheric Administration

ERRATA NOTICE

One or more conditions of the original document may affect the quality of the image, such as:

Discolored pages
Faded or light ink
Binding intrudes into the text

This has been a co-operative project between the NOAA Central Library and the Climate Database Modernization Program, National Climate Data Center (NCDC). To view the original document, please contact the NOAA Central Library in Silver Spring, MD at (301) 713-2607 x124 or Library.Reference@noaa.gov

HOV Services
Imaging Contractor
12200 Kiln Court
Beltsville, MD 20704-1387
July 23, 2010