STATE OF WASHINGTON September 2022

Periodic Status Review for the Brown Pelican

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Washington Department of FISH AND WILDLIFE
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The Washington Department of Fish and Wildlife maintains a list of endangered, threatened, and sensitive species (Washington Administrative Codes 220-610-010 and 220-200-100). In 1990, the Washington Wildlife Commission adopted listing procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 220-610-110. The procedures include how species listings will be initiated, criteria for listing and delisting, a requirement for public review, the development of recovery or management plans, and the periodic review of listed species.

The Washington Department of Fish and Wildlife is directed to conduct reviews of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing by the Washington Fish and Wildlife Commission. The periodic status reviews are designed to include an update of the species status report to determine whether the status of the species warrants its current listing status or deserves reclassification. The agency notifies the general public and specific parties who have expressed their interest to the Department of the periodic status review at least one year prior to the five-year period so that they may submit new scientific data to be included in the review. The agency notifies the public of its recommendation at least 30 days prior to presenting the findings to the Fish and Wildlife Commission. In addition, if the agency determines that new information suggests that the classification of a species should be changed from its present state, the agency prepares documents to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act.

This is the final status review prescribed by WAC 220-610-110, five years after de-listing. The Department presented the results of the 2015 periodic status review to the Fish and Wildlife Commission at the 8 April 2016 meeting, and the Commission voted to remove the Brown Pelican from the state list of Endangered Species. This periodic status review for the Brown Pelican was reviewed by species experts and state and federal agencies. It was available for a 90-day public comment period from 3 February–4 May 2022. All comments received were considered during the preparation of the final periodic status review. This review and recommendation was presented to the Fish and Wildlife Commission at a meeting at Ocean Shores on 23 September 2022.

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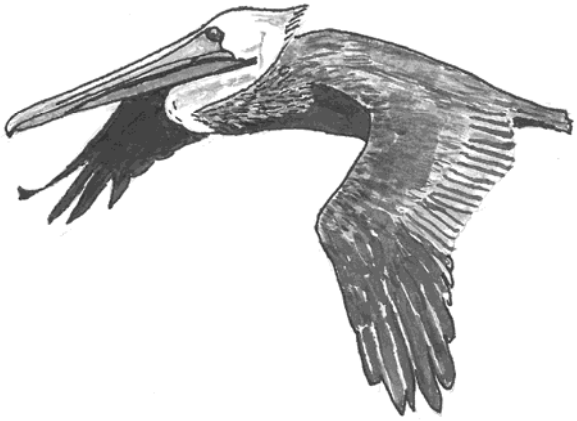

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EXECUTIVE SUMMARY

The Brown Pelican (*Pelecanus occidentalis*) was removed from the state endangered list in 2016. As required in WAC 220-610-110, this document reviews the status of the Brown Pelican in Washington five years after removal from state-listing as endangered, threatened, or sensitive. The Pacific coast and Gulf of Mexico populations were delisted by the U. S. Fish and Wildlife Service under the Endangered Species Act in 2009. These populations were listed as federally endangered in 1970 in response to a DDT-related population crash of the southern California breeding colonies and the Gulf of Mexico population due to Endrin and other toxins.

The Brown Pelicans present seasonally in Washington belong to the California subspecies (*P. o. californicus*). They nest on islands in the Gulf of California and along the coast of Baja California in Mexico, north to Channel Islands National Park in southern California. California Brown Pelicans disperse north seasonally along the Pacific coast from nesting areas in search of food, with small numbers reaching as far as southern British Columbia. Birds occur in Washington's coastal waters, mainly from April through November with a peak typically in late July to early September; their numbers decline in October and November with the onset of stormy weather. The total metapopulation of California Brown Pelicans was estimated at 70,000 breeding pairs in 2006.

Brown Pelicans require secure night roosts and loafing sites where they can dry and preen their plumage after feeding because their feathers become water-logged. In Washington, Brown Pelicans gather in roosts on sandy islands, exposed shoals, and a few artificial structures in the Columbia River, Grays Harbor, and Willapa Bay estuaries, and rocky islands off the coast of the Olympic Peninsula. East Sand Island, Oregon, in the Columbia River estuary has been the largest night roost for Brown Pelicans in the region, where their annual peak numbers increased markedly from <100 during 1979-1986 to a high of >16,000 in 2009. Peak numbers have since declined, with 5,282 in 2016, and 3,000-3,500 each year since. The reasons for this decline are uncertain, but likely relate to forage fish abundance here and in their breeding areas.

California Brown Pelicans feed primarily on small schooling fishes, including Pacific Sardines, Northern Anchovies, and Pacific Mackerel. The steady increase in Brown Pelican numbers in Washington from 1987-2011, was likely due to cyclic changes in ocean conditions that affect forage fish abundance, and perhaps the recovery of nesting colonies in the Southern California Bight. Natural fluctuations in ocean conditions and forage fish abundance caused a crash in sardine and anchovy populations in the pelican's southern breeding areas and led to three consecutive years of extremely poor reproductive success. Other factors affecting populations include incidental capture in fishing nets and fisheries impacts on forage fish in the Gulf of California, unprecedented ocean warming, toxic algae blooms, and climate change. Although climate change and other factors present uncertainty about future population trends, Brown Pelicans still occur seasonally in Washington and they are not immediately threatened.

The Brown Pelican was removed from the state-endangered list in 2016 and we do not recommend reconsidering that decision at this time. Brown Pelicans are protected from 'take' by federal law under the Migratory Bird Treaty Act, and are a 'protected wildlife' species by state law. Because Brown Pelicans concentrate at terrestrial communal roosts, particularly at night, they remain a Priority Species of the Priority Habitats and Species program (PHS) due to these vulnerable aggregations.

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INTRODUCTION

This document reviews the status of the Brown Pelican in Washington five years after they were removed from the state endangered list in 2016 (as required: WAC 220-610-110). It briefly reviews and updates the natural history, status of populations and habitat, and factors affecting them. The 2015 periodic status review, and the literature cited therein, provide a more thorough review of the past and factors that have affected their numbers.

Figure 1. Brown Pelican near Westport (*photo: Rod Gilbert*).

DESCRIPTION AND LEGAL STATUS

Brown Pelicans (*Pelecanus occidentalis*) are a largely marine species known for their plunge dives to capture fish, and the habit of roosting to dry their feathers. Nonbreeders are seen in substantial numbers in Washington's coastal waters. Brown Pelicans that occur in Washington waters are part of a population that was removed from the federal Endangered Species List in 2009 (USFWS 2009a).

DISTRIBUTION

Brown Pelicans are found along marine coasts of the eastern Pacific Ocean from southern British Columbia, south to Chile and the Galapagos, and on the Atlantic, Caribbean, and Gulf coasts from Maryland to Venezuela (AOU 1998). Within this range, the California Brown Pelican (*P. o. californicus*) nests on islands from southern California, south to the Gulf of California, Baja, and the Pacific coast of mainland Mexico (USFWS 2007; Anderson and others 2017). California Brown Pelicans seasonally migrate north along the Pacific coast from nesting areas in search of food, with small numbers migrating as far as the southern coast of British Columbia (Shields 2002). Nesting colonies in southern California are the closest to Washington, but there is a large post-breeding migration out of the Gulf of California, so the exact origins of birds in Washington are uncertain. Birds return to the south by December (Briggs and others 1983; Wahl 2005).

Washington. Brown Pelicans occur primarily on shores and waters of Washington's outer coast; they are generally seen from late April through November with the peak in abundance from July through early September (Wahl 2005; Roby & Collis 2012; WOSNews 2005-2011; eBird 2013). Small numbers may occur in the Strait of Juan de Fuca and Puget Sound. East Sand Island in the Columbia River estuary has been the largest known night roost for California Brown Pelicans in the Pacific Northwest (Fig. 2; Wright and others 2012). Night roosts also exist in Grays

Figure 2. East Sand Island, Oregon, in the Columbia River estuary (arrow).

Harbor, and intermittently in Willapa Bay during years when subtidal shoals become islands. Significant numbers also roost on rocky islands north of Grays Harbor.

NATURAL HISTORY

Brown Pelicans are found in marine habitats, typically nesting in colonies on small offshore islands that are relatively free of disturbance by humans and terrestrial predators. Nesting is rather asynchronous, with timing related to foraging conditions. In California, nesting can occur from December to August, with peaks of egg-laying most often from February through May (Anderson & Gress 1983); in the Gulf of California, nesting occurs from November to May (Shields 2002). The clutch of 2–3 eggs is incubated with warmth from the adult's webbed feet (Shields 2002). Brown Pelicans are slow-maturing and long-lived, not reaching sexual maturity until 3–5 years of age; the oldest individual on record lived 43 years (Shields 2002).

Brown Pelicans are known for their head-first plunge-dives to capture fish in their expandable gular pouch; they will also seize prey while on the water surface, particularly in shallow water (Shields 2002). California Brown Pelicans feed on schooling marine fishes, especially Pacific Sardines (*Sardinops sagax*), Northern Anchovies (*Engraulis mordax*), and Pacific Mackerel (*Scomber japonicus*) (Shields 2002). There are no diet data for Brown Pelicans in Washington, but incidental observations of prey captured have mostly been anchovies (Jaques 1994). Although present in substantial numbers in the Columbia River estuary, Brown Pelicans are not a major predator of migrating salmon smolts (Roby & Collis 2012).

The California Brown Pelican experiences low breeding success during years of El Niño, when warmer waters become less suitable for anchovies (Hayward 2000; Shields 2002). In extremely strong El Niño years, widespread breeding failures and mortality of adult pelicans can result (Anderson and others 1982, Shields 2002), but impacts are generally limited to a single breeding season and do not result in long-term population declines. In contrast to the pelicans in the Southern California Bight, pelicans in the Gulf of California feed opportunistically on at least 30 fish species with no single species dominating (D. Anderson, unpubl. data, *cited in* Burkett and others 2007).

Habitat use. Brown Pelicans forage in relatively shallow waters (<150 m), typically within 20 km of shore in prey-rich areas of upwelling (Briggs and others 1983; Shields 2002). The large estuaries on Washington's southwest coast offer a variety of prey in abundance, including anchovy, Pacific Herring (*Clupea pallasii*), Pacific Sand Lance (*Ammodytes hexapterus*), various smelt (family Osmeridae), and American Shad (*Alosa sapidissima*). Grays Harbor and Willapa Bay provide shallows that allow for surface feeding that may be helpful for young, relatively inexperienced pelicans, and these estuaries provide undisturbed roost sites on sandbars and islands (Jaques 1994). Roosting and loafing sites are important habitat for Brown Pelicans because they cannot remain on the water for more than an hour as their feathers become water-logged, hindering thermoregulation (Shields 2002). After feeding, pelicans gather at roosts such as piers, breakwaters and jetties, on islands and offshore rocks, and on beaches at the mouths of estuaries where they dry and preen their plumage (Schreiber & Schreiber 1982; Jaques & Strong 2002, 2003). Secure nocturnal roost sites are a critical resource; islands that provide a water barrier that inhibits disturbance by mammalian predators and humans are used most often (Jaques & Strong 2003).

Roosting habitat in Washington. In Washington, Brown Pelicans seasonally roost in substantial numbers at a few artificial structures and low sandy islands and exposed shoals in the Columbia River, Willapa Bay, and Grays Harbor estuaries (Jaques & O'Casey 2006; Wright and others 2007). They also use many Olympic Peninsula sites, including several beaches and rocky islands off the coast. East Sand Island, Oregon, in the Columbia River estuary has been the largest night roost in the region (Fig. 2; Wright 2004; Roby & Collis 2012). The island is owned by the U.S. Army Corps of Engineers and is closed to public access. Willapa Bay has hosted up to several hundred pelicans (Jaques & O'Casey 2006). Day use depended on the availability of a night roost which has changed over time with the formation and erosion and disappearance of sandy islands. When islands became subtidal pelicans shifted to other sites for night roosting, primarily East Sand Island (Jaques & O'Casey 2006; Wright and others 2007). Brown Pelicans have used at least 12 different roost sites in Grays Harbor, including natural sand islands or intertidal sandbars, sandspits, and artificial structures (Jaques & O'Casey 2006). North of Grays Harbor, Brown Pelicans have been recorded roosting in significant numbers (>200) at various beaches and rocky islands (Fig. 3; eBird 2013; WOSNews 2005-2011; S. Thomas 2015, pers. comm.). An estimated 3,000 were observed foraging off Bottle Beach on 28 August 2015 (D. DeSilvis 2015, pers. comm.).

Figure 3. Locations of important roost sites for Brown Pelicans in Washington.

POPULATION STATUS AND TREND

Brown Pelicans declined dramatically in the 20th century as a result of DDT contamination (Shields 2002). During the late 1960s and early 1970s, the Southern California Bight (SCB) population was <1,000 breeding pairs and reproductive success was nearly zero (USFWS 2009a). The SCB population recovered after the banning of most uses of DDT in 1972 and the cessation of discharge of contaminated wastes off the California coast. In 2006, there were approximately 11,700 breeding pairs at 10 locations in the SCB, and the estimate for the entire California Brown Pelican subspecies in 2006 was about 70,680 birds (Anderson and others 2013). Most breed in Mexico, with ~76% breeding at Gulf of California and Mexican mainland estuary sites (Anderson and others 2017).

Changes and cycles in ocean conditions can dramatically affect availability of the schooling fishes that pelicans eat. During El Niño/Southern Oscillation (ENSO) events, the normal pattern of upwelling of nutrient-rich water is disrupted and fewer forage fish are available and many pelicans and other seabirds defer breeding (Anderson and others 2017). Brown Pelican populations can forego breeding occasional years without incurring a major decline in adult numbers. However, 2014-2016 saw unprecedented rangewide breeding failures during a warm ocean anomaly (the 'blob'); breeding effort and success were severely reduced even when compared only to ENSO years; reproductive success in 2014 and 2015 in the Gulf of

California was the lowest in 46 years of surveys (Anderson and others 2017). Gulf of California Brown Pelican breeding effort has been reduced since 2014 (Anderson and others 2013, 2017), although a slow improvement has occurred since, but the trend has continued (D.W. Anderson 2021, pers. comm.). Monitored colonies in eight island groups have, in general, increased the last few years and slowly recovering from the recent crash (Y. Bedolla 2021, pers. comm.). Commercial fisheries in the Gulf, may be affecting numbers through fishing pressure on sardine stocks, and directly through by-catch of pelicans (Velarde and others 2015; Anderson and others 2017).

Breeding populations in the California Channel Islands increased in recent years and have reached near historic high levels (California Institute of Environmental Studies 2021); reproductive success is variable between breeding locations and years; on Anacapa Island an estimated 11,575–12,403 chicks were produced in 2019, up from 1,095–2,190 in 2016; nest attempts were higher in 2020, but a chick die-off resulted in lowered production (3,006–5,750 chicks). The colony on Santa Barbara Island did not have a chick die-off and produced 2,713–3,463 chicks in 2020, up from 473-697 in 2016 (California Institute of Environmental Studies 2021). In 2019, the proportion of subadult pelicans (~52%) in fall roost counts suggested improved recruitment compared to 2014, when only10% were subadults (Jaques 2020).

Abundance in Washington. Historical information on Brown Pelican numbers in Washington is meager, but the numbers have apparently varied greatly over time. David Douglas observed “many” at the mouth of the Columbia River in July 1825 (Jewett and others 1953), and their numbers were “surprisingly great” in fall 1857 when J. G. Cooper reported “large flocks” in Willapa Bay (Suckley and Cooper 1860). Lawrence (1892) noted that they were “pretty common” in Willapa Bay in the fall and “not uncommon” in Grays Harbor. In the mid-20th century, when sardine stocks collapsed, their non-breeding range retracted southward (Jaques 1994), and in the 1960s, even single birds were noteworthy (Wahl 2005). Brown Pelicans began expanding their non-breeding range northward again in the early 1970s (Jaques 1994). Changes in numbers observed in the Pacific Northwest are driven by ENSO events and multi-decade cycles in ocean temperature and conditions that affect prey availability (see *Prey availability*; Jaques 1994; Wright and others 2007); during ENSO years, pelicans typically occur in higher numbers (Ainley and others 1995). There was a record influx during the ENSO events of 1976, and 1982-83, but the annual migration to the Pacific Northwest involving thousands did not begin until 1985 (Jaques 1994). From 1976 to 1990, their non-breeding range expanded north ~260 km from Tillamook Bay, Oregon, to Rounded Island, Washington (Jaques 1994).

The southward retreat and subsequent northward expansion in the the 20th Century appear to be unrelated to the SCB population crash caused by DDT contamination. Jaques (1994) noted that the southward retreat seems to have occurred with the shift in oceanogrphic conditions and changes in distribution and abundance of forage fish stocks that began in the 1940s, and the northward return began in the early 1970s at a time when the SCB population was at its’ lowest from DDT contamination. She suggested that the El Niño events of 1976 and 1982-83 led to one or more cohorts of pelicans “discovering” the favorable habitat and foraging conditions available, including the northern stock of anchovy, and the large shallow estuaries with multiple roosting sites. For a few years, large numbers of Brown Pelicans (up to 16,000) roosted on East Sand Island in the Columbia River estuary, and significant numbers roosted at sites from the Columbia, north to Neah Bay.

Pelican numbers recorded during aerial surveys by USFWS refuge personnel each September from 1987–2017 fluctuated from 922–11,308. Totals from Smith River, Del Norte County, California, north to Grays Harbor, Washington, increased from 4,522 in 1987 to a high of 18,769 in 2007. September counts declined after 2011, but this may reflect an earlier seasonal peak; for example, the 2014 count was the lowest since surveys began (Stephensen & Szumski 2013; Stephensen & Ebert 2014), but the tide and wind conditions during the survey suggested many birds were foraging offshore and not detected; peak numbers earlier in the season were >10,000. Aerial seabird surveys were conducted on single days from mid-June to mid-July, 2010-2019; 1,274 Brown Pelicans were counted on the rocky islets from Erin's Bride to Carroll Island on 30 June 2014, but often no pelicans were observed during that June/July time period (S. Thomas 2020, unpubl. data).

The East Sand Island roost, which is at least sometimes the largest non-breeding roost of California Brown Pelicans throughout their range (Jaques 2016), increased sharply from less than 100 during 1979–1986, to a high count of over 16,000 in 2009 (Roby & Collis 2012). Peak numbers have declined since 2009, with 5,282 in 2016, and 3,011–3,300 in 2017-2019 (Roby and others 2019, 2020). The reason for this decline is unknown, but likely related to concurrent declines in anchovy, and perhaps disturbance related to control of Double-crested Cormorants (*Phalacrocorax auritus*). In 2020, 572 were counted on East Sand Island during fall roost counts (J. Liebezeit 2021, pers. comm.).

In 2008, breeding behavior by Brown Pelicans on East Sand Island was observed (Collis & Roby 2009). In July 2013, three birds laid eggs in nests, but failed to produce hatchlings; 6–11 nests were built in June 2014, but all were abandoned (Bird Research Northwest 2013, 2014); these nesting attempts occurred 900 miles north of the nearest colony in the Channel Islands. In 2018, 6 individuals in breeding plumage and red gular pouches were observed in May, but no nest building was observed (Roby and others 2019). In 2019, a few individual Brown Pelicans were observed carrying sticks in flight, but no nest structures, or breeding behaviors were observed, and no other nesting activity was detected (Roby and others 2020).

Current monitoring. Colony monitoring efforts by USFWS in the Southern California Bight stopped with the federal de-listing in 2009, though a draft post-delisting monitoring plan had been developed (USFWS 2009b). Monitoring of the colonies on Anacapa Island and Santa Barbara Island is being done by the California Institute of Environmental Studies, under contract with the National Park Service and USFWS. A coast-wide cooperative community science and professional monitoring project of roost sites began in 2016 (https://audubonportland.org/get-involved/community-science/brown-pelican/). The bi-annual survey is a joint effort of the West Coast Audubon Network, U.S. Fish & Wildlife Service, and the Conservacion de Islas. Since 2016, the surveys have become more structured with a standardized protocol. An evaluation of the volunteer data compared to professional surveys in 2019 found that abundance indices and age ratios were not significantly different when roost size was less than 100 birds (75% of roosts), but volunteer observers significantly underestimated group size and overestimated the portion of subadults of large roosts (>500 birds), a large portion of the population (Jaques 2020). The standard roost sites in Washington include Hoquiam Sewage Treatment Plant, Damon Point, Westport Marina, Tokeland Marina, and Leadbetter Point; East Sand Island and the South Jetty in the Columbia River estuary are among 18 pre-selected sites in Oregon. Coast-wide in September 2019, 84 of 119 known roost sites were surveyed and 10,829 pelicans were counted, with >90% in California; 509 were counted at 6 roost sites in Washington (Jaques 2020). The

low pelican numbers in Oregon and Washington in 2019 may have related to cooler ocean conditions and increased anchovy production in California (Jaques 2020).

Factors Affecting Brown Pelicans

Regulatory Mechanisms

Federal protection. The California Brown Pelican was listed as endangered under the U. S. Endangered Species Act (ESA) from 1970 to 2009 (USFWS 2009a). Brown Pelicans are still protected from 'take' by the federal Migratory Bird Treaty Act, and the nesting colonies in California are relatively protected from disturbance in Channel Islands National Park. However, laws to protect wildlife and habitat were not designed to address global issues like climate change, which is likely to be the most important factor affecting Brown Pelicans in the future.

***State status*.** In Washington, Brown Pelicans were state listed as endangered from 1980-2016. Brown Pelicans are still 'protected wildlife' (WAC 220-200-100), and unlawful taking is a misdemeanor (RCW 77.15.130). Direct human-caused mortality is not known to be a significant factor affecting pelican numbers in Washington.

Prey Availability

The abundance of forage fish prey is the most important factor affecting Brown Pelican populations and distribution. Forage fish populations are characterized by periods of abundance and scarcity in response to changes in oceanic conditions (e.g. El Niño, La Niña, decadal oscillations) (Brodeur and others 2005; Auth and others 2011; Crone and others 2011). El Niño/Southern Oscillation (ENSO) events act as a major ecological driver, reducing availability of prey fish which results in reduced pelican breeding efforts and success (Anderson and others 2017).

Northern Anchovy and Pacific Sardine are generally the most important species for Brown Pelicans (Fig. 4). In the 20th Century, sardine and anchovies tended to alternate in abundance over periods of roughly 50–60 years, with sardines more productive during warm phases and anchovies more productive during cold phases (Chavez and others 2003). Sardines have varied more dramatically than anchovies; they supported the largest fishery in the western hemisphere during the 1930s-40s until stocks collapsed in 1947 (Bargmann 1998; Hill and others 2011). During the 1950s-70s, a period of cold sea surface temperatures, the stock apparently abandoned the northern portion of its range, and sardines did not occur in commercial quantities north of Baja California (Hill and others 2019).

In recent decades, increased stock size and warmer sea surface temperatures resulted in the stock re-occupying areas off central California, north to southern British Columbia (Hill and others 2011). Sardines went from being nonexistent to one of the dominant pelagic species in the northern California Current in the span of slightly more than a decade (Emmett and others 2005). In British Columbia, sardines re-appeared in 1992, after an absence of 45 years (McFarlane & Beamish 2001). By 2011, the oceanographic conditions had again shifted back to a colder regime; Zwolinski & Demer (2012) noted parallels with the 1940s and predicted an imminent collapse, which then occurred (Pynn 2013; CDFW 2014; NMFS 2014;

Figure 4. Pacific Sardines (left) and Northern Anchovies (right; *photo Monterey Bay Aquarium*).

Anderson and others 2017). This resulted in breeding failures at pelican colonies in Mexico and California, and rehab centers in California and Oregon cared for higher numbers of starving pelicans (*articles cited in* Stinson 2015). The large numbers of pelicans that failed or did not attempt to breed resulted in an earlier influx of pelicans in the Pacific Northwest; 2014 numbers peaked in June, about six weeks earlier than typical (Jaques 2016).

During the winter of 2013/2014, the California current system underwent a major phase change (Leising and others 2014); the Pacific Decadal Oscillation changed to positive values, indicative of warmer waters, suggesting sardines would rebound, but conditions in 2015 shifted toward a strong El Nino, and unusual weather produced a warm water 'blob', and an extraordinary toxic algae bloom occurred. Many pelicans did not attempt to breed, and Washington again saw an early peak in numbers. Also, NMFS (2019) determined that the northern subpopulation of Pacific Sardine was overfished, and the directed fishery for sardines has remained closed since 2015 (PFMC 2019).

Northern Achovies are likely an important prey of pelicans while in Washington (Jaques 2016). Anchovies generally form tightly packed schools found near the surface within 18 mi (30 km) of shore and support an important fishery off California and Mexico. Although upwelling is an important factor in anchovy habitats, rivers also contribute, and water affected by the plume of the Columbia River provides important habitat (Emmett and others 2005). The bulk of the anchovy population is offshore, but during the summer months, anchovies may be found in Grays Harbor, Willapa Bay, and the Columbia River mouth, where their abundance varies from year to year (Bargmann 1998). Anchovies are typically caught only in a small fishery for bait centered off the Columbia River, although a substantial fishery occurred in the estuary in 2015, and a small-scale purse seine fishery out of Westport (Bargmann 1998; Litz and others 2008; L. Wargo 2015, pers. comm.).

In addition to anchovies and sardines, fish species available to pelicans in Washington include Pacific Herring, various smelt (family Osmeridae), Pacific Sand Lance, and Pacific Mackerel. Pacific Herring that spawn in the coastal embayments of Willapa Bay and Grays Harbor, and possibly the Columbia River estuary, are likely components of large summer herring aggregations that concentrate in coastal offshore areas (Stick & Lindquist 2009). Little else is known about these coastal herring populations. The rules allow for herring to be fished as a target species, with a limited entry license in Willapa Bay or Grays Harbor, but there is no active fishery (L. Wargo 2015, pers. comm.). Pacific Mackerel also experience cyclical 'boom-bust' periods of abundance. In the northeastern Pacific, they range from southeastern Alaska to Banderas Bay,

Mexico, but are most abundant south of Point Conception, California (Crone and others 2011). Over the last two decades, the stock appears to have more fully occupied Pacific Northwest coasts in response to a warm oceanographic regime. In 2016, the Washington Department of Fish and Wildlife authorized a trial directed mackerel purse seine fishery, but no vessels participated during 2016-2017 (PFMC 2019).

Forage fish and climate change. Climate change will affect the availability of sardines and anchovies through ocean warming, acidification, habitat compression (e.g. areas with decreased oxygen), nutrient supply, phenology, and changes in the food web (Checkley and others 2017). Anchovy and sardine may respond differently to climate changes because of their different diets and use of habitats. Sardines, being migratory and more pelagic, may be more able to shift northward, but anchovies are more tied to coasts and river outflows (Checkley and others 2017). Recent warming events led to unprecedented pelican breeding failures (Sydeman and others 2015; MacCall and others 2016). It is uncertain how, or if, pelican populations can adapt to long-term warming effects, or if that will include a shift of their breeding range further north in the California Current region (Anderson and others 2017).

Potential impact of commercial harvest of forage fish. Commercial fishing has the potential to negatively affect prey availability for seabirds. Anderson & Gress (1984) described the potential impacts of the anchovy fishery on Brown Pelican reproduction in southern California. Many authors have called for more conservative management of forage fish stocks to maintain healthy ecosystem function (Cury and others 2011; Smith and others 2011; Pikitch and others 2012; Zwolinski & Demer 2012; Essington and others 2015). In Washington, commercial fisheries exist for herring, Surf Smelt, anchovy (largely inactive), and sardine (currently closed), and recreational fisheries exist for herring and Surf Smelt (Lowry 2013). It does not appear that recent harvest levels have been negatively affecting Brown Pelicans in Washington, since their numbers have seemed to respond more to ocean conditions, particularly in their breeding areas. The Pacific Fishery Management Council (PFMC) has used a conservative approach to harvest management of forage fish (coastal pelagic species), such as sardines, in response to their ecological role as prey (e.g. for salmon) and importance to West Coast fisheries. In the late-1990's, the PFMC chose a conservative harvest rule for sardines, focused on maximizing biomass versus maximizing catch, reducing sardine harvest in cooler ocean regimes (CPSMT 2013); annual harvest levels do not exceed 12% of the estimated biomass for that year. Harvest rules for coastal pelagic species, including sardines, anchovies, and other forage fish, have used a "cutoff" parameter to protect core spawning populations (PFMC 2013, p. 93-94).

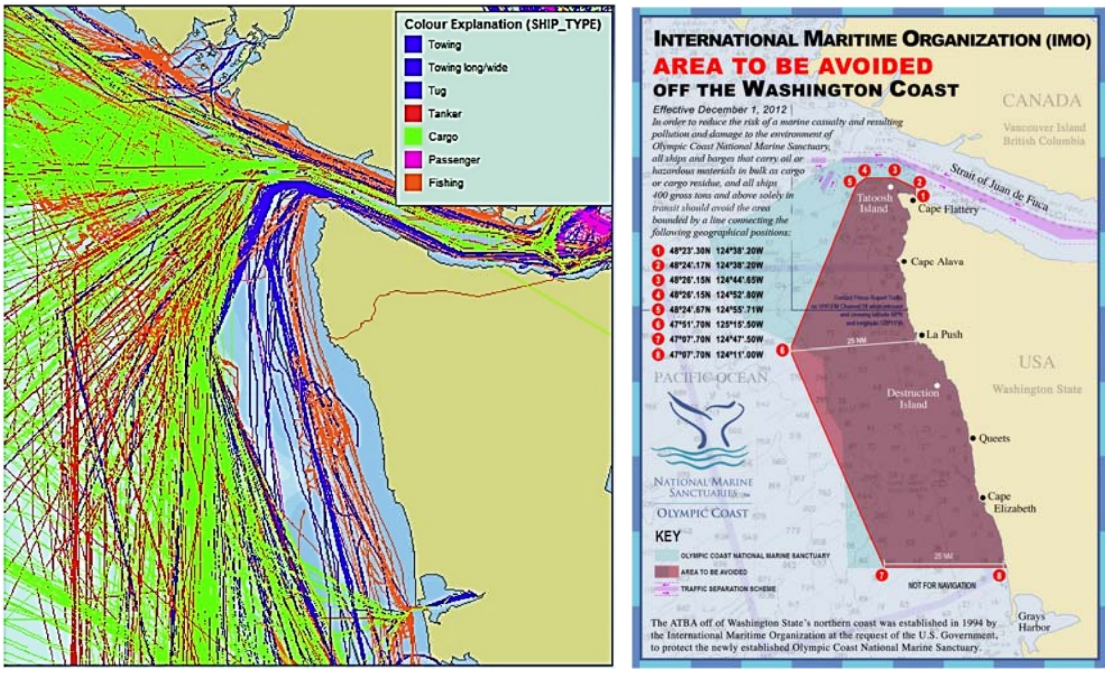
The PFMC recently re-evaluated forage fish management and research priorities and issued a Fishery Ecosystem Plan (PFMC 2013). The plan is an informational, not prescriptive, document the purpose of which is to enhance the Council's species-specific management programs with more ecosystem science. The PFMC now requires rigorous scientific review before any new fishery for currently unfished forage fish species can occur. Beginning in 2014, the National Marine Fisheries Service began issuing annual state of the ecosystem reports for the California Current to support ecosystem-based management processes (NMFS 2014).

The U.S. Fish and Wildlife Service concluded that current levels of commercial fishing were not likely to endanger the Brown Pelican and suggested that pelicans would respond to changes in prey biomass by switching to feed on other fish species (USFWS 2009a). However, the Pacific Seabird Group noted an impending decline of some major prey species associated with an increased purse-seine fishery as potential threats to subpopulations in the Gulf of California (Senner 2013).

Oil Spills

The U.S. Fish and Wildlife Service concluded that oil spills are localized and infrequent within the range of California Brown Pelicans (USFWS 2009a). Nonetheless, oil spills and oil pollution remain a potential threat. Major ports exist in Puget Sound, Grays Harbor, and the Columbia River, and every year, more than 15 billion gallons of oil are transported through Washington by vessel, pipeline, railcar, and truck, and large numbers of non-tanker vessels carry large amounts of fuel (WDOE 2012). For example, the *Tenyo Maru* was a fishing vessel that released ~100,000 gallons killing an estimated 10,000–30,000 murres in 1991 (Thompson 2003). Neel and others (1997) listed 12 other major oil spills in Washington waters between 1972 and 1996. The Strait of Juan de Fuca receives 5,300 transits of vessels annually, including 800 tankers (Fig 5; WDOE 2015).

The threat of oil spills has lessened to some degree by stringent regulations, improved tanker safety, requirements of double hulls or their equivalent, and improvements in oil spill response (McMahon Anderson and others 2012; Ramseur 2012). Vessel safety and oil spill prevention efforts in Washington have decreased the amount of oil spilled, and improved response has reduced the impacts of spills (Neel and others 1997). After a request by Olympic Coast National Marine Sanctuary and the U.S. Coast Guard, the International Maritime Organization designated an Area to be Avoided (ATBA) on the Olympic coast that went into effect in 1995 (Fig. 6; Galasso 2000). The implementation of an ATBA education and monitoring program by the Sanctuary has been aided by the cooperation of industry and the U.S. and Canadian Coast Guards. In addition, a rescue tug is now stationed in Neah Bay, and the Departments of Fish and Wildlife and Ecology oil spill teams provide round-the-clock spill response.



Figures 5,6. Tracks of vessel traffic through the Strait of Juan de Fuca and along the Olympic coast of Washington, Dec 2012-Jan 2013 (Left; WDOE 2015), and designated Area to Be Avoided (right).

Planned expansion of the Trans-Mountain Pipeline and increased oil handling capacity at Delta Port in British Columbia, however, could add hundreds of additional tanker, barge, and large ship transits of the waters of the Strait of Juan de Fuca and northern Puget Sound. This would result in an increased risk of oil spills in this area (Van Dorp & Merrick 2013). Spills at the mouth of the Strait of Juan de Fuca could spread and be moved south to areas where impact to Brown Pelicans is more likely.

Miscellaneous Factors

Disturbance of roosting sites. Disturbance-free roosting habitat is essential for Brown Pelicans for drying their feathers, resting, and sleeping. Night roosts in particular need to be large and inaccessible to predators (USFWS 1983; Croll and others 1986; Jaques & Strong 2002). Many roosts are vulnerable to human disturbance (Jaques & Strong 2002), and chronic disturbance can affect body condition and subsequent reproductive success and survival (Wright and others 2012). In Washington, pelicans in Grays Harbor and Willapa Bay seem to be habituated to passing boat traffic (Jaques & O'Casey 2006), but pelicans roosting on state beaches are subject to disturbance by vehicles, and other roosts are susceptible to disturbance by foot traffic. East Sand Island in the Columbia River estuary is closed to the public, but infrequent visits by beachcombers or birdwatchers do occur (Wright and others 2007, 2012). Disturbance by humans on the island (mostly related to research/control of cormorants and Caspian Terns) was negatively associated with pelican numbers (Wright and others 2007), and intensified after federal de-listing (D. Jaques 2015, pers. comm.).

Harmful algal blooms. Brown Pelicans are affected by harmful algal blooms or 'red tides', and there are some indications that they are increasing in frequency as a result of degraded water quality and possibly climate change (Jessup and others 2009; Phillips and others 2011). The population impact on pelicans and other seabirds is not well understood (Shumway and others 2003). *Pseudonitzschia australis* is a dinoflagellate that produces domoic acid, a neurotoxin that killed an 'abnormal number' of Brown Pelicans in California in 1991 (Work and others 1993), and 150 pelicans in 1996 (Shumway and others 2003). Some species of birds may learn to avoid prey that have accumulated toxins, but pelicans swallow fish whole so may be less able to adapt (Shumway and others 2003). Blooms may also affect pelicans by reducing prey– a bloom killed sardines off South Africa, while minimally affecting anchovy (van der Lingen and others 2016).

A second type of harmful algae bloom involves the cellular breakdown of the dinoflagellate *Akashiwo sanguinea* which produces a foam containing surfactant-like proteins that foul the plumage of marine birds, causing waterlogging, hypothermia, and stranding or death. A massive 2007 event in Monterey Bay, California affected >700 marine birds, including Brown Pelicans (Jessup and others 2009). Two events occurred in autumn 2009 along the southern Washington/northern Oregon coast that were estimated to have killed >10,000 marine birds, though no pelicans were among the recovered birds (Phillips and others 2011; Jones and others 2017).

Fishery bycatch and injury and entanglement by fishing gear. Fishery bycatch is not known to be a significant problem for Brown Pelicans in Washington waters, but is a significant issue in the Gulf of California (Senner 2013). Brown Pelicans were the most frequently caught of 18 seabird species in purse-seines, with an estimated 19,430 affected during 17 months of observation (Velarde and others 2018). Birds released alive are soiled by fish oil and often succumb later. Fishing tackle can cause direct physical injury

and pelicans are occasionally hooked. Fishing gear interactions result in dozens of pelicans being cared for at rehabilitation centers each year, but there are no data suggesting this is a significant factor affecting their populations (USFWS 2009a).

CONCLUSIONS AND RECOMMENDATION

The number of Brown Pelicans occurring in Washington has increased markedly since the 1980s, though their numbers have declined in more recent years. The changes in seasonal abundance in Washington likely reflect the abundance of forage fish related to ocean conditions, and the recovery of the Southern California Bight population. Natural fluctuations in ocean conditions and forage fish abundance have caused changes in pelican numbers in Washington in the past and will again in the future.

The Brown Pelican was removed from the state-endangered list in 2016 and we do not recommend reconsidering that decision at this time. Although climate change, increases in fisheries bycatch, and breeding failures in recent years create a complicated and uncertain future for the California Brown Pelican, fairly robust numbers (~3,000) still occur seasonally in Washington. The species is likely being affected by climate change and may be a very useful indicator for seabirds; the ocean ecosystem, and breeding colonies and roost sites should continue to be monitored.

REFERENCES CITED

The references that are cited in the Periodic *Status Review for the Brown Pelican* are categorized for its level of peer review pursuant to section 34.05.271 RCW, which is the codification of Substitute House Bill 2661 that passed the Washington Legislature in 2014. A key to the review categories under section 34.05.271 RCW is provided in Table A.

Table A. Key to 34.05.271 RCW Categories:

Category Code	34.05.271(1)(c) RCW
i	(i) Independent peer review: review is overseen by an independent third party.
ii	(ii) Internal peer review: review by staff internal to the department of fish and wildlife.
iii	(iii) External peer review: review by persons that are external to and selected by the department of fish and wildlife.
iv	(iv) Open review: documented open public review process that is not limited to invited organizations or individuals.
v	(v) Legal and policy document: documents related to the legal framework for the significant agency action including but not limited to: (A) federal and state statutes; (B) court and hearings board decisions; (C) federal and state administrative rules and regulations; and (D) policy and regulatory documents adopted by local governments.
vi	(vi) Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under the processes described in (c)(i), (ii), (iii), and (iv) of this subsection.
vii	(vii) Records of the best professional judgment of department of fish and wildlife employees or other individuals.
viii	(viii) Other: Sources of information that do not fit into one of the categories identified in this subsection (1)(c).

Reference	Category
Ainley, D. G., R. L. Veit, S. G. Allen, L. B. Spear, and P. Pyle. 1995. Variations in marine bird communities of the California Current, 1986-1994. California Cooperative Oceanic Fisheries Investigations Report 36:72-77.	i
AOU (American Ornithologists' Union). 1998. Check-list of North American birds. 7th edition. Forty-fifth supplement to the American Ornithologists' Union. Auk 121:985-995.	i
Anderson, D. W., and F. Gress. 1983. Status of a northern population of California Brown Pelicans. Condor 85:79-88.	i
Anderson, D. W., and F. Gress. 1984. Brown Pelicans and the anchovy fishery off southern California. Pp 128-135, in D. N. Nettleship, G. A. Sanger, and P. F. Springer. (eds) Marine birds: their feeding ecology and commercial fisheries relationships. Proceedings of the Pacific Seabird Group Symposium, Seattle, Washington, 6-8 January 1982. Special Publication, Canadian Wildlife Service. 220 pp.	i
Anderson, D. W., F. Gress, and K.F. Mais. 1982. Brown pelicans: influence of food supply on reproduction. Oikos 39:23-31.	i

Reference	Category
Anderson, D.W., C.J. Henny, C. Godinez-Reyes, F. Gress, E. L. Palacios, K. Santos del Prado, and J. Bredy. 2007. Size of the California brown pelican metapopulation during a non-El Nino year. U. S. Geological Survey, Resdton VA, Open-File report 2007-1299. 35 pp.	i
Anderson, D. W., C. J. Henny, C. Godinez-Reyes, F. Gress, E. L. Palacios, K. Santos del Prado, J. Bredy. 2013. Size and distribution of the California brown pelican metapopulation in a non-ENSO year. Marine Ornithology 41:95-106.	i
Anderson, D.W., C.R. Godínez-Reyes, E. Velarde, R. Avalos-Tellez, D. Ramírez-Delgado, H. Moreno-Prado, T. Bowen, F. Gress, J. Trejo-Ventura, L. Adrean, L. Meltzer. 2017. Brown Pelicans, Pelecanus occidentalis californicus (Aves: Pelecanidae): Five decades with ENSO, dynamic nesting, and contemporary breeding status in the Gulf of California. Ciencias Marinas 43(1):1-34	i
Auth, T. D., R. D. Brodeur, H. L. Soulen, L. Ciannelli, and W. T. Peterson. 2011. The response of fish larvae to decadal changes in environmental forcing factors off the Oregon coast. Fisheries Oceanography 20(4):314-328.	i
Bargmann, G. 1998. Forage Fish Management Plan: a plan for managing the forage fish resources and fisheries of Washington. Washington Department of Fish and Wildlife, Olympia, Washington. 66 pp.	ii, iii
Bird Research Northwest. 2013. Columbia River Estuary, Weekly Update for 7/22 – 7/28/2013. (http://www.birdresearchnw.org/Project-Info/weekly-update/columbia-river-estuary-weekly-update/default.aspx)	vi
Bird Research Northwest. 2014. Columbia River Estuary, Weekly Update for 6/9 – 6/15. (http://www.birdresearchnw.org/Project-Info/weekly-update/columbia-river-estuary-weekly-update/default.aspx)	vi
Briggs, K.T.. W. B. Tyler, D. B. Lewis, P. R. Kelly, and D. A. Croll. 1983. Brown Pelicans in central and northern California. Journal of Field Ornithology, 54(4):353-373.	i
Brodeur, R. D., J. P. Fisher, R. L. Emmett, C. A. Morgan, and E. Casillas. 2005. Species composition and community structure of pelagic nekton off Oregon and Washington under variable oceanographic conditions. Marine Ecology Progress Series 298:41–57.	i
Burkett, E.E., R.J. Logsdon, and K.M. Fien. 2007. Status review of California Brown Pelican (*Pelecanus occidentalis californicus*) in California. Calif. Dept. of Fish and Game, Wildlife Branch, Nongame Wildlife Program Report 2007-04. 26pp.+ appendices.	viii
California Institute of Environmental Studies. 2021. California Brown Pelican Post-delisting Monitoring in the U.S. (CA). USFWS Pacific Southwest Species Fund 2015 - Submit Final Programmatic Report. NFWF Project ID: 0804.15.052216. 15 pp.	viii
CDFW (California Department of Fish and Wildlife) 2014. Review of selected California fisheries for 2013: coastal pelagic finfish, market squid, groundfish, highly migratory species, Dungeness crab, basses, surfperch, abalone, kelp and edible algae, and marine aquaculture. Fisheries Review. CalCOFI Reports 55:11-50.	i
Chavez, F. P., J. Ryan, S. E. Lluch-Cota, M. Niquen. 2003. From anchovies to sardines and back: multidecadal change in the Pacific Ocean. Science 299 (10 January):217-221.	i
Checkley, D.M.Jr, R.G. Asch, and R.R. Rykaczewski. 2017. Climate, anchovy, and sardine. Annual Review of Marine Science 9:469-493.	i
Collis, K. and D. D. Roby. 2009. Research, Monitoring, and Evaluation of Avian Predation on Salmonid Smolts in the Lower and Mid-Columbia River 2008 Final Season Summary. Report prepared for the Bonneville Power Administration and the U.S. Army Corps of Engineers. Real Time Research,	vi

Reference	Category
Inc., Bend, Oregon and Oregon State University, Corvallis, Oregon. 158 pp.	
CPSMT (Coastal Pelagic Species Management Team). 2013. Coastal Pelagic Species Management Team report on adjustments to sardine harvest parameters. Pacific Fishery Management Council, Portland Oregon. 5 pp.	i
Croll, D. A., L. T. Balance, B. G. Wursig and W. B. Tyler. 1986. Movements and daily activity patterns of a Brown Pelican in central California. Condor 88:258-260.	i
Crone, P. R., K. T. Hill, J. D. McDaniel, and K. Lynn. 2011. Pacific mackerel (*Scomber japonicus*) stock assessment for USA management in the 2011-12 fishing year. Pacific Fishery Management Council, Portland, Oregon. 100 p.	viii
Cury, P. M., I. L. Boyd, S. Bonhommeau, T. Anker-Nilssen, R. J. M. Crawford, R. W. Furness, J. A. Mills, E. J. Murphy, H. Osterblom, M. Paleczny, J. F. Piatt, J. P. Roux, L. Shannon, W. J. Sydeman. 2011. Global seabird response to forage fish depletion—one-third for the birds. Science 334:1703-1706.	i
eBird. 2013. Basic Dataset. Version: EBD_relAug-2013. Cornell Lab of Ornithology, Ithaca, New York. August 2013.	vi
Emmett, R. L., R. D., Brodeur, T. W. Miller, S. S. Pool, P. J. Bentley, G. K. Krutzikowsky, and J. McCrae. 2005. Pacific sardine (*Sardinops sagax*) abundance, distribution and ecological relationships in the Pacific Northwest. CalCOFI Report 46:122–143.	i
Erickson, W. P., G. D. Johnson, M. D. Strickland, D. P. Young, Jr., K. J. Sernka, and R. E. Good. 2001. Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of avian collision mortality in the United States. National Wind Coordinating Committee Resource Document. 62 pp.	vi
Essington, T. E. , P. E. Moriarty, H. E. Froehlich, E.E. Hodegson, L. E. Koehn, K. L. Oken, M. C. Siple, and C. C. Stawitz. 2015. Fishing amplifies forage fish population collapses. PNAS 112: 6648-6652.	i
Galasso, G. 2000.Olympic Coast National Marine Sanctuary Area to be Avoided (ATBA) Education and Monitoring Program. Marine Sanctuaries Conservation Series MSD-00-1. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Marine Sanctuaries Division, Silver Spring, MD. 35 pp	v
Hayward, T.L. 2000. El Niño 1997-98 in the coastal waters of southern California: a timeline of events. CalCOFI Report 41:98-116.	i
Hill, K. T., P. R. Crone, N. C.H. Lo, B. J. Macewicz, E. Dorval, J. D. McDaniel, and Y. Gu. 2011. Assessment of the Pacific Sardine resource in 2011 for U.S. management in 2012 NOAA-TM-NMFS-SWFSC-487. U.S. Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service Southwest Fisheries Science Center. 265 pp.	i
Hill. K. T., P. R. Crone, J. P. Zwolinski. 2019. Assessment of the Pacific sardine resource in 2019 for U.S. management in 2019-20. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-615	i
Jaques, D.L. 1994. Range expansion and roosting ecology of non-breeding California Brown Pelicans. M.S. Thesis. University of California, Davs, CA. 133 pp.	vi
Jaques, D. L. 2002. Brown Pelican distribution and abundance in Willapa Bay and surrounding estuaries: aerial survey results 2001. Annual Report to the Washington Department of Transportation, Chehalis Field Office, Chehalis, Washington. USFWS/WSDOT Project # 13552-2001-2	viii

Reference	Category
Jaques, D. and C. O'Casey. 2006. Brown Pelican Roost Site Use in Grays Harbor and Willapa Bay, Washington, 2003-2005. Final Report to Washington State Department of Transportation, Chehalis, Washington. Crescent Coastal Research, Crescent City, California.	vi
Jaques, D. L., and C. S. Strong. 2002. Disturbance to Brown Pelicans at communal roosts in southern and central California. Unpublished report prepared for the American Trader Trustee Council. Crescent Coastal Research, Astoria, Oregon. 128 pp.	vi
Jaques, D.L. and C.S. Strong. 2003. Brown Pelican Night Roost Sites on the Southern California Coast. Unpublished report prepared for American Trader Trustee Council, U.S. Fish and Wildlife Service, California Department of Fish and Game and National Oceanic and Atmospheric Administration, prepared by Crescent Coastal Research, Crescent City, California. 19 pp.	vi
Jaques, D.L. 2016. California Brown Pelican Monitoring Summary, 2014-the year of the Blob. Prepared for U.S. Fish and Wildlife Service, Ventura, CA. by D. L. Jaques, Pacific Eco Logic. 54 pp.	vi
Jaques, D.L. 2020. California Brown Pelican Community Science Survey 2019 Efficacy Evaluation. Unpublished Report. Pelican Science.	viii
Jessup, D.A., M.A. Miller, J. P. Ryan, H. M. Nevins, H. A. Kerkering, A. Mekebri, D. B. Crane, T. A. Johnson, R. M. Kudela. 2009. Mass stranding of marine birds caused by a surfactant-producing red tide. PLoS ONE 4(2): e4550. doi: 10.1371/journal. pone.0004550\	i
Jewett, S. G., W. P. Taylor, W. T. Shaw, and J. W. Aldrich. 1953. Birds of Washington State. University of Washington Press, Seattle. 767 pp.	viii
Jones, T., J.K. Parrish, A.E. Punt, V.L.Trainer, R. Kudela, J. Lang, M. Brancato, A. Odell, and B. Hickey. 2017. A mass mortality event of marine birds in the Northeast Pacific caused by *Akashiwo sanguinea*. Marine Ecology Progress Series 579:111-127.	i
Lawrence, R. H. 1892. Further notes on the birds of the Gray's Harbor region, Washington. Auk 9:352-357.	i
Leising, A. W., I. D. Schroeder, Steven J. Bograd, Eric Bjorkstedt, John Field, Keith Sakuma, and others 2014. State of the California Current 2013-14: El Niño looming. CalCOFI Reports 55: 51-87.	i
Litz, M. N. C., R. L. Emmett, S. S. Heppell, and R. D. Brodeur. 2008. Ecology and distribution of the northern subpopulation of Northern Anchovy (*Engraulis mordax*) off the U.S. west coast. CalCOFI Report 49: 167-182.	i
Lowry, D. 2013. Forage fish management in Washington. Pp 3-4, *in* T. Liedtke, C. Gibson, D. Lowry, and D. Fagergren. Conservation and Ecology of Marine Forage Fishes—Proceedings of a Research Symposium, September 2012. Publications of the US Geological Survey. Paper 116. http://digitalcommons.unl.edu/usgspubs/116	i
MacCall, A.D., W.J. Sydeman, P.C. Davison, J.A. Thayer. 2016. Recent collapse of northern anchovy biomass off California. Fisheries Research 175:87-94.	i
McFarlane, G. A., and R. J. Beamish. 2001. The re-occurrence of sardines off British Columbia characterises the dynamic nature of regimes. Progress in Oceanography 49: 151–165	i
McMahon Anderson, C., M. Mayes, and R. LaBelle. 2012. Update of Occurrence Rates for Offshore Oil Spills. OCS Report, BOEM 2012-069, BSEE 2012-069, Department of the Interior, Bureau of Ocean Bureau of Energy Management and Bureau of Safety and Environmental Enforcement, Herndon Virginia. 76 pp.	viii
Neel, J., C. Hart, D. Lynch, S. Chan and J. Harris.1997. Oil Spills in Washington State: A Historical Analysis. Washington Department of Ecology Spill Management Program, Lacey, Washington. Publication #97-252. 51 pp.	viii

Reference	Category
NMFS (National Marine Fisheries Service) Northwest and Southwest Fisheries Science Centers. 2014. Annual State of the California Current Ecosystem Report. (available at: http://www.pcouncil.org/ecosystem-based-management/annual-state-of-the-california-current-ecosystem/)	i
NMFS. 2019. Determination of Overfishing or an Overfished Condition. Federal Register / Vol. 84, No. 164 / Friday, August 23, 2019 / Notices, p. 44286-44287.	v
PFMC (Pacific Fishery Management Council). 2013. Pacific Coast Fishery Ecosystem Plan for the U.S. Portion of the California Current Large Marine Ecosystem – Public Review Draft, February 2013. Pacific Fishery Management Council, Portland, Oregon. 190 pp.	i
PFMC (Pacific Fishery Management Council). 2019. Status of the Pacific Coast Coastal Pelagic Species Fishery and Recommended Acceptable Biological Catches. Stock Assessment and Fishery Evaluation for 2018.	i
Petersen, I. K., T. K. Christensen, J. Kahlert, M. Desholm, and A. D. Fox. 2006. Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark. National Environmental Research Institute, Ministry of the Environment, Denmark. 166 pp.	i
Phillips, E. M. J. E. Zamon, H. M. Nevins, C. M. Gibble, R. S. Duerr, and L. H. Kerr. 2011. Summary of birds killed by a harmful algal bloom along the south Washington and north Oregon coasts during October 2009. Northwestern Naturalist 92:120–126.	i
Pikitch, E., P. D. Boersma,. I.L. Boyd, D. O. Conover, P. Cury, T. Essington, S. S. Heppell, E. D. Houde, M. Mangel, D. Pauly, É. Plagányi, K. Sainsbury, and R. S. Steneck. 2012. Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs. Lenfest Ocean Program. Washington, DC. 108 pp	i
Pynn, L. 2013. Sudden disappearance of sardines has serious economic and ecological effects on the B. C. coast. Vancouver Sun, 14 October.	viii
Ramseur, J. L. 2012. Oil Spills in U.S. Coastal Waters: Background and Governance, Congressional Research Service, 7-5700.	viii
Roby, D., and K. Collis. 2012. Research, Monitoring, and Evaluation of Avian Predation on Salmonid Smolts in the Lower and Mid-Columbia River. 2011 Annual Report, prepared for Bonneville Power Administration and the U.S. Army Corps of Engineers.171 pp. Available at: http://www.birdresearchnw.org/Project-Info/publications-reports/default.aspx	vi
Roby, D., K. Collis, T. J. Lawes, K. S. Bixler, D. E. Lyons, Y. Suzuki, J. Scheibe, A. Turecek, and M. Hawbecker. 2019. Implementation and Evaluation of Efforts to Reduce Predation on ESA-listed Salmonids by Caspian Terns Nesting at East Sand Island, Columbia River Estuary. 2018 Final Annual Report, prepared for the Bonneville Power Administration & Northwest Power and Conservation Council. Contract No. 60846, Project No. 1997-024-00. Oregon State University and Real Time Research, Inc. 65 pp.	vi
Roby, D., K. Collis, T. J. Lawes, K. S. Bixler, D. E. Lyons, O. Bailey, A. Turecek, and M. Hawbecker.. 2020. Monitoring and Evaluation of Efforts to Reduce Predation on ESA-listed Salmonids by Caspian Terns Nesting at East Sand Island, Columbia River Estuary. 2019 Final Report, prepared for Bonneville Power Administration & Northwest Power and Conservation Council. Contract No. 60846, Project No. 1997-024-00. Oregon State University and Real Time Research, Inc. 48 pp.	vi
Schreiber, R. W. and E. A. Schreiber. 1982. Essential habitat of the Brown Pelican in Florida. Florida Field Naturalist 10:9-17.	i
Senner, S. 2013. [Letter to Gary Frazer, Assistant Director for Endangered Species, U. S. Fish and Wildlife Service. 16 September 2013]. Pacific Seabird Group.	viii

Reference	Category
Shields, M. 2002. Brown Pelican (*Pelecanus occidentalis*). *In* The Birds of North America, No. 609 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington D.C.	i
Shumway, S. E., S. M. Allen, P. D. Boersma. 2003. Marine birds and harmful algal blooms: Sporadic victims or under-reported events? Harmful Algae 2:1–17.	i
Smith, A. D. M., C. J. Brown, C. M. Bulman, E. A. Fulton, P. Johnson, I. C. Kaplan, H. Lozano-Montes, S. Mackinson, M. Marzloff, L. J. Shannon, Y. Shin, J. Tam. 2011. Impacts of fishing low–trophic level species on marine ecosystems. Science 333(6046): 1147–1150.	i
Stephensen, S. W. 2016. California Brown Pelican aerial survey 2016 trip report. 4 pp.	vi
Stephensen, S. W. 2017. California Brown Pelican aerial survey 2017 trip report. 5 pp.	vi
Stephensen, S. W, and D. Ebert. 2014. California Brown Pelican aerial survey 2013: trip report. Oregon Coast National Wildlife Refuge Complex, Newport, Oregon. 4 pp.	vi
Stephensen, S. W, and M. J. Szumski. 2013. California Brown Pelican aerial survey 2013: trip report. Oregon Coast National Wildlife Refuge Complex, Newport, Oregon. 4 pp.	vi
Stick, K. C. and A. Lindquist. 2009. 2008 Washington State Herring Stock Status Report. Fish Management Division Fish Program, Washington Department of Fish and Wildlife. Stock Status Report No. FPA 09-05	ii
Stinson, D.W. 2015. Periodic status review for the Brown Pelican in Washington. Washington Department of Fish and Wildlife, Olympia, WA. 32+iv pp.	viii
Suckley, G. and J. G. Cooper. 1860. The natural history of Washington Territory and Oregon. Bailliere Bros., New York, NY. 399 pp.	viii
Sydeman, W.J., E. Poloczanska, T.E. Reed, S.A. Thompson. 2015. Climate change and marine vertebrates. Science 350 (13 November):772-777	i
Thompson, C.W., K. Ryan, J.K. Parrish, S. Zador, and K. Warheit. 2003. Restoration of Common Murre Colonies in the Copalis National Wildlife Refuge, Washington Phase I [draft final report]. Lacey, Washington: Tenyo Maru Trustee Committee.	viii
USFWS (U.S. Fish and Wildlife Service). 1983. The California brown pelican recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. 179 pp.	v
USFWS (U.S. Fish and Wildlife Service). 1985. Removal of the Brown pelican in the southeastern United States from the list of endangered and threatened wildlife. 50 Federal Register 23:4938-4945.	v
USFWS (U.S. Fish and Wildlife Service). 2007. Listed Distinct Population Segment of the Brown Pelican (*Pelecanus occidentalis*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Division of Ecological Services, Southwestern Regional Office, Albuquerque, New Mexico. 66 pp.	v
USFWS (U.S. Fish and Wildlife Service). 2009a. Removal of the Brown Pelican (*Pelecanus occidentalis*) from the federal list of endangered and threatened wildlife: Final Rule. Federal Register 74(220): 59444-59472 (November 17, 2009).	v
USFWS (U.S. Fish and Wildlife Service). 2009b. Draft post-delisting monitoring plan for the brown pelican. U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office, Ventura, California. 19 pp.	v
USFWS (U.S. Fish and Wildlife Service). 2013. Proposed threatened status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (*Coccyzus americanus*): Proposed rule. Federal Register 78(192): 61622-61666 (October 3, 2013).	v

Reference	Category
Van der Lingen C.D, L. Hutchings, T. Lamont, and G.C. Pitcher. 2016. Climate change, dinoflagellate blooms and sardine in the southern Benguela Current Large Marine Ecosystem. Environmental Development 17(Suppl. 1):230–43	i
Van Dorp, J.R. and J.R.W. Merrick. 2013. DRAFT Final Report Vessel Traffic Risk Assessment (VTRA) 2010, Preventing Oil Spills From Large Ships and Barges In Northern Puget Sound & Strait of Juan de Fuca, Prepared for the Washington State Puget Sound Partnership.	viii
Velarde, E., E. Excurra, and D.W. Anderson. 2015. Seabird diet predicts following-season commercial catch of Gulf of California Pacific Sardine and Northern Anchovy. J. of Marine Systems 146:82-88.	i
Velarde, E., D.W. Anderson, and E. Gastelum-Nava. 2018. (abstract). Pacific Seabird Group, 45th Annual Meeting.	viii
Wahl, T. R. 2005. Brown Pelican. Pages 96-97 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow, eds. Birds of Washington: status and distribution. Oregon State University Press, Corvallis. 436 pp.	i
Washington Department of Ecology. 2012. Spill Prevention, Preparedness and Response Program 2012-2013 Program Plan. Olympia, Washington.	viii
Washington Department of Ecology. 2015. Washington state 2014 marine and rail oil transport study. Publication 15-08-010. Spill Prevention, Preparedness & Response Program, Washington Department of Ecology, Olympia, Washington. 570 pp.	viii
WOSNews (Washington Ornithological Society). 2005-2011. WOSNews Issues 103-129.	viii
Work, T.M., B. Barr, A. Beale, L. Fritz, M.A. Quilliam, and J. L.C.Wright. 1993. Epidemiology of domoic acid poisoning in Brown Pelicans (*Pelicanus occidentalis*) and Brandt's Cormorants (*Phalcrocorax penicillatus*) in California. Journal of Zoo and Wildlife Medicine 24(1):54-62.	i
Wright, S. K. 2004. Disturbance and roosting ecology of California brown pelicans (*Pelecanus occidentalis californicus*) on East Sand Island in the Columbia River Estuary. M. S. Thesis. Oregon State University, Corvallis, Oregon. 106 pp.	viii
Wright, S. K., D. D. Roby, and R. G. Anthony. 2007. Responses of California Brown Pelicans to disturbances at a large Oregon roost. Waterbirds 30 (4):479-487.	i
Wright, S. K., D. D. Roby, and R. G. Anthony. 2012. Factors affecting the behavior of Brown Pelicans at a post-breeding roost. Western Birds 43:21-36.	i
Zwolinski, J. P., and D. A. Demer. 2012. A cold oceanographic regime with high exploitation rates in the Northeast Pacific forecasts a collapse of the sardine stock. PNAS| vol. 109(11): 4175–4180	i

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APPENDIX A. Public Comments

WDFW received four comments during the 90-day public comment period. Two supported the recommendation to maintain the de-listed status of the Brown Pelican. Two did not make a clear recommendation; one remarked about the appearance and increase in Brown Pelican numbers on the lower Columbia River and possible association with the ban of DDT; the other was critical of WDFW and the state of Columbia River fish stocks, but made no suggestion about Brown Pelicans.

Washington State Status Reports, Periodic Status Reviews, Recovery Plans, and Conservation Plans

Periodic Status Reviews

2022 Brown Pelican
2022 American White Pelican
2022 Cascade Red Fox
2022 Snowy Plover
2021 Gray Whale
2021 Humpback Whale
2021 Greater Sage-grouse
2020 Mazama Pocket Gopher
2019 Tufted Puffin
2019 Oregon Silverspot
2018 Grizzly Bear
2018 Sea Otter
2018 Pygmy Rabbit
2017 Fisher
2017 Blue, Fin, Sei, North Pacific Right, and Sperm Whales
2017 Woodland Caribou
2017 Sandhill Crane
2017 Western Pond Turtle
2017 Green and Loggerhead Sea Turtles
2017 Leatherback Sea Turtle
2016 American White Pelican
2016 Canada Lynx
2016 Marbled Murrelet
2016 Peregrine Falcon
2016 Bald Eagle
2016 Taylor's Checkerspot
2016 Columbian White-tailed Deer
2016 Streaked Horned Lark
2016 Killer Whale
2016 Western Gray Squirrel
2016 Northern Spotted Owl
2016 Greater Sage-grouse
2016 Snowy Plover
2015 Steller Sea Lion

Conservation Plans

2013 Bats

Recent Status Reports

2019 Pinto Abalone
2017 Yellow-billed Cuckoo
2015 Tufted Puffin
2007 Bald Eagle
2005 Mazama Pocket Gopher, Streaked Horned Lark, and Taylor's Checkerspot
2005 Aleutian Canada Goose
1999 Northern Leopard Frog
1999 Mardon Skipper
1999 Olympic Mudminnow
1998 Margined Sculpin
1998 Pygmy Whitefish
1997 Gray Whale
1997 Olive Ridley Sea Turtle
1997 Oregon Spotted Frog

Recovery Plans

2020 Mazama Pocket Gopher
2019 Tufted Puffin
2012 Columbian Sharp-tailed Grouse
2011 Gray Wolf
2011 Pygmy Rabbit: Addendum
2007 Western Gray Squirrel
2006 Fisher
2004 Sea Otter
2004 Greater Sage-Grouse
2003 Pygmy Rabbit: Addendum
2002 Sandhill Crane
2001 Lynx
1999 Western Pond Turtle
1996 Ferruginous Hawk
1995 Pygmy Rabbit
1995 Snowy Plover

Status reports and plans are available on the WDFW website at:

http://wdfw.wa.gov/publications/search.php