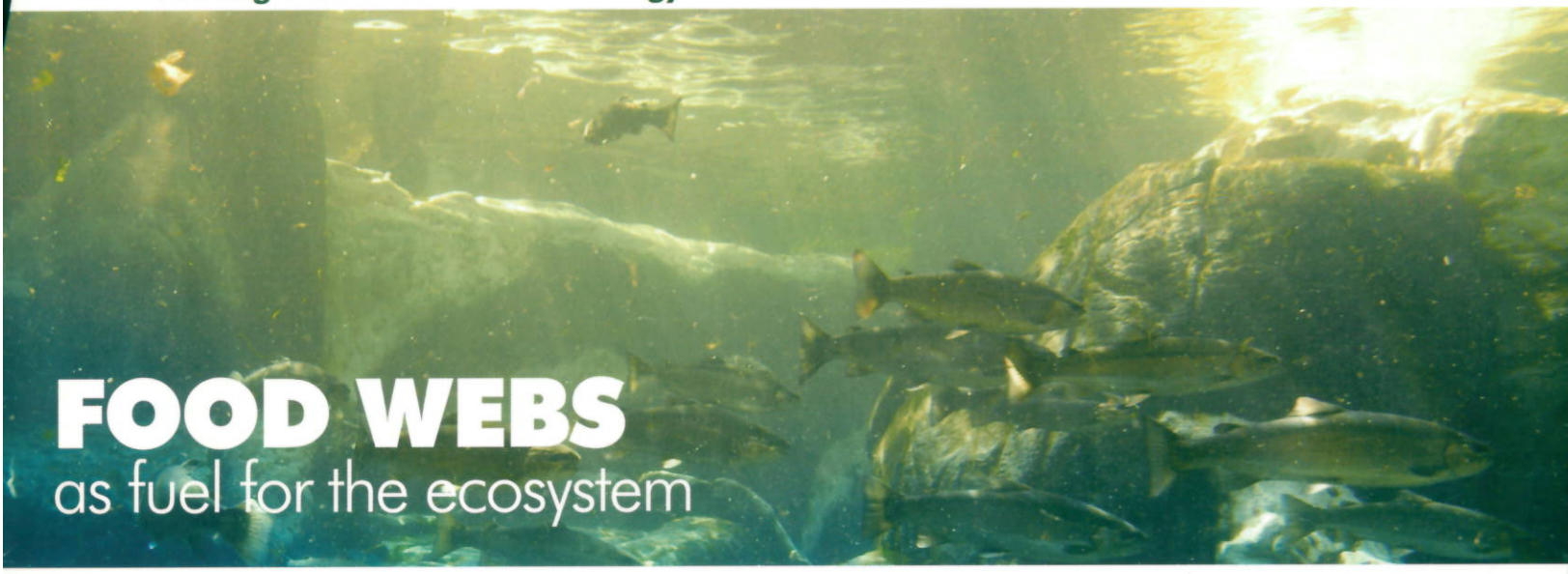
COUNCIL QUARTERLY
Winter 2011
Northwest Power and Conservation Council
Striking a balance between energy and the environment in the Columbia River Basin



FOOD WEBS
as fuel for the ecosystem

THE IDEA that all parts of life are interconnected is an ancient motif found in mythology, religion, art, and science. It's also a concept central to a recent report on the importance of food webs to the health of the Columbia River Basin ecosystem. As lead report author Dr. Robert J. Naiman puts it, "food webs fuel that ecosystem," underpinning the productivity and resiliency of the basin's fisheries.

The three key areas of concern: whether the system can produce enough of the right food at the right times to maintain thriving populations of native fishes; the effects of non-native species on food supply; and the proliferation of contaminants and chemicals in the watershed.

The report was undertaken by the Council's Independent Scientific Advisory Board in late 2009 to help understand the role of aquatic food webs in the basin and how they affect native fish restoration efforts. The Council's fish and wildlife program strives to establish and maintain an ecosystem that sustains an abundant, productive, and diverse community of fish and wildlife.

Food webs reveal insights into the basic properties of a healthy ecosystem beyond simply addressing the impacts of the hydrosystem, habitat, hatcheries, and harvest—usually the main areas of focus for restoration activities.

Until now, the Council, NOAA Fisheries, tribes, and other state agencies haven't really focused attention on changes to

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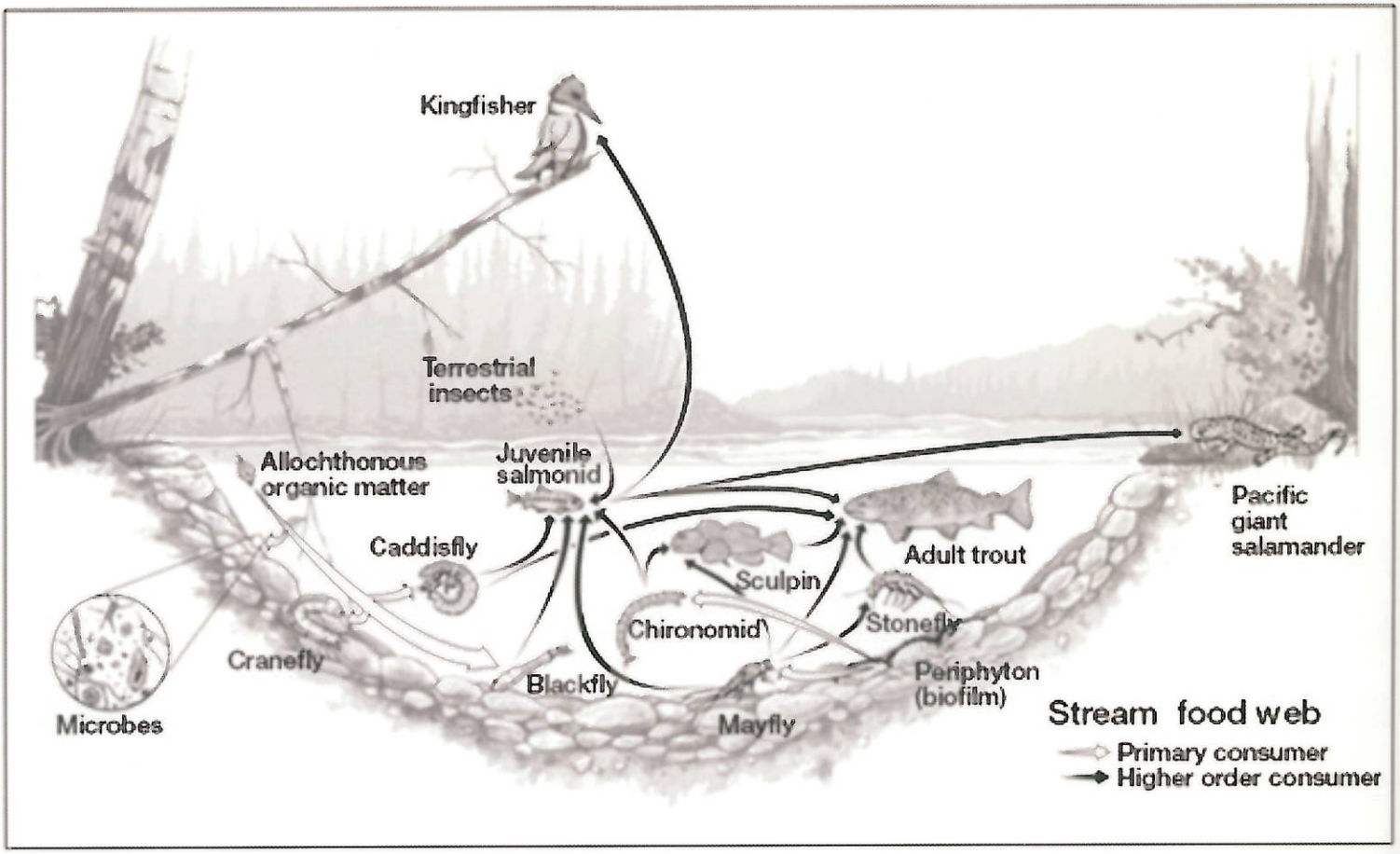
A GROWING NUISANCE: An invasive algae known as didymo may cause great harm to habitat and fish by choking out the insects that fish feed on.

PREDICTING SALMON SURVIVAL Using 16 indicators of weather and ocean conditions, NOAA scientists can better predict salmon runs.

HUNGRY CORMORANTS are now consuming salmon and steelhead in ever-increasing numbers. What can be done about it?



A simple food web for a representative Pacific Northwest salmonid community

Continued from page 1

food webs, assuming that conditions have been relatively favorable and stable. But as the ISAB report indicates, changes to the basin's food webs are widespread and appear to be affecting the aggregate carrying capacity of the river to produce wild fish.

"The question of the carrying capacity of the river was something we hadn't really considered before," says Naiman. "Are we overlooking the impact of competition for food between native fish and hatchery fish and other non-native species?"

The impact of massive annual releases of juvenile fish from hatcheries appears to be taking a toll on stocks of wild fish. About 130 - 150 million hatchery salmon and steelhead are released each year, and according to the report, "The thousands of metric tons of food used to raise them, as well as the hundreds of thousands of metric tons of natural foods required to maintain them in the river, affect the capacity of the Columbia River to support naturally produced native fishes."

"While not completely clear, it sure looks like we may be exceeding the carrying capacity of the river, and that was a big surprise."

Dr. Robert J. Naiman

Added to this is the proliferation of non-native plants and animals, creating so-called "hybrid" food webs. According to Naiman, "There are so many non-native creatures that are part of the system now; realizing the magnitude of their impact is a new reality."

"While not completely clear, it sure looks like we may be exceeding the carrying capacity of the river, and that was a big surprise."

The growing presence of contaminants in the river system is another enormous factor affecting the health of food webs. "We were stunned by just how much is in the watershed," says Naiman. "These chemicals, from pesticides to personal care products to medicines, disproportionately affect food webs, especially the small, but essential organisms at their base. We know so little about them, yet they could be a lynchpin in whether or not restoration actions succeed."

Restoration activities have traditionally focused on physical habitat, an approach that assumes local habitats dictate fish production and that most fish food is produced locally. In reality, though, much food come from external or very distant sources — marine nutrients brought by adult returns, from numerous

headwater tributaries that transport prey downstream, and from adjacent streamside and estuarine vegetation and other riparian and terrestrial habitats.

And key food sources vary over time and space throughout the watershed. When restoration activities aren't successful, it's often because they don't take a broad enough spatial and temporal view of the watershed, including food webs and the processes that influence food availability. Many fishes use a variety of habitats to complete their life cycles and use many different important prey resources. Understanding the entire fish life cycle and food chain is critical to developing effective actions.

"We tend to look at habitat individually and visually; we don't see the internal workings in the water, what kind of food is there and whether it's the right kind of food," notes Naiman. "We need to go beyond that and we need to do it quickly."

For Naiman and his associates on the report, the ultimate message is clear. "We're at a turning point, and we need to understand that 10 or 20 years from now, there is a high probability that we may be looking at a vastly different ecosystem. We need to ask ourselves if the restoration actions in place now will still be viable, and will they still make sense."

Understanding food webs, and using them to advantage, will help in designing effective restoration activities and in managing the Columbia River as an *integrated and productive ecosystem for native fishes.*

The report is available on the Council's website, ***www.nwcouncil.org,*** *and includes interactive maps, a species table, and other educational materials.*

Notes From the Chair

The importance of food webs to ecosystem health is the focus of a recent report by the Council's scientific advisory board, and it's the lead story in this edition of the CQ. As Bob Naiman, lead author describes it, food webs are fundamental to ecosystem health, determining the productivity and resiliency of the Columbia River Basin's fisheries. And, as the report suggests, it signals a turning point in how we approach restoration actions.

We also interview Steve Oliver, Bonneville's co-coordinator in the process to review the Columbia River treaty, that milestone trans-boundary agreement between the U.S. and Canada on hydropower generation and flood control. Flood control costs will necessarily be revisited, while issues such as climate change and fish and wildlife requirements, which were not considered in the 1964 treaty, will be on the agenda of many in the region.

Council Chair Bruce Measure

A GROWING NUISANCE

Didymo's Impact on Fish

AT THE COUNCIL'S January meeting in Missoula, Brian Marotz of Montana Fish, Wildlife & Parks described a recent phenomenon below Libby and Hungry Horse dams: the proliferation of a form of invasive algae called didymosphenia gemenata, also known as "rock snot" and didymo. Didymo was first reported in New Zealand in 2004 where it's become a significant problem. It's also been found in North and South America.

According to Marotz, the plant has the potential to cause great harm to habitat and fish by choking out the insects that fish feed on. Very little is known about why didymo is growing near the dams. It was first noticed below Libby Dam several years ago, and then below Hungry Horse about three years ago. Marotz noted that research is underway to better understand didymo's effect on habitat and how to address the problem.

"For some reason, it's proliferating," says Marotz. "It's alarming because now were starting to see a reduction in fish numbers as a result."

Marotz has been working with Dr. Jack Stanford at the University of Montana Biological Station and other didymo experts to better understand this diatom.

According to Marotz, "Some researchers aren't very concerned about didymo because it's believed to be cyclical." Montana fish and wildlife managers thought so, too, over 11 years ago when the dense blooms began to grow in the Kootenai.

"The diatom does have annual growth and death cycles, but it hasn't dissipated, and it's getting worse, even when we attempted to flush the river with planned dam discharges," notes Marotz.

"We're now documenting the widespread loss of most aquatic insect species where these nuisance blooms occur in the Kootenai and South Fork Flathead." Although there are a number of factors involved, Marotz says that fish populations have apparently declined or moved elsewhere for food.

"Like others, I hope these blooms simply disappear, but they haven't to date. We need to learn what makes didymo flourish and how we might control it." ■

Stephen R. Oliver *is the vice president of generation asset management for the Bonneville Power Administration, the Portland-based federal power marketing agency that sells electricity generated at 31 federal dams and one non-federal nuclear plant in the Northwest. He is also the co-coordinator of the U.S. Entity for implementing the Columbia River Treaty between the United States and Canada.*

Northwest Q& A:

Steve Oliver: REASSESSING THE COLUMBIA RIVER TREATY

Q. What benefits do the United States and Canada enjoy under the treaty, and would those change if the treaty is terminated? If so, how?

A. Since 1964, the Columbia River Treaty has brought benefits to both the United States and Canada by providing a cooperative way to regulate the Columbia River. Under the treaty, the two nations jointly manage the river for power generation and flood control as it flows from British Columbia into the United States. The treaty is widely praised worldwide as a model of international cooperation in the management of a large trans-boundary river.

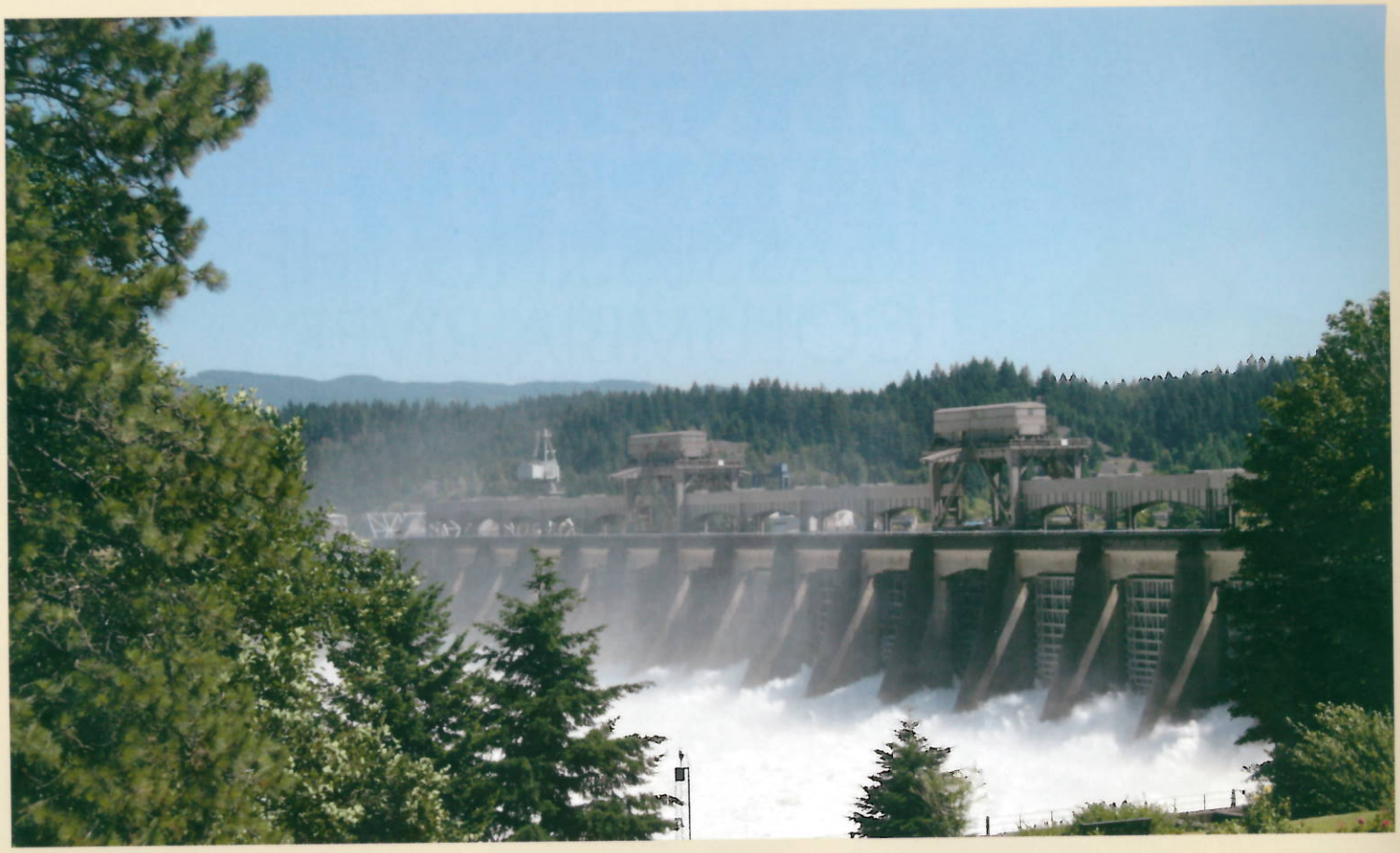
The impetus for the treaty came from the disastrous flood at Vanport (now part of Portland) in 1948 and the subsequent opportunity for low-cost hydropower to fuel the Northwest economy. The treaty doubled water storage capacity on the Columbia River system with construction of three large storage projects—Duncan, Keenleyside, and Mica in Canada, and Libby Dam in the United States. These projects have provided billions of dollars of flood control and power benefits in both Canada and the U.S.

Although the treaty has no termination date, it does have two provisions that take effect on and after September 16, 2024 that will change flood control operations and payments between Canada and the United States and provide the option for either country to terminate most of the treaty provisions with a minimum of 10 years' notice. This is why 2014 is an important date with regard to the future of the treaty. Absent any decision regarding termination or renegotiation, the other current terms of the treaty will continue with its current terms indefinitely, and new flood control procedures will occur regardless of the termination decision.

As to your specific question regarding termination, the studies we have performed, both jointly with Canada and by the U.S. Entity on its own, indicate that terminating the treaty would cause a relatively small decrease in U.S. generation of 90 to 94 annual average megawatts, which is less than 1 percent of the total system generation. However, the seasonal shape varies from month-to-month and between different water conditions. In general, U.S. generation increased January to May and decreased July through September. The reduction in summer generation was especially large, greater than 1,000 average megawatts, in low-water years. These studies, however, are very preliminary, and are based on a limited number of assumptions. Much more analysis needs to be done.

Q. How is the treaty actually implemented?

A. The treaty provides for the appointment of entities to formulate and carry out operating arrangements necessary to implement the treaty. The U.S. Entity is the Bonneville Power Administrator as chairman and the U.S. Army Corps of Engineers Northwestern



Northwest Q& A: *Continued from page 5*

Division Engineer as a member. The Canadian government appointed the Crown Corporation, BC Hydro & Power Authority, as the Canadian Entity. Under the terms of the treaty, Canada must operate 15.5 million acre-feet of storage in the three Canadian treaty projects for power and flood control benefits in both countries; while the U.S. returns to Canada in electrical energy and capacity one half of the estimated annual average downstream U.S. power benefits (referred to as the Canadian entitlement).

The Canadian entitlement is delivered to BC Hydro by BPA, so the cost is ultimately born by ratepayers. The power associated with the Canadian entitlement is produced at both federal and non-federal dams in the U.S. The non-federal dams involved are owned by three public power utilities. The Canadian entitlement is valued at approximately $250 million to $350 million per year and the revenue from the sale of that power flows directly into the BC government's general fund. The entitlement is required to be calculated based on the most effective use of the water for power generation in the United States. However, actual U.S. hydropower operations are significantly constrained by fish and wildlife obligations that were not anticipated at the time the treaty was negotiated and are today not considered in the treaty entitlement calculation.

In addition to the Canadian entitlement, the U.S. also paid Canada $64 million for the use of 8.45 million acre feet of storage in the three Canadian treaty projects to be used for flood control in the U.S. This amount was based on flood damages prevented in the U.S., assuming the control of floods to 600,000 cubic feet per second at The Dalles, Oregon, and reflected one-half of the estimated downstream U.S. flood protection benefits until 2024, which is 60 years after treaty ratification. These payments were made with appropriated federal funds when the dams were completed.

Whether the treaty continues or is terminated, requirements for flood control provided by the treaty projects will automatically change in 2024 to a process referred to as "called upon." The called upon procedure would give the U.S. the right to request flood control assistance, and Canada is obligated to provide it, but only to the extent needed after the U.S. has completely exhausted all of its own flood control capability, which is referred to as "effective use." The U.S. must pay Canada for its operating costs and economic losses from providing the called upon operation. However, the amount of storage required, the methods to determine costs, and the operating procedures that would be deployed are not clearly spelled out in the treaty. Studies of post 2024 flood control alternatives and scenarios that are now referred to as "flood risk management studies" are currently being conducted

"Because the review has such enormous implications for people throughout the Pacific Northwest, it's paramount that all interests are represented in the process."

by the U.S. Army Corps of Engineers.

Q. What is the 2014/2024 Columbia River Treaty Review?

A. As an analytic starting point for a regionwide treaty review, the U.S. and Canadian Entities conducted a joint study to measure changes and effects under various scenarios, including the treaty continuing or being terminated with the automatic change in flood control operations, as well as a scenario in which flood control operations remain as they are today and the treaty continues. Similar to current treaty operating plans, these studies considered only power and flood control objectives. A subsequent study was performed by the U.S. Entity in which U.S. biological opinion legal operating requirements were overlaid on the U.S.-Canadian studies for a more accurate and realistic view of U.S. operations. Ultimately, the two studies combined will serve as an excellent, neutral foundation for the broader and more intensive regional review now underway.

The U.S. Entity has developed a team of regional sovereigns to work and consult with in developing a regional recommendation regarding the appropriate future of the treaty. Representatives of the four states, 15 tribal governments, and the Northwest federal caucus are at the core of this process. Interest groups and utility companies, including some that own affected dams, will also be invited to work with this core team beginning in March 2011. Technical teams will be organized to work cooperatively with Corps of Engineers and BPA treaty technical experts to develop new analyses to assess the merits of different future treaty scenarios.

As part of this process, the U.S. Entity has committed to directly consult with tribal interests through the federal government's tribal trust responsibility. In addition, BPA and the Corps of Engineers, through the Columbia Basin Fish Accords, have agreed with certain tribes to coordinate on the review to ensure that tribal rights and concerns are brought to the U.S. Entity for consideration.

Q. The treaty addresses only flood control and hydropower generation. Is the review considering how other river uses, such as irrigation, water supply, or ESA-required flows for salmon and steelhead migration, can best be met in the future; whether that future continues under the existing treaty or under a terminated, modified or new treaty? If so, how?

A. Yes, it is. The world is a different place than it was in 1964. Power and flood control are not the only relevant issues when determining how to best manage the resources of the Columbia River for the common good. The U.S. Entity's overarching challenge in the review will be to adequately consider the ecosystem, environmental, irrigation, navigation, and other issues that were not addressed in the original treaty, and balance those interests with the continuing need for flood control and power benefits. Bonneville and the Corps of Engineers already have substantial expertise and demonstrated competency in balancing such interests in the Pacific Northwest through implementing various statutory obligations aimed at balancing power, ecological, safety, and other interests. We have made it clear that our goal is to gain a regional consensus, if possible, regarding post 2024 Columbia River treaty operations.

It is the U.S. Entity's intention to submit a recommendation to the State Department in September of 2013; one year before either nation can transmit its intention to terminate the treaty, in order to provide federal authorities sufficient time to deliberate and review that recommendation.

Q. While there are myriad issues to address and resolve in the review, what are several of the most important in your opinion?

A. Going forward, the policy and analytical challenges are substantial. Since the treaty's signing, far reaching fish and wildlife statutory protections have been enacted that bear on BPA's and the Corps of Engineers' responsibilities for managing the Columbia River. Fourteen fish and wildlife species have been listed and the current biological opinion explicitly notes the need to address river flows resulting from treaty operations. Also critical are the changes to flood control that automatically occur in 2024, and the need to assure that the amount of the Canadian entitlement aligns with the real benefits. These changes, or any other modifications to the treaty storage operations, will involve challenges and the need for cooperation between the Northwest states, tribes, and federal agencies, as well as between power, irrigation, fish and wildlife, recreation, and other concerns. The U.S. Entity intends for this review to be transparent, open, collaborative, and inclusive among the sovereigns, tribal, state, and stakeholder interests. ■

Understanding Shifting Ocean Conditions to Improve Predictions of Juvenile Salmon Survival

Scientists prepare to trawl for juvenile salmon off the Oregon cost.

USING 16 INDICATORS of weather and ocean conditions in the Pacific Ocean, scientists at the National Oceanic and Atmospheric Administration are improving their ability to understand why Columbia River salmon runs are abundant in some years and scarce in others.

The scientists have been studying the indicators, which include sea-surface temperatures, upwelling of ocean nutrients, the abundance of zooplankton species like copepods and krill, and actual counts of juvenile salmon trawl surveys, for 13 years. The indicators are aiding predictions of how well juvenile salmon will survive in their important first few months in the ocean, and therefore how the fish may fare as they mature to adults and eventually return to spawn.

"These indicators, taken as a whole, represent an 'ecosystem approach' to providing management advice" to fish and wildlife agencies, the scientists wrote in a memo to the Northwest Power and Conservation Council. NOAA scientists John Ferguson of Seattle and Bill Peterson of Newport, Oregon, discussed the most recent results of their work at a Council meeting in December.

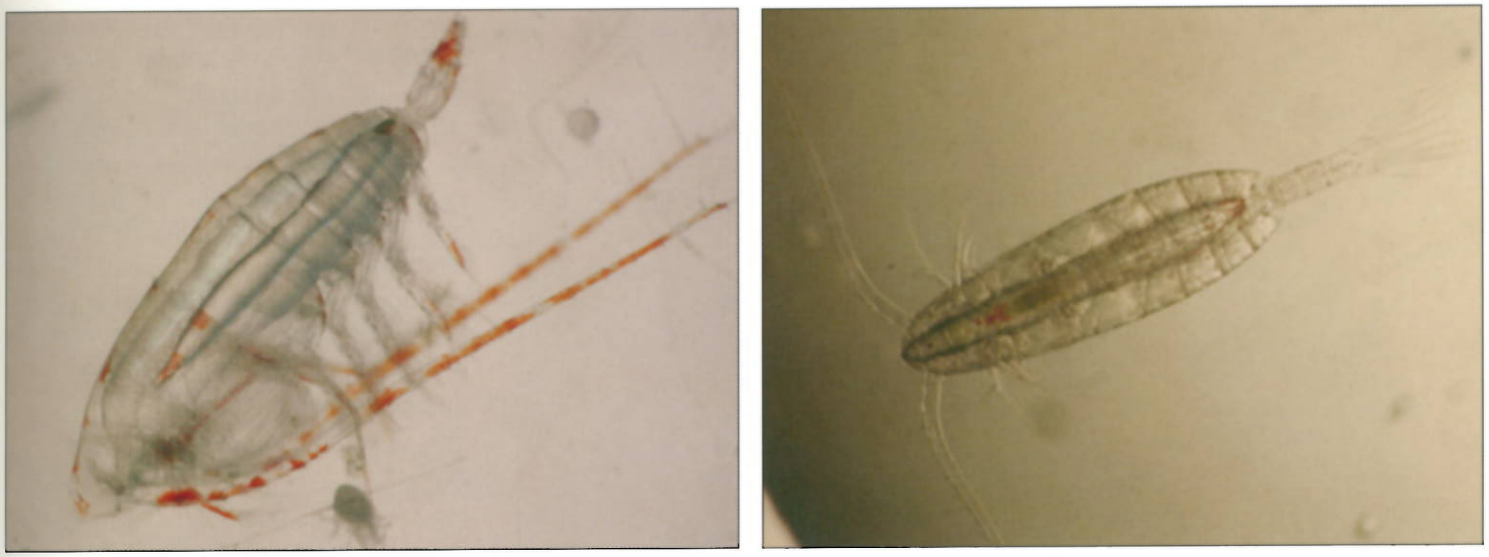
"We feel like we've got it figured out," Peterson told the Council. Ferguson said the indicators and analysis should help salmon managers improve their prediction of future runs sizes and make better decisions about how many fish to allow for harvest.

In the north Pacific Ocean, changes in water temperature and current direction are driven by a climate phenomenon known as the Pacific Decadal Oscillation. The PDO has two phases, warm and cold, resulting from the direction winter winds. Major changes in Northeast Pacific marine ecosystems correlate with phase changes in the PDO. Warm eras have seen enhanced coastal ocean biological productivity in Alaska and decreased productivity off the West Coast, while cool PDO eras have seen the opposite—better conditions off the West Coast and poorer conditions in Alaska. Cool periods correspond with increased salmon and steelhead returns to the Columbia River Basin.

The negative, or cold-water PDO phase brings fatty, cold-water copepods from the coastal Gulf of Alaska to the coasts of Oregon and Washington—rich food for juvenile salmon. The warm-water PDO phase, on the other hand, brings smaller, less-fatty copepods from Southern California to the northern coast—a poorer food supply.

From 1925-1998, the PDO shifted phase every 20-30 years, Peterson said. "However, we've had two shifts of four years' duration recently: 1999-2002 and 2003-2006, and another shift in late 2007," he said. It isn't clear why the PDO phase has changed so quickly in recent years, but the sudden changes may hint at future volatility that could make ocean productivity even more difficult to predict.

Ferguson said the indicators and analysis should help salmon managers improve their prediction of future runs sizes and make better decisions about how many fish to allow for harvest.



This "fat" krill from Alaska (left) has more nutrients for juvenile salmon than its skinnier cousin from California (right).

Another important source of research data collected over the last 13 years is information about where salmon go in the ocean. "In order to forecast returns of various salmon life history types, we first establish where they live in the ocean," Peterson said.

Ocean conditions in one year affect the return of adult salmon in later years after they spend one to three years in the ocean. Peterson said 2008 was a particularly good year for Columbia River salmon in the ocean, a year in which the 16 ocean indicators tracked by NOAA scientists were the best in 12 years. Subsequently, in 2009 the return of adult coho was the fifth-highest since 1970, and the upriver spring Chinook run in 2010 was the fourth-highest, based on counts at Bonneville Dam.

This past year, "2010 was a very confusing year," Peterson said. "The ocean was anomalously warm in winter and spring due to the El Nino event, but in July, the ocean turned cold almost overnight. "Because of the highly variable ocean conditions, we are less clear on what happened to the juvenile salmon in 2010," he said. "But this year provided an experiment in which we'll be able to see whether the physics or biological interactions drive the system."

The sudden shift improved conditions for juvenile salmon, but was the change in July, which usually occurs in April or May, too late for the fish? Peterson said NOAA scientists are trying to understand why the ocean shifted suddenly this year and what that might mean for their forecasts of coho and spring Chinook returns in 2011 and 2012.

COUNCIL NEWS

Montana and Washington Members Will Lead Northwest Power and Conservation Council in 2011

Meeting in Montana in January, members of the Northwest Power and Conservation Council re-elected Bruce Measure, a Montana member, chair of the Council for 2011, and Dick Wallace, a Washington Member, vice chair.

"I'm honored to be elected to chair the Council again in 2011," Measure said. "This year the Council will be working with the Bonneville Power Administration and the region's electric utilities to implement the aggressive energy efficiency in the Sixth Northwest Power Plan, which we approved in 2010. We also are reviewing projects funded by Bonneville through our fish and wildlife program to ensure they are performing as intended, and we are beginning to focus Council attention on the future of the Columbia River Treaty with Canada. It will be a challenging, exciting year for the Council."

As vice-chair, Wallace is the Council's designated liaison to the Columbia Basin Trust, the Council's closest counterpart agency in British Columbia. The CBT and the Council are working on several projects, including developing public information about the future of the Columbia River Treaty.

"It 's a privilege to continue serving as vice chair," Wallace said. "I especially look forward to coordinating our productive relationship with the CBT, whose work we support in the river basin that our two countries share. Building strong relationships and collaborating on projects is particularly important as discussions on the future of the Columbia River Treaty move forward."

Montana Governor Brian Schweitzer appointed Measure to the Council in January 2005. Dick Wallace was appointed to the Council in February 2008 by Washington Governor Chris Gregoire.

Idaho member Bill Booth will continue to chair the fish and wildlife committee, and Washington member Tom Karier will chair the power committee.

Feathery crests give this seabird its name.

Cormorants Taking More Juvenile Salmon and Steelhead in the Columbia River Estuary

DOUBLE-CRESTED CORMORANTS, fish-eating seabirds that nest by the thousands in the Columbia River estuary, are consuming juvenile salmon and steelhead in ever-increasing numbers. From an estimated 2.4 million smolts in 2005, consumption increased to 19.2 million in 2010, the highest of any year in the last decade, according to Dan Roby, an Oregon State University research scientist who has been studying the birds since the late 1990s.

Roby studies cormorants and Caspian terns on East Sand Island, which is near the mouth of the river. There, researchers counted about 13,600 breeding pairs of cormorants in 2010, a slight increase from about 12,100 in 2009 and nearly double the number 10 years ago.

The number of tern pairs on the island was about 8,300, an amount that, unlike the cormorant population, appears to have stabilized. In 2010, the East Sand terns consumed about 5.3 million salmon and steelhead smolts, roughly the average annual number from 2000 through 2009. In 2009, however, about 6.4 million were consumed.

East Sand Island is a good place for the fish-eating birds to nest since it's close to their primary food source. Being close to the ocean, the mix of prey includes more marine species like anchovies and herring than farther upriver in the estuary, where the percentage of salmon and steelhead smolts is greater. The U.S. Army Corps of Engineers created ideal habitat for cormorant and tern nesting on the island. Researchers constructed a field observation station where they can monitor the birds' habits, including the kind of fish they bring back from the estuary on their periodic foraging trips. On the island, terns lay their eggs on bare sand, and cormorants nest on rocky embankments and piles of driftwood.

Over the last decade, predation on salmon and steelhead by Caspian terns has leveled off in the estuary, thanks in part to relocating the large colony from Rice Island to East Sand Island 16 miles upstream. But predation by double-crested cormorants has increased steadily. The East Sand Island population represents 39 percent of the western cormorant population of 31,500 pairs, which includes colonies west of the Continental Divide from California to British Columbia. When Roby's research project began in 1997, the East Sand cormorant colony totaled about 5,000 pairs.

While double-crested cormorants are more numerous in the central and eastern United States, the growing western population, and specifically the East Sand colony, is causing concern among fish and wildlife managers because of the birds' impact on juvenile salmon and steelhead survival, particularly species protected under the Endangered Species Act. Researchers don't know how many threatened and endangered species are being consumed, but they do know, based on recovered tags from smolts at dams and hatcheries upstream, that all but one of the 13 ESA-listed salmon and steelhead species in the basin have been found in the diet of terns and cormorants that nest on East Sand.

In an effort to reduce Caspian tern predation, the Corps reduced the size of the tern nesting area by more than one-third in recent years, but the tern colony size didn't decline accordingly. The birds simply nested in higher densities.

Double-crested cormorants nesting amid driftwood on East Sand Island.

Further reductions in the size of the tern nesting area are planned in the coming years and will likely result in a significant decline in the number of terns attempting to nest on East Sand. Given the growing number of smolts consumed by double-crested cormorants nesting on the island, resource managers are considering similar plans to relocate nesting cormorants from East Sand to other sites along the Pacific Coast.

The project is partially funded by the Bonneville Power Administration through the Council's Columbia River Basin Fish and Wildlife Program, and the U.S. Army Corps of Engineers. Project partners also include Oregon State University, Real Time Research, and the U.S. Geological Survey. ■

Caspian terns on East Sand Island prefer to nest on open sand.

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COUNCIL QUARTERLY

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