CASPIAN TERN INTERIM MANAGEMENT PLAN FY 2003-2004
and PILE DIKE EXCLUDER MAINTENANCE TO DISCOURAGE CORMORANT USE
LOWER COLUMBIA RIVER
OREGON

DRAFT INTERIM ENVIRONMENTAL ASSESSMENT

SUMMARY

This environmental assessment (EA) covers interim actions proposed by the U.S. Army Corps of Engineers (Corps) for the next 2 years to address requirements to prevent tern nesting on Rice Island found in the Incidental Take Statement in the National Marine Fisheries Service's Biological Opinion (Biop) on the Corps of Engineers' Columbia River Channel Operation and Maintenance Program, issued September 15, 1999. These interim measures are proposed as a result of a court settlement in April 2002.

Research conducted during previous years' nesting season has shown that efforts to move the Rice Island tern colony to East Sand Island have been successful, with no adverse impacts on the birds to date. The Corps proposed action, to maintain this relocation of terns from Rice Island to East Sand Island, is a short-term measure. It is the Corps opinion that a longer-term management plan to move a percentage of the Columbia River estuary Caspian tern colony outside the Columbia River Basin would be appropriate, supported with appropriate environmental documents. As a result of the court settlement, the U.S. Fish and Wildlife Service (USFWS) is scheduled to prepare a long-term management plan and associated Environmental Impact Statement (EIS) for Caspian tern management in the Columbia River estuary, with a Record of Decision by February 28, 2005. USFWS is also preparing a feasibility study of potential Caspian tern nesting sites in the Pacific Northwest. The interim measures described below are to be implemented from 2002 through the 2004 Caspian tern breeding season, or until the long-term management plan and EIS are complete, whichever is last.

In 2000, about 8,500 pairs of Caspian terns nested on the bare sand habitat that was provided on East Sand Island. The terns used 3.4 acres of the 4 acres of available habitat. On Rice Island, where about 590 pairs of terns nested, the area of the colony was 0.55 acres. In 2001 and in 2002 the entire colony nested on 3.9 and 4.5 acres, respectively, on East Sand Island. No terns nested on Rice, Miller Sands or Pillar Rock in 2002. There were about 9,000 breeding pairs of terns in 2001 and over 9,900 pairs in 2002.

This proposed action is consistent with the action proposed and described in the EA for Fiscal Year (FY) 2001-2002, as agreed to via settlement of legal action, signed April 2, 2002.

The actions proposed for FY 2003/2004, in compliance with the legal settlement, are:

- Clear and maintain a minimum of 6 acres of suitable habitat on East Sand Island to ensure adequate nesting area for Caspian tern breeding population established in 2000.

Continue to attract terns from Rice Island to East Sand Island using decoys and a sound system that broadcasts tern calls.

- Provide 1) passive habitat modification, such as silt fencing, on Rice Island, to dissuade Caspian terns from nesting there and 2) provide active harassment to discourage nesting up to initiation of egg laying, as necessary. No MBTA permit is required for either 1) or 2). Passive and active harassment (up to egg laying) is also proposed on Miller Sands Spit and Pillar Rock, as necessary.

- Maintain cormorant excluders previously installed at Corps pile dikes from Columbia River Mile 4-52.

INTRODUCTION

Caspian tern breeding was first documented in the Columbia River estuary in 1984 when about 1,000 pairs were reported nesting on fresh dredged material on East Sand Island. Prior to 1984, the species was a non-breeding, summer resident of the Columbia River estuary. Most of the colony moved to Rice Island in 1986, probably because of vegetation development on East Sand Island. Rice Island originated in 1962 from dredged material disposal. The island has large, barren sandy areas, which are attractive to nesting terns, due to lack of vegetative cover associated with continued disposal actions.

Because of concerns regarding avian (bird) predation on outmigrating juvenile salmonids, the March 2, 1995 National Marine Fisheries Service (NMFS) Biological Opinion on Operation of the Federal Columbia River Power System (1995 Biological Opinion) included as Incidental Take Provision #9 the requirement that the US Army, Corps of Engineers (Corps) "conduct studies to identify (a) Caspian Tern predation of juvenile salmonids, and (b) methods to discourage tern nesting." A Biological Opinion signed September 15, 1999 on Corps of Engineers' Columbia River Channel Operation and Maintenance Program addressed both Caspian tern and cormorant concerns, and included in sub-section C. Terms and Conditions:

> 1a. The COE shall modify the habitat on Rice Island by April 1, 2000, so that it is no longer suitable as a nesting site for Caspian terns or provide for the hazing of terns off the island in a manner that will preclude their nesting. The COE shall ensure that any terns hazed off the island do not nest on any dredge spoil islands in the action area (other than East Sand Island). The COE shall continue to prevent nesting of Caspian terns on disposal islands within the action area for the life of the project.
>
> 1b. The COE shall work with NMFS to identify methods to prevent cormorant usage of COE maintained pile dikes. The COE shall then modify these pile dikes so that they are unable to be utilized by cormorants for resting and loafing or as feeding platforms. The COE shall modify COE maintained pile dikes located in the Columbia River Estuary around Rice Island, Miller Sands and East Sand Island by April 1, 2000. The COE shall monitor the success of the efforts in preventing cormorant usage in that area during the spring and summer of 2000. If the techniques are successful, the COE shall begin modifications on all COE maintained pile dikes throughout the action area in coordination with NMFS. If the techniques are unsuccessful, the COE shall further coordinate with NMFS to develop other methodologies of prevention.

Research on Caspian tern foraging ecology began in 1996 in response to the 1995 Biological Opinion. Research was conducted by Oregon State University (OSU), Columbia River Inter-Tribal Fish Commission (CRITFC) and Real Time Research (RTR). Research results indicated the colony has grown rapidly. The colony size was estimated to be about 7,200 breeding pairs in 1997 and about 8,700 breeding pairs in 1998. There were about 8,300 breeding pairs at Rice Island in 1999 plus 1,400 breeding pairs at East Sand Island. Some of the pairs on East Sand Island were failed breeders from Rice Island, thus the total breeding population in the Columbia River estuary in 1999 was probably about 8,900 pairs.

Caspian terns in the Columbia River estuary were estimated to consume large amounts of salmonid smolts in 1997 (5.9 to 10.4 million) and 1998 (9.1 – 15.7 million). (Collis, K. *et al.* 1999; see Table 4) Consequently, NMFS requested immediate remedial action to lessen impacts to salmonids. A multi-agency working group, the Caspian Tern Working Group (CTWG) was formed in May 1998 to develop a short-term plan for reducing salmon predation by Caspian terns nesting at Rice Island to be implemented before the 1999 juvenile salmonid out-migration. The CTWG is an inter-agency group consisting of participants from the Corps, the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, Bonneville Power Administration, Oregon Department of Fish and Wildlife, Oregon Division of State Lands, Washington Department of Fish and Wildlife, Idaho Department of Fish and Game, the Columbia River Inter-Tribal Fish Commission (CRITFC), and research staff from CRITFC, Oregon State University and Real Time Research (RTR).

A short-term "pilot" plan was developed and implemented in 1999. The plan consisted of seeding and installing silt fences on all but 1 acre of the 8-acre nesting site on Rice Island (to provide for 1,000 pairs of nesting terns) and creating nesting habitat on East Sand Island. (A little more than 8 acres were cleared of vegetation at East Sand Island.) Tern decoys and recorded calls were utilized to attract terns to nest on East Sand Island. An environmental assessment was released for public review on October 29, 1998, and a Finding of No Significant Impact (FONSI) was signed January 15, 1999.

The pilot project had some success: about 1,400 pairs of terns nested on East Sand Island in 1999. Their overall seasonal diet consisted of 46 percent salmonids, compared to 77 percent for those terns nesting on Rice Island. An estimated 8,300 pairs of terns nested on Rice Island in 1999. This was roughly the same number as nested there in 1998, although the nesting area was reduced to a little more than 1 acre, and the birds were harassed until nesting began. There was heavy predation on tern eggs and chicks by gulls at Rice Island in 1997 and 1998; however, gull predation was reduced in 1999, perhaps due in part to the increased nesting density of terns on Rice Island. Very little gull predation occurred at East Sand Island in 1999, attributable primarily to the removal of problem gulls in order to enhance successful establishment of a tern colony. An estimated 9.4 to 14.1 million salmonid smolts were consumed in 1999 by Caspian terns nesting in the estuary (Collis, K. *et al.* 1999).

Based on the results from the pilot project, a FY2000 Management Plan was developed. This plan called for providing 4 acres of nesting habitat and gull control at East Sand Island, passive and active harassment of terns attempting to nest on Rice Island, and attempts to attract terns to areas outside the Columbia River estuary along the Washington Coast (e.g., Grays Harbor). Local entities raised strong objection to tern relocation in Grays Harbor and elsewhere along the Washington Coast, and that element was set aside. A FONSI was signed on March 17, 2000.

Conservation groups sued to prevent active harassment on Rice Island, and a temporary restraining order was issued April 10, 2000. Subsequently, a preliminary injunction against the Corps and the U.S. Fish and Wildlife Service was issued, restricting active or passive harassment of Caspian terns on Rice Island.

About 590 pairs of terns successfully nested at Rice Island in 2000. Most terns did relocate to East Sand Island, however, resulting in about 8,500 pairs nesting there, for a total estuary population of about 9,100 breeding pairs. This relocation resulted in an estimated 4.4 million fewer smolts being consumed by estuary terns in 2000 than in 1999. About 6.1 to 8.6 million smolts were consumed by terns in 2000 (Columbia Bird Research 2000). Research activities and gull control continued at East Sand Island in 2000.

Bird excluders were placed on four pile dikes at Miller Sands, on two at Jim Crow Creek and on three at Puget-Tenasillahe Islands in 2000. Two pile dikes at Pillar Rock Island served as controls. Researchers observed that bird excluders appear to be effective in reducing numbers of foraging cormorants near pile dikes in the upper estuary, particularly at pile dikes near Miller Sands Island and Pillar Rock (Collis, K. *et al.* 2002).

Data from 1999 and preliminary research results from 2000 were considered in developing the fiscal year (FY) 2001-02 plan, which resulted in 6 acres of nesting habitat provided at East Sand Island and habitat modification (flagging) at Rice Island. In FY 2001, 9,000 pairs of terns nested at East Sand Island and no terns nested at Rice, Miller Sands or Pillar Rock Islands (Columbia Bird Research 2001). The tern colony's diet consisted of about 33 percent salmonids in 2001, and consumption was estimated to be 4.7 to 7.0 million salmonid smolts (*Ibid*.). In 2002, 6 acres were again prepared for nesting at East Sand Island and flagging was replaced at Rice Island. About 9,900 pairs of terns nested at East Sand Island, consuming about 31 percent salmonids. No terns nested at Rice, Miller Sands or Pillar Rock Islands (Columbia Bird Research 2002). Hazing was implemented for about 2 weeks at Pillar Rock in 2002 to preclude an attempt by about 250 terns to nest there.

Much of the data presented in this document are from the 1999 Environmental Assessment on the Caspian Tern Pilot Project; the 1997 and 1998 Annual Reports on Avian Predation on Juvenile Salmonids in the Lower Columbia River (Roby *et al.*, 1998, Collis *et al.*, 1999); the Environmental Assessment on Caspian Tern Relocation--FY2000 Management Plan, and from various reports posted on the OSU-CRITFC-RTR researchers web page (www.columbiabirdresearch.org). Data from 1997/1998 have also been refined and published in Collis *et al.*, 2002, Roby *et al.*, 2002, and Columbia Bird Research 2002. Recent information from the two completed reports required by the court settlement is also included. (One additional USFWS report is still in preparation.)

There was a recognition by many of the CTWG members and the agencies they represent, including the Corps, that the information obtained through the pilot project and relocation efforts would be essential information to the development of a system-wide, long-term plan to reduce predation by piscivorous (fish-eating) birds (terns, cormorants and gulls) on juvenile salmonids.

NEED FOR ACTION

A court settlement from the U.S. District Court for the Western District of Washington, signed April 2, 2002, requires the defendants (Corps and USFWS) to prepare an interim EA addressing

management actions pending completion of a Caspian tern management plan/EIS. The settlement requires the creation of at least 6 acres of suitiable tern habitat on East Sand Island, and allows harassment of terns on Rice, Miller Sands and Pillar Rock Islands, up to egg-laying. Development of a managment plan/EIS for managment of Capsian terns in the Columbia River Estuary is required by the settlement. Completion of three documents is also required to develop the plan/EIS: (1) avian predation analyis to determine levels of predation that do not impede salmon recovery (completed by NMFS in September 2002); (2) Status Assemssment of Caspian terns (completed by USFWS in August 2002) and (3) Feasibiltity study of potential Caspian tern nesting sites in the Pacific Northwest (under preparation by USFWS).

This interim EA addresses actions proposed for 2003-2004, pending completion of the management plan/EIS, scheduled to be prepared and finalized, with a Record of Decision by February 28, 2005.

Of 20 evolutionarily significant units (ESU) of naturally produced anadromous salmonids in the Columbia Basin, three are listed as endangered and nine are listed as threatened. Six ESUs have been determined as unwarranted for listing. Two of these six ESUs, the Wenatchee and Okanogan sockeye salmon, represent rapidly declining stocks. A large and growing colony of Caspian terns has located in the Columbia River estuary and is consuming millions of salmonid smolts, including listed stocks. Terns nesting on Rice Island consumed a greater percentage of salmonids in their diet than do terns nesting on East Sand Island. Terns have been successfully relocated to East Sand Island; however, habitat must be maintained for terns to remain nesting there. The management option to implement hazing at Rice Island, Miller Sands Spit and Pillar Rock remains necessary to prevent terns from nesting at these islands.

Background: Presence of Caspian Terns in the Pacific Coastal States

That Caspian terns nested in the Pacific Coast states was not confirmed until 1899, though they were suspected of nesting there in the late 1800's. Nesting was first reported at Tule Lake in California (Bailey 1902 IN Gill and Mewaldt 1983, hereafter referred to as G&M 1983). They were reported among gulls at Lower Klamath Lake, Oregon by Finley (1907 IN Ibid.). By the 1930's, Caspian terns were reported or suspected in several locations in California (Sacramento Valley, San Joaquin Valley, Goose Lake, San Francisco Bay and the Salton Sea), Baja California and southeastern Oregon (G&M 1983). Colonies tended to be small, but increasing: for example, the colony in San Francisco Bay increased from 150 pairs to 400 pairs between 1926 and 1943 (DeGroot 1931 and Miller 1943 IN G&M 1983).

A major expansion began in the Pacific Coast population in the early 1940's. Birds began nesting in Nevada, San Diego Bay and on dredged material disposal islands in coastal Washington (numerous citations IN G&M 1983). In the 1950's, populations declined at Salton Sea and Sacramento-San Juaquin Valley locations while new colonies were discovered in Humboldt Bay and Moss Landing, California in 1970. Populations underwent another expansion period in San Francisco Bay and Grays Harbor and Willapa Bay, Washington, in the 1960's and 1970's (numerous citations IN G&M 1983).

In 1980, there were about 6,000 pairs of Caspian terns nesting in 24 colonies at 20 sites along the Pacific Coast (G&M 1983) No nesting colony is known to be reported prior to 1984 in the Columbia River estuary: the colony reported by Thompson and Tabor, 1981, was on Three Mile

Canyon Island in the John Day Pool. That colony had 184 pairs in 1977 and 210 in 1978 (Thompson and Tabor 1981) and had 275 pairs in 2000 (Table 4).

From 1960 to 1980 the Pacific Coast Caspian tern population increased almost 74 percent, from 3,500 to 6,000 breeding pairs, with an average annual growth of 2.7 percent. A fledging rate of 0.64 young per breeding pair is necessary for this recruitment level, a rate which is within the range of fledging rates (0.61 to 1.61) reported previously for this species (numerous citations IN G&M 1983). The current estimate for the Pacific Coast population in 2002 stands at 13,500 pairs (see Table 3). About 74 percent (9,900) of the total population nested in the Columbia River estuary, whereas none of the 1960-1980 population (or prior years' populations as far as is known) nested in the Columbia River estuary.

Since the mid-1960's, the tern population shifted northward from California, with the largest breeding concentration being along coastal Washington until the mid-1980's, when the population began to concentrate in the Columbia River estuary. Loss of preferred habitat in Grays Harbor (erosion of islands, vegetation of sandy areas, increased predation), coupled with ideal habitat in the Columbia River estuary (open sandy areas, copious food supply), probably led to this relocation. About 26 percent (3,600 pairs) of Pacific Region colonies still breeds elsewhere, primarily in California (Table 3). The northward trend is continuing, however, with a few nesting pairs reported on a small island off the Yukon Delta, in the Bering Sea, Alaska in 1996-97 (B.J. McCaffery *et al.* 1977) and at the head of Taku Inlet in southeastern Alaska in 2000 (D. Roby 2000, pers. comm.). The USFWS (2002) has prepared a status assessment on the Caspian tern which summarizes historic and current distribution, population trends, and conservation recommendations for the species (Shuford and Craig 2002).

While some habitat has been lost, other habitat remains apparently available and underutilized. Why the terns appeared in California in the 1890's, why they began moving north in the 1960's, and why present habitat outside the Columbia River estuary remain apparently underutilized is not fully understood. (The USFWS' upcoming report on "A Prliminary Assessment of Alternative Nesting Sites for Columbia River Terns" will address this issue.) What is clear is that the Pacific Coast population has increased dramatically since 1960 and continues to expand into areas it was not known to have colonized prior to 1984, with the subsequent consumption of millions of Columbia/Snake River salmonid smolts. Although relatively stable from 1998 to 2001 (i.e,. 8,700 to 9,100 breeding pairs), the number of nesting terns in the Columbia River estuary increased in 2002 (i.e., 9,900 breeding pairs).

<u>Present Caspian Tern Colony Salmonid Predation in the Columbia River Estuary:</u>

(The following information has been excerpted from *Caspian Tern Predation on Salmon and Steelhead Smolts in the Columbia River Estuary*. NOAA Fisheries, Portland, Oregon, September 26, 2002.)

> "The ecosystems inhabited by anadromous salmonids is extensive and complex. In the case of upper Columbia River and Snake River salmon and steelhead, their range extends inland as far as 1500 km and rise to elevations of 2500 m above mean sea level. Their oceanic range extends through the North Pacific Ocean to the Bering Sea and the Sea of Japan. Climate conditions and human activities have had adverse affects on water flows, river conditions, spawning and rearing

habitat, ocean productivity, and eventually, salmonid survival and productivity. Wild and naturally reproducing stocks of steelhead have declined dramatically in the interior Columbia River Basin (Lee et al. 1997). Wild and naturally reproducing spring- and summer-run chinook stocks also have declined dramatically throughout the Pacific Northwest. As a result, nearly every population of naturally producing anadromous salmonids in the Columbia River Basin is now listed (or is a candidate for listing) under the Endangered Species Act (ESA). Salmon experience high mortality rates as juveniles in freshwater, the estuary and early ocean, leading researchers to suggest that reducing mortality during the juvenile stage has the potential to increase population growth rates (Kareiva et al. 2000). Although significant mortality of juvenile salmon and steelhead occur in the ocean, our ability to influence ocean survival is limited. Therefore, improvements in freshwater survival and production are imperative and can directly affect the number of returning adult salmon and steelhead (Raymond 1988, Beamesderfer et al. 1996).

Increasing populations of piscivorous birds (primarily Caspian terns) nesting on islands in the Columbia River estuary annually consume large numbers of migrating juvenile salmonids (Roby et al. 1998) and thus constitute one of the factors that currently limit salmonid stock recovery (Roby et al. 1998; Independent Multidisciplinary Science Team 1998; Johnson et al. 1999). Therefore, reducing Caspian tern predation in the estuary, is one potential mechanism to reduce mortality, thereby increasing population growth rates of Endangered Species Act (ESA) listed salmonid Evolutionarily Significant Units (ESUs) in the Columbia River Basin.

Two approaches have been taken to evaluate the extent of salmonid mortality resulting from Caspian tern predation. Since 1997, biologists with the BPA funded research project ("Avian Predation on Juvenile Salmonids in the Lower Columbia River," -a joint project of OSU, U.S. Geological Survey, CRlTFC, and Real Time Research Consultants) have observed salmonid consumption at tern colony sites and utilized a bioenergetics model to provide estimates of mortality. The second approach is analyses of the number of passive integrated transponders (PIT) tags detected on the tern colonies to estimate salmonid predation rates by ESU (Collis et al. 2001b, Ryan et al. 2001). These analytical approaches indicate that salmon and steelhead constituted a major portion of tern diets when the birds nested on Rice Island. For example, diet analysis in 1997 and 1998 indicated that 77.1 % and 72.7%, respectively, of prey items consumed by Caspian terns nesting on Rice Island were juvenile salmonids (Collis et al. 2002). During the peak of smolt out-migration through the estuary for yearling chinook salmon, coho salmon and steelhead, which coincides with the tern incubation period in May, the diet of Caspian terns was consistently over 90% juvenile salmonids (Collis et al. 2002). This concentration on smolts as a food source translates into substantial juvenile mortality during the outmigration period. Roby et al. (In Review) used a bioenergetics model to estimate that in 1998, Caspian terns nesting on Rice Island consumed about 11.2 million juvenile salmonids. Best estimates of smolts consumed since 1997 are listed in Table 1 [see Table 1 below]. A description of

the bioenergetics model used to develop the estimate may be found in Roby et al. (1998).

In 1997 and 1998, between one and two million salmonid smolts listed under the ESA entered the Columbia River estuary. This represented about one or two percent of the total of all salmonid smolts estimated to be migrating to the estuary. However, in 1999, seven more ESUs of anadromous salmonids in the Columbia River Basin were listed, and roughly 6 million listed smolts entered the estuary along with over 80 million unlisted smolts (primarily of hatchery origin). The majority of juvenile salmonids in the estuary are of hatchery origin and the majority being consumed by Caspian terns are hatchery fish (Independent Multidisciplinary Science Team 1998). Overall, Caspian terns consumed approximately 6% to 14% of the estimated out migrating population of juvenile salmonids originating from the Columbia River basin.

Since 1987, researchers in the Columbia River Basin have placed over five million PIT tags in juvenile salmonids for various studies (Ryan et al. 2001). Identifying PIT tags on Rice and East Sand Islands can provide a minimum estimate of proportion of the stocks that were consumed by terns in these colonies. In recent years, approximately one million juvenile salmonids have been PIT tagged annually (Collis et al. 2001b). The vast majority of PIT-tagged juvenile salmonids are from Snake River ESUs, primarily steelhead and chinook.Using tag detection equipment, over 115,000 PIT tags were detected on Rice Island in 1998 and 1999 (Ryan et al. 2001). Collis et al. (2001b) indicate that the majority of these PIT tags detected were from chinook, coho and sockeye salmon, and steelhead. Of the PIT tags placed in steelhead smolts in 1997 that were detected at Bonneville dam, 2.8% of wild smolts and 5.4% of hatchery-raised smolts were subsequently detected on the Rice Island tern colony (Collis et al. 2001b). For those steelhead PIT-tagged in 1998 and detected at Bonneville Dam, 11.7% of wild smolts and 13.4% of hatchery-raised smolts were subsequently detected on the Rice Island tern colony (Collis et al. 2001b). For yearling chinook salmon PIT-tagged in 1998 and detected at Bonneville Dam, 0.5% of wild smolts and 1.6% of hatchery-raised smolts were subsequently detected on the Rice Island tern colony (Collis et al. 200lb). Ryan et al. (2002 in review), analyzing PIT tag data from 1998 to 2000 on Rice Island and East Sand Island, determined that steelhead experienced higher predation rates (0.6% to 8.1% on East Sand Island and 1.3% to 9.4% on Rice Island) than chinook salmon (0.2% to 2.0% on East Sand Island and 0.6% to 1.6% on Rice Island). Additional PIT tag data from East Sand Island in 2001 and 2002 has yet to be analyzed. This data should provide a better evaluation of any changes in predation rates that may have been realized by relocating the colony to East Sand Island.

There are some important uncertainties and findings derived from estimating predation rates of salmon by Caspian terns. First, predation impacts derived from PIT tags (although a more direct measure of predation than that derived from a bioenergetic model) represent a minimum estimate of proportion of the stocks that were consumed because an unknown number of tags are regurgitated or defecated off the colony site, wind and water erosion removes an unknown number, some

tags may have been damaged and not detectable by the equipment, and not all tags are detected (Ryan et al. 2001, Collis et al. 2001b, Collis et al. 2002). Secondly, predation rates vary annually and by the methodology used to make the estimate, making it difficult to derive a single predation rate. Although there is good correspondence of predation rates between methodological estimates, utilizing the upper and lower bounds of the predation rates to bracket potential recovery improvements represent the most reliable approach that currently should be used to assess potential impacts of smolt predation by Caspian terns. Finally, it is clear that predation rates are not uniform for all salmon species, thus evaluation of the impact of Caspian tern predation should be salmon species specific, to the extent possible.

NOAA Fisheries has developed a life cycle model--under the auspices of the Cumulative Risk Initiative at the Northwest Fisheries Science Center--to assess salmonid population trends and the impact of an anthropogenic activity on those trends (Appendix I). This model has application when mortality rates can be constructed and attributed to a particular activity. The value of life cycle models derive from providing an objective outcome for comparing the influence of various factors influencing population growth rates, rather than attempting to estimate real gains from any management action. Assessing the impact of predation by Caspian terns on juvenile salmonids during a particular life history phase is amenable to such an evaluation. [See NMFS 2002 for further discussion of life cycle model.]"

Table 1. Estimates of juvenile salmonids (in millions) consumed by Caspian terns in the Columbia River estuary 1997-2002* and numbers reaching the estuary**

Year	Number of Smolts Estimated Consumed (95% confidence interval in parentheses)	Estimated number of smolts migrating to the estuary
1997	7.48 (5.36 – 9.6)	57.5
1998	11.2 (8.3 – 14.2)	116.9
1999	11.7 (9.4 – 14.0)	86.3
2000	7.3 (6.1 – 8.6)	117.3
2001	5.9 (4.7 – 7.0)	96.3
2002	5.45 (5.5 – 7.6)	126.5 (predicted)

*Collis, K. et al. 2001a, and Columbia Bird Research 2002. (See also Table 4)

** Data from NOAA Fisheries Fish Ecology Division and Fish Passage Center. Predicted values for 2002 from a memo from Michael Schiewe, Director NMFS/NWR Fish Ecology Division to Donna Darm, NMFS-NWR Assistant Regional Administrator for Protected Resources, March 28, 2002)

(This table appears as Table 1 in NMFS 2002. It has been altered to add data from 2002. Minor differences between this table and Table 4 are due to refinement of data.)

The peak migration period of juvenile salmonids coincides with the nesting and rearing season of the terns. Additionally, Rice Island is located near the furthest upstream intrusion of salt water into the estuary. Smolts may delay before entering salt water or may move into the fresh water

lens that "floats" on the denser saltwater. Estimates in 1997 and 1998 were that the tern colony consisted of about 7,200 and 8,700 nesting pairs of birds, respectively. In 1999, the tern colony on Rice Island was about 8,300 nesting pairs, with 1,400 pairs diverted to East Sand Island. In 1999, salmonids comprised 77 percent of the diet composition of Caspian terns nesting at Rice Island whereas salmonids only represented 46 percent of the diet by prey item at East Sand Island. In 2000, the colony consisted of about 8,500 breeding pairs of terns on East Sand Island and 590 pairs on Rice Island. Diet of those terns nesting at Rice Island was 90 percent salmonids, while that of East Sand Island terns was 47 percent salmonids. The pilot project and the 2000 management efforts demonstrate that it is possible to shift nesting terns en masse to a different colony site and that their harvest of juvenile salmonids can be reduced by moving them to sites nearer the ocean where other prey species are available. Compared to the estimate of total consumption of juvenile salmonids in 1998 (12.4 million), when all Caspian terns nested on Rice Island, consumption of juvenile salmonids by all Caspian terns nesting in the Columbia River estuary was lower by approximately 41 percent, 52 percent and 48 percent in 2000, 2001 and 2002, respectively. This decline in losses of juvenile salmonids to Caspian tern predation coincided with the shift of breeding terns from Rice Island to East Sand Island.

Resource agencies, including the NMFS, Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), Columbia River Inter-Tribal Fish Commission and Idaho Department of Fish and Game (IDFG), are concerned that the observed level of predation remains injurious to species and stocks of salmonids listed under the Endangered Species Act.

Certain listed stocks have been incorporated into the hatchery program to facilitate Columbia River salmonid recovery efforts. Some Upper Columbia River steelhead, nearly all Snake River sockeye, many Snake River spring-summer chinook and some Snake River fall chinook now originate from hatcheries. The hatchery components as well as the wild stocks are ESA listed. Some lower Columbia River summer and winter steelhead (Kalama, Sandy and Clackamas River) originate from hatcheries and are ESA listed. Cowlitz River re-introductions of winter steelhead and spring chinook are ESA listed. Hatchery chums (Grays and Elochoman River) are also ESA proposed stocks. Hatchery fish remain an important component of Columbia River salmonid recovery efforts.

Tens of thousands of PIT tags have been recovered from bird colonies in the estuary. Based on PIT tag recoveries on Rice Island, Caspian terns consume a higher proportion of available hatchery-raised smolts versus wild smolts in the Columbia River estuary, for some stocks in some years. PIT-tagged hatchery-reared steelhead in 1997 and spring/summer chinook in 1998 were over-represented on colony as compared with their wild counterparts. Double-crested cormorants, however, foraged on hatchery and wild smolts in proportion to their availability in the estuary (Collis *et al.*, 2001). These data suggest that some hatchery smolts may be more surface oriented as compared to wild fish and therefore more susceptible to tern predation (i.e., terns forage at or near the surface, while cormorants forage throughout the water column).

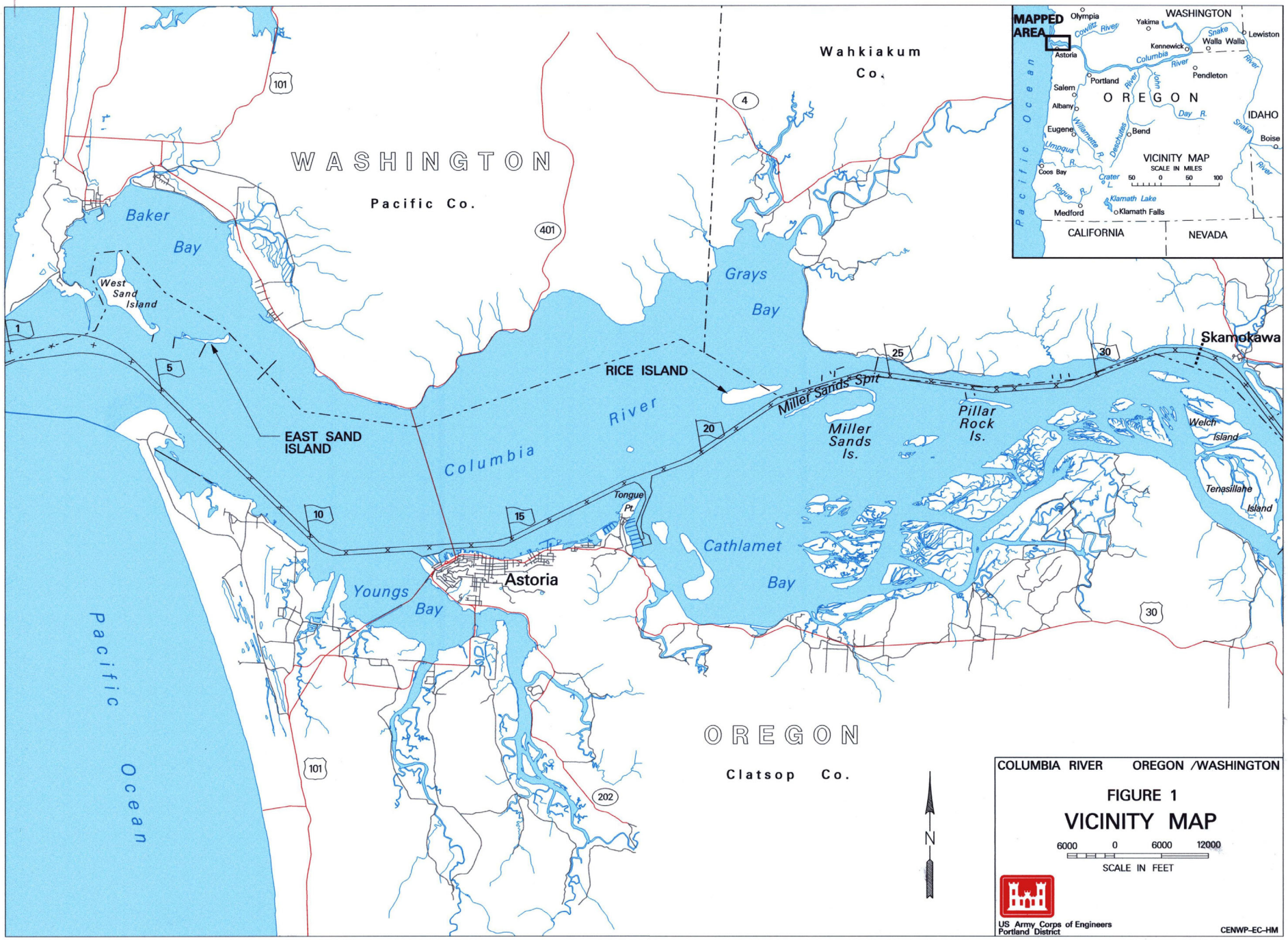
Retention of the former Caspian tern colony on East Sand Island (closer to the mouth of the Columbia River) and eventual restoration to other historic nesting locations, has expanded the diversity of prey species available for terns, thus reducing predation on salmonids. An increased geographical distribution of Caspian terns also reduces the risk of catastrophic loss for Caspian

terns to storms, oil spills, disease, etc. A wide geographical distribution of Caspian terns would represent a return to historic distribution of the species.

PROPOSED ACTION and ALTERNATIVES

The proposed Caspian tern management actions for 2003-2004 result from the settlement agreed to in April 2002. (see above). Actions occur primarily on East Sand Island in the Columbia River estuary. (Figure 1)

As agreed to in the settlement, the Corps will provide a minimum of 6 acres of suitable habitat on East Sand Island and encourage terns to nest there by active and passive harassment of terns trying to nest on Rice Island, Miller Sands Spit and Pillar Rock. Decoys and a sound system



COLUMBIA RIVER OREGON /WASHINGTON

FIGURE 1

VICINITY MAP

6000 0 6000 12000

SCALE IN FEET

US Army Corps of Engineers
Portland District

CENWP-EC-HM

playing tern calls will continue at East Sand Island to attract terns, and predator control will continue as needed. These actions are proposed for a 2-year period, 2003-2004, pending completion of a management plan and EIS by the USFWS by February 2005. The Corps will also maintain existing cormorant excluders, installed on pile dikes in 2000/2002. (see Table 2)

Present Proposed Action

The presently proposed action covers interim measures described in the April 2002 court settlement. These measures apply through the 2003 Caspian tern breeding seasnon, after which a Caspian tern management plan, developed by the USFWS, will be used to direct long-term management of Caspian terns in the Columbia River estuary. A Caspian tern management plan, developed by the USFWS, will be used to direct long-term management of Caspian terns in the Columbia River estuary. The settlement agreed upon plan/EIS is to be finalized by February 2005. Actions to establish this area of suitable habitat and to control predators are to be implemented annually through the 2004 tern breeding season and may be modified thereafter according to the terms of the completed EIS and Record of Decision.

Table 2- Action Matrix

Proposed Action	Rice Island	Miller Sands/Pillar	East Sand Island
Nesting Habitat Development and/or Maintenance – Tillage, Herbicides and Use of Social Attractions (Decoys and Recorded Calls).	Not Applicable	Not Applicable	Objective: Maintain Caspian Tern Colony. Action: Till 6 acres or more at u/s tip of island to provide suitable nesting habitat for Caspian terns; lure them to site. Implementation of tillage in winter; decoys/recorded calls begin late March. Management of predators occurs in spring, if deemed necessary.
Human Disturbance, silt fencing, plastic sheeting, application of adaptive management techniques to disperse Caspian terns.	Probable timeframe April 1-egg laying. Objective: Preclude tern nesting. Action: Maintain silt fencing or other features on entire 8-acre nesting site.	Harassment as necessary	Adaptive management measures may be employed, e.g., predator control activities. Research activities would continue.

To maintain the colony presence at East Sand Island, suitable nesting habitat, in conjunction with social attraction measures (e.g., decoys, recorded tern calls), will be employed. Habitat management actions at East Sand Island would entail annual preparation of 6 acres of bare sand and silty sand at the upstream tip of the island. The objective is to maintain a bare sand environment suitable for nesting Caspian terns. Six acres were prepared for tern nesting in early

April 2002. Vegetation, primarily European beachgrass, American dunegrass and various herbaceous species, was tilled and/or bulldozed off the site. A heavy drag harrow was utilized to level the 6-acre site. Sand was also brought onto the site with a front-end loader. These are typical efforts for annual control of vegetative development on the site. In addition to vegetation management, sand lost to erosive winds will be replaced. For 2003, an estimated 3,200 cubic yards of sand will be removed from the beach by track hoe and trucked to the nesting site to replace sand and maintain the 6 acres in suitable condition.

In 2000, about 8,500 pairs of Caspian terns nested on the bare sand habitat that was provided on East Sand Island, and the terns used 3.4 acres of the 4 acres of available habitat. In 2001, about 9,000 pairs nested on 3.9 acres, and in 2002, about 9,900 pairs nested on 4.5 acres. (The periphery of the additional 2 acres of buffer was less desirable for nesting due to silty substrate, revegetation, wetness and adjacent gulls.) Colony area was measured using high-resolution aerial photographs taken near the end of the incubation period.) The density of active nests on East Sand Island in 2000 (0.62 nests/m^2) was intermediate between the nesting density at East Sand Island in 1999 (0.26 nests/m^2) and the nesting density on Rice Island in 1999 (0.78 nests/m^2), when colony area on Rice Island had been restricted by managers. The nesting density at Rice Island in 2000 (0.25 nests/m^2) was lower than has been recorded previously in the Columbia River estuary. Nesting density on East Sand Island was 0.57 in 2001 and 0.55 in 2002.

Nesting success of Caspian terns on East Sand Island during the 1999 and 2000 breeding seasons indicates that the East Sand Island colony is a suitable site for a large Caspian tern colony, at least in the short-term. In 1999, when 1,400 pairs of terns nested on East Sand Island, productivity averaged 1.20 young terns raised per nesting pair. In 2000, when the East Sand Island tern colony had increased to 8,500 pairs, productivity averaged 0.57 young terns raised per nesting pair. The lower productivity of the East Sand Island colony in 2000 compared to 1999 resulted in part from a severe storm that caused extensive mortality of young tern chicks (>1,000 deaths) on June 11, 2000, and perhaps the much larger size of the colony and associated increase in density-dependent mortality among older tern chicks. In comparison, the productivity of the Rice Island tern colony averaged 0.55 young raised per nesting pair in 1999 and only 0.15 young raised per nesting pair in 2000. The low productivity of terns nesting at the Rice Island colony in 2000 was a consequence of both the small colony size (590 pairs) and the large number of predatory gulls that nested in the vicinity of the Rice Island tern colony. Nesting success in 2001 and 2002, when all terns were nesting on East Sand Island, was 1.39 and 1.08 fledglings per breeding pair, respectively; with over 10,000 fledglings produced in each year. Although a 1.08 nesting success is still exceptional for tern species the lower nesting success in 2002 may be due to less availability of marine forage fish (supported by an increase in average duration of tern foraging trips in 2002 as compared to 2001, attributable to changes in marine upwelling) and a severe late June storm which caused flooding of portions of the nest area. Gull predation may also have been higher than in 2001. (Columbia Bird Research 2002)

In 2003-2004, nesting habitat management actions would include disking and tillage, possibly after application of herbicide, to remove vegetation. Sand would be added to compensate for erosion. This action would occur both years, as necessary. Decoys and a sound system to play back recordings of Caspian tern colony calls would be placed at the constructed nesting site to attract terns. Maintenance actions for 6 acres of tern habitat at East Sand Island are to be conducted by the Corps. Management of nest predators, if necessary, would be accomplished by researchers or the appropriate resource management agency (e.g., USDA - Wildlife Services).

The Corps' planned action on Rice, Miller Sands Spit and Pillar Rock islands includes active harassment of terns, if necessary to dissuade terns from nesting activities. Active harassment would likely reduce the number of terns attempting to nest, but would not necessarily eliminate all nesting activities. Habitat alteration, such as modifying potential nesting sites at Rice Island that are unvegetated with silt fences or flagging to establish conditions not conducive to tern nesting (i.e., passive harassment) may also be used. Almost the entire former colony area on Rice is now vegetated. However, due to the ample supply of unvegetated dredge material on Rice Island, habitat modification may not completely prevent nesting on Rice Island. Therefore, in addition to passive harassment, the Corps proposes active harassment of terns at Rice and other dredge material islands in the upper estuary (i.e., Miller Sands Spit and Pillar Rock) until egg-laying begins. The proposed action will primarily consist of passive harassment, but active harassment is also included but will only be implemented if necessary.

Human intrusion into areas and habitats not used by Caspian terns would be minimized to the extent practicable in order to avoid disturbance to other wildlife, including bald eagles, shorebirds, and waterfowl, including nesting Canada geese. Caspian terns typically occur in open sandy uplands and/or on beaches. Thus it is not necessary, typically, for personnel to enter vegetated habitats. Under the Migratory Bird Treaty Act (MBTA), take of migratory birds is regulated by the USFWS. MBTA permits are not required to conduct non-lethal harassment. The USFWS regulations contain requirements for lethal take of migratory birds. The Corps' action will be consistent with the Migratory Bird Treaty Act (MBTA). Since all passive/active harassment actions would cease as soon as egg-laying begins, no MBTA permit is required. If researchers intend to continue banding efforts, they will be responsible for obtaining the required permits for this activity. An EA on these research activities was prepared by Bonneville Power Administration and updated in 2002 by a Supplemental Analysis. If lethal take of gulls is necessary, the responding agency/organization would obtain MBTA permits.

Monitoring will be conducted to document tern distribution, dispersal, reproductive success and diet composition for future management decisions. Intensive monitoring and evaluation of Caspian tern nesting success and consumption of salmonids would occur in Oregon through an on-going research effort conducted by OSU-CRITFC-RTR. Monitoring at other nesting sites may occur, depending on several factors, such as location and ownership, and funding.

Habitat modification at East Sand Island would be accomplished by the Corps in conjunction with USFWS and ODFW. Researchers associated with OSU-CRITFC-RTR would be responsible for placement of decoys and sound devices and their implementation at East Sand Island. Discouragement of Caspian tern nesting would occur at Rice Island, Miller Sands Spit and Pillar Rock, and would be accomplished via contract.

Excluders placed on pile dikes to preclude cormorant perching would be maintained as needed Maintenance would be accomplished by contract.

<u>Alternatives</u>

One alternative to the proposed action is no action. Given the natural re-vegetation of the cleared site on East Sand Island, and the strong history of nesting on Rice Island, "no action" would probably result in the return of most of the terns to nest at Rice Island, with concomitant high

levels of predation on salmonids. Given the habitat modification (flagging, natural vegetation growth) at the former nesting site, many terns will likely not find suitable nesting in their former area. However, there are ample off-colony areas on Rice Island where terns might nest. Given that the proposed action is directed under a court-approved settlement agreement, the alternative of no action is not feasible.

Other Related Actions

Under the April 2002 settlement, the Corps may resume deposition of dredged material on Rice, Miller Sands and Pillar Rock Islands (impacts of dredged material disposal have been addressed in previous EISs). A joint recommendation from USFWS and the Corps regarding the future ownership of East Sand Island and funding for its management is due no later than March 1, 2003. Scientific research to monitor and assess Caspian tern and cormorant diet may continue. Three technical reports are to be prepared by Federal and State agencies, and a management plan/EIS is to be prepared by USFWS in cooperation with NMFS and the Corps, with the recommended alternative initiated by March 2005. The USFWS' Assessment and Status Report was finalized in August 2002. The NMFS's report on Caspian tern predation on salmon in the Columbia River estuary was finalized in September 2002. The third report, a USFWS feasibility study of potential Caspian tern nesting sites in the Pacific Northwest, is under preparation.

AFFECTED ENVIRONMENT

Overview: Caspian Tern and Cormorant Populations

(The following description is excerpted from Collis *et al.* 1999, pp. 61-65, with data from the Final 2000 Season Summary (Columbia Bird Research 2000) and Final 2001 Season Summary (Columbia Bird Research 2001) inserted in brackets.)

"The Caspian tern colony on Rice Island, a dredged material disposal island in the Columbia River estuary, is currently the largest of its kind in North America (about 8,000 nesting pairs), and perhaps the world (Cuthbert and Wires 1999). This colony has increased by over 600% since 1986, when nesting by Caspian terns on Rice Island was first discovered (G. Dorsey, USACE, pers. comm.); annual growth in the tern colony is currently about 15 – 20% [i.e., from 1986 to 1998]. The colony has apparently expanded at the expense of other Caspian tern colonies formerly located in Grays Harbor, Willapa Bay, and northern Puget Sound, as well as East Sand Island near the mouth of the Columbia River. [In 2000, this colony had increased to about 9,100 breeding pairs, with the majority (8,500) nesting on East Sand Island, and 590 nesting on Rice Island.]

Breeding colonies of Caspian terns were not recorded for coastal Washington and Oregon until the late 1950s. During the first half of this century Caspian terns were known as a breeding species in the Pacific Northwest only from inland lakes, marshes, and impoundments (Gill and Mewaldt 1983). The first breeding record on the coast was a small colony discovered on Goose Island, Grays Harbor, Washington in 1957 (Alcorn 1958). This colony peaked in size at about 1,000 pairs in 1973, and had been abandoned by 1976 (Speich and Wahl 1989; E. Cummins, WDFW, unpubl. data). Beginning in 1974, a Caspian tern colony became established on Whitcomb Island, also in Grays Harbor, that increased in size to 1,240 pairs by 1976, but this colony was abandoned by 1981. Beginning in 1976, Sand Island, another island in Grays Harbor, was used by nesting Caspian terns. By 1981 over 2,000 pairs were nesting on Sand Island, the largest known Caspian tern colony anywhere along the Pacific Coast of North America (Gill and Mewaldt 1983). In 1984 the number of nesting pairs was estimated at over 2,775, but this colony in turn disappeared by 1993 (J. Smith, WDFW, pers. comm.). During the 1990s there has been no confirmed successful nesting by Caspian terns in Grays Harbor, although nesting attempts by small numbers of terns have been noted (M. Zahn, WDFW, unpubl. data).

In 1976 several hundred pairs of Caspian terns were discovered nesting on Gunpowder Island, near the mouth of Willapa Bay, Washington. By 1982 the Gunpowder Island tern colony had peaked at about 1,500 nesting pairs

(Speich and Wahl 1989). Thereafter the Gunpowder Island colony declined, and the last confirmed nesting was by about 150 pairs in 1989 (E. Cummins, WDFW, unpubl. data).

In 1984 a colony of about 1,000 pairs of Caspian terns was noted breeding on East Sand Island in the Columbia River estuary (G. Dorsey, USACE, pers. comm.). This was apparently the first nesting record for Caspian terns anywhere in the Columbia River estuary. By 1987 the colony on East Sand Island had been abandoned, and all breeding pairs had apparently shifted to Rice Island, a large, sandy dredge disposal island 21 km further up-river.

The Rice Island Caspian tern colony increased rapidly from the initial estimate of 1,000 pairs in 1986 to about 6,200 pairs in 1991 (A. Clark, USFWS, pers. comm.). The [population estimate in 1998] of about [8,700] nesting pairs at the Rice Island colony is larger than the estimate of the entire Pacific Coast population of Caspian terns 15 years ago (Gill and Mewaldt 1983). The initial rapid buildup of this colony in the late 1980s and early 1990s apparently was due to shifting of breeding pairs from Sand Island in Grays Harbor, Gunpowder Island in Willapa Bay, and East Sand Island near the mouth of the Columbia River to the single large colony at Rice Island. After 1991 colony growth appeared to slow, but there was a substantial jump in the size of the Rice Island tern colony between 1995 and 1996 (Fig. 4). This increase coincided with the reported demise of a large Caspian tern colony (ca. 1,500 – 3,000 pairs) in northern Puget Sound, on the grounds of the U.S. Naval Base at Everett, WA (G. Dorsey, USACE, pers. comm.). Although details are sketchy, this colony was apparently precluded from using the former colony site in 1995 by new construction on-site. There are no subsequent reports of Caspian terns nesting in the northern Puget Sound area. This suggests that the Everett Caspian tern colony was subsumed in the Rice Island colony during the 1996 breeding season.

Other than the Rice Island colony, there were no confirmed Caspian tern breeding colonies along the coast of Washington or Oregon in 1998. Nesting was suspected, however, at a mainland site on the shores of Commencement Bay, southern Puget Sound, near Tacoma, Washington (M. Tirhi, WDFW, pers. comm.). The site is fenced off because of heavy metal contamination, and is slated for soil removal and remediation as an EPA superfund site in 1999. This site should be closely monitored to ascertain whether nesting occurs. [In 2000, between 800 and 1,000 pairs of Caspian terns nested at the Asarco superfund site on Commencement Bay.]

Some evidence from band returns supports our interpretation of the origins of the Rice Island Caspian tern colony. In 1997 and 1998, we collected a total of 10 banded adult Caspian terns on or adjacent to the Rice Island colony. All had been banded as young chicks on the Sand Island colony in Grays Harbor during the late 1970s or early 1980s. Washington Department of Fish and Wildlife banded approximately 500-1,500 Caspian tern chicks annually on Sand Island during this period (Gill and Mewaldt 1983, J. Smith, WDFW, pers. comm.). These banded adults were 17 (N = 2), 18 (N = 1), 19 (N = 3), 20 (N = 1), and 21 (N = 3) years-old at the time that they were collected on Rice Island. The number of banded adults (N = 5) in the sample of randomly collected adults for diet composition analysis (N = 304) suggests that there were several hundred banded adults on the Rice Island colony in 1997 and 1998.

In summary, the history of the Caspian tern breeding population along the Washington and Oregon coasts has been a short one (ca. 40 years) of rapid expansion, low philopatry (nest site fidelity), and large colony sizes compared with other areas of North America. This is part of a general trend for Pacific Coast Caspian terns of (1) shifting breeding colonies from inland, natural sites to coastal anthropogenic sites (dredged material disposal islands), (2) shifting from nesting in small groups within larger colonies of gulls to nesting in large, single-species colonies, (3) dramatic overall population increase, and (4) rapid northward range expansion.

Both bald eagles and glaucous-winged/western gulls have apparently played roles in the demise of former Caspian tern colonies on islands in Grays Harbor and Willapa Bay. The history of short-lived colonies and shifting breeding sites, plus observations of increasing gull and eagle disturbance at former Caspian tern colonies (J. Smith, WDFW, pers. comm.), suggests that low nest site fidelity may be related to the gradual build-up of predator populations once a colony is established. Predation by gulls and eagles is not the sole explanation, however, because some colonies have been lost primarily due to habitat degradation and loss. Caspian terns prefer to nest on bare or sparsely vegetated sand, so colony sites are frequently situated where sand accretion and erosion are persistent processes that maintain unvegetated substrate. Such sites can be washed away during winter storm tides, leaving no area above high spring tides. This was a major factor in the demise of the Gunpowder Island colony in Willapa Bay and the Whitcomb Island colony in Grays Harbor. Finally, Caspian tern colonies that become established on dredged material are usually constrained by encroaching vegetation within a few years of dredged material deposition. The

demise of the East Sand Island tern colony after 1984 has been attributed to vegetation succession, combined with aerial seeding by the U.S. Army Corps of Engineers. ...

The estuary-wide population of double-crested cormorants increased in 1998 by an estimated [14 percent] over 1997. This population trend is part of a continuing expansion of populations of double-crested cormorants along the Pacific coast (recently reviewed by Carter *et al.* 1995) and throughout North America following persecution and habitat destruction in the late 1800's and early 1900's. But the dramatic increase in the size of the East Sand Island colony over the last decade is unparalleled elsewhere in the Pacific Northwest. The East Sand Island colony was first discovered in 1987 and in 1989 there were 91 active nests (D. Bell, pers. comm. to R. Lowe, USFWS) at the site that supported about 5,250 nesting pairs during the 1998 breeding season. Thus the population of double-crested cormorants in the Columbia River estuary, like the Caspian tern population, experienced rapid growth in the early 1990s. The cormorant colony on Rice Island was first noted in 1988, soon after Caspian terns colonized the site. Again, the rapid initial build-up of these breeding colonies indicates that breeders were recruited from other colonies. Unlike Caspian terns, however, no large colonies of double-crested cormorants along the coast of Washington or Oregon declined or disappeared concurrent with increases in the Columbia River estuary (Carter *et al.* 1995; R. Lowe, USFWS, pers. comm.). Instead, it appears that the rapid influx of double-crested cormorants to the estuary occurred at the expense of inland colonies (e.g., Malheur NWR), where large colonies were adversely affected by prolonged drought in the late 1980's and early 1990's, which resulted in a dramatic decline in forage fish availability (G. Ivey, USFWS, pers. comm.). The double-crested cormorant colonies at East Sand Island [ca. 5,500 pairs] and Rice Island (ca. 800 pairs) [were in 1998] the two largest known colonies of this species on the Pacific Coast of North America (Carter *et al.* 1995). [The Rice Island colony moved to East Sand Island in 1999 and 2000. This colony, estimated to be roughly 6,000 pairs in 1999, and about 6,600 in 2000, is the largest breeding colony of double-crested cormorants on the west coast of North America.] Furthermore, there have been recent dramatic increases in the number of glaucous-winged/western gulls in the Columbia River estuary. Since 1989, when 1,760 gulls were counted on East Sand Island (D. Bell, pers. comm. to R. Lowe, USFWS) the direct count of gulls on East Sand has increased by more than a factor of three by 1998. These data suggest that all populations of piscivorous colonial waterbirds have been increasing in the Columbia River estuary in the last decade."

Columbia River Estuary. The Columbia River estuary is 4 to 5 miles wide and extends upriver to around RM 38. There are various side channels in addition to the main channel. The main navigation channel is dredged annually by the Corps to maintain the presently authorized 40-foot-deep, 600-foot-wide navigation project. A north channel extends to about RM 20, near the downstream end of Rice Island. Wide, shallow intertidal and subtidal flats separate these two deep channels. Hydrology of the estuary is affected by downstream flows, which are regulated by the upriver system of dams, and ocean tides. Tidal influence extends upstream to Bonneville Dam, at RM 143. The salt wedge, however, penetrates upstream to about RM 23.

Islands in the estuary are typically intertidal in nature and most occur in Cathlamet Bay. Exceptions are East and West Sand Island in Baker Bay, Rice, Miller Sands Island and Spit and Pillar Rock (Jim Crow Sands) on the northern edge of Cathlamet Bay, and Puget and Tenasillahe Islands at the upstream end of the estuary. Rice, Miller Sands Island and Spit, and Pillar Rock were artificially created from sandy material dredged from the Columbia River navigation channel. The Columbia River, estuary and Pacific Ocean provide habitat for a variety of aquatic flora and fauna. Plants range from phytoplankton to tidal marsh plant communities. Animal life ranges from zooplankton to mammals. Large concentrations of waterfowl shorebirds and fish-eating birds are present. Of significance to this Environmental Assessment (EA) are the fish species fed upon by birds for which adaptive management is proposed to continue.

Fish. Estuarine habitats support a variety of anadromous and resident fish species. Anadromous fish are present in the river almost year-round, either as adults migrating upstream to spawn, or as juveniles, migrating downstream to the ocean or rearing in the estuary (fall chinook). Anadromous species include the following salmonids: spring, summer and fall run chinook; coho; sockeye; chum salmon; winter and summer run steelhead; searun cutthroat trout

and bull trout. Other anadromous species include green and white sturgeon, Columbia River smelt, American shad and lamprey.

Resident species remain in the river and estuary throughout their life cycles. Some resident species are northern pikeminnow, common carp, small and largemouth bass, yellow perch, peamouth, large-scale sucker and white crappie.

Marine fish occur in the ocean and the estuary. Dominant marine fish in the estuary include northern anchovy, Pacific herring, Pacific sand lance, Pacific staghorn sculpin, starry flounder, longfin smelt, surf smelt, whitebait smelt, Pacific tomcod, English sole, various species of surf perches, shiner perch, rockfish species, and sanddabs. Abundance of migratory populations (smelt, anchovy, etc.) can vary with changing ocean conditions. For instance, Columbia River smelt populations had decreased to very low levels during the El Niño years and then greatly increased in numbers when the El Niño event ended and cooler La Niña event began. Populations of residential species tend to be stable.

Run size of salmon in the river has been decreasing since the turn of the century. Further declines in wild salmon numbers in the early 1990's prompted the NMFS to list or propose for listing several Columbia Basin salmonids. Estimates, provided by NMFS, of numbers of smolts reaching the estuary in 1997-2002 are shown above in Table 2. The majority of the out-migrating smolts, and many of the returning adult salmonids, are hatchery fish that are produced to support important tribal, recreational and commercial fisheries, to mitigate for fish and habitat lost to the Federal Columbia River Power System (dams), and to restore threatened and endangered species. The majority of the remaining stocks of wild fish are ESA listed species. The exact proportion of wild to hatchery fish is not specifically known; however, many wild ESA stocks have been incorporated into the hatchery program.

Wildlife. There is a great diversity of wildlife in and around the estuary. These include marine mammals, furbearers, deer, numerous small mammals (including rodents), reptiles and amphibians. However, it is primarily birds that occur in the area, which could be affected by the proposed action. Three species of loons occur as spring and fall migrants and have been observed
in the estuary during the winter. Grebes occur in the estuary particularly in bays, during migration and in winter. Brown pelicans typically occur from mid-spring to late fall along the coast, with concentrations of nearly 11,000 birds at the mouth of the Columbia at South Jetty and East Sand Island-Baker Bay in recent years (S. Wright, Oregon State University, unpublished data). Pelicans have increased in numbers at East Sand Island (see below).

Double-crested, pelagic and Brandt's cormorants occur in the estuary and forage in estuary waters. Cormorants tend to perch on the numerous pile dikes in the estuary. Double-crested cormorants are the most numerous and occur year-round. East Sand Island supports a large nesting colony of double-crested cormorants. Rice Island also supported a large colony of cormorants; however, this colony apparently moved to East Sand Island in 1999 (Double-crested cormorants nested on Rice Island in 2001 [roughly 150 pairs] and 2002 [roughly 50 pairs]. Nine gull species commonly occur off the Oregon coast, and three others are known to occur. Gull colonies are located on East Sand Island, Rice Island and Miller Sands Spit and consist of glaucous-winged/western gull hybrids. Ring-billed gulls also nest on the Spit and East Sand Island. Three species of tern occur in the estuary or nearshore areas. Common and Arctic terns

occur off the coast in spring and fall, principally as migrants. Caspian terns are present from April to September and occupied a large breeding colony on the western end of Rice Island. The Caspian tern nesting population has grown from about 1,000 pairs in 1984 (on East Sand Island) to an estimated 9,900 pairs in the estuary in 2002. In 2000, about 8,500 breeding pairs nested on East Sand Island, and 590 pairs located on Rice Island. Most of the East Sand Island terns had previously nested on Rice Island. This colony currently represents the largest known Caspian tern colony in North America and perhaps the largest in the world and comprises about 74 percent of the Pacific Coast population. Relocation of nesting colonies has been a repeatedly observed behavior of Caspian terns along the Pacific Coast of North America (Gill and Mewaldt 1983).

Waterfowl are seasonally abundant. Agricultural lands along the river and intertidal marshes in the estuary provide substantial habitat along the lower river. Mallards, northern pintails, American wigeon, green-winged teal, Canada geese, and scaup are the most abundant wintering species. Mallards and Canada geese are the principal nesting species. Islands, particularly dredged material islands, are important nesting sites for the resident populations of Canada geese and mallards. Substantial numbers of wintering Canada geese use the estuary and adjacent pasturelands.

Raptors (hawks, owls) occur both as residents and/or wintering birds. Bald eagles are relatively abundant, with a relatively large breeding population supplemented by an influx of transient and wintering birds. Peregrine falcons are also present, as are several species of hawks and owls.

Many other nongame bird species occur throughout the estuary. Shorebirds are abundant during spring and fall migration with substantial numbers over-wintering in the estuary. Large concentrations of shorebirds use high tide roosts at the downstream tips of Rice Island and Miller Sands Spit. While riparian habitat is important to many of these nongame bird species, some prefer grassy uplands and others prefer dredged material disposal sites. Savannah and white-crowned sparrows and horned larks inhabit disposal sites where the open, sparsely vegetated terrain provides preferred nesting and foraging habitat.

Human Population. Except for the Cities of Astoria, Warrenton, Hammond, Chinook and Ilwaco, human population along the estuary is sparse. Astoria is the largest population center and sustains the only deep draft port on the Columbia River below RM 64. Clatsop County, Oregon, and Wahkiakum and Pacific County, Washington, all have relatively small populations and resource based manufacturing sectors. Forest and farmlands dominate lands adjacent to the estuary and lower river. Fishing, and fish related industry, is the primary economic base of some smaller communities such as Ilwaco and Chinook, Washington, and Warrenton, Oregon. Tribes also have economic and other interests in fish and fishing. Tribes had a long history in the estuary, and upriver tribes and their fishing economy are dependent today on the health of the estuary.

Sea Resources, a community non-profit organization that is presently involved in watershed restoration in Chinook, Washington, maintains a salmon hatchery at RM 4 on the Chinook River, a tributary to the Columbia River estuary. The hatchery is a tool to restore fish runs as part of a healthy watershed. About a million chinook, chum and coho are raised and released from the hatchery.

There are six Select Area Fisheries in the estuary. These are in Young's Bay (Oregon), Steamboat Slough (Washington), Tongue Point/South Channel (Oregon), Blind Slough/Knappa Slough (Oregon) and Deep River (Washington). Salmon are reared in net pens and released as juveniles. Returning adults are harvested near the release spot. The Youngs Bay fisheries were established as part of a Clatsop County Economic Development Council program. These and other estuary select area fishery efforts have ODFW and BPA involvement. Net pens at Tongue Point were recently moved to the former Corps' dock at South Tongue Point.

East Sand Island. East Sand Island, located near RM 5 of the Columbia River, was withdrawn from the public domain for military use in 1863, was utilized as a military observation post during World War II, and reassigned to the Corps in 1954. Over the years, accretion (some from dredged material disposal) and erosion have changed the size and shape of the island and caused it to shift in location north of its original position. Presently, the island mass is separated by a channel between West Sand Island and East Sand Island. The entire island mass remains within the State of Oregon, the State boundary following the channel separating the islands from Chinook and Ilwaco, Washington. (The islands remain in Oregon because of their origins on the south side of the historic Columbia River channel.) West Sand Island is occasionally used as a disposal area for maintenance dredging of material from Baker Bay's West Channel. Chinook Channel material, containing silts, has gone to East Sand Island, most recently in 1983. Pile dikes were built along the island beaches to control erosion and control the river at both islands. During the 1970's, West Sand Island was leased for cattle grazing, but this activity has not occurred since 1975. The only access to the islands is by boat. Minimal recreational activity occurs on these islands, principally camping, beach combing and waterfowl hunting. The islands are not managed for any activity other than dredged material disposal.
East Sand Island is presently about 6,000 feet long by 100 to 500 feet wide and contains about 53 acres of grass-covered sandy and silty soil. Dredged material has been disposed on the eastern end and southern side several times, the most recent in 1983. The disposal location, a diked upland site, has developed wetlands on a portion of the area and an alder forest on the upstream end. Tidal marsh flats are present along the bay side of the island. The eastern end of the island is covered with herbaceous vegetation, primarily European beach grass and some American dune grass. Coast willow and red alder are also present. Woody debris left by high river flows and tides occurs at the high tide line. Central and western portions of the East Sand Island have remnants of WW II era railroad and concrete "pill boxes." Any remaining cultural resources on the east end have been covered by dredged material.

Approximately 7,000 pairs of glaucous-winged/western gulls nest throughout East Sand Island. An estimated 300 pairs nested in the area at East Sand Island managed for tern nesting habitat prior to habitat management efforts in 1999 (Corps, 1999). Double-crested cormorants nest in a large colony on the downstream half of the island. This colony, estimated to be roughly 6,000 pairs in 1999, and about 6,600 in 2000, is the largest breeding colony of double-crested cormorants on the west coast of North America. There is also a small colony of 30 to 40 pairs of Brandt's cormorants nesting on the pile dike at the western end of East Sand Island. The western half of East Sand Island currently constitutes the largest brown pelican night roost site in the Pacific Northwest. OSU recorded 1,200 pelicans here in 1998, about 3,400 in 2000, and about 11,000 in 2002. Canada geese and mallard ducks nest to a limited extent in the project area. Nesting by Caspian terns in the Columbia River estuary was first observed in 1984 when approximately 1,100 pairs nested at East Sand Island. The 1984 colony location was within the diked disposal area used in 1983 for dredged material placement, approximately 350 feet

northwest of the pipeline outfall location. The colony location in 1985 was still within the diked disposal area, north of the 1984 location and west of the outfall location. The 1986 colony location at East Sand Island was outside the diked disposal area, in a low-lying area just above the beach and amongst the driftwood. Approximately 1,000 terns were reported nesting on Rice Island in 1986 and the entire colony relocated at Rice Island thereafter. Revegetation by native and exotic species within the diked disposal area apparently led to shifts in the colony location at East Sand Island and ultimately to the colony's shift to Rice Island.

Preferred nesting habitat in coastal Washington State apparently also was reduced over the past several decades through erosion, invasive vegetation overrunning newly accreted sand habitat, human alteration of nesting habitat (e.g., Everett Naval Base, ASARCO Industrial Site in Commencement Bay), and the rapid build-up of predator populations, all of which contributed to the shifts in tern nesting locations and the increase in size of the tern colony in the Columbia River estuary.

About 8 acres of East Sand Island were scarified in 1999 to provide nesting area for Caspian terns. Up to 1,400 pairs of terns did nest at the site, using about 0.7 acre of bare sand habitat. Revegetation was rapid, however, and the entire cleared area largely vegetated by 2000. Further efforts to re-establish the colony resulted in about 8,500 pairs nesting here in 2000 on 3.4 acres of 4 acres re-scarified to provide habitat. About 6 acres were prepared in 2001 and 2002. Rapid regrowth of vegetation on silty sands and the presence of gulls resulted in less than the full 6 acres being used for nesting.

The island's cormorant colony also increased in size in 1999. It is assumed these birds moved from Rice Island likely due to human presence associated with tern management, which also disturbed the cormorants. More cormorants nested on East Sand Island in 2000, as compared to 1999. Over 7,400 pairs of cormorants nested in the estuary in 2001 and roughly 8,700 pairs in 2002. A few pairs nested on Rice Island in 2001 (150 pairs) and 2002 (50 pairs).

Rice Island. Rice Island, located at RM 21-22 of the Columbia River north of the main navigation channel, is one of a series of dredged material disposal islands created by the Corps upstream of Astoria. Continued use of Rice Island, as a disposal site, is a significant component in maintaining the navigation channel. The Corps utilizes Rice Island for disposal approximately every other year. All of this material comes from maintenance dredging of the existing 40-foot Federal navigation channel, whether it is pumped there directly from the channel or is rehandled there from Harrington Sump, which lies between the channel and Rice Island. The island is primarily owned by the Oregon Division of State Lands (DSL), with right of entry held by the Port of Portland. The upstream tip is owned by Washington Department of Natural Resources. Rice Island is just north and west of Miller Sands Island and Miller Sands Spit, also dredged material disposal islands. Rice Island is about 8,000 feet long by 1,800 feet wide and covers about 230 acres. It consists of sandy material dredged from the Columbia River navigation channel. Dredged material is placed on some portion of the island nearly every other year (i.e., at the middle of the island, east of the former tern colony area). Grasses have been planted periodically in the past to reduce blowing sand. Planting has been generally unsuccessful at Rice Island, due to wind erosion of sand around seedling roots. The USFWS formerly incorporated Rice Island into the Lewis and Clark National Wildlife Refuge, until 1994, under a management option with Oregon DSL. Since then, the USFWS has not renewed its option to lease Rice Island.

The island has remained uncolonized by animals other than voles and birds, principally double-crested cormorants, Caspian terns, glaucous-winged/western gull hybrids, Canada geese, and horned larks and other passerines (perching songbirds) that prefer sparsely vegetated habitat. In 1986, a portion of the Caspian tern colony from East Sand Island, about 1,000 pairs, began nesting at Rice Island. There were about 8,700 pairs of Caspian terns nesting on Rice Island in 1998 and 8,300 in 1999, and about 590 breeding pairs in 2000. None have nested on the island since 2000.

Caspian terns first arrive on the colony in late March to early April. Egg laying takes place throughout May, with the peak of laying during the second week of May. Most young have fledged by mid-July. Caspian terns nesting on Rice Island fed entirely on fish, and mostly juvenile salmonids, during the 1997, 1998, 1999 and 2000 breeding seasons.

Collis *et al.* (2002) reported that the diet composition (based on bill load observation and fish dropped) of terns nesting on Rice Island contained the highest percentage of salmonids (73 percent of identifiable prey items in 1997-1998) of those fish-eating birds that were studied in the estuary. For comparison (based on chick regurgitations and adult stomach contents), the salmonid diet composition for double-crested cormorants nesting on Rice Island and East Sand Island consisted of 46 percent and 15 percent of identifiable prey items, respectively. The proportion of juvenile salmonids in the diet for gull hybrids was 11 percent and 4 percent of identifiable prey biomass for those nesting at Rice Island and East Sand Island, respectively (Collis *et al.* 2002).

For terns in 1997-1998, chinook smolts were the most prevalent species of identifiable salmonid prey types (46 percent), followed by coho (38 percent) and steelhead (16 percent). Early in the 1997 and 1998 breeding seasons, the diet was comprised mostly of steelhead smolts, by coho smolts in the middle of the breeding season, and by chinook salmon and other species later in the season. The proportion of salmonids in the diet declined as the breeding season progressed, and by July, salmonids no longer composed the majority of prey consumed. Estimates of consumption of juvenile salmonids by terns were based on fish identified in bill loads throughout the 1997 and 1998 nesting season (sample size = 1,448 fish). Foraging distribution of Caspian terns from the Rice Island colony location was investigated in 1998 by OSU-CRITFC researchers through the use of aerial surveys. They determined (Collis *et al.* 1999) that 25 percent of foraging terns were within 2.6 miles of Rice; 50 percent within 4.6 miles or to just downstream of Tongue Point; 75 percent were within 9.2 miles, between rivermile 11 and 30; and 90 percent within 13 miles. The 90 percent ring encompasses East Sand Island at the downstream end to just upstream of Skamokawa. The aerial survey technique used to describe spatial use of the estuary by Caspian terns could not distinguish between commuting and foraging birds, so results are biased, perhaps underestimating foraging range by as much as 30 percent (Ostrand *et al.*, 1998). In 2000, about 590 tern pairs nested on Rice Island, and diet data indicate that 90 percent of prey items were juvenile salmonids. Tern eggs and chicks were heavily preyed upon by gulls, and productivity was relatively low (0.15fledglings per nesting pair).

Double-crested cormorants established a nesting colony on Rice Island, arriving in 1988. There were about 1,200 nesting pairs on Rice Island in 1995 (Carter *et al.* 1995 IN ODFW 1998). This was the second largest colony on the west coast of North America north of Mexico. Cormorants

arrive on the colony in early April and lay eggs from early May to mid-June. Fledging extends through the beginning of August. There were no cormorant nests on Rice Island in 1999 or 2000. Management activities associated with Caspian terns on Rice Island likely disturbed the cormorants as well and they apparently moved to East Sand Island. Collis *et al.* (2002) noted that the cormorants nesting on East Sand Island had fewer salmonids in their diet (about 15 percent) as opposed to those nesting farther up-river at Rice Island and nearby channel markers (46 percent). Also, cormorants nesting on Rice Island had consistently poorer nesting success than those nesting on East Sand Island (Collis *et al.* 1999). Cormorants returned to Rice Island in 2001, with about 150 pairs nesting there in 2001 and 50 pairs in 2002.

Miller Sands Spit and Pillar Rock. Miller Sands consists of two dredged material disposal sites, Miller Sands Island and Miller Sands Spit. These sites lie within the USFWS' Lewis and Clark National Wildlife Refuge. Miller Sands Island was created in the 1930's and has not been disposed on since that time. The Spit is a 2.5-mile-long curving finger of sand just south of the navigation channel, and about .5 mile north of Miller Sands Island, except where the Spit curves toward the island. It was created in 1976, is actively utilized as a disposal site, and continued use of the site for disposal is important to maintenance of the navigation channel.

Western/glaucous-winged gull hybrids and ring-billed gulls nest on the western tip of the Spit. Canada geese also nest on the Spit, as well as on nearby Miller Sands Island. There is a harbor seal haulout south of the islands. Western grebe, mallard, many other duck species, shorebirds and various species of gulls are abundant in the vicinity, particularly the embayment between the spit and the island. Nutria are abundant at Miller Sands Island and a few muskrat also inhabit this island. A pair of bald eagles nest on Miller Sands Island; the Spit is part of their home range and foraging territory.

The Spit has periodically been planted with grasses following placement of dredged material. Vegetation attempts have been moderately successful on the Spit. Miller Sands Island also has Scot's broom, willow and alder habitat. The Spit was the site of feasibility study investigating the efficacy of social attraction in relocating nesting Caspian terns from Rice Island in 1998. A few pairs tried to nest here, lured by decoys and calls: predatory gulls and crows made nesting unsuccessful. In 2001, terns were prospecting for nest sites in upland areas on Miller Sands Spit, but various means to dissuade terns from nesting there (e.g., streamers) were successful.

Pillar Rock is a dredged-material formed island upstream of Miller Sands at RM 28. The island is actively utilized as a disposal site, and continued use of the site for disposal is important to maintenance of the navigation channel. Most of the island is currently vegetated. No colonial nesting birds occur at Pillar Rock Island. Aggregations of Caspian terns do gather on the upstream beaches to loaf. In 2002, Caspian terns were observed in upland areas on Pillar Rock Island, apparently prospecting for nests sites (Columbia Bird Research 2002). Contractors working for the USACE were successful in preventing terns from nesting at the site. Waterfowl, shorebirds, various gulls and herons make substantial use of the marsh-mudflat habitat associated with the island. Canada geese nest on the island in relatively substantial numbers, and there is considerable use by bald eagles.

Threatened and Endangered Species. The US Fish and Wildlife Service (USFWS) has identified several threatened and endangered species as occurring in or near the Columbia Estuary. These are brown pelican, bald eagle, western snowy plover and Oregon silverspot butterfly; and one

plant species, Howellia. Brown pelicans occur at and around East Sand Island and are generally present from June to October. Wintering and resident bald eagles are known to nest and forage throughout the Columbia River estuary, and resident pairs occur in the project vicinity. One pair nests on Miller Sands Island, and previously attempted to nest on Rice Island. Another pair nests on the Washington mainland near East Sand Island. Western snowy plovers formerly occurred on Oregon beaches just south of the Columbia River and a small population is present at Leadbetter Point, Willapa Bay, Washington. Oregon silverspot butterfly requires very specific habitat and is not known to occur in the project area, nor does Howellia. Stellar's sea lion occurs near the mouth of the estuary. Columbia River bull trout have been listed, but are not known to occur in the estuary.

The NMFS has listed the Snake River spring, summer and fall run chinook salmon as threatened and Snake River sockeye as endangered; Lower Columbia River steelhead , Snake River steelhead, Columbia River chum salmon; Lower Columbia River, and Upper Willamette River chinook; and Middle Columbia River steelhead and Upper Willamette River steelhead as threatened; and the Upper Columbia River steelhead and Upper Columbia River chinook as endangered. The coastal cutthroat trout, recently considered for listing as threatened, is no longer proposed after an assessment.

State-listed or sensitive species (for Oregon) known to occur in the project vicinity include brown pelicans and bald eagles, which are also on the Federal list, peregrine falcon and Lower Columbia River coho. Horned larks nest on Rice Island; it has not been established if these are streaked horned lark, an Oregon Natural Heritage Program species of concern in the Willamette Valley. This species' State status is "critical" in the Willamette Valley and Klamath Mountains.

ENVIRONMENTAL EFFECTS

Impacts to Columbia River Estuary. Maintenance of the Caspian tern colony at East Sand Island would affect the fish species that the terns would eat. More species and total numbers of fish are present in the lower estuary. Fish expected to replace salmonids in the terns' diet include American shad, northern anchovy, Pacific herring, Pacific sand lance, Pacific staghorn sculpin, starry flounder, longfin smelt, surf smelt, whitebait smelt, Pacific tomcod, English sole, various species of surf perches and shiner perch (also sardines). These species are cosmopolitan in nature and serve as the prey source for most piscivorous fish species in the ocean. These species are in high abundance and losses due to predation by the terns would not likely affect these populations. Results from 1999 field work on Caspian tern dietary composition indicates that terns nesting on East Sand Island ate fewer salmonids (46 percent of fish delivered) than terns at Rice Island (77 percent of fish delivered). Research from 2000 indicated that salmonids made up 47 percent of the diet of East Sand Island terns. Anchovies were the next most consumed fish. For the Rice Island terns, salmonids made up 90 percent of their diet. These results are consistent with the hypothesis that a more diverse array of prey is available to terns lower in the Columbia River estuary. Research from 2001 and 2002 continues to support the dietary composition, with herring, anchovy, surfperch and smelt composing the majority of their diet.

Impacts to the Sea Resources' hatchery are not expected to be significant. While most Sea Resources hatchery releases into the Chinook River occur outside of the tern breeding season, some increase in consumption of chinook smolt would occur. Other fish species are available for terns to feed on.

The Select Area Fisheries at Tongue Point and Deep River (Grays Bay) are not expected to be significantly negatively affected. These locations are closer to Rice Island than East Sand Island and tern predation rates on smolts from these two sites may be reduced. Releases from the net pens at Youngs Bay may be exposed to greater tern predation; however, given the availability of other fish species, this is not expected to be significant. Management techniques, such as releasing net pen fish at night on outgoing tides to reduce the potential impacts on those fish by avian predators, can be implemented if desired.

Impacts to Caspian terns are not expected. The colony nested successfully on East Sand Island in 1999-2002, and recently (i.e., 2002) have been increasing in numbers. Provision of 6 acres of nesting habitat at East Sand Island, without harassment of this core area, is expected to accommodate the entire estuary tern population for the years 2003 and 2004. In 2000, the entire Caspian tern population in the Columbia River estuary nested on a total of 4 acres (8,500 pairs nested on 3.4 acres on East Sand Island and 590 pairs nested on 0.6 acres on Rice Island). Other, unmanaged areas of habitat do exist within the Pacific Northwest, such as islands in Grays Harbor, which could accommodate some terns with habitat management. Caspian terns have nested, in fluctuating numbers, at several sites within five western States in recent years. (Table 3) Availability of habitat fluctuates, which accounts for some of the nesting changes. Caspian terns are long-lived colonial nesting birds that typically change their nesting locations. Terns have a mean breeding life expectancy of 8.6 years (Gill and Mewaldt 1983), with some living to be over 20 years old (Collis *et al.* 1999). This species can withstand short-term losses in nesting success, since adults will produce young in future years. Maintaining the estuary colony at East Sand Island is not expected to have significant, long-term impacts on the terns. See specific impacts by activity site, below.

Impacts to double-crested cormorants from maintaining excluders at pile dikes include discouragement of resting and feeding from these sites. The action in 2000 appears to have caused the birds to move from pile dikes having excluders to those dikes not having excluders. Research activities in 2001 also suggest that the total number of foraging cormorants near pile dikes in the lower Columbia River estuary was not reduced by excluders, but resulted in redistribution of foraging cormorants to pile dikes not fitted with excluders. Cormorants also perched on pile dikes where excluders had been damaged and not replaced. (Collis *et al*., 2001 Final Report)

Impacts to juvenile salmonids in the estuary from the proposed action's maintenance of tern habitat at East Sand Island are predicted to be comparable to the observed results for the 2001 and 2002 nesting seasons. Maintenance of the Caspian tern colony near the mouth of the Columbia River will allow for terns to access a more diverse prey base. Thus, tern predation on juvenile salmonids will be reduced compared to a situation where terns nested on Rice Island, where their diet would be focused extensively on juvenile salmonids.

<u>Impacts to East Sand Island</u>. Mechanical equipment and/or herbicides would be used to till and control vegetation on approximately 6 acres of first-year successional grass-forb habitat. Sand would be excavated from the adjacent beach and placed on portions of the 6 acre site, as required, to replace eroding sand. Few small mammals (rodents, such as voles) occupy the affected environment, based on field observation. This activity would occur in winter or early spring before colonial and other nesting birds have initiated nesting activities and before brown

pelicans have arrived. There could be some minor, short-term turbidity as the equipment is loaded off/on a barge. Based on experience during the 1999 to 2002 seasons, recorded Caspian tern calls as part of the relocation attempt are not audible to humans on the mainland. The closest residences, at Chinook, Washington, are about 1 mile distant. Herbicide application would be scheduled for September, after tern nesting had been completed.

Large numbers of Caspian terns would begin nesting in this area in April 2003. It is assumed that similar foraging behavior would occur around an East Sand Island colony as was observed in 1999 to 2002

Tern foraging would not be precluded from the area near Rice Island by maintaining the colony at East Sand Island, but the majority of their foraging activity would be expected to occur downstream of the Astoria-Megler bridge, or in offshore waters. In 2000, radio-tagged terns that

Table 3 NUMBERS OF BREEDING PAIRS OF CASPIAN TERNS AT COLONIES IN THE PACIFIC REGION (WASHINGTON, OREGON, CALIFORNIA, BAJA CALIFORNIA, IDAHO, NEVADA, MONTANA, WYOMING), 1997-2002[a]

	1997	1998	1999	2000	2001	2002	Source (1997-2002)[b]
WASHINGTON							
COASTAL BAYS							
Commencement Bay, Pierce Co.	–	–	423	620[c]	388	215[c]	A. Edwards, M. Tirhi, Collis *et al.* (2000, 2001c, in press), Shugart and Tirhi (2001)
Grays Harbor, Grays Harbor Co.	0	0	0	0	0	0	
Willapa Bay, Pacific Co.	0	0	0	0	0	0	
MID-COLUMBIA RIVER							
Miller Rocks, Klickitat Co.	–	–	–	–	15	0	M. Antolos, Collis *et al.* (2000, 2001c).
Crescent Island, Walla Walla Co.	614[c]	357[c]	552[c]	571	720	578	Roby *et al.* (1998), Collis *et al.* (1998, 2000, 2001c, 2002)
COLUMBIA BASIN/PLATEAU							
Banks Lake, Grant Co.	–	–	–	10	23	–	Collis *et al.* (2000, 2001c), M. Antolos.
Potholes Reservoir, Grant Co.	259	–	–	150	~250	~250[d]	J. Tabor, Collis *et al.* (2000, 2001c)
Sprague Lake, Adams Co.	–	–	~50	20	20	–	M. Monda, M. Antolos, Collis *et al.* (2000, 2001c)
OREGON							
COLUMBIA RIVER ESTUARY							
East Sand Island, Clatsop Co.	0	0	1,400	8,513	8,896	9,933	Roby *et al.* 2002
Rice Island, Clatsop Co.	7,151	8,691	8,328	588	0	0	Roby *et al.* (1998, 1999), Collis *et al.* (1999, 2000, 2001c)
Miller Sands Spit, Clatsop Co.	0	17	0	0	0	0	Collis *et al.* (1999)
MID-COLUMBIA RIVER							
Threemile Canyon Island, Morrow Co.	354[c]	210[c]	238[c]	260	2	0	Roby *et al.* (1998), Collis *et al.* (2000, 2001c, 2002)
GREAT BASIN							
Malheur Lake, Harney Co.	65	25	30	192[c]	51[c]	0	G. Ivey, M. Laws

Table 3 NUMBERS OF BREEDING PAIRS OF CASPIAN TERNS AT COLONIES IN THE PACIFIC REGION (WASHINGTON, OREGON, CALIFORNIA, BAJA CALIFORNIA, IDAHO, NEVADA, MONTANA, WYOMING), 1997-2002[a]

	1997	1998	1999	2000	2001	2002	Source (1997-2002)[b]
Crump Lake, Warner Valley, Lake Co.	–	–	–	155[c]	–	–	Collis *et al.* (2001c)
Summer Lake, Lake Co.	–	–	38	16	0	~5	M. St. Louis
CALIFORNIA (COAST)							
HUMBOLDT BAY	–	–	–	–	~17[c]	~6[c]	M. Colwell
San Francisco Bay							
Little Island, Napa Co.	–	–	–	–	–	–	
Knights Island, Solano Co.	400	~200	–	121[c]	43[c]	153	J. Evens
Brooks Island, Contra Costa Co.	~500	582	active	806[c]	512[c]	825	S. Bobzien, Ryan (2000), SF Bay NWR
China Basin, San Francisco Co.	–	–	–	–	–	86[c]	
Hayward Regional Shoreline, Alameda Co.	1	1	1	1	1	1	S. Bobzien, SFBBO, SF Bay NWR
Bair Island, San Mateo Co.	0	0	0	0	0	0	SF Bay NWR
Ravenswood (Pond R1), San Mateo Co.	0	(4 ad.)	0	1	1	1	P. Metropulos, SF Bay NWR
Alameda NAS, Alameda Co.	285	267	1	0	0	0	L. Collins, M. Elliott, USFWS 1998, Ryan (2000),
Coyote Hills, Alameda Co.	30	22	0	0	–	–	Ryan (2000), SF Bay NWR
Baumberg Tract, Alameda Co.	0	33	26	79	116	80	SFBBO, SF Bay NWR
Alviso (Pond A7), Santa Clara Co.	104	30	122	118	155	73	SFBBO, SF Bay NWR
CENTRAL AND SOUTHERN COAST							
Elkhorn Slough, Monterey Co.	0	0	~30	~80	~65	~50	J. Parkin, K. Wasson
Salinas River NWR	–	–	–	–	2	93[c]	K. Neuman, D. Roberson
Bolsa Chica, Orange Co.[e]	175	40	58	51	92	192	C. Collins
Pier 400, Terminal Island, Los Angeles Harbor, Los Angeles Co.	25	146	250	336	160	151	K. Keane
South San Diego Bay NWR, San Diego Co.	320	198	261	380	350	379	B. Collins, J. Fancher, R. Patton

Table 3 NUMBERS OF BREEDING PAIRS OF CASPIAN TERNS AT COLONIES IN THE PACIFIC REGION (WASHINGTON, OREGON, CALIFORNIA, BAJA CALIFORNIA, IDAHO, NEVADA, MONTANA, WYOMING), 1997-2002[a]

	1997	1998	1999	2000	2001	2002	Source (1997-2002)[b]
CALIFORNIA (INTERIOR)							
MODOC PLATEAU/GREAT BASIN							
MEISS LAKE, BUTTE VALLEY WA, SISKIYOU CO.	25[c]	16	27	19	0	0	K. Novick *et al.*, D. Shuford
Clear Lake NWR, Modoc Co.	180[c]	68[c]	118	242[c]	201	0	J. Beckstrand, D. Shuford
Goose Lake, Modoc Co.	143[c]	–	310[c]	4	~240	133	D. Shuford
Big Sage Reservoir, Modoc Co.	62[c]	–	0	48	0	0	D. Shuford
Honey Lake WA, Lassen Co.	152	–	87	82	92	46	D. Shuford, B. Tatman
Mono Lake, Mono Co.	0	0	0	8	6	11	J. Jehl, Jr., P. Wrege
SAN JOAQUIN VALLEY, TULARE BASIN, (ALL KINGS CO.)							
Lemoore NAS sewer ponds	–	20[c]	0	–	–	0	J. Seay
Westlake Farms South Evaporation Basin, Kings Co.	0	3	0	0	0	0	J. Seay
Tulare lakebed	0	20[c]	0	0	0	0	D. Shuford
South Wilbur Flood Area	0	70	27	0	0	0	J. Silvas, D. Shuford
Tulare Lake Drainage District, North Evaporation Basin	0	0	0	0	1	0	R. Hansen
Tulare Lake Drainage District, South Evaporation Basin	0	40	0	0	0	0	R. Hansen
COASTAL SLOPE, SERN CALIFORNIA							
Lake Elsinore, Riverside Co.	–	–	14	–	–	0	D. Shuford, J. Dillon
COLORADO DESERT							
Salton Sea, Imperial Co.	1,200	800	211	207	327	29	Molina (2001)
MEXICO							
BAJA CALIFORNIA							
Cerro Prieto geothermal ponds,	30	34	–	0	0	4	Molina and Garrett (2001), K. Molina

Table 3 NUMBERS OF BREEDING PAIRS OF CASPIAN TERNS AT COLONIES IN THE PACIFIC REGION (WASHINGTON, OREGON, CALIFORNIA, BAJA CALIFORNIA, IDAHO, NEVADA, MONTANA, WYOMING), 1997-2002[a]

	1997	1998	1999	2000	2001	2002	Source (1997-2002)[b]
Mexicali Valley							
Isla Montague	–	–		–		83	E. Mellink
IDAHO							
SNAKE RIVER PLATEAU							
Morman Reservoir, Camas Co.	–	–	–	–	~2	25	C. Trost
Minidoka NWR, Cassia Co.	–	–	–	1	0	4	C. Trost, S. Bouffard
American Falls Reservoir, Bingham Co.	–	–	–	–	–	5	C. Trost
Blackfoot Reservoir, Caribou Co.	–	–	–	–	0	50	C. Trost
NEVADA							
GREAT BASIN							
Carson Sink, Churchill Co.	0	–	685	0	0	0	W. Henry
Anaho Island NWR, Pyramid Lake	1	5	0	0	0	0	W. Henry
MONTANA							
Canyon Lake Ferry Reservoir, Lewis and Clark Cos.	5	0	2	7	35	43	T. Carlsen
Fort Peck Reservoir, Charles M. Russell NWR, Valley County	?	?	?	?	~25	~25	C. EDGEWOOD
WYOMING							
Molly Island, Yellowstone Lake, Yellowstone National Park	4	5	4	0	3	5	A. Cerovski, T. McEneany
Soda Lake islands, Natrona Co.	0	0	0	7	12	19	A. Cerovski
PACIFIC REGION TOTALS[f]	12,085	11,900	13,293	13,693	12,823	13,503	

Table 3 NUMBERS OF BREEDING PAIRS OF CASPIAN TERNS AT COLONIES IN THE PACIFIC REGION (WASHINGTON, OREGON, CALIFORNIA, BAJA CALIFORNIA, IDAHO, NEVADA, MONTANA, WYOMING), 1997-2002[a]

	1997	1998	1999	2000	2001	2002	Source (1997-2002)[b]

[a] Table from Shuford and Craig 2002 with additional data for 2002 from USFWS and D. Shuford. To enable estimation of the total numbers of breeding pairs in the entire region, we adjusted some raw counts or estimates. When a range was given for numbers of nests or pairs we report the mid-point (e.g., 800-850 pairs reported as 825 pairs) and for breeding adults we use the mid-point as the basis for estimating numbers of pairs. Counts or estimates of breeding adults were multiplied by 0.62 to approximately estimate numbers of breeding pairs based on the average ratio of nests to adults at sites on the California coast (0.625, Carter *et al.* 1992, p. I-45) and the California interior (0.61, D. Shuford unpubl. data). Dashes (–) indicate that no survey conducted or no data available, zeroes (0) that a survey was conducted but no evidence of nesting observed, and question marks (?) that nesting strongly suspected but no solid data available.

[b] Includes published sources, unpublished reports, unpublished data, and personal and written communications (denoted by contributors names).

[c] Counts of adults were converted to an estimate of breeding pairs by multiplying raw adults by the 0.62 correction factor described above. Terns at Commencement Bay in 2002 were nesting on the rooftop of a Port of Tacoma building (# 407); the count of adults on which the estimate of pairs was made was taken late in the nesting season (9 July).

[d] The 2002 number is an estimate. Analysis of aerial photos of nesting islands has not been completed at this time.

[e] All counts from Bolsa Chica are of total nest attempts (on the basis of marked nests), which likely overestimates nesting pairs because of pairs that renest after initial failures.

[f] Totals are likely underestimates because of a lack of surveys at some sites in particular years or during the whole time period (e.g., most sites in Mexico).

Table provided by USFWS, from USFWS 2002.

nested at East Sand Island were most often (90 percent) detected below the bridge or outside the estuary, as noted by OSU-CRITFC-RTR researchers. As expected, tern diet composition shifted, and consisted of a higher percentage of marine fishes such as herring, anchovy, smelt, sand lance and perch, with relocation to East Sand Island. Research results from the 2000 project indicated that the proportion of juvenile salmonids in the diet of Caspian terns relocated to East Sand Island was 48 percent lower than the proportion of juvenile salmonids in the diet of terns nesting on Rice Island. However, terns continued to consume many salmonids. Anchovies were the species consumed in second highest quantities.

For 2001, salmonids composed 33 percent of the terns' diet on East Sand Island. Marine forage fishes (herring, sardine, anchovy, surfperch, smelt and Pacific sand lance) made up 67 percent of the diet. In 2002, salmonids composed 31 percent of the terns' diet, with marine forage fishes composing 79 percent. Herring, anchovy and surfperch composed the majority of fishes consumed. (Columbia Bird Research 2001 and 2002).

Gulls that exhibit predatory behavior toward the nesting Caspian terns would be removed, if deemed necessary by the CTWG. Based on the previous 2 years, it is likely that gull control on East Sand Island will not be needed in 2003 and 2004. The more important issue is control of other predators, such as great horned owls, opossums, raccoons, etc. If necessary, this would be by lethal means. Forty gulls were killed in 2000, none in 2001 (due to the restraining order) and none in 2002. Up to 50 gulls may have to be killed to protect tern nesting efforts early in the season. This loss constitutes less than 1 percent of the gulls (7,000 pairs) presently nesting on East Sand Island. Given the many thousands of gulls in the estuary, this is not a significant loss. Gulls and Canada geese that formerly nested at the project site are expected to nest elsewhere on the island. No significant impacts to the gull population or the use of East Sand Island as an index site for Canada goose management are foreseen. The cormorant colony is located on the downstream half of the island and is not expected to be affected by activities on the upstream end. In-season management actions would be coordinated with the CTWG to avoid disturbance of cormorants. Brown pelicans also occur on the downstream end of the island. Protective measures requested by USFWS would be implemented to avoid impacts to pelicans. These include signage to preclude human access.

Provision of a harassment-free, 6-acre core nesting area on East Sand Island is expected to accommodate the entire estuary tern colony, depending on nesting densities, for the years 2003-2004, and longer if necessary (assuming the population does not increase dramatically). East Sand Island supported about 8,500 breeding pairs of terns in 2000. Approximately 9,000 pairs nested at East Sand Island in 2001, and 9,900 pairs in 2002. While 4 acres would be adequate to support the entire population, an additional 2 acres for buffer against gulls was agreed to and will continue to be provided. Caspian terns nesting at East Sand Island in 2000 occupied 3.4 acres, with a density of 0.62 pairs/square meter (m2) and productivity of 0.57 fledglings per breeding pair. Production (young per nesting pair) has been relatively high at East Sand Island: 1999, 1.2; 2000, 0.57; 2001, 1.39; 2002; 1.08. The mean young/pair over 4 years is 1.06. Previously observed population growth of the Caspian tern colony (from 1960 to 1980 the Pacific population increased about 70 percent, to 6,000 breeding pairs) was calculated to have resulted from an average annual fledgling rate of 0.64 (Gill and Mewaldt, 1983). Should productivity at East Sand Island remain at these levels, it would not only maintain this colony, but continue its population increase. Table 4 compares nesting results from 1997-2002. Over the long term, more terns would return to East Sand Island as long as the expanded habitat was maintained and

no other habitat was available. More Caspian terns in the Columbia River estuary would result in the consumption of more salmonids. This issue would need to be addressed by the USFWS in subsequent environmental documents.

Impacts to Rice Island. Provision of 6 acres of nesting habitat at East Sand Island in 2001 and 2002, plus some maintenance of flagging at the Rice Island site resulted in no terns nesting at Rice Island in 2001 and 2002. Thus, it is expected that there would be no Caspian terns nesting on Rice Island as long as these actions continue. The Corps proposes passive harassment in the form of habitat modification and active harassment, if necessary, that would cease once terns begin egg-laying. In 2000, the temporary restraining order prevented any kind of harassment, and about 590 breeding pairs nested on Rice Island. Productivity was low, however, due to heavy predation by gulls. (Gull predation estimates by researchers are more than 1,500 eggs and 100 chicks taken by gulls during the 2000 nesting season.)

If human disturbance of terns occurs (prior to egg-laying), other birds, especially cormorants and gulls, attempting to nest in that area may also be disturbed. In-season management of disturbance

Table 4 Caspian Terns Population Trends, Productivity and Diet in the Columbia River Estuary

	1997	1998	1999		2000		2001	2002
	Rice I.	Rice I.	Rice I.	E. Sand I.	Rice I.	E. Sand I.	E.Sand I.	E.Sand I.
# of terns on colony in aerial photos	9,796	12,276	13,742	1,195	2,070	11,443	14,581	13,970
Est. # of breeding pairs	7,200	8,700	8,300	550	590	8,500	9,000	9,900
% of breeding pairs in the estuary	100%	100%	94%	6%	6%	94%	100%	100%
Colony area (acres)	3.8	4.9	2.6	0.5	0.6	3.4	3.9	4.5
Colony area (m^2)	15,470	19,698	10,679	2,094	2,350	13,720	15,703	18,024
Nesting density (pairs/m^2)	0.46	0.44	0.78	0.26	0.25	0.62	0.57	0.55
Productivity (fledglings/breeding pair)	0.06	0.45	0.55	1.20	0.15	0.57	1.39	1.08
Salmonid smolts in diet	85%	73%	77%	46%	90%	47%	33%	31%
Salmonids consumed in millions (best est.)*	5.9-10.4 (8.1)	9.1-15.7 (12.4)	9.4-14.1 (11.7)		6.1-8.6 (7.3)		4.7-7.0 (5.9)	5.5-7.6 (6.5)

Source: Collis, K. *et al.* 1999; Columbia Bird Research 2000, 2001, 2002.
* based on bioenergetic models

activities implemented in coordination with the CTWG is expected to avoid significant impacts to other wildlife species at Rice Island. A few Canada goose nests may be lost due to measures implemented at the tern colony location. These losses are not expected to compromise use of

Rice Island as an index site used by Washington Department of Fish and Wildlife for Canada goose management purposes. The cormorant colony did not nest here in 1999 to 2000, but returned in 2001 and 2002. Maintenance of the tern colony at East Sand Island would reduce available prey for bald eagles in the vicinity of Rice Island. However, relocation is typical of tern colonies and predator species have had to adjust when this occurred. Further, prey resources for bald eagles in the Columbia River estuary are not considered limiting to the population as they feed primarily on fish.

Due to the high success of relocation efforts in 2000-2002, maintenance of the colony on East Sand Island is expected. The entire colony nested here in 2001 and 2002. Some terns relocated here in 2002 from the Asarco site in Washington. Information on young fledged in 1999 indicates that about 4,600 young fledged at Rice Island, and 1,700 fledged at East Sand Island. The successful fledging at East Sand Island in 1999 may reflect less crowded conditions and removal of predatory gulls. In 2000, about 4,800 young were fledged on East Sand Island, and about 90 on Rice Island. Birds with long life spans, like the tern, can withstand short-term production losses, since the adults will produce young in future years. Monitoring and evaluation during the proposed action will document nesting success during the 2003-2004 actions, contingent upon funding. Provision of alternate nesting habitat at East Sand Island, coupled with attraction measures and field research (contingent on funding by others) to be conducted on tern nesting and foraging ecology, represent measures taken to ensure colony retention and nest success. Information obtained will be used to fine-tune future colony restoration efforts.
See Table 4 for nest success in 2001/2002.

Impacts to Miller Sands Spit and Pillar Rock. Operation and maintenance of cormorant excluders on pile dikes is not expected to significantly affect other wildlife species. These actions are short term. Harassment of Caspian terns at these locations is restricted to upland, open sand sites. Contractors activities are not to extend into other habitats in order to preclude disturbance
to other species. The use of Miller Sands Spit and Pillar Rock as index sites for goose management by WDFW should not be compromised by proposed activities.

Impacts to Threatened and Endangered Species. The relocation of the Caspian tern colony from Rice Island to East Sand Island has reduced tern predation on out-migrating Columbia and Snake River salmonid smolts, a portion of which consists of listed threatened and endangered species. Reduction in avian predation is expected to benefit these listed species, both wild and ESA-stocks from hatcheries. The NMFS (2002) predicts that the rate of population growth of listed salmonids would increase, based on reductions in tern predation.

Based on revised estimates (Table 4), an estimated 11.7 salmonids were taken by Caspian terns in 1999 and 7.3 million in 2000. A percentage of these salmonids were listed smolts. Relocation of the tern colony substantially reduced predation of ESA stocks in the estuary in 2001 from what would be expected to occur if the tern colony nested on Rice Island, though predation on ESA stock still occurred. Based on 2000 diet composition for Rice Island terns (90 percent of their diet was salmonids), relocation of most of the colony to East Sand Island resulted in about 6 million fewer smolts being consumed by Caspian terns, a portion of which could have been listed stocks.

Estimates of salmonids consumed by terns for 1997-2002 are shown in Table 4. A similar result would be expected in 2003 and 2004, if all of the terns continue to nest on East Sand Island rather than Rice Island. Numbers of smolts consumed would be expected to increase annually due to the increase in total tern population. Bull trout (if present) would be unaffected as they are adults and generally too large for predation by terns.
Relocation of the colony has shifted a prey resource from an area used by one or two territorial pairs of bald eagles to the territory of another pair. Prey resources around Rice Island are sufficient for bald eagles without the presence of nesting Caspian terns. Any necessary disturbance activities on Miller Sands Spit would be greater than 3,000 feet from either nest site and visually buffered by cottonwood stands, and should not disturb the eagles at the nest sites. Any nesting attempt by Caspian terns would likely be near the western end or on recently disposed material near the upstream end. Brief disturbance actions at these localized sites are not likely to adversely affect bald eagles nesting at Miller Sands Island or their foraging in the embayment at Miller Sands Spit. Activities associated with this project are not likely to adversely affect bald eagles.

Brown pelicans that loaf on East Sand Island normally migrate before habitat modification occurs. Brown pelicans, when present (May-October), utilize the entire island. The presence of a tern colony on the east end of East Sand Island would have no effect on brown pelicans. Research activities at East Sand Island are discrete in order to minimize potential for disturbance to colonial nesting birds and brown pelicans. Thus actions implemented at East Sand Island are not likely to adversely affect brown pelicans. A site visit protocol and signage have been developed in consultation with USFWS to further protect brown pelicans. Excluders placed on pile dikes used by some brown pelicans for roosting would be maintained in late spring to minimize impacts to the pelicans. Some pilings are left free of excluders to provide perch points for pelicans. The brown pelican population has increased considerably at East Sand Island: about 11,000 were reported there in 2002. Future disturbance to brown pelicans associated with research activities will lessen as only tern research (contingent on funding) would occur. Research on brown pelicans and cormorants has been completed.

Western snowy plovers, Stellar's sea lions, Oregon silverspot butterfly and Howellia do not occur in the immediate vicinity of any of the Oregon islands where project activities are slated. The proposed actions should have no effect on these listed species.

PROJECT COORDINATION

Originally, this project was coordinated with Federal, State and Tribal agencies via the Caspian Tern Working Group (CTWG). This working group, established in May 1998, has met periodically to discuss resolution of this issue. However, not all members of the CTWG concurred with every element of the present proposed action, which is a result of court settlement, with the Corps of Engineers as the primary action agency for interim tern habitat maintenance. In particular, the State of Idaho and CRITFC, as members of CTWG, have issues with the proposed action. While the tribes support efforts to relocate the colony to East Sand Island in order to encourage the birds to rely less on a diet of salmonids (and more on other marine species), the tribes still oppose management actions that result in increased tern population density in the estuary. CRITFC supports actions and plans that develop suitable habitats elsewhere in the region, limiting the habitat in the Columbia River and encouraging the population to become widely distributed. The State of Idaho is concerned about unnatural levels

of avian predation on juvenile salmonids throughout the smolt migration and supports actions to reduce the total impact (all seabirds at all locations) to conservation levels of 5 percent or less as soon as possible.

There also has been other interagency coordination since the Biological Opinion in 1995 required research on avian predation of listed salmonids. The draft Environmental Assessment for the 1999 pilot study was circulated for agency and public review on October 29, 1998. The EA and subsequent Finding of No Significant Impact (FONSI) also were made available on the Internet. A draft EA on the FY2000 management plan was circulated for a 30-day public and agency review on January 19, 2000. A FONSI was signed March 17, 2000. That decision was challenged by the National Audubon Society, Defenders of Wildlife, Seattle Audubon Society and American Bird Conservancy, and a temporary restraining order was issued April 10, 2000, prohibiting harassment actions on Rice Island. The Corps and USFWS were then enjoined from any form of harassment on Rice Island. Thus the 2000 action on Rice Island was limited to research activities. Actions on East Sand Island and pre-egg laying actions on Rice Island did result in most of the colony nesting on East Sand Island in 2000.

A settlement was agreed to and signed April 2, 2002. The settlement directed that the defendants (Corps and USFWS) implement interim measures to annually create suitable habitat of at least 6 acres on East Sand Island, deploy decoys and sound system to attract terns, and control predators through the 2004 Caspian tern breeding season. Measures to preclude terns from nesting on Rice Island, Miller Sands Island and Pillar Rock could be resumed prior to egg-laying, and maintenance of excluders was allowed. Preparation of an EA for interim management actions that will be conducted in 2003-2004, and the development of a long-term Caspian tern management plan/EIS to be completed by February 2005, was also part of the settlement. Caspian tern management in the Columbia River estuary has been elevated since the settlement and is now coordinated through a policy group, comprised of representatives from associated Federal and State agencies.

This environmental assessment is being coordinated through 30-day agency and public review. Comments are being requested from:

- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- National Marine Fisheries Service
- Columbia River Inter-Tribal Fish Commission
- National Audubon Society
- American Bird Conservancy
- Pacific Seabird Group
- Defenders of Wildlife,
- Seattle Audubon Society
- Oregon
    - Department of Environmental Quality
    - Department of Fish and Wildlife
    - Department of Land Conservation and Development
    - Division of State Lands
    - Oregon State University
    - Clatsop County

Washington
- Department of Ecology
- Department of Fish and Wildlife
- Department of Natural Resources
- Pacific County
- City of Chinook
- Sea Resources

CONSULTATION REQUIREMENTS

a. Clean Water Act of 1977: Section 404 of the Clean Water Act will be complied with. No fill in waters of the U.S. is proposed. Approximately 3,200 cubic yards of sand removed from below ordinary high water at the beach on East Sand Island will be removed by track hoe or other similar (non-scraping) equipment, trucked off site and deposited at the upland nesting site. Section 404 does not apply to this activity.

b. Coastal Zone Management Act: The proposed action is within the Columbia River estuary. East Sand Island, Rice Island and Miller Sands Spit are designated Conservation shorelands in the Clatsop County Comprehensive Plan. Lands with this designation are to be managed for protection and maintenance of water quality, fish and wildlife habitat, water-dependent uses, economic resources, esthetic values and recreation. East Sand Island has two areas designated Priority 1 for dredged material disposal. Disposal site CC-S-6.8, on the upstream end of East Sand Island, is noted in the 1986 Dredged Material Management Plan prepared by CREST as having a nesting colony of Caspian terns and prefers this site not be revegetated after disposal activities. All of Rice Island is designated Priority 1 for disposal. The northeast corner of Rice Island is within the State of Washington, and Rice Island also contains a disposal location designation for Wahkiakum County, Washington. No actions are proposed for the Washington portion of Rice Island. All of Miller Sands Spit is designated Priority 1 for disposal. A Coastal Zone Consistency Determination was submitted to the Oregon Department of Land Conservation and Development (DLCD) for review for the 1999 EA. DLCD concurred with the Consistency Statement in correspondence dated December 15, 1998. DLCD was advised of changes included in the FY 2000 plan, and concurred with the Corps determination that the proposed project remains consistent with the Oregon Coastal Management Program. DLCD was advised of the FY2001-02 proposed action and had no comment. The 2003-2004 proposed action is similar to the previous action.

c. Endangered Species Act of 1973, as amended: Listed or proposed threatened or endangered species are not likely to be adversely affected (brown pelican, bald eagle) or are not affected (western snowy plover, Oregon silverspot butterfly, Howellia) by the proposed actions. The threatened bald eagle nests and winters in the vicinity of East Sand Island, Rice Island and Miller Sands Spit. The brown pelican is a summer resident in and around East Sand Island. Western snowy plovers, Oregon silverspot butterfly and Howellia do not occur in the project area. The biological assessment (BA) prepared in 1999, with a finding of not likely to adversely affect or no effect for listed species in the project vicinity, was amended in 2000 and submitted to USFWS for concurrence. The proposed action would increase the eagles' prey base. Bull trout would be unaffected. The USFWS has previously concurred with the Corps' determination. The Corps will update the BA for the 2003-2004 proposed action. The proposed action would have

no effect on bull trout, recently listed as threatened, or cutthroat trout, no longer proposed for listing. Proposed critical habitat for bull trout does not include the Columbia River estuary.

Listed species of Columbia and Snake River salmonids are expected to benefit from the proposed action, and the Corps will again amend the BA prepared in 1999 to that effect. Impacts to listed salmonids were addressed in the consultation with NMFS for Columbia River Channel Operation and Maintenance Program. Actions described in this EA are required under the non-discretionary terms and conditions of the NMFS' September 15, 1999, Biological Opinion. The Corps continues to consult and coordinate with NMFS on this matter.

d. Fish and Wildlife Coordination Act: The proposed action is in compliance with the requirements of this act.

e. Migratory Bird Treaty Act of 1918, as amended. This act prohibits the taking of migratory birds except as permitted through certain regulations. These regulations (50 CFR 21) authorize the taking of migratory birds through establishment of hunting seasons and issuance of various permits. Permits may be issued for "depredation control purposes," including reducing damage to public property. Permits may be issued to wildlife management authorities for the purpose of protecting State and Federal listed plants or animals, or species of management concern from predation or competition at levels documented to jeopardize the recovery of stability of such species. Permits are not required to scare or herd depredating migratory birds, unless such hazing results in the abandonment of active nests, or the loss of eggs, nestlings or adults. No harassment of Caspian terns is proposed after egg-laying, thus no permit is required.

The United States Government continues to be bound by the international agreements (four bilateral Migratory Bird Conventions) to protect migratory birds. The USFWS continues to informally consult with other Federal agencies, to ensure those agencies conduct Federal actions in a manner that complies with the obligations of the Government under the various Migratory Bird Conventions.

e. Marine Protection, Research, and Sanctuaries Act of 1972, as amended: No marine resources covered under this Act would be affected by the proposed action.

f. Cultural Resources Acts: No cultural resources would be affected by activity at this location due to the extent of past disturbance. Historical resources (remnants of WW II military action) on East Sand Island located in the project area have been buried under dredged material and would be unaffected by removal of vegetation and surface soil. The Oregon and Washington State Historic Preservation Offices have been advised of activity in the area.

g. Executive Order 11988, Flood Plain Management, 24 May 1977: No flood plains would be affected by the proposed action.

h. Executive Order 11990, Protection of Wetlands: No wetlands would be affected by the proposed action.

i. Analysis of Impacts on Prime and Unique Farmlands: Not applicable.

j. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource conservation and Recovery Act (RCRA). No hazardous, toxic and radioactive waste (HTRW) concerns have been identified.

REFERENCES CONSULTED

Bottom, D.L., and K.K. Jones. 1990. Species composition, distribution, and invertebrate prey of fish assemblages in the Columbia River Estuary. Progr. Oceanogr.25:243-270.

Collis, K., S.L. Adamany, D.D. Roby, D.P. Craig, and D.E. Lyons. 1999. Avian predation on juvenile salmonids in the lower Columbia River. 1998 Annual Report. Oregon State University, Corvallis, Oreg. and Columbia River Inter-Tribal Fish Commission, Portland, Oreg. Sept. 1999.

Collis, K., M. Hawbecker, D.D. Roby, M. Thompson, C. Faustino, C. Cardoni, C.D. Anderson and D.E. Lyons. 2002. Cormorant and brown pelican use of excluder-fitted pile dikes in the Columbia River estuary, 2001. Real Time Research (Bend, Oreg)/Oregon State University (Corvallis, Oreg.). January 2002.

Collis, K., D.D. Roby, D.P. Craig, B.A. Ryan, and R.D. Ledgerwood. 2001. Colonial waterbird predation on PIT-tagged juvenile salmonids in the Columbia River estuary: Vulnerability of different salmonid species, stocks, and rearing types. Trans. Amer. Fisheries Soc., 130:385-396.

Collis, K., D. D. Roby, D. P. Craig, S. L. Adamany, J. Y. Adkins, and D. E. Lyons. 2002. Colony size and diet composition of piscivorous waterbirds on the lower Columbia River: implications for losses of juvenile salmonids to avian predators. Transactions of the American Fisheries Society 131: 537–550.

Columbia Bird Research. 2000. Caspian tern research on the lower Columbia River: 2000 Final Season Summary. Real Time Research, Bend, Oreg. http://www.columbiabirdresearch.org.

Columbia Bird Research. 2001. Caspian tern research on the lower Columbia River: 2001 Final Season Summary. Real Time Research, Bend, Oreg. http://www.columbiabirdresearch.org.

Columbia Bird Research. 2002. Caspian tern research on the lower Columbia River: 2002 Draft Season Summary. Real Time Research, Bend, Oreg. http://www.columbiabirdresearch.org.

Emmett, R.L., and Michael H. Schiewe (Editors). 1997 Estuarine and ocean survival of Northeastern Pacific salmon: Proceedings of the workshop. U.S. Department of Commerce, NOAA Tech Memo. NMFS-NWFSC-29, 313 p.

Gill, Robert E. Jr. and L. Richard Mewladt. 1983. Pacific Coast Caspian Terns: Dynamics of an expanding population. The Auk 100: 369-381.

McCaffery, B.J., C.M. Harwood, and J.R. Morgart. 1997. First nests of Caspian terns (*Sterna caspia*) for Alaska and the Bering Sea. Pacific Seabirds 24(2): 71-72.

Oregon Department of Fish and Wildlife. 1998. Draft Predation Action Plan: Avian Species. Portland, Oreg.

Ostrand, W.D., G.S. Drew, R.M. Suryan, and L.L. McDonald. 1998. Evaluation of radio-tracking and strip transect methods for determining foraging ranges of black-legged kittiwakes. Condor 100:709-718.

Pacific Fishery Management Council. 1999. Review of 1998 Ocean Salmon Fisheries. Portland, Oreg. Feb. 1999.

Peters, Carl F., Klaus O. Richter, David A. Manuwal, and Steven G. Herman. 1978. Colonial Nesting Sea and Wading Bird Use of Estuarine Islands in the Pacific Northwest. Prepared for the Office, Chief of Engineers, U.S. Army, for the Dredged Material Research Program. Technical Report D-78-17, Waterways Experiment Station, Vicksburg, Miss. John Graham Company, Seattle, Wash., May 1978. Final Report.

Raymond, H.L. 1988. Effects of hydroelectric development and fisheries enhancement on spring and summer chinook salmon and steelhead in the Columbia River Basin. N. Am. J. Fish. Management. 8: 1-24.

Roby, D.D., D.P. Craig, K. Collis, and S.L. Adamany. 1998. Avian predation on juvenile salmonids in the lower Columbia River. 1997 Annual Report. Oregon State University, Corvallis, Oreg. and Columbia River Inter-Tribal Fish Commission, Portland, Oreg. Sept. 1998.

Roby, D.D., K. Collis, D.E. Lyons, D.P. Craig, J.Y. Adkins, A.M. Myers, and R.M. Suryan. 2002. Effects of Colony Relocation on Diet and Productivity of Caspian Terns. Journal of Wildlife Management, 66(3):662-673.

Schiewe, Michael H. 1999. Estimation of Percentages of Listed Spring/Summer and Fall Chinook, Sockeye Salmon and Steelhead Smolts Arriving at Various locations in the Columbia River Basin in 1999. Memo to Kevin Collins, National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle Washington March 3, 1999.

U.S. Army, Corps of Engineers. 1974. Coastal Reconnaissance Study, Oregon and Washington. Prepared by Battelle, for Portland District.

U.S. Army, Corps of Engineers. 1998. Dredged Material Management Plan & Supplemental Environmental Impact Statement: Columbia and Lower Willamette River Federal Navigation Channel. Portland, Oreg.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2002. Caspian Tern Predation on Salmon and Steelhead Smolts in the Columbia River Estuary. Portland, Oreg. September 26, 2002.

U.S. Department of Energy, Bonneville Power Administration. 1995. Lower Columbia River Terminal Fisheries Research Project, Final Environmental Assessment. Portland, Oreg.

_____. 2002. Avian Predation On Juvenile Salmonids In The Lower Columbia River Research Project Supplement Analysis. March 21, 2002. Portland, Oreg.

U.S. Department of the Interior, Fish and Wildlife Service. 2002. Status Assessment and Conservation Recommendations for the Caspian Tern in North America. Prepared by Shuford, W.D. and D. P. Craig. Portland, Oreg. August 2002.

Wright, S. 2002. California Brown Pelicans on East Sand Island, Columbia river Estuary, 2001. Annual Report. USGS-Oregon Cooperative Fish and wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University. Corvallis, Oreg. April 2002. (preliminary)

References Cited by NMFS

Beamesderfer, R.C.P., D.L. Ward and A.A. Nigro, 1996. Evaluation of the biological basis for a predator control program on northern squawfish (*Ptychocheilus oregonensis*) in the Columbia and Snake Rivers. Can. J. Fish. And Aquat. Sci. 53:2898-2908.

Collis, Ken, D.D. Roby, D. E. Lyons, R.M. Suryan, M. Antolos, S.K. Anderson, A.M. Meyers, and M. Hawbecker. 2001a. Caspian Tern Research on the Lower Columbia River, Draft 2001 Summary. Columbia Bird Research. www.columbiabirdresearch.org

Collis, Ken, D.D. Roby, D.P. Craig, B.A. Ryan, and R.D. Ledgerwood. 2001b. Colonial waterbird predation on juvenile salmonids tagged with passive integrated transponders in the columbia River estuary: vulnerability of different salmonid species, stocks and rearing types. Trans. Am. Fish. Soc. 130:385-396.

Collis, K., D. D. Roby, D. P. Craig, S. L. Adamany, J. Y. Adkins, and D. E. Lyons. 2002. Colony size and diet composition of piscivorous waterbirds on the lower Columbia River: Implications for losses of juvenile salmonids to avian predation. Trans. Am. Fish. Soc.131:537-550.

Independent Multidisciplinary Science Team. 1998. Pinniped and seabird predation: Implications for recovery of threatened stocks of salmonids in Oregon under the Oregon Plan for Salmon and Watersheds. Technical Report 1998-2 to the Oregon Plan for Salmon and Watersheds. Governor's Natural Resources Office. Salem, Oregon.

Johnson, O.W., M.H. Ruckelshaus, W.S. Grant, F.W. Waknitz, A.M. Garrett, G.J. Bryant, K. Neely, and J.J. Hard. 1999. Status review of coastal cutthroat trout from Washington, Oregon and California. NOAA Technical Memorandum NMFS-NWFSC-37. Seattle, Washington. 292 p.

Kareiva, P., M. Marvier, and M. McClure. 2000. Recovery and management options for spring/summer chinook salmon in the Columbia River Basin. Science 290:977- 979. Lee, D. C., and 20 co-authors. 1997. Broadscale assessment of aquatic species and habitats. In press: Report of the Interior Columbia Basin Ecosystem Management Project.

Raymond, H.L. 1988. Effects of hydroelectric development and fisheries enhancement on spring and summer chinook salmon and steelhead in the Columbia River Basin. N. Am. J. Fish. Management. 8: 1-24.

Roby, D.D., D.P. Craig, K. Collis, and S.L. Adamany. 1998. Avian Predation on Juvenile Salmonids in the Lower Columbia River 1997 Annual Report. Bonneville Power Administration Contract 97BI33475 and U.S. Army Corps of Engineers Contract E96970049. 70 p.

Ryan, B.A., J.A. Ferguson, R.D. Ledgerwood, and E.P. Nunnallee. 2001. Detection of passive integrated transponder tags from juvenile salmonids on piscivorous bird colonies in the Columbia River Basin. N. Am. 1. Fish Mgmt. 21 :417-421.