

U.S. Army Corps of Engineers – Walla Walla District

Caspian Tern Colony Site Assessment: Management Opportunities in Western North America

Final Report



**CASPIAN TERN COLONY SITE ASSESSMENT:
MANAGEMENT OPPORTUNITIES IN WESTERN NORTH AMERICA**

Final Report

Submitted to:

U.S. Army Corps of Engineers – Walla Walla District

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EXECUTIVE SUMMARY

We compiled existing information on biological factors throughout the breeding range of Caspian terns (*Hydroprogne caspia*) in western North America to assess potential locations as alternative nesting sites for Caspian terns currently nesting at certain colonies in the Columbia Plateau region of Washington. This work provides an update and expansion upon the previous review of Caspian tern nesting habitat in western North America by the U.S. Fish and Wildlife (Seto et al. 2003). This report presents information for consideration with regard to the possible relocation of Caspian terns nesting at colonies on Crescent Island (in McNary Pool on the mid-Columbia River near Wallula, WA) and on Goose Island (in Potholes Reservoir near Othello, WA) to alternative colony sites as part of a prospective management plan for Caspian terns in the Columbia Plateau region (i.e., Inland Avian Predation Management Plan [IAPMP]).

A total of 145 current, former, or potential Caspian tern colony sites were identified in western North America (Alaska to northwestern Mexico, west of the Continental Divide). Movement data from Caspian terns banded at Crescent Island or Goose Island-Potholes during 2005-2011 indicated some connectivity across an extensive array of sites throughout coastal and interior western North America. Specifically, Caspian terns banded at Crescent Island or Goose Island-Potholes were re-sighted at nesting or roosting locations in Alaska, British Columbia, Washington, Oregon, California, Idaho, Utah, and northwestern Mexico.

Evaluations of the 145 potential alternative nesting sites for Caspian terns identified by this study were conducted via literature review, colonial waterbird atlases, online databases, and extensive discussions with academic, federal, state, non-governmental, and provincial biologists across western North America. Our results suggested that 41 of these sites (28%) have management potential, 82 sites (57%) were considered to not have management potential, and there was insufficient information available to evaluate 22 sites (15%); 17 of the 22 sites with insufficient information are in Mexico or Canada.

The efficacy of initiatives developed as part of the IAPMP to increase salmonid smolt survival through reductions in the number of nesting Caspian terns at certain colonies in the Columbia Plateau region depends not only on the successful reduction in numbers of nesting Caspian terns at Crescent Island and/or Goose Island-Potholes, but also on adaptive management to prevent terns from forming new colonies that would negate those reductions. Prospective tern colony sites located on the Columbia or Snake rivers were therefore considered to not have management potential due to the likelihood of continued conflicts with ESA-listed salmonids from the Columbia River basin. Similarly, potential colony sites on the Columbia or Snake rivers

where suitable tern nesting habitat is currently available may require some level of adaptive management to prevent Caspian terns from relocating to these sites.

Biological characteristics for the 41 sites with apparent management potential were then used to assess the suitability of each site to attract Caspian terns to nest, the potential constraints at the site for sustaining a Caspian tern colony, and considerations for enhancing the site to accommodate a Caspian tern breeding colony. Of the 41 sites that were considered to have management potential, 13 were considered to have high overall suitability as alternative Caspian tern colony sites, based on 15 suitability criteria and additional site information.

Of the 13 sites considered to have high overall suitability as alternative Caspian tern colony sites, all are in either Washington or California; 4 are in coastal Washington, 3 are in interior Washington, 3 are in coastal northern California, 1 is in interior northern California, and 2 are in coastal southern California. Each of these 13 sites, however, ranked poorly in at least one suitability criterion, indicating that some biological conflicts or constraints exist at even the most suitable management sites. For instance, at some of the 13 highly-suitable sites, there is potential geographic overlap between a new or expanded Caspian tern breeding colony and threatened or endangered fish species protected by the U.S. Endangered Species Act (ESA). Caspian tern diet data were generally lacking at the majority of these potential colony sites; thus, potential conflicts were evaluated based on spatial overlap alone. Actual site-specific impacts, therefore, are difficult to predict because the availability of alternative prey and factors influencing the susceptibility of ESA-listed fish species to Caspian tern predation are not known for all sites. Further investigation of this and other biological conflicts or constraints (e.g., factors limiting tern colony size and nesting success) may be prudent prior to or as part of the final site selection conducted by the resource management agencies in order to avoid conflicts with other fish species of conservation concern and effectively manage those factors that might prevent colony establishment or long-term colony viability.

Overall, this colony site assessment evaluated biological factors influencing establishment of a suite of potential sites that could be restored, created, or enhanced to attract nesting Caspian terns. Assessments of social, political, and economic factors that could legitimately influence the selection of alternative colony sites for Caspian terns were outside the scope of this report. Additionally, potential conflicts were limited to federally protected fish and wildlife species and did not include foreign (Canada, Mexico), state, or local species or populations of conservation, economic, or cultural concern. Consideration of these possible conflicts, public input, and long-term strategies to evaluate the effectiveness of this plan will be necessary to assess the success of Caspian tern management to increase survival of juvenile salmonids from the Columbia River basin.

INTRODUCTION

As part of an earlier review of Caspian tern (*Hydroprogne caspia*) nesting habitat in western North America, Seto et al. (2003) summarized sites available to restore, create, or enhance nesting habitat for Caspian terns throughout most of western North America. The report herein is intended to provide an update and expand upon that review of Caspian tern nesting habitat, with a particular emphasis on prospective alternative colony sites for Caspian terns currently nesting in the Columbia Plateau region of Washington.

Should Caspian tern colonies in the Columbia Plateau region be managed to reduce their impact on ESA-listed salmonids, we anticipate that displaced terns will likely relocate to alternative nesting sites both within and outside the Columbia Plateau region. For instance, Caspian terns banded at the breeding colony on Crescent Island in the mid-Columbia River have been re-sighted at numerous other Caspian tern nesting sites throughout western North America (Suzuki 2012). The potential for these sites to sustain colonies of nesting Caspian terns, however, varies greatly due to a number of biological constraints.

The objectives of this Colony Site Assessment are to (1) identify sites or regions where Caspian terns potentially displaced from colonies on the Columbia Plateau including Crescent Island (in McNary Pool on the mid-Columbia River) and/or on Goose Island (in Potholes Reservoir, WA) may relocate to, (2) identify potential Caspian tern nesting sites throughout the range of the Pacific Coast/Western Population of Caspian terns, and (3) evaluate the management potential of each potential colony site with regard to its prospects for attracting and sustaining a colony of nesting Caspian terns. Objective 1 utilized data from Caspian terns banded at Crescent and Goose islands in the Columbia Plateau region to determine connectivity with other Caspian tern colonies in western North America. Objectives 2 and 3 evaluated biological characteristics to assess the relative suitability of alternative sites for sustaining a colony of nesting Caspian terns.

This colony site assessment evaluated biological characteristics to establish a suite of potential sites that can be considered for restoration, creation, or enhancement as nesting habitat for Caspian terns. Assessments of social, political, and economic constraints to site development, although important, are outside the scope of this report. Public input, inter-agency coordination, and research will be required as part of the decision process for establishing a network of suitable colony sites for Caspian terns in western North America and their long-term management.

METHODS

Geographic Scope

The Pacific Coast/Western North America Population of Caspian terns is known to breed locally along the coast from western Alaska to Baja California Sur, and inland at colonies in British Columbia, Washington, Oregon, California, Nevada, Idaho, Wyoming, Montana, and Utah (Wires and Cuthbert 2000, Shuford and Craig 2002; Figure 1). An extensive array of sites within the breeding range of the species west of the Continental Divide was evaluated to determine management opportunities for the creation, enhancement, or expansion of Caspian tern nesting sites. For the purposes of this report, the geographic scope of the study area was subdivided into 19 regions, similar to those used in the review of Caspian tern nesting habitat by the U.S. Fish and Wildlife Service (Table 1; Seto et al. 2003).

Colony and Regional Connectivity

Data from Caspian terns banded at the Crescent Island and Goose Island-Potholes breeding colonies during 2005-2011 were summarized to evaluate where nesting Caspian terns may disperse to if Columbia Plateau colonies are managed. Caspian terns were banded with a metal leg-band issued by USGS and two small colored plastic leg-bands on one leg and a wide plastic leg-band engraved with an alphanumeric code on the other leg (see Suzuki 2012 for description of methods). A total of 962 terns (148 adults and 814 chicks) and 522 terns (110 adults and 412 chicks) were banded at Crescent Island and Goose Island, respectively, during 2005-2011. Band re-sighting was at least opportunistically attempted in 13 of the 19 regions in the study area. Efforts to re-sight banded Caspian terns varied among regions and locations/colonies, with re-sighting conducted daily at some locations/colonies and infrequently (e.g., 1 time per breeding season) at other locations/colonies. Therefore, these results document connectivity among regions/sites, but do not represent movement rates or degrees of connectivity among regions/sites. In general, Caspian terns were color-banded and re-sighted at breeding colonies throughout the breeding range of this population, with more effort on re-sighting in the Columbia River basin. Less intensive re-sighting effort, including opportunistic reports from local agencies and citizens, was conducted at some sites in Alaska, British Columbia, Washington, Oregon, California, Montana, Idaho, Utah, and northwestern Mexico.

Site Identification and Evaluation

Site assessments were focused on historical and currently-active Caspian tern colonies within the breeding range of the Pacific Coast/Western North America Population. All sites identified by Seto et al. (2003) and new sites identified by Bird Research Northwest or other participating agencies were included.

Management potential of all sites was evaluated, and sites were considered not to have management potential if the site was (1) located on the Columbia or Snake rivers, (2) located in the same water body or near a previously constructed island for Caspian tern nesting (< 20 km) as part of the Columbia River Estuary Caspian Tern Management Plan [CRECTMP]), or (3) other factors limiting management potential at the site as noted in the report.

For each site considered to have management potential, biological information was collected to assess the current condition of the site and evaluate management opportunities for creation, enhancement, or expansion of Caspian tern nesting habitat. Each site was then assessed based on its suitability to attract and sustain nesting by Caspian terns. Suitability ranking involved 15 different criteria, which are listed and defined in Appendix 1. In brief, suitability ranking criteria for each site with management potential included (1) Caspian tern nesting status, (2) documented use of site by Caspian terns, (3) Caspian tern connectivity as determined by band re-sighting, (4) distance from Crescent or Goose islands, (5) nesting status of inter-specific allies (e.g., gulls) at the site, (6) potential conflicts with ESA-listed fish species, (7) potential conflicts with federally protected species other than fish species (e.g., ESA-listed bird species), (8) potential for human or other disturbances to nesting terns, (9) accessibility to terrestrial mammalian predators, (10) possible impacts from avian predators (e.g., bald eagles, great horned owls), (11) annual availability of site due to fluctuating water levels, (12) distance to a previously constructed Caspian tern mitigation site, (13) site preparation requirements, (14) site maintenance requirements, and (15) land ownership. Suitability ranking criteria 1-5 describe the potential of the site to attract terns, criteria 6-11 address potential constraints at each site, while criteria 12-15 describe considerations for site enhancement. Specific details on the evaluation of potential conflicts with ESA-listed fish species are provided in Appendix 3.

Academic, federal, state, non-governmental, and provincial biologists across western North America were contacted for information on those sites not surveyed by BRNW (see Appendix 4 for a list of agency and other contacts). Published papers, unpublished reports, colonial waterbird atlases, and online databases were also used, when available. Most sites evaluated in this report were not visited by BRNW. Similarly, although extensive discussions occurred, some parties with management authority or stakeholders at each site were not contacted.

Potential Conflicts with ESA-listed Fish Species

Spatial overlap between the potential foraging range of prospective Caspian tern colonies (80-km; Adrean 2011) and fish species listed as Threatened or Endangered under the U.S. Endangered Species Act as of March 2012 were evaluated to determine whether ESA-listed fish are potential prey for terns nesting at a prospective colony site. Overlap between the potential

foraging range of Caspian terns nesting at a prospective colony site and known critical habitat of ESA-listed fish species was based on the colony location and designated critical habitat for the ESA-listed fish species (NOAA 2012; USFWS 2012), where available. In cases where designated critical habitat was not available, overlap was evaluated based on species distribution maps or other geospatial maps provided by the listing agency. Critical habitat for listed anadromous fish was limited to freshwater because migration routes for anadromous fish in marine waters are largely unknown. As such, overlap between the potential foraging range of prospective colonies and ESA-listed anadromous fish species was limited to the natal waters and freshwater migration corridors of each fish species.

Breeding Caspian terns are known to forage up to 80 km (50 miles) from their breeding colony (Adrean 2011); however, the vast majority of foraging occurs much closer to the colony (Lyons et al. 2005, Anderson et al. 2005, Lyons et al. 2007, Adrean 2011). To account for this, two different scenarios were used to evaluate geospatial overlap between a prospective colony site and the presence of an ESA-listed fish species: (1) ESA-listed fish were documented within the potential foraging distance (80 km) of the site or (2) ESA-listed fish were documented at the site (i.e., contiguous waters surrounding the colony). In some cases ESA-listed fish were documented within potential foraging range but were considered unavailable to Caspian terns because birds would have to travel long distances over land to forage on the fish in mountain streams, a very unlikely scenario.

Because diet data were generally lacking at prospective alternative colony sites, potential conflicts with ESA-listed fish were determined by spatial overlap alone. Impacts to ESA-listed fish populations (i.e., fish losses relative to population abundance) from Caspian tern predation at prospective colony sites may vary greatly depending on numerous factors, including availability of alternative prey, fish behavior and life history characteristics, foraging range of terns nesting at a specific colony, and other factors (Appendix 3). Results from the few sites where diet data and fish abundance were available were taken into consideration and are presented in Appendix 3.

Finally, the ESA-listed prey species analysis does not include foreign (Canada, Mexico), state, or local fishes of conservation concern. Similarly, non-listed fish of high economic or cultural value were not included but may be of importance to advocacy groups, states, tribes, or federal agencies.

SUMMARY OF FINDINGS

The following is a summary of the results from this assessment of alternative Caspian tern colony sites for consideration in the preparation of an Inland Avian Predation Management Plan (IAPMP).

Identification of Sites

- 134 currently active (in 2011) or formerly active (pre-2011) nesting sites for Caspian terns were cataloged in western North America (west of the Continental Divide, from Alaska to northwestern Mexico; Figure 1), of which 32 colonies were confirmed to have been active during the 2011 breeding season (Table 1, Figure 2).
- Caspian terns banded at Crescent Island or Goose Island-Potholes during 2005-2011 have been re-sighted at 17 different colony sites and 5 different roost sites, including sites in British Columbia, coastal Washington, interior Washington, coastal Oregon, interior Oregon, coastal northern California, interior northern California, coastal southern California, interior southern California, Idaho, and northwestern Mexico (Table 2). Other data sets suggest additional population connectivity to Idaho, Utah, and Alaska (Y. Suzuki, OSU, unpubl. data).
- 145 current, former, or potential Caspian tern colony sites in western North America were evaluated for their management potential as alternative nesting sites for Caspian terns that currently nest at sites in the Columbia Plateau region; 41 of these sites (28%) were considered to have management potential, 82 sites (57%) were considered to not have management potential, and there was insufficient information available to evaluate 22 sites (15%); 17 of the 22 sites with insufficient information are in Mexico or Canada (Table 3).
- Potential, former, or existing State, Tribal, County, or local policies against restoring, enhancing, or creating Caspian tern colony sites at the 145 colony sites evaluated here were not considered in this analysis.

Sites with Management Potential

- Of the 41 sites that were considered to have management potential as alternative Caspian tern colony sites, 13 were considered to have high overall suitability (Table 4, Figure 3) based on 15 suitability criteria that each site was scored on and other site information (Appendix 1); these suitability criteria evaluated sites based on the potential to attract Caspian terns to nest at the site, the potential constraints of the site to support a Caspian tern colony, and considerations for enhancing the site to accommodate a Caspian tern

breeding colony (Table 4; see Appendix 2 for site notes on all 41 sites considered to have management potential).

- All of the high-suitability colony sites have a history of Caspian tern and gull nesting, and most (62%) are currently active (during the 2011 breeding season).
- Connectivity between Columbia Plateau Caspian tern colonies and the regions of the alternative colony sites deemed to have high suitability has been documented for all of the high-suitability sites.
- Although conflicts with listed/protected forage fish species are possible at some of the high-suitability sites, the impacts are not expected to be significant, based on currently available information.
- Human disturbance and predation by terrestrial mammals or avian raptors were generally determined to have very little to moderate impact to nesting terns at all the high-suitability sites.
- All high-suitability sites identified in this analysis, with the exception of Goose Lake, CA, are outside the potential foraging range of existing tern islands created as part of the CRECTMP.
- Most of the prospective high-suitability sites (69%) were considered to require moderate to little in the way of site preparations for tern nesting, and all high-suitability sites were deemed to require moderate to very little subsequent site maintenance.
- Nine of 13 high-suitability alternative colony sites are located on the coast (Table 4); in recent history, coastal sites have generally supported larger, more persistent Caspian tern colonies than interior sites; no sites in Idaho, Utah, Wyoming, or Montana were considered to have high overall suitability because Caspian tern colonies in these states have generally been small and ephemeral.
- Of the 13 sites considered to have high overall suitability as alternative Caspian tern colony sites, all are in Washington or California; 4 are in coastal Washington, 3 are in interior Washington, 3 are in coastal northern California, 1 is in interior northern California, and 2 are in coastal southern California (Table 4).
- Of the 13 prospective Caspian tern colony sites with a high-suitability ranking, sites in coastal southern California (Terminal Island in Los Angeles Harbor and the salt works in San Diego Bay NWR) had very little or no geographic overlap with ESA-listed fish (Tables 5-6).

- Additional prospective colony sites along the coast with a high-suitability ranking and minimal concern over potential impacts on ESA-listed fish include Hayward Regional Shoreline and Agua Vista Park in San Francisco Bay, California; Smith and Minor islands in the Strait of Juan de Fuca, Washington; and Sand Island in Grays Harbor, Washington (Tables 5-6, Appendix 3).
- Additional prospective colony sites in the interior with a high suitability ranking and perhaps minimal concern over potential impacts on ESA-listed fish include Goose Lake, northeastern California; Twining Island and Goose Island on Banks Lake, Washington; and Harper Island in Sprague Lake, Washington (Tables 5-6, Appendix 3).
- Each of the 13 high-suitability sites ranked poorly in at least one suitability criterion, indicating that potential biological conflicts or constraints could exist at even the most suitable management sites (Table 7).
- Factors limiting current tern colony size and nesting success are uncertain for at least 4 of the 13 high-suitability sites (i.e., Goose Lake, northeastern California; Twining Island and Goose Island on Banks Lake, Washington; and Harper Island in Sprague Lake, Washington; see Appendix 2). Further investigation of these uncertainties may be prudent prior to or as part of the final site selection conducted by the resource management agencies.
- Additional data to address these uncertainties may lead to changes in the relative rank/suitability of a site as a prospective colony site for Caspian terns.

MANAGEMENT CONSIDERATIONS

Efforts to reduce predation on Columbia Basin salmonids without adversely affecting the Caspian tern population in western North America may require redistribution of tern colony sites in the Columbia Plateau region to multiple dispersed colony sites elsewhere within their breeding range (USFWS 2005). This approach would require the implementation of management initiatives to dissuade terns from nesting at sites in the Columbia Plateau region that are deemed undesirable, while attracting the displaced terns to alternative nest colony sites deemed suitable. The following are a list of management considerations that may aid in developing such a short- and long-term plan.

Tern Nesting Habitat

- Caspian terns prefer to nest on islands with patches of open, non-vegetated habitat (Quinn and Sirdevan 1998), at a safe elevation above the high water line, in the presence of interspecific allies (i.e., gulls), and devoid of terrestrial mammalian predators (Cuthbert and Wires 1999).
 - If suitable island sites are unavailable, Caspian terns have also been documented to nest on rooftops, piers, barges, and at fenced mainland sites.
- In inland regions, suitable colony sites for Caspian terns are generally located on lakes, reservoirs, diked impoundments, or large rivers that have ample prey fish availability and open water habitat for foraging. Caspian tern nesting at inland sites is limited primarily by lake/reservoir/river levels as it affects the availability of suitable nesting habitat, prey availability, competition with other colonial waterbirds for nest sites, and predation by gulls and other predators (e.g., great horned owls, mink).
- At coastal/estuarine sites, Caspian terns have been observed to nest on islands, diked impoundments, rooftops, piers, and barges. Natural tern nesting habitat along the coast seems to be primarily limited by the availability of protected island sites, vegetation encroachment, competition for nest sites with other colonial waterbirds, and predation by gulls and other predators (in particular, bald eagles at north coast sites). Food is generally not limiting at coastal/marine sites.
- Tern nesting habitats are typically ephemeral, and can be created or destroyed during winter storm events (coast) or during floods/droughts (inland).

Colony and Regional Connectivity

- Breeding Caspian terns adapt to changes in available nesting habitat and other factors affecting their colony size and nesting success by shifting their nesting activities among sites. Consequently, Caspian terns have the ability to shift their nesting activities from site to site more readily than most other colonial seabirds (Cuthbert 1988, Cuthbert and Wires 1999).
- Due to high vagility, delayed onset of reproduction, and high adult annual survival of Caspian terns in this metapopulation (i.e., the Western North America Population), individuals can prospect and select nest sites over an extensive area, hence establishing a high degree of connectivity among colonies throughout western North America (Suzuki 2012).

- Caspian terns displaced from colonies in the Columbia Plateau region as part of the IAPMP are likely to relocate to existing or historical Caspian tern colony sites and/or to locations where inter-specific allies (e.g., gulls) are currently nesting.
- In the short term (i.e., first year or two), some, if not most, of the Caspian terns displaced from colonies on the Columbia Plateau would likely initially prospect for nest sites in the Columbia Plateau region. These sites likely include, but are not limited to:
 - Columbia River sites with a documented or suspected history of Caspian tern nesting (i.e., Blalock Islands, Badger Island, Foundation Island)
 - Historical nest sites with suitable nesting habitat on the Columbia River (i.e., Miller Rocks)
 - Islands on the Columbia River with no history of tern nesting, but where gulls are currently nesting and suitable habitat exists (e.g., Richland Islands)
 - Other Columbia Plateau sites off the Columbia River that are currently, or have a recent history of tern/gull nesting (i.e., Twining and Goose islands in Banks Lake, Harper Island in Sprague Lake, islands in Potholes Reservoir other than Goose Island).
- Band re-sighting data suggest that Caspian terns displaced from their colonies on the Columbia Plateau would eventually relocate to existing or newly-created tern nesting habitat outside the region, even if it is a great distance from the Columbia Plateau.

Critical Uncertainties

- Most sites evaluated in this report were not visited, nor were all the parties with management authority or stakeholders at each site contacted or spoken to. Site visits and extensive discussions with local agencies/stakeholders would greatly benefit any final decisions on site selection.
- Further evaluation of some sites may be necessary to determine the factors limiting Caspian tern colony size and nesting success in order to effectively manage those factors that might prevent colony establishment or long-term colony viability.
- Without diet studies and data on fish abundance it is not possible to accurately determine the impacts of a newly restored Caspian tern colony on fish prey species of conservation concern. These data are lacking for most of the sites evaluated in this report.

- If needed, temporary nest sites can be established (e.g., using floating nesting rafts or barges) at some locations to collect information on these critical uncertainties prior to establishment of a permanent colony site (Lampman et al. 1996, Quinn et al. 1996, Collis et al. 2002b).

Tern Colony Establishment and Sustainability

- To maximize the likelihood of initial colony establishment, a combination of habitat enhancement, social attraction, colony monitoring, and predator control are required (Kress 1983).
- Once established, on-going (annual or periodic) management of the nesting habitat (e.g., vegetation control and erosion abatement) and other factors limiting tern colony size and nesting success (e.g., predator control) may be needed to ensure the long-term sustainability of the site as nesting habitat for Caspian terns.
- Creation, enhancement, or restoration of multiple Caspian tern colony sites would increase the likelihood that at least some colony sites would be available in all years.
- It may be preferable to create, enhance, or restore Caspian tern nesting sites that are not proximal to other newly created nest sites (i.e., as part of the CRECTMP). As part of CRECTMP (USFWS 2005), a total of 9 islands have been built in interior Oregon and California as alternative nesting habitat for Caspian terns that previously nested on East Sand Island in the Columbia River estuary. Coastal/estuarine nesting islands and interior sites not proximal to those mentioned above may be preferred as alternative colony sites for Caspian terns as part of the IAPMP (P. Schmidt, USACE, pers. comm.).
- If Caspian terns displaced from colonies on Crescent and/or Goose islands relocate to other islands on the mid-Columbia River, the per-capita impacts to Columbia Basin salmonids will likely be similar to those of terns nesting at Crescent and Goose islands (Collis et al. 2002a, Evans et al. 2012). If this is a concern to managers, adaptive management may be necessary to prevent Caspian terns from nesting at other sites on or within foraging range of the Columbia and Snake rivers.
- The efficacy of any initiatives developed as part of the IAPMP would depend not only on the successful redistribution of Caspian terns from sites on the Columbia Plateau to more suitable sites elsewhere, but also on preventing Caspian terns from emigrating in large numbers to the Plateau from other managed sites (i.e., East Sand Island), as well as unmanaged sites. It is likely that emigration rates to the Columbia Plateau region would

lessen if ample suitable nesting habitat was available for all Caspian terns belonging to the Western North America Population at colony sites outside the Columbia Plateau region.

- Given the high degree of connectivity among colony sites in western North America, especially between the Columbia River estuary and the Columbia Plateau region, any initiatives developed as part of the IAPMP should be considered an action at the scale of the metapopulation (western North America), as opposed to the region (Columbia Plateau).

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FIGURES

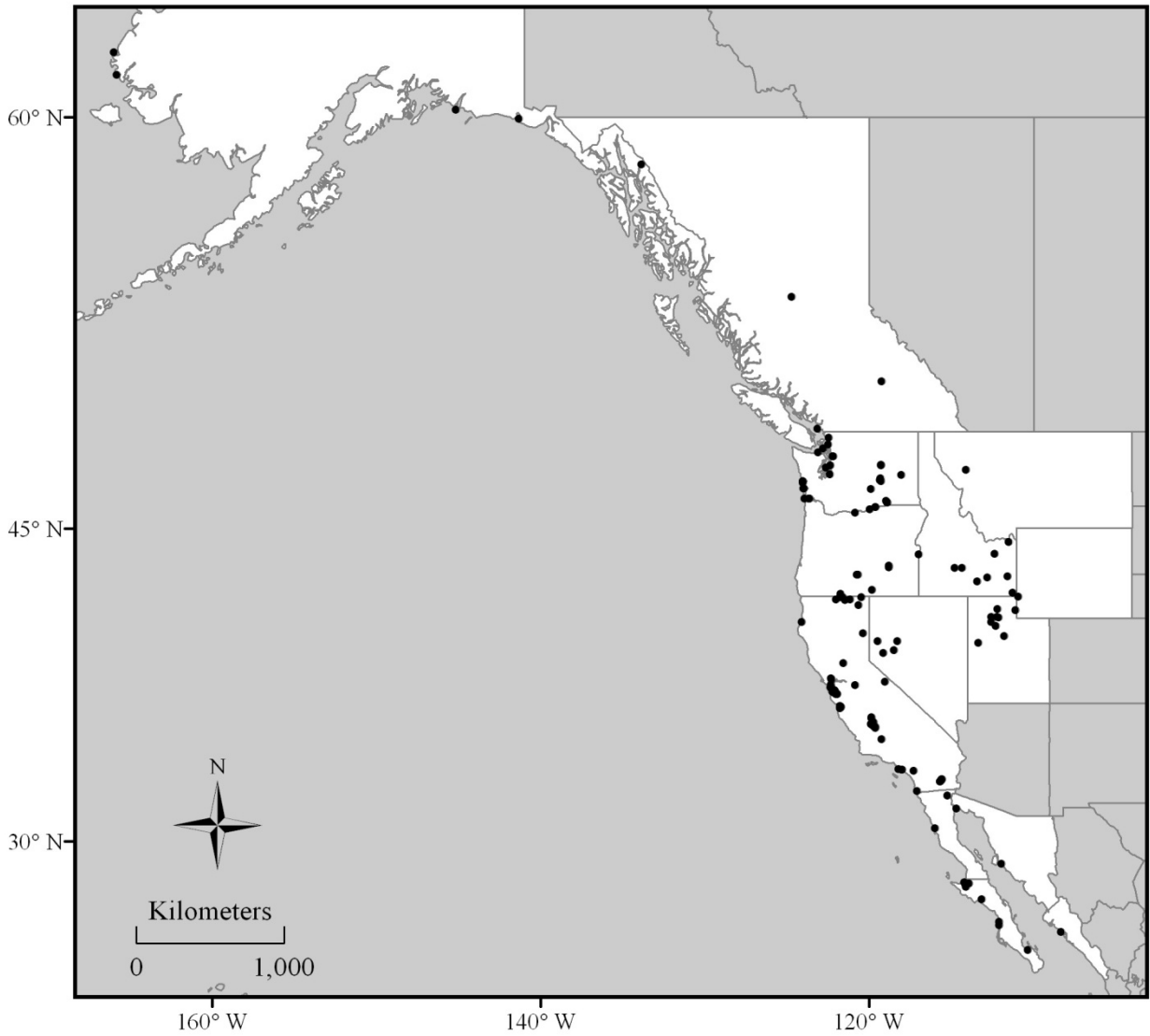


Figure 1. Distribution of current and historical Caspian tern breeding colonies within the Inland Avian Predation Management Plan affected environment.

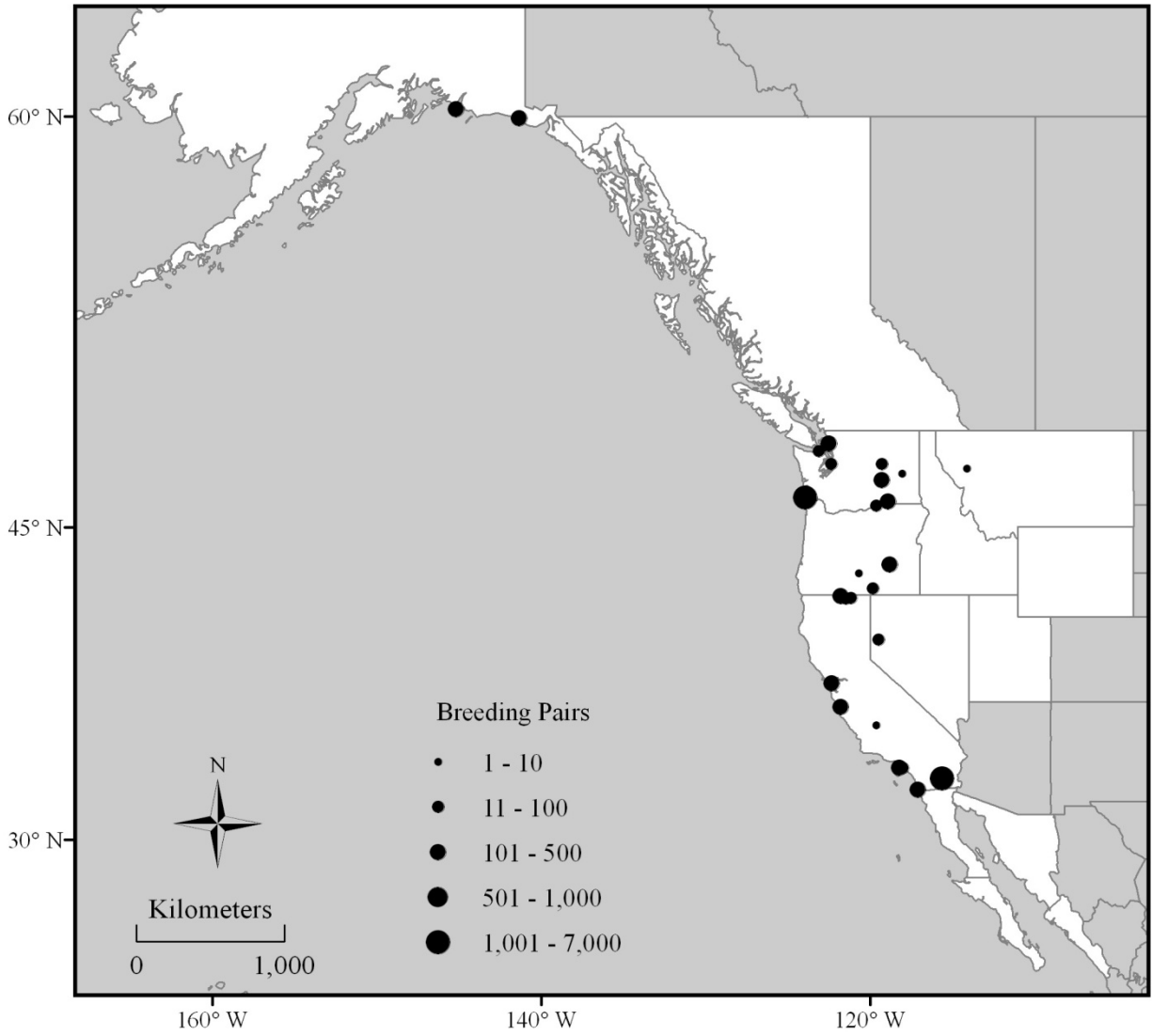


Figure 2. Distribution and relative size of Caspian tern breeding colonies surveyed in 2011.

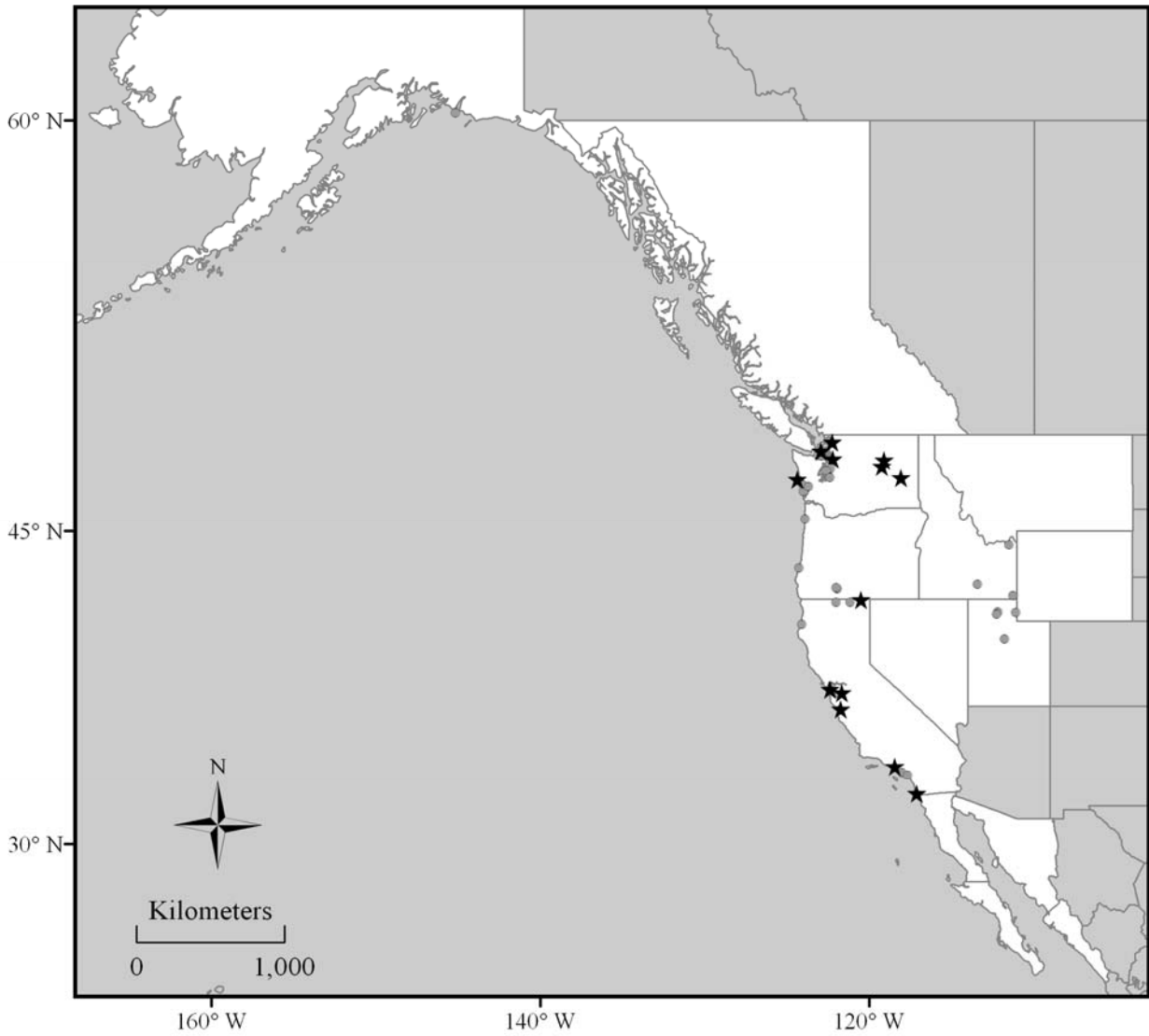


Figure 3. Distribution of potential management sites for Caspian tern breeding colonies (n = 41 sites). Sites are separated into moderate management potential sites (grey circles; n = 28) and high management potential sites (stars; n = 13).

TABLES

Table 1. Known historical and currently active Caspian tern colonies (N = 134) in western North America (west of the Continental Divide). List of Caspian tern colony sites from Gill and Mewaldt (1983), Shuford and Craig (2002), Seto et al. (2003), Suryan et al. (2004), Strong et al. (2004), Mellink et al. (2007), agency sources, and this research group (Bird Research Northwest [BRNW]). Current colony size estimates (number of breeding pairs) are for the 2011 breeding season; "0" indicates no nesting activity occurred and "-" indicates that no information on colony size is available. All colony size estimates are provided by BRNW, unless otherwise noted.

STATE/REGION/Site	2011 Colony Size (breeding pairs)
ALASKA	
Copper River Delta - Kokinhenik Bar	241
Icy Bay - Gull Island ¹	250
Yukon-Kuskokwim Delta - Neragon Island ²	-
Yukon-Kuskokwim Delta - Unnamed Island ³	-
Twin Glacier Lake ⁴	-
BRITISH COLUMBIA	
Fraser River Delta - Roberts Banks ⁵	-
Fraser Lake ⁵	-
Shuswap Lake ⁵	-
WASHINGTON	
COASTAL WASHINGTON	
Bellingham Bay - Port of Bellingham	0
Padilla Bay - Unnamed Island	424
Strait of Juan de Fuca - Smith and Minor islands	5
Strait of Juan de Fuca - Dungeness Spit	42
Puget Sound - Everett Naval Station	0
Puget Sound - Jetty Island	0
Puget Sound - Seattle Waterfront (Pier 90)	60
Puget Sound - Bremerton (Sinclair Inlet)	0
Puget Sound - Tacoma Waterfront	0
Grays Harbor - Goose Island	0
Grays Harbor - Sand Island	0
Grays Harbor - Whitcomb Flats	0
Willapa Bay - Ellen Sands (part of Snag islands)	0
Willapa Bay - Gunpowder Sands	0
INTERIOR WASHINGTON	
Banks Lake - Goose Island	0
Banks Lake - Twining Island	19

STATE/REGION/Site	2011 Colony Size (breeding pairs)
Sprague Lake - Harper Island	4
Moses Lake - Unnamed Island	0
Potholes Reservoir - Solstice Island	0
Potholes Reservoir - Goose Island	422
Columbia River - Miller Rocks	0
Columbia River - Blalock Islands ("Anvil" Island)	20
Columbia River - Blalock Islands (Rock Island)	0
Columbia River - Crescent Island	419
Columbia River - Badger Island	31
Columbia River - Foundation Island	5
Columbia River - Cabin Island	0
OREGON	
COASTAL OREGON	
Columbia River Estuary - East Sand Island	6,969
Columbia River Estuary - Rice Island	3
Columbia River Estuary - Miller Sands Spit	0
INTERIOR OREGON	
Malheur Lake - Singhus Ranch	150
Malheur Lake - Tern Island	0
Summer Lake Wildlife Area, Dutchy Lake (tern island)	0
Summer Lake Wildlife Area, East Link Impoundment (tern island)	2
Warner Valley, Crump Lake (tern island)	35
Lower Klamath Lake	0
Spring Lake	0
Columbia River - Threemile Canyon Island	0
NEVADA	
Pyramid Lake - Anaho Island ⁶	16
Carson Sink ⁷	0
Lahontan Reservoir ⁸	0
Stillwater Point Reservoir ⁷	0
IDAHO	
Island Park Reservoir ⁹	-
Magic Reservoir ⁹	-
Mormon Reservoir - Unnamed Island ⁹	-
Blackfoot Reservoir - Gull Island ⁹	0
American Falls Reservoir - Gull Island ⁹	-
Minidoka NWR - Tern Island ⁹	0

STATE/REGION/Site	2011 Colony Size (breeding pairs)
Mud Lake Wildlife Management Area (previously North Lake WMA) ⁹	0
Deer Flat NWR - Snake River islands ⁹	-
Bear Lake NWR - Unnamed Island ⁹	-
UTAH	
Great Salt Lake - Hat Island ¹⁰	-
Great Salt Lake - Bear River Migratory Bird Refuge ¹⁰	-
Great Salt Lake - Egg Island ¹⁰	-
Great Salt Lake - Farmington Bay Waterfowl Management Area ¹⁰	-
Great Salt Lake - Minerals Complex ¹⁰	-
Great Salt Lake - Stansbury Island Saltworks ¹⁰	-
Utah Lake - Rock Island ¹¹	-
Neponset Reservoir ¹⁰	0
Fish Springs Wildlife Refuge ¹¹	-
Stansbury Park Sewage Lagoons ¹¹	-
WYOMING	
Cokeville Meadows NWR (previously Bear River Marshes) ¹²	0
MONTANA	
Ninepipe Reservoir ¹³	3
CALIFORNIA	
COASTAL CALIFORNIA (NORTH)	
Humboldt Bay - Sand Island ¹⁴	-
San Francisco Bay - Little Island ¹⁵	0
San Francisco Bay - Knight Island ¹⁵	0
San Francisco Bay - Brooks Island	306
San Francisco Bay - Alameda Naval Air Station ¹⁵	0
San Francisco Bay - San Francisco Waterfront (Agua Vista Park)	8
San Francisco Bay - Hayward Regional Shoreline ¹⁵	0
San Francisco Bay - Baumberg/Eden Landing ¹⁵	0
San Francisco Bay - Turk Island ¹⁵	0
San Francisco Bay - Coyote Hills ¹⁵	0
San Francisco Bay - Drawbridge/Mowry ¹⁵	0
San Francisco Bay - Marina ¹⁵	0
San Francisco Bay - Redwood Shores ¹⁵	0
San Francisco Bay - Bair Island ¹⁵	0

STATE/REGION/Site	2011 Colony Size (breeding pairs)
San Francisco Bay - Ravenswood ¹⁵	0
San Francisco Bay - Alviso Ponds ¹⁵	0
San Francisco Bay - Moffett/Stevens Creek ¹⁵	0
Monterey Bay - Parajo River mouth ¹⁶	0
Monterey Bay - Elkhorn Slough ("Boomerang" Island) ¹⁶	4
Monterey Bay - Elkhorn Slough (unnamed island) ¹⁶	0
Monterey Bay - Moss Landing (salt ponds) ¹⁷	0
Monterey Bay - Salinas River mouth (NWR) ¹⁸	261
COASTAL CALIFORNIA (SOUTH)	
Los Angeles Harbor - Terminal Island (Pier 400) ¹⁹	112
Huntington Beach - Bolsa Chica Ecological Reserve (North Tern Island [NTI]) ²⁰	65
Huntington Beach - Bolsa Chica Ecological Reserve (South Tern Island [STI]) ²¹	0
Huntington Beach - Bolsa Chica Ecological Reserve (Nest Site 1 [NS1]) ²¹	0
San Diego Bay - San Diego Bay NWR (Salt works) ²²	260
INTERIOR CALIFORNIA (NORTH)	
Lower Klamath NWR, Sheepy Lake (tern island)	188
Lower Klamath NWR, Orems Unit (tern island)	2
Tule Lake NWR, Tule Lake (tern island)	34
Clear Lake - Clear Lake NWR	12
Meiss Lake - Butte Valley Wildlife Area	0
Goose Lake	0
Big Sage Reservoir	0
Honey Lake Wildlife Area	0
Sutter Basin	0
Woodward Reservoir	0
Mono Lake ²³	0
INTERIOR CALIFORNIA (SOUTH)	
Tulare Basin - Lemoore Naval Air Station ²⁴	-
Tulare Basin - South Wilbur Flood Area ²⁴	0
Tulare Basin - Tulare Lake Drainage District (South Evaporation Basin) ²⁴	0
Tulare Basin - Tulare Lakebed ²⁴	0
Tulare Basin - Westlake Farms (South Evaporation Basin) ²⁴	0
Buena Vista Lake	-
Lake Elsinore ²⁵	-
Salton Sea - Mullet Island	0
Salton Sea - Morton Bay	0

STATE/REGION/Site	2011 Colony Size (breeding pairs)
Salton Sea - Headquarters Unit "D"	1114
Salton Sea - Obsidian Butte	0
MEXICO	
BAJA CALIFORNIA	
Laguna Figueroa ²⁶	-
Cerro Prieto ²⁷	107
Isla Montague ²⁶	-
SONORA	
Laguna San Ignacio - Isla Pelicanos	-
BAJA CALIFORNIA SUR	
Laguna Ojo de Liebre (Scammon's Lagoon) - Isla Concha ²⁶	-
Laguna Ojo de Liebre (Scammon's Lagoon) - Islet in Area 8 ²⁶	-
Laguna Ojo de Liebre (Scammon's Lagoon) - Isla Piedra ²⁶	-
Laguna Ojo de Liebre (Scammon's Lagoon) - Islet in Area S1-A ²⁶	-
Laguna Ojo de Liebre (Scammon's Lagoon) - Isla Vasco	-
Laguna San Ignacio - Bellena Island ²⁶	-
Bahia Magdalena - Boca de las Animas ²⁶	-
Bahia Magdalena - Boca de Santo Domingo ²⁶	-
Ensenada de La Paz - Isla Afegua	-
SINALOA	
Bahia Santa Maria - Isla Larición ²⁶	-

¹ M. Kissling (U.S. Fish and Wildlife Service), pers. comm.

² B. McCaffery (U.S. Fish and Wildlife Service), pers. comm.

³ R. Gill (U.S. Geological Survey), pers. comm.

⁴ G. Baluss (U.S. Forest Service), pers. comm.

⁵ B.C. Conservation Data Centre, 2012

⁶ D. Withers (U.S. Fish and Wildlife Service), pers. comm.

⁷ J. Jeffers (Nevada Department of Wildlife) and B. Henry (U.S. Fish and Wildlife Service), pers. comm.

⁸ B. Henry (U.S. Fish and Wildlife Service), pers. comm.

⁹ C. Moulton (Idaho Department of Fish and Game), pers. comm.

¹⁰ J. Neill (Utah Division of Wildlife Resources), pers. comm.

¹¹ J. Cavitt (Weber State University), pers. comm.

¹² A. Orabona (Wyoming Game and Fish Department), pers. comm.

¹³ C. Wightman (Montana Fish, Wildlife, & Parks), pers. comm.

¹⁴ M. Coldwell (Humboldt State University), pers. comm.

¹⁵ C. Strong (U.S. Fish and Wildlife Service), pers. comm.

¹⁶ S. Fork (Elkhorn Slough Estuarine Research Reserve), pers. comm.

¹⁷ R. Eby (Elkhorn Slough Estuarine Research Reserve), pers. comm.

¹⁸ estimate based on peak number of adults counted on colony (522) divided by 2; D. Kodama (U.S. Fish and Wildlife Service), pers. comm.

¹⁹ K. Keane (Keane Biological Consulting), pers. comm.

²⁰ estimate based on peak number of adults counted on colony (130) divided by 2; K. O'Reilly (Bolsa Chica Ecological Reserve), pers. comm.

²¹ K. O'Reilly (Bolsa Chica Ecological Reserve), pers. comm.

²² R. Patton, pers. comm.

²³ K. Nelson (Point Reyes Bird Observatory Conservation Science), pers. comm.

²⁴ J. Seay (H.T. Harvey & Associates), pers. comm.

²⁵ C. McCaugh (Tierra Madre Consultants), pers. comm.

²⁶ E. Mellick and E. Palacios (Centro de Investigacion), pers. comm.

²⁷ E.S. Montoya (R.B. Alto Golfo de California y Delta del Rio Colorado), pers. comm.

Table 2. Connectivity of various colonies/roost sites with Columbia Plateau colonies based on re-sightings of Caspian terns marked with alphanumeric leg-bands on Crescent Island and Goose Island in 2005-2011; "0" indicates that re-sighting surveys were conducted at site, but no banded terns were seen. Efforts to re-sight banded Caspian terns varied among regions and colonies (see Methods). Therefore, these results document connectivity among nesting sites, but do not represent movement rates or degrees of connectivity among sites. Other data sets suggest some connectivity with Blackfoot Reservoir in Idaho, Bear River Migratory Bird Refuge in Utah, and a roost site in Gustavus, Alaska (Y. Suzuki, OSU, unpubl. data).

REGION/Colony or Roost	Crescent Island		Goose Island		TOTAL
	adults	chicks	adults	chicks	
ALASKA¹					
Copper River Delta - Kokinhenik Bar	0	0	0	0	0
Icy Bay - Gull Island	0	0	0	0	0
TOTAL					0
BRITISH COLUMBIA					
Fraser River Delta (roost) ²		>10		>10	>20
TOTAL					>20
COASTAL WASHINGTON					
Bellingham Bay - Port of Bellingham	1	4	4	2	11
Strait of Juan de Fuca - Dungeness Spit	1	0	0	0	1
Puget Sound - Seattle Waterfront (Pier 90)	0	0	0	0	0
Padilla Bay - Unnamed Island	0	0	1	0	1
TOTAL					13
INTERIOR WASHINGTON					
Potholes Reservoir - Goose Island	10	15	--	--	25
Columbia River - Crescent Island	--	--	14	2	16
TOTAL					41
COASTAL OREGON					
Columbia River Estuary - East Sand Island	14	5	7	5	31
Joaquin Miller State Park (roost near Florence)	0	0	0	1	1
TOTAL					32
INTERIOR OREGON					
Malheur Lake - Singhus Ranch	3	0	1	4	8
Summer Lake Wildlife Area - Dutchy Lake	0	0	1	0	1
Summer Lake Wildlife Area - East Link Impdmt.	0	5	1	2	8

REGION/Colony or Roost	Crescent Island		Goose Island		TOTAL
	adults	chicks	adults	chicks	
Summer Lake Wildlife Area - Gold Dike Impdmt.	0	0	0	0	0
Warner Valley - Crump Lake	6	12	5	8	31
TOTAL					48
IDAHO					
American Falls Reservoir - Gull Island	0	0	0	1	1
TOTAL					1
COASTAL CALIFORNIA (NORTH)					
San Francisco Bay - Brooks Island	1	0	0	0	1
San Francisco Bay - Eden Landing	0	0	0	0	0
TOTAL					1
COASTAL CALIFORNIA (SOUTH)					
Huntington Beach - Bolsa Chica Ecol. Reserve	0	0	0	1	1
Mouth of Sand Diego River (roost)	0	0	0	1	1
Oceano (roost)	0	1	0	0	1
TOTAL					3
INTERIOR CALIFORNIA (NORTH)					
Lower Klamath NWR - Sheepy Lake	0	8	6	6	20
Lower Klamath NWR - Orems Unit	1	4	0	1	6
Tule Lake NWR - Tule Lake	3	12	4	5	24
TOTAL					50
INTERIOR CALIFORNIA (SOUTH)					
Salton Sea - Headquarters Unit "D"	1	2	1	2	6
TOTAL					6
MEXICO					
Shrimp Farm near Mazatlan (roost)	0	1	0	1	2
TOTAL					2

¹ Banded Caspian terns from East Sand Island seen in Mendenhall Wetlands, Copper River Delta, and Icy Bay, Alaska

² Based in incomplete review of band resighting records from the Fraser River Delta

Table 3. Evaluation of the management potential for nesting sites in western North America for Caspian terns. The sites include previously evaluated sites (Seto et al. 2003), sites with a history of Caspian tern and/or gull nesting, and other potential sites identified by BRNW and agency sources.

STATE/REGION/Site	Management Potential			Factors limiting management potential
	Yes	No	?	
ALASKA				
Copper River Delta - Kokinhenik Bar	X			
Icy Bay - Gull Island		X		Private property; no access
Yukon-Kuskokwim Delta - Neragon Island		X		Small ephemeral colony; no recent tern nesting
Yukon-Kuskokwim Delta - Unnamed Island		X		Small ephemeral colony; no recent tern nesting
Twin Glacier Lake		X		Small ephemeral colony
BRITISH COLUMBIA				
Fraser River Delta - Roberts Banks			X	Insufficient information available on site
Fraser Lake			X	Insufficient information available on site
Shuswap Lake			X	Insufficient information available on site
WASHINGTON				
COASTAL WASHINGTON				
Bellingham Bay - Port of Bellingham	X			
Padilla Bay - Unnamed Island	X			
Strait of Juan de Fuca - Smith and Minor islands	X			
Strait of Juan de Fuca - Dungeness Spit	X			
Strait of Juan de Fuca - Protection Island	X			
Puget Sound - Everett Naval Station		X		No site available; near Jetty Island (preferable site)
Puget Sound - Jetty Island	X			
Puget Sound - Seattle Waterfront (Pier 90)	X			
Puget Sound - Bremerton (Sinclair Inlet)	X			
Puget Sound - Tacoma Waterfront	X			

STATE/REGION/Site	Management Potential			Factors limiting management potential
	Yes	No	?	
Puget Sound - McNeil Island		X		No site available; other sites in Puget Sound preferable
Grays Harbor - Goose Island		X		Island no longer exists ¹ ; other sites in Grays Harbor preferable
Grays Harbor - Unnamed Island	X			
Grays Harbor - Sand Island	X			
Grays Harbor - No Name Island	X			
Grays Harbor - Whitcomb Flats		X		Island no longer exists ¹ ; other sites in Grays Harbor preferable
Grays Harbor - CATE Island		X		Island connected to mainland during low tide
Willapa Bay - Snag islands	X			
Willapa Bay - Gunpowder Sands	X			
INTERIOR WASHINGTON				
Banks Lake - Goose Island	X			
Banks Lake - Twining Island	X			
Sprague Lake - Harper Island	X			
Moses Lake - Unnamed Island		X		Conflict with Columbia Basin salmonids possible
Potholes Reservoir - Solstice Island		X		Conflict with Columbia Basin salmonids documented
OREGON				
COASTAL OREGON				
Tillamook Bay	X			
Umpqua River Estuary - Steamboat Island		X		Controlling public access a problem ² ; no history of nesting
Umpqua River Estuary - Unnamed Island		X		Controlling public access a problem ² ; no history of nesting
Coos Bay - "North" Island		X		Heavy boat traffic, potential for high level of human disturbance ¹
Coos Bay - "Middle" Island		X		Heavy boat traffic, potential for high level of human disturbance ¹
Coos Bay - "South" Island		X		Heavy boat traffic, potential for high level of human disturbance ¹
Coos Bay - Unnamed Island	X			
INTERIOR OREGON				
Fern Ridge Reservoir		X		Island already created as part of CRECTMP ³

STATE/REGION/Site	Management Potential			Factors limiting management potential
	Yes	No	?	
Malheur Lake - Singhus Ranch		X		Island already created as part of CRECTMP ³ in Malheur NWR
Malheur Lake - Tern Island		X		Island already created as part of CRECTMP ³ in Malheur NWR
Summer Lake Wildlife Area		X		Islands (3) already created as part of CRECTMP ¹
Upper Klamath Lake - Williamson River Delta	X			
Upper Klamath Lake - Upper Klamath NWR	X			
Swan Lake		X		Island on private land
Gerber Reservoir		X		Controlling public access a problem ²
Drews Reservoir		X		Controlling public access a problem ²
Warner Valley		X		Island already created as part of CRECTMP ³ in Crump Lake
Lower Klamath Lake		X		Islands (2) already created as part of CRECTMP ³ in Lower Klamath NWR
Spring Lake		X		Islands (2) already created as part of CRECTMP ³ in Lower Klamath NWR
Columbia River - Miller Rocks		X		Conflict with Columbia Basin salmonids
Columbia River - Threemile Canyon Island		X		Conflict with Columbia Basin salmonids
NEVADA				
Pyramid Lake - Anaho Island		X		Prey base limiting ⁴
Carson Sink		X		Nesting and foraging habitat limiting ⁴
Lahontan Reservoir		X		Nesting and foraging habitat limiting ⁴ ; controlling public access may be difficult ⁵
Stillwater Point Reservoir		X		Nesting and foraging habitat limiting ⁴
IDAHO				
Island Park Reservoir	X			
Magic Reservoir		X		Water levels variable, island land-bridged in most years ⁶
Mormon Reservoir - Unnamed Island		X		Water levels variable, island land-bridged in most years ⁶
Blackfoot Reservoir - Gull Island		X		Water level variable, nesting area often floods, conflicts with sensitive prey species ⁶

STATE/REGION/Site	Management Potential			Factors limiting management potential
	Yes	No	?	
American Falls Reservoir - Gull Island		X		Competition with other colonial waterbirds for nest sites, other sites in Idaho preferable ⁶
Minidoka NWR - Tern Island	X			
Mud Lake Wildlife Management Area		X		No site available, marsh habitat ⁶ ; no recent tern nesting history
Deer Flat NWR - Snake River islands		X		Water level variable, nesting area often floods, controlling public access a problem ⁶
Bear Lake NWR - Unnamed Island	X			
UTAH				
Great Salt Lake - Hat Island		X		Competition with other colonial waterbirds for nest sites, prey base limiting ⁷
Great Salt Lake - Bear River Migratory Bird Refuge	X			
Great Salt Lake - Egg Island		X		Prey base limiting ⁷
Great Salt Lake - Farmington Bay Waterfowl Management Area		X		Conflicts with management purpose (waterfowl) ⁷
Great Salt Lake - Minerals Complex	X			
Great Salt Lake - Stansbury Island Salt works			X	Insufficient information available on site
Utah Lake - Rock Island	X			
Neponset Reservoir	X			
Fish Springs Wildlife Refuge			X	Insufficient information available on site
Stansbury Park			X	Insufficient information available on site
WYOMING				
Cokeville Meadows NWR		X		Marsh habitat, no recent nesting history, not many terns in Wyoming ⁸
MONTANA				
Ninepipe Reservoir		X		Not many terns in Montana ⁹
CALIFORNIA				
COASTAL CALIFORNIA (NORTH)				
Humboldt Bay - Sand Island	X			

STATE/REGION/Site	Management Potential			Factors limiting management potential
	Yes	No	?	
San Francisco Bay - Little Island		X		Site restored for other purposes; conflicts with sensitive prey species likely
San Francisco Bay - Knight Island		X		Site restored for other purposes; conflicts with sensitive prey species documented ¹⁰
San Francisco Bay - Brooks Island	X			
San Francisco Bay - Alameda Naval Air Station		X		Other sites in San Francisco Bay preferable ²
San Francisco Bay - San Francisco Waterfront (Agua Vista Park)	X			
San Francisco Bay - Hayward Regional Shoreline	X			
San Francisco Bay - Sisters Island		X		Site not available (steep sided rock with little to no substrate)
San Francisco Bay - Baumberg/Eden Landing		X		Other sites in San Francisco Bay preferable ²
San Francisco Bay - Turk Island		X		Other sites in San Francisco Bay preferable ²
San Francisco Bay - Coyote Hills		X		Other sites in San Francisco Bay preferable ²
San Francisco Bay - Drawbridge/Mowry		X		Other sites in San Francisco Bay preferable ²
San Francisco Bay - Marina		X		Other sites in San Francisco Bay preferable ²
San Francisco Bay - Redwood Shores		X		Other sites in San Francisco Bay preferable ²
San Francisco Bay - Don Edwards NWR		X		Refuge and Corps withdrew plans to build tern islands ²
San Francisco Bay - Bair Island		X		Other sites in San Francisco Bay preferable ²
San Francisco Bay - Ravenswood		X		Other sites in San Francisco Bay preferable ²
San Francisco Bay - Alviso Ponds		X		Other sites in San Francisco Bay preferable ²
San Francisco Bay - Moffett/Stevens Creek		X		Other sites in San Francisco Bay preferable ²
Monterey Bay - Parajo River mouth			X	Insufficient information available on site
Monterey Bay - Elkhorn Slough	X			
Monterey Bay - Moss Landing (salt ponds)			X	Insufficient information available on site
Monterey Bay - Salinas River mouth (NWR)		X		Incompatible with management of snowy plovers ¹
COASTAL CALIFORNIA (SOUTH)				
Los Angeles Harbor - Terminal Island (Pier 400)	X			

STATE/REGION/Site	Management Potential			Factors limiting management potential
	Yes	No	?	
Huntington Beach - Bolsa Chica Ecological Reserve	X			
Newport Beach - Upper Newport Bay Ecological Reserve	X			
San Diego Bay - San Diego Bay NWR (Salt works)	X			
INTERIOR CALIFORNIA (NORTH)				
Lower Klamath NWR		X		Islands (2) already created as part of CRECTMP ³
Tule Lake NWR		X		Island already created as part of CRECTMP ³
Clear Lake - Clear Lake NWR	X			
Meiss Lake - Butte Valley Wildlife Area	X			
Goose Lake	X			
Big Sage Reservoir		X		Controlling public access a problem ²
Honey Lake Wildlife Area		X		Nesting and foraging habitat limiting ¹
Sutter Basin		X		Nesting and foraging habitat limiting ¹
Woodward Reservoir		X		Controlling public access a problem ¹¹
Buena Vista Lake		X		Nesting and foraging habitat limiting ¹¹
Mono Lake		X		Prey base limiting ¹
INTERIOR CALIFORNIA (SOUTH)				
Tulare Basin - Hacienda Ranch Flood Basin		X		Nesting and foraging habitat limiting ¹
Tulare Basin - Lemoore Naval Air Station		X		Nesting and foraging habitat limiting ¹
Tulare Basin - South Wilbur Flood Area		X		Nesting and foraging habitat limiting ¹
Tulare Basin - Tulare Lake Drainage District (S. Evaporation Basin)		X		Nesting and foraging habitat limiting ¹
Tulare Basin - Tulare Lakebed		X		Nesting and foraging habitat limiting ¹
Tulare Basin - Westlake Farms (N. Evaporation Basin)		X		Nesting and foraging habitat limiting ¹
Tulare Basin - Westlake Farms (S. Evaporation Basin)		X		Nesting and foraging habitat limiting ¹
Tulare Basin - Westlake Mitigation Wetland (Section 3)		X		Nesting and foraging habitat limiting ¹

STATE/REGION/Site	Management Potential			Factors limiting management potential
	Yes	No	?	
Lake Elsinore		X		Very limited foraging habitat within range
Salton Sea - Mullet Island		X		Long-term availability of site uncertain
Salton Sea - Morton Bay		X		Long-term availability of site uncertain
Salton Sea - Headquarters Unit "D"		X		Tern islands already built in impoundment
Salton Sea - Obsidian Butte		X		No longer available due to low water levels
Salton Sea - Unit 1-B4		X		Long-term availability of site uncertain
Salton Sea - Unit 1-A4		X		Long-term availability of site uncertain
MEXICO				
BAJA CALIFORNIA				
Laguna Figueroa			X	Insufficient information available on site
Cerro Prieto			X	Insufficient information available on site
Isla Montague			X	Insufficient information available on site
SONORA				
Bahia Santa Maria - Isla Larición			X	Insufficient information available on site
BAJA CALIFORNIA SUR				
Laguna Ojo de Liebre (Scammon's Lagoon) - Isla Concha			X	Insufficient information available on site
Laguna Ojo de Liebre (Scammon's Lagoon) - Islet in Area 8			X	Insufficient information available on site
Laguna Ojo de Liebre (Scammon's Lagoon) - Isla Piedra			X	Insufficient information available on site
Laguna Ojo de Liebre (Scammon's Lagoon) - Islet in Area S1-A			X	Insufficient information available on site
Laguna Ojo de Liebre (Scammon's Lagoon) - Isla Vasco			X	Insufficient information available on site
Laguna San Ignacio - Bellena Island			X	Insufficient information available on site
Bahia Magdalena - Boca de las Animas			X	Insufficient information available on site
Bahia Magdalena - Boca de Santo Domingo			X	Insufficient information available on site
Ensenada de La Paz - Isla Afegua			X	Insufficient information available on site

STATE/REGION/Site	Management Potential			Factors limiting management potential
	Yes	No	?	
SINALOA				
Laguna San Ignacio - Isla Pelicanos			X	Insufficient information available on site

¹ Seto et al. (2003)

² P. Schmidt (U.S. Army Corps of Engineers - Portland District), pers. comm.

³ Columbia River Estuary Caspian Tern Management Plan (USFWS 2005)

⁴ Shuford and Craig (2002)

⁵ Yochem et al. (1991)

⁶ C. Moulton (Idaho Department of Fish and Game), pers. comm.

⁷ J. Luft (Utah Division of Wildlife Resources), pers. comm.

⁸ A. Orabona, Wyoming Game and Fish Department, pers. comm.

⁹ Wightman et al. (2011)

¹⁰ Collis et al. (2012)

¹¹ D. Shuford (Point Reyes Bird Observatory Conservation Science), pers. comm.

Table 4. Suitability scoring of sites having management potential as Caspian tern nesting colonies in western North America (Table 1). See Suitability Criteria for detailed explanation of criteria and scoring (Appendix 1). Sites given an overall suitability ranking of "H" and highlighted in grey have been determined to have high management potential by BRNW.

	Nesting status	Use of site by Caspian terns	Connectivity ¹	Proximity to Goose or Crescent islands	Inter-specific allies present	Potential conflicts with ESA - listed fish	Conflicts with other protected species	Human and other disturbance	Mammalian predators	Avian predators	Site availability	Proximity to previously constructed sites	Site preparation requirements ²	Site maintenance requirements ²	Ownership	Overall suitability		
STATE/REGION/Site	Potential of Site to Attract Terns					Potential Constraints of Site						Site Enhancement Considerations					Lat.	Long.
ALASKA																		
Copper River Delta - Kokinhenik Bar	4	3	1	1	3	3	3	3	2	2	2	3	2	3	F		60.227	-145.170
WASHINGTON																		
COASTAL WASHINGTON																		
Bellingham Bay - Port of Bellingham	3	3	3	2	3	1	3	1	2	2	3	3	?	?	L		48.747	-122.488
Padilla Bay - Unnamed Island	4	3	3	2	3	1	3	2	2	2	3	3	2	2	P	H	48.475	-122.532
Strait of Juan de Fuca - Smith and Minor islands	4	3	2	2	3	1	1	3	3	1	3	3	2	2	N	H	48.323	-122.822
Strait of Juan de Fuca - Dungeness Spit	4	3	3	2	3	1	3	2	1	1	3	3	2	2	N		48.166	-123.137
Strait of Juan de Fuca - Protection Island	1	2	2	2	3	1	1	2	3	1	3	3	2	2	N		48.128	-122.925
Puget Sound - Jetty Island	2	3	2	2	3	1	3	1	2	2	3	3	2	2	L	H	48.007	-122.228
Puget Sound - Seattle Waterfront (Pier 90)	4	3	2	2	3	1	3	1	3	2	3	3	?	?	P		47.636	-122.382
Puget Sound - Bremerton (Sinclair Inlet)	3	3	2	2	3	1	3	1	3	2	3	3	?	?	F		47.548	-122.652

	Nesting status	Use of site by Caspian terns	Connectivity ¹	Proximity to Goose or Crescent islands	Inter-specific allies present	Potential conflicts with ESA - listed fish	Conflicts with other protected species	Human and other disturbance	Mammalian predators	Avian predators	Site availability	Proximity to previously constructed sites	Site preparation requirements ²	Site maintenance requirements ²	Ownership	Overall suitability		
STATE/REGION/Site	Potential of Site to Attract Terns					Potential Constraints of Site						Site Enhancement Considerations					Lat.	Long.
Puget Sound - Tacoma Waterfront	2	3	2	2	3	1	3	1	3	2	3	3	?	?	P		47.254	-122.422
Grays Harbor - Unnamed Island	1	1	2	2	1	1	2	3	3	2	3	3	1	2	S		46.967	-124.003
Grays Harbor - Sand Island	2	3	2	2	3	1	2	3	3	1	3	3	2	2	S	H	46.963	-124.063
Grays Harbor - No Name Island	1	2	2	2	2	1	2	3	3	1	3	3	2	2	S		46.954	-124.045
Willapa Bay - Snag Islands	1	2	2	2	1	2	2	2	2	2	3	3	1	2	P		46.669	-123.968
Willapa Bay - Gunpowder Sands	2	3	2	2	2	2	2	3	2	2	3	3	1	1	U		46.683	-124.033
INTERIOR WASHINGTON																		
Banks Lake - Goose Island ³	2	3	2	3	3	2	3	2	2	3	3	3	2	3	F	H	47.647	-119.291
Banks Lake - Twining Island ³	4	3	2	3	3	2	3	2	2	3	3	3	2	3	F	H	47.625	-119.303
Sprague Lake - Harper Island	4	3	2	3	3	2	3	3	3	3	3	3	2	3	P	H	47.248	-118.086
OREGON																		
COASTAL OREGON																		
Tillamook Bay	1	2	-	2	1	1	3	2	3	2	3	3	1	2	U		45.516	-123.919
Coos Bay - Unnamed Island	1	1	2	1	1	1	2	2	2	2	3	3	2	2	S		43.386	-124.298
INTERIOR OREGON																		
Upper Klamath Lake - Williamson River Delta	1	2	2	2	1	1	3	2	2	2	2	2	1	3	P		42.465	-121.957

	Nesting status	Use of site by Caspian terns	Connectivity ¹	Proximity to Goose or Crescent islands	Inter-specific allies present	Potential conflicts with ESA - listed fish	Conflicts with other protected species	Human and other disturbance	Mammalian predators	Avian predators	Site availability	Proximity to previously constructed sites	Site preparation requirements ²	Site maintenance requirements ²	Ownership	Overall suitability		
STATE/REGION/Site	Potential of Site to Attract Terns					Potential Constraints of Site						Site Enhancement Considerations				Lat.	Long.	
Upper Klamath Lake - Upper Klamath NWR	1	2	2	2	3	1	3	3	2	2	2	2	1	3	N		42.515	-122.058
IDAHO																		
Island Park Reservoir	3	3	2	1	3	3	3	2	3	3	2	3	2	2	S/P		44.406	-111.536
Minidoka NWR - Tern Island	3	3	2	1	3	3	3	2	3	3	3	3	1	2	N		42.664	-113.451
Bear Lake NWR - Unnamed Island	2	3	2	1	3	3	3	3	2	3	2	3	1	2	N		42.160	-111.296
UTAH																		
Great Salt Lake - Bear River Migratory Bird Refuge	2	3	3	1	3	3	2	2	2	2	2	3	1	2	N		41.429	-112.213
Great Salt Lake - Minerals Complex	2	3	2	1	3	3	3	2	2	2	1	3	1	2	S		41.314	-112.302
Utah Lake - Rock Island	2	3	2	1	2	1	3	2	3	2	3	3	2	2	S		40.176	-111.801
Neponset Reservoir	3	3	2	1	3	3	3	3	2	2	2	3	2	2	P		41.380	-111.130
CALIFORNIA																		
COASTAL CALIFORNIA (NORTH)																		
Humboldt Bay - Sand Island	3	3	-	1	2	1	3	2	3	3	3	3	1	2	S		40.840	-124.124
San Francisco Bay - Brooks Island ⁴	4	3	3	1	3	1	3	2	2	2	3	3	3	2	L		37.900	-122.361
San Francisco Bay - SFB Waterfront (Agua Vista)	4	3	2	1	3	1	3	2	3	2	3	3	1	2	L	H	37.768	-122.384
San Francisco Bay - Hayward Regional Shoreline	2	3	2	1	3	1	2	3	2	2	3	3	2	3	L	H	37.629	-122.144

	Nesting status	Use of site by Caspian terns	Connectivity ¹	Proximity to Goose or Crescent islands	Inter-specific allies present	Potential conflicts with ESA - listed fish	Conflicts with other protected species	Human and other disturbance	Mammalian predators	Avian predators	Site availability	Proximity to previously constructed sites	Site preparation requirements ²	Site maintenance requirements ²	Ownership	Overall suitability		
STATE/REGION/Site	Potential of Site to Attract Terns					Potential Constraints of Site						Site Enhancement Considerations					Lat.	Long.
Monterey Bay - Elkhorn Slough	4	3	-	1	3	1	2	2	2	2	2	3	1	2	S	H	36.814	-121.743
COASTAL CALIFORNIA (SOUTH)																		
Los Angeles Harbor - Terminal Island (Pier 400)	4	3	2	1	3	2	2	2	2	2	3	3	3	2	L	H	33.717	-118.248
Huntington Beach - Bolsa Chica Ecological Reserve	4	3	2	1	3	2	2	2	2	2	3	3	1	2	S		33.695	-118.042
Newport Beach – Upper Newport Bay Ecol. Reserve	1	2	2	1	3	2	1	2	2	2	3	3	1	2	S		33.648	-117.886
San Diego Bay - San Diego Bay NWR (Salt works)	4	3	2	1	3	3	2	3	2	2	3	3	1	2	N	H	32.600	-117.106
INTERIOR CALIFORNIA (NORTH)																		
Clear Lake - Clear Lake NWR	4	3	2	1	3	1	3	3	2	2	2	2	1	2	N		41.860	-121.170
Meiss Lake - Butte Valley Wildlife Area	2	3	2	1	3	2	3	3	2	2	1	2	1	2	S		41.859	-122.049
Goose Lake	3	3	2	2	3	2	3	3	2	2	2	2	1	2	S	H	41.962	-120.486

¹ Dash ("-") indicates that very little to no band resighting effort was conducted at site or in the region of the site

² "?" indicates the site preparation and maintenance requirements are unknown (i.e., depends on the type of nesting habitat prepared; island, barge, pier, or rooftop)

³ Two sites in Banks Lake were determined to have high suitability for tern nesting. Although Twining Island scored higher than Goose Island with regard to "Nesting status", Goose Island may be preferable over Twining Island as a tern nesting site in Banks Lake based on other suitability criteria (see Appendix 2 for explanation).

⁴ Brooks Island was not deemed to be a high suitability site because of perceived salmonid impacts at that site relative to other sites in San Francisco Bay

Table 5. Threatened or endangered fish protected by the U.S. Endangered Species Act (ESA) as of March 2012 that are potential prey for Caspian terns nesting at alternative colonies (see Table 6 for Species Codes). Overlap between a given tern colony and fish species was based on colony location and designated critical fish habitat, where available. Critical habitat for anadromous fish was limited to freshwater. In cases where critical habitat was not designated for an ESA-listed fish species, overlap was evaluated based on species distribution maps provided by the listing agency. Potential conflicts were evaluated solely on the geographic overlap between a colony and critical fish habitat; information was generally lacking to evaluate the potential impacts of predation based on prey abundance or susceptibility to tern predation (See Appendix 3 for details).

State/Region/Site	Suitability	ESA-listed Fish at Site ¹	ESA-Listed Fish within Potential Foraging Range ²
ALASKA			
Copper River Delta - Kokinhenik Bar			
WASHINGTON			
COASTAL WASHINGTON			
Bellingham Bay - Port of Bellingham ³		01, 03, 04, 43	02, 13, 29
Padilla Bay - Unnamed Island	H	01, 03, 43	02, 04, 13, 29
Strait of Juan de Fuca - Smith and Minor islands	H	01, 03, 43	02, 04, 13, 26, 29
Strait of Juan de Fuca - Dungeness Spit ⁴		01, 02, 03, 04, 13, 29, 43	26
Strait of Juan de Fuca - Protection Island		01, 03, 43	02, 04, 13, 26, 29
Puget Sound - Jetty Island ⁵	H	01, 02, 03, 04, 29, 43	13
Puget Sound - Seattle Waterfront (Pier 90)		01, 03, 43	02, 04, 13, 29
Puget Sound - Bremerton (Sinclair Inlet)		01, 03, 43	02, 04, 13, 29
Puget Sound - Tacoma Waterfront ⁶		01, 02, 03, 04, 29, 43	13
Grays Harbor - Unnamed Island		02	05, 06, 07, 08, 09, 14, 15, 26, 28, 30, 31, 32, 33, 34
Grays Harbor - Sand Island	H	02	05, 06, 07, 08, 09, 14, 15, 26, 28, 30, 31, 32, 33, 34
Grays Harbor - No Name Island		02	05, 06, 07, 08, 09, 14, 15, 26, 28, 30, 31, 32, 33, 34
Willapa Bay - Snag islands			02, 05, 06, 07, 08, 09, 14, 15, 16, 26, 28, 30, 31, 32, 33, 34
Willapa Bay - Gunpowder Sands			02, 05, 06, 07, 08, 09, 14, 15, 16, 26, 28, 30, 31, 32, 33, 34

State/Region/Site	Suitability	ESA-listed Fish at Site ¹	ESA-Listed Fish within Potential Foraging Range ²
INTERIOR WASHINGTON			
Banks Lake - Goose Island			02, 07, 33
Banks Lake - Twining Island	H		02, 07, 33
Sprague Lake - Harper Island	H		02, 08, 09, 28, 34
OREGON			
COASTAL OREGON			
Tillamook Bay		16	02, 05, 06, 07, 08, 09, 14, 15, 26, 28, 30, 31, 32, 33, 34
Coos Bay - Unnamed Island		16	26
INTERIOR OREGON			
Upper Klamath Lake - Williamson River Delta ⁷		23, 27	02
Upper Klamath Lake - Upper Klamath NWR ⁷		23, 27	02
IDAHO			
Island Park Reservoir			
Minidoka NWR - Tern Island			
Bear Lake NWR - Unnamed Island ⁸			
UTAH			
Great Salt Lake - Minerals Complex ⁸			
Great Salt Lake - Bear River Migratory Bird Refuge ⁸			
Neponset Reservoir ⁸			
Utah Lake - Rock Island		22	
CALIFORNIA			
COASTAL CALIFORNIA (NORTH)			
Humboldt Bay - Sand Island		10, 17, 35, 40	26
San Francisco Bay - Brooks Island ⁹		11, 12, 19, 21, 36, 38	18, 40
San Francisco Bay - Waterfront (Agua Vista Park) ⁹	H	11, 12, 19, 21, 36, 38	18, 40
San Francisco Bay - Hayward Regional Shoreline ⁹	H	11, 12, 19, 21, 36, 38	18, 40
Monterey Bay - Elkhorn Slough	H	37, 40	18, 36

State/Region/Site	Suitability	ESA-listed Fish at Site ¹	ESA-Listed Fish within Potential Foraging Range ²
COASTAL CALIFORNIA (SOUTH)			
Los Angeles Harbor - Terminal Island (Pier 400)	H		39, 40, 41, 44
Huntington Beach - Bolsa Chica Ecological Reserve			39, 40, 44
Newport Beach - Upper Newport Bay Ecological Reserve			39, 40, 44
San Diego Bay - San Diego Bay NWR (Salt works)	H		
INTERIOR CALIFORNIA (NORTH)			
Clear Lake - Clear Lake NWR ¹⁰		23, 27	24
Meiss Lake - Butte Valley Wildlife Area ¹⁰			23, 27
Goose Lake	H		20, 23, 24, 27, 42

¹ ESA-listed fish potentially found in waters immediately adjacent to the colony site (see Appendix 3 for detailed definition)

² ESA-listed fish potentially found in waters within maximum foraging distance (80 km) of the colony site but not in waters immediately adjacent to the colony site (see Appendix 3 for detailed definition)

³ Considers fish from Whatcom Creek to be "at site"

⁴ Considers fish from Dungeness River to be "at site"

⁵ Considers fish from Snohomish River to be "at site"

⁶ Considers fish from Puyallup River to be "at site"

⁷ Assumes fish from mountain streams in Rogue and Klamath River basins are outside the foraging range of terns nesting at this site

⁸ Assumes Lahontan cutthroat in mountain streams are outside the foraging range of terns nesting at this site

⁹ Considers fish from rivers that drain into San Francisco Bay to be "at site"

¹⁰ Assumes bull trout in mountain streams are outside the foraging range of terns at this site

Table 6. U.S. Endangered Species Act status (threatened [T], endangered [E]) of listed fishes as of March 2012 that are potential prey for alternative Caspian tern colonies (see Table 5). Evolutionarily Significant Units (ESUs) or Distinct Population Segments (DPSs) for each species are provided.

Species	Scientific Name	ESU or DPS (status)	Species Code
Bocaccio	<i>Sebastes paucispinis</i>	Puget Sound/Georgia Basin (E)	01
Bull Trout	<i>Salvelinus confluentus</i>	Contiguous United States (T)	02
Canary Rockfish	<i>Sebastes pinniger</i>	Puget Sound/Georgia Basin (T)	03
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Puget Sound (T)	04
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Upper Willamette River (T)	05
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	L. Columbia River (T)	06
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	U. Columbia River spring-run (E)	07
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Snake River fall-run (T)	08
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Snake River spring/summer-run (T)	09
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	California Coast (T)	10
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Central Valley spring-run (T)	11
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Sacramento winter-run (E)	12
Chum Salmon	<i>Oncorhynchus keta</i>	Hood Canal (T)	13
Chum Salmon	<i>Oncorhynchus keta</i>	Columbia River (T)	14
Coho Salmon	<i>Oncorhynchus kisutch</i>	Lower Columbia River (T)	15
Coho Salmon	<i>Oncorhynchus kisutch</i>	Oregon Coast (T)	16
Coho Salmon	<i>Oncorhynchus kisutch</i>	S, Oregon/N. California (T)	17
Coho Salmon	<i>Oncorhynchus kisutch</i>	Central California Coast (E)	18
Delta Smelt	<i>Hypomesus transpacificus</i>	Wherever found (T)	19
Foskett Speckled Dace	<i>Rhinichthys osculus ssp</i>	Wherever found (T)	20
Green Sturgeon	<i>Acipenser medirostris</i>	Southern (T)	21
June Sucker	<i>Chasmistes liorus</i>	Wherever found (E)	22
Lost River Sucker	<i>Deltistes luxatus</i>	Wherever found (E)	23
Modoc Sucker	<i>Catostomus microps</i>	Wherever found (E)	24
Lahontan Cutthroat Trout	<i>Oncorhynchus clarki henshawi</i>	Wherever found (T)	25
Pacific Eulachon	<i>Thaleichthys pacificus</i>	Southern (T)	26
Shortnose Sucker	<i>Chasmistes brevirostris</i>	Wherever found (E)	27
Sockeye Salmon	<i>Oncorhynchus nerka</i>	Snake River (E)	28
Steelhead	<i>Oncorhynchus mykiss</i>	Puget Sound (T)	29
Steelhead	<i>Oncorhynchus mykiss</i>	Upper Willamette River (T)	30
Steelhead	<i>Oncorhynchus mykiss</i>	Lower Columbia River (T)	31
Steelhead	<i>Oncorhynchus mykiss</i>	Middle Columbia River (T)	32
Steelhead	<i>Oncorhynchus mykiss</i>	Upper Columbia River (T)	33
Steelhead	<i>Oncorhynchus mykiss</i>	Snake River (T)	34

Steelhead	<i>Oncorhynchus mykiss</i>	N. California (T)	35
Steelhead	<i>Oncorhynchus mykiss</i>	Central California Coast (T)	36
Steelhead	<i>Oncorhynchus mykiss</i>	South-Central California Coast (T)	37
Steelhead	<i>Oncorhynchus mykiss</i>	California Central Valley (T)	38
Steelhead	<i>Oncorhynchus mykiss</i>	S. California (E)	39
Tidewater Goby	<i>Eucyclogobius newberryi</i>	Wherever found (E)	40
Unarmored Threespine Stickleback	<i>Gasterosteus aculeatus williamsoni</i>	Wherever found (E)	41
Warner Sucker	<i>Catostomus warnerensis</i>	Wherever found (T)	42
Yelloweye Rockfish	<i>Sebastes ruberrimus</i>	Puget Sound/Georgia Basin (T)	43
Santa Ana Sucker	<i>Catostomus santaanae</i>	Wherever found (T)	44

Table 7. Priority issues at the 13 sites considered to have high overall suitability as alternative Caspian tern colony sites (Table 4). See Appendix 2 for complete description of biological conflicts and uncertainties at each site.

Site	State	Priority issues
Padilla Bay - Unnamed Island	WA	Privately owned, occasionally land-bridged, unknown impacts to ESA-listed fish species
Strait of Juan de Fuca - Smith and Minor islands	WA	Eagle disturbance, harbor seal pupping site may limit monitoring, unknown impacts to ESA-listed fish species
Puget Sound - Jetty Island	WA	Human disturbance, unknown impacts to ESA-listed fish species especially nearby Snohomish River salmonids
Grays Harbor - Sand Island	WA	Eagle disturbance, unknown impacts to ESA-listed fish species
Banks Lake - Goose Island	WA	Unknown limiting factors, limited data on prey base, unknown impacts to ESA-listed salmonids
Banks Lake - Twining Island	WA	Unknown factors are limiting the current Caspian tern colony, limited data on prey base, unknown impacts to ESA-listed salmonids
Sprague Lake - Harper Island	WA	Unknown factors are limiting the current Caspian tern colony, limited data on prey base, unknown impacts to ESA-listed salmonids, privately owned
San Francisco Bay - Waterfront (Agua Vista)	CA	Nesting structure needed, unknown impacts to some ESA-listed fish species
San Francisco Bay - Hayward Regional Shoreline	CA	Competing conservation goals in area, unknown impacts to some ESA-listed fish species
Monterey Bay - Elkhorn Slough	CA	Secure nesting habitat needed, unknown impacts to ESA-listed fish species
Los Angeles Harbor - Terminal Island (Pier 400)	CA	Distant mitigation, competing conservation goals in area, unknown impacts to ESA-listed fish species
San Diego Bay - San Diego Bay NWR (Salt works)	CA	Distant mitigation, contribution to management activities on the Columbia Plateau uncertain
Goose Lake	CA	Secure nesting habitat needed, limited data on prey base, unknown impacts to ESA-listed fish species

APPENDICES

APPENDIX 1:

ASSESSMENT OF ALTERNATIVE CASPIAN TERN COLONY SITES FOR THE INLAND AVIAN PREDATION MANAGEMENT PLAN: RANKING CRITERIA

Potential for Site to Attract Breeding Caspian Terns

I. **Nesting Status:** This criterion describes nesting activity of Caspian terns at the site.

<i>4 = Currently active</i>	Caspian terns confirmed to be currently nesting at site
<i>3 = Recently active</i>	Caspian terns confirmed to have nested at site within the last 5 years
<i>2 = Historically active</i>	Documented prior nesting by Caspian terns, but nesting not been confirmed in the last 5 years
<i>1 = None documented</i>	No documentation of any Caspian tern nesting

II. **Use of Site by Caspian Terns:** This criterion describes historical use of site by Caspian terns.

<i>3 = Breeding at site</i>	Documented use by nesting Caspian terns
<i>2 = Use of site</i>	Documented use by non-nesting Caspian terns (i.e., loafing, foraging, roosting)
<i>1 = None documented</i>	No documentation of use by Caspian terns

III. **Connectivity:** This criterion describes connectivity between the tern colony site or the region of the site with the Caspian tern colonies at Goose Island or Crescent Island.

<i>3 = Documented at site</i>	Documentation of connectivity based on re-sighting of individuals banded at Goose or Crescent islands
<i>2 = Documented in region</i>	Documentation of connectivity based on re-sighting of individuals banded at Goose or Crescent islands in the region of site

<i>1 = Not Documented</i>	No documentation of connectivity based on re-sightings of individuals banded at Goose or Crescent islands at the site or region of the site (only sites/regions where terns were banded and where re-sightings of banded individuals were conducted multiple times a year are included)
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IV. **Proximity to Goose or Crescent Islands:** This criterion describes the shortest distance to either Goose Island or Crescent Island.

<i>3 = Close</i>	Site < 200 km from either Goose or Crescent islands
<i>2 = Intermediate</i>	Site 200 - 500 km from either Goose or Crescent islands
<i>1 = Far</i>	Site > 500 km from either Goose or Crescent islands

V. **Inter-specific Allies Present:** This criterion describes the use of a site for nesting by bird species that use similar habitats as Caspian terns (i.e., gulls).

<i>3 = Recently active</i>	Inter-specific allies confirmed to have nested at site within the last 5 years
<i>2 = Historically active</i>	Documented prior nesting by inter-specific allies, but nesting has not been confirmed in the last 5 years
<i>1 = None documented</i>	No documentation of any nesting by inter-specific allies

Potential Constraints of Colony Site

VI. **Potential Conflicts with ESA-listed Fish Prey Species:** This criterion describes the potential for conflict with ESA-listed fish prey species.

<i>3 = Conflicts unlikely</i>	No ESA-listed fish prey species originate at the site or within the potential foraging range of the site
<i>2 = Conflicts possible</i>	ESA-listed fish prey species are present within the potential foraging range of the site
<i>1 = Conflicts likely</i>	ESA-listed fish prey species are present at the site

VII. **Conflicts with Other Protected Species:** This criterion describes the potential for conflict with protected species other than prey fish (i.e., ESA-listed bird species, marine mammals, or other specially-protected species).

- | | |
|-------------------------------|---|
| <i>3 = Conflicts unlikely</i> | No other ESA-listed species, marine mammals, or other protected species occur at the site |
| <i>2 = Conflicts possible</i> | Other ESA-listed species, marine mammals, or other protected species are present; constraints on Caspian tern management are possible |
| <i>1 = Conflicts likely</i> | Other ESA-listed species, marine mammals, or other protected species are present; constraints on Caspian tern management are likely |

VIII. **Human and Other Disturbance:** This criterion describes the level of human and other (e.g., livestock) disturbance that might occur at a site.

- | | |
|------------------------|---|
| <i>3 = Very little</i> | Site is relatively inaccessible with no documentation of human use or other potential disturbance |
| <i>2 = Moderate</i> | Site is accessible and has some history of human and/or other uses; disturbance levels are manageable |
| <i>1 = Substantial</i> | Site is readily accessible with regular human and other uses and there are limited opportunities for managing use |

IX. **Mammalian Predators:** This criterion describes the expected level of mammalian predation that might impact a Caspian tern colony.

- | | |
|------------------------|--|
| <i>3 = Very little</i> | Site inaccessible to terrestrial mammals with no documentation of use by terrestrial mammals |
| <i>2 = Moderate</i> | Terrestrial mammalian predators on-site or nearby, but potential impacts to tern colony are low or manageable |
| <i>1 = Substantial</i> | Site is readily accessible to terrestrial mammalian predators and there are limited opportunities for managing use |

X. **Avian Predators:** This criterion describes the expected level of avian predation that might impact a Caspian tern colony.

<i>3 = Very little</i>	No known concentration of avian predators in close proximity
<i>2 = Moderate</i>	Avian predators on-site or nearby, but potential impacts to tern colony are low or manageable
<i>1 = Substantial</i>	Site has large concentrations of avian predators on-site or nearby and there are limited opportunities for managing use

XI. **Annual Availability:** This criterion describes the inter-annual variability in site availability (e.g., due to lack of water) as it affects nesting habitat for Caspian terns.

<i>3 = High</i>	Stable water levels, site available in all years (100%)
<i>2 = Moderate</i>	Moderately variable water levels, site available in most years (> 75%)
<i>1 = Low</i>	Highly variable water levels; site available in some years (< 75%)

Site Enhancement Considerations

XII. **Proximity to Previously Constructed Colony Sites:** This criterion describes the shortest distance from the site to previously constructed sites for tern nesting as part of the Caspian Tern Management Plan for the Columbia River Estuary.

<i>3 = Far</i>	Site > 80 km (i.e., outside the potential foraging range for Caspian terns) from existing tern islands
<i>2 = Intermediate</i>	Site 20 - 80 km from an existing tern island
<i>1 = Close</i>	Site < 20 km from an existing tern island

XIII. **Site Preparation Requirements:** This criterion describes the degree of habitat modification needed to create nesting habitat required to accommodate an additional 1,000 pairs of Caspian terns (i.e., the approximate total number of terns that nest in the Columbia Plateau region).

<i>3 = Very little</i>	Site is currently suitable for nesting or requires only minor enhancement or modification
<i>2 = Moderate</i>	Site is available after manipulation, such as dredging, island expansion, or vegetation removal with heavy equipment
<i>1 = Substantial</i>	Site needs to be constructed, requiring extensive permitting, consultation, labor, and expense

XIV. **Site Maintenance Requirements:** This criterion describes the degree of habitat maintenance required for long-term site management as a Caspian tern colony.

<i>3 = Very little</i>	Short-term or infrequent management requirements
<i>2 = Moderate</i>	Annual habitat maintenance, but heavy equipment not required
<i>1 = Substantial</i>	Annual maintenance with heavy equipment required

XV. **Ownership:** This criterion identifies ownership of the site.

<i>N = National Wildlife Refuge</i>	Site is within a National Wildlife Refuge (NWR)
<i>F = Federal</i>	Site is under federal ownership, not a NWR
<i>S = State</i>	Site is under state ownership
<i>T = Tribal</i>	Site is under tribal ownership
<i>L = Local</i>	Site is under local (e.g., county) ownership
<i>P = Private</i>	Site is under private ownership
<i>U = Unknown</i>	Site ownership is unknown

APPENDIX 2:

NOTES ON ALTERNATIVE CASPIAN TERN COLONY SITES WITH MANAGEMENT POTENTIAL

ALASKA

Copper River Delta - Kokinhenik Bar

Pros:

- Current Caspian tern nesting site
- Owned by U.S. Forest Service
- Site preparation may only require moderate modification, such as increasing elevation of nesting area, which is currently low and tidally influenced
- No known ESA-listed fish species within 80 km of site
- Inter-specific allies have recently nested at site (glaucous-winged gulls)
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- Periphery of Caspian tern breeding range
- Site is very remote and difficult to access
- Band re-sighting data from Columbia Plateau Caspian terns indicates no connectivity with site
- Predators documented – brown bears, bald eagles

WASHINGTON - COASTAL

Bellingham Bay - Port of Bellingham

Pros:

- Historical Caspian tern nesting site; 1,500 pairs used site in 2010
- Banding data from Columbia Plateau Caspian terns indicates high connectivity with site
- Inter-specific allies have recently nested at site (glaucous-winged gulls)
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats
- Local Audubon Chapter support

Cons:

- Possible conflicts with ESA-listed fish species: Bocaccio rockfish (endangered), canary rockfish (threatened), yelloweye rockfish (threatened), bull trout (threatened), Puget Sound Chinook salmon (threatened), Puget Sound steelhead (threatened), and Hood Canal chum salmon (threatened) are within 80 km of site

- Whatcom Creek is in close proximity to the site

Unknowns:

Site preparation requirements unknown; no natural habitat to enhance; island, barge, pier, or rooftop would need to be provided as nesting habitat

Padilla Bay - Unnamed Island

Pros:

- Current Caspian tern nesting site; several hundred pairs attempted to nest there in 2011
- Area consists of four dredge spoil islands – Caspian terns nested on the northern-most island in 2011, but nesting area was flooded during high high tide
- Washington Department of Fish and Wildlife was considering building islands in the area to provide winter loafing areas for brant geese
- Banding data from Columbia Plateau Caspian terns indicates high connectivity with site
- Inter-specific allies have recently nested at site (glaucous-winged gulls)
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- Island is privately owned
- Potential for mammal access - islands are close (< 0.5 km) to shore
- Island is connected to mainland at extreme low tide events. Dredging around island would likely be necessary
- Possible conflicts with ESA-listed fish species: Bocaccio rockfish (endangered), canary rockfish (threatened), yelloweye rockfish (threatened), bull trout (threatened), Puget Sound Chinook salmon (threatened), Puget Sound steelhead (threatened), and Hood Canal chum salmon (threatened) are within 80 km of site

Strait of Juan de Fuca - Smith and Minor islands

Pros:

- Current Caspian tern nesting site; about 5 pairs attempted to nest there in 2011
- Owned by San Juan Islands National Wildlife Refuge
- Site preparation may only require moderate modification, such as vegetation removal
- Presumed abundant and diverse prey resources
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Inter-specific allies have recently nested at site (glaucous-winged gulls)
- Predation by terrestrial mammalian predators very unlikely due to remoteness of islands and distance to mainland

Cons:

- Harbor seal pupping at site may restrict access for research and monitoring
- Possible conflicts with ESA-listed fish species: Bocaccio rockfish (endangered), canary rockfish (threatened), yelloweye rockfish (threatened), Pacific eucalon (threatened), bull trout (threatened), Puget Sound Chinook salmon (threatened), Puget Sound steelhead (threatened), and Hood Canal chum salmon (threatened) are within 80 km of site
- Popular bald eagle loafing site, with recent history of nesting
- Islands are exposed and isolated, making monitoring a tern colony more challenging

Strait of Juan de Fuca - Dungeness Spit

Pros:

- Current Caspian tern nesting site; formerly the site of a colony of at least 1,500 pairs of Caspian terns
- Owned by Dungeness National Wildlife Refuge
- Site preparation may only require moderate modifications, such as building and maintaining a predator enclosure fence
- Banding data from Columbia Plateau Caspian terns indicates high connectivity with site
- Inter-specific allies have recently nested at site (glaucous-winged gulls)
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- Intense predation pressure from terrestrial mammalian predators (coyotes) due to land-bridge
- Construction and maintenance of a predator-proof fence would be required to restore this former Caspian tern colony
- Bald eagles are common in area
- Possible human disturbance due to high recreational use of area
- Possible conflicts with ESA-listed fish species: Bocaccio rockfish (endangered), canary rockfish (threatened), yelloweye rockfish (threatened), Pacific eucalon (threatened), bull trout (threatened), Puget Sound Chinook salmon (threatened), Puget Sound steelhead (threatened), and Hood Canal chum salmon (threatened) are within 80 km of site
 - Dungeness River is in close proximity to the site

Strait of Juan de Fuca - Protection Island

Pros:

- Owned by Protection Island National Wildlife Refuge

- Site preparation may only require moderate modification, such as vegetation removal
- Presumed abundant prey resources
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Inter-specific allies have recently nested at site (glaucous-winged gulls)

Cons:

- No documentation of Caspian terns nesting at site
- Harbor seal pupping at site may restrict access for research and monitoring
- Gull colony at Protection Island has been declining for several years, apparently due to bald eagle disturbance and depredation
- Possible conflicts with ESA-listed fish species: Bocaccio rockfish (endangered), canary rockfish (threatened), yelloweye rockfish (threatened), Pacific eucalalon (threatened), bull trout (threatened), Puget Sound Chinook salmon (threatened), Puget Sound steelhead (threatened), and Hood Canal chum salmon (threatened) are within 80 km of site

Puget Sound – Jetty Island

Pros:

- Historical Caspian tern nesting site
- Island is owned by Port of Everett and managed by the city of Everett
- Site preparation may only require moderate modification, such as vegetation removal
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Inter-specific allies have recently nested at site (glaucous-winged gulls)
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats
- Local Audubon Chapter support

Cons:

- Possible human disturbance due to high recreational use of island (i.e., city park with boat dock, popular kite-boarding location)
- Potential mammal access – domestic dogs allowed on island and potentially other mammalian predators present
- Possible conflicts with ESA-listed fish species: Bocaccio rockfish (endangered), canary rockfish (threatened), yelloweye rockfish (threatened), bull trout (threatened), Puget Sound Chinook salmon (threatened), Puget Sound steelhead (threatened), and Hood Canal chum salmon (threatened) are within 80 km of site
 - Snohomish River is in close proximity to the site

Puget Sound - Seattle Waterfront (Pier 90)

Pros:

- Current Caspian tern nesting site
 - Caspian terns have attempted to nest in multiple years on multiple warehouse rooftops
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Inter-specific allies have recently nested at site (glaucous-winged gulls)
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- Possible human disturbance due to urban setting
- Possible conflicts with ESA-listed fish species: Bocaccio rockfish (endangered), canary rockfish (threatened), yelloweye rockfish (threatened), bull trout (threatened), Puget Sound Chinook salmon (threatened), Puget Sound steelhead (threatened), and Hood Canal chum salmon (threatened) are within 80 km of site
 - < 5 km from Puget Sound Chinook salmon and Puget Sound steelhead migration corridor from Lake Washington to Puget Sound

Unknowns:

- Site preparation requirements unknown; no natural habitat to enhance; island, barge, pier, or rooftop would need to be provided as nesting habitat

Puget Sound – Bremerton (Sinclair Inlet)

Pros:

- Close proximity to former Caspian tern nesting site (Puget Sound Naval Shipyard - Bremerton)
 - Caspian terns attempted to nest on multiple warehouse rooftops on-base in multiple years
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Inter-specific allies have recently nested at site (glaucous-winged gulls)
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- Possible human disturbance due to urban setting
- Possible conflicts with ESA-listed fish species: Bocaccio rockfish (endangered), canary rockfish (threatened), yelloweye rockfish (threatened), bull trout (threatened), Puget Sound Chinook salmon (threatened), Puget Sound steelhead (threatened), and Hood Canal chum salmon (threatened) are within 80 km of site

Unknowns:

- Site preparation requirements unknown; no natural habitat to enhance; island, barge, pier, or rooftop would need to be provided as nesting habitat

Puget Sound - Tacoma Waterfront

Pros:

- Close proximity to former Caspian tern nesting site (ASARCO Industrial Site and several warehouse rooftops at Port of Tacoma)
 - Attempts to attract nesting Caspian terns to a barge in Commencement Bay were successful in 2001 (Collis et al. 2002)
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Inter-specific allies have recently nested at site (glaucous-winged gulls)
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- Possible conflicts with ESA-listed fish species: Bocaccio rockfish (endangered), canary rockfish (threatened), yelloweye rockfish (threatened), bull trout (threatened), Puget Sound Chinook salmon (threatened), Puget Sound steelhead (threatened), and Hood Canal chum salmon (threatened) are within 80 km of site
 - Puyallup River is in close proximity to the site
 - Previous efforts to attract Caspian terns to nest in Commencement Bay were strongly opposed by the Puyallup Tribe who operate a salmon hatchery on Puyallup River

Unknowns:

- Site preparation requirements unknown; no natural habitat to enhance; island, barge, pier, or rooftop would need to be provided as nesting habitat

Grays Harbor - Unnamed Island

Pros:

- Close proximity to former Caspian tern nesting sites (Goose Island, Sand Island, and Whitcomb Flats)
- Caspian terns have been documented roosting at the site
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Owned by Washington Department of Natural Resources
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- No documentation of Caspian terns or other colonial waterbirds nesting at site

- Nearby Caspian tern colony on Sand Island apparently failed due to bald eagle disturbance
- Site preparation may be substantial and include increasing elevation of nesting area, which is currently low and tidally influenced
- Documented harbor seal haul out site
- Possible California brown pelican roost location
- Possible conflicts with ESA-listed fish species: bull trout (threatened), Upper Willamette River Chinook salmon (threatened), Lower Columbia River Chinook salmon (threatened), Upper Columbia River spring-run Chinook salmon (endangered), Snake River fall-run Chinook salmon (threatened), Snake River spring/summer-run Chinook salmon (threatened), Columbia River chum salmon (threatened), Lower Columbia River coho salmon (threatened), Pacific eulachon (threatened), Snake River sockeye salmon (endangered), Upper Willamette River steelhead (threatened), Lower Columbia River steelhead (threatened), Middle Columbia River steelhead (threatened), Upper Columbia River steelhead (threatened), and Snake River steelhead (threatened) are within 80 km of site
 - Bull trout are the only ESA-listed fish species with designated critical habitat in Grays Harbor (i.e., at site)
 - Columbia River estuary is ~ 80 km from this site
 - Puget Sound is < 80 km from site. ESA-listed fish species from the Puget Sound were not included as birds would need to cross the Olympic Peninsula to access fish populations in Puget Sound

Grays Harbor - Sand Island

Pros:

- Former Caspian tern nesting site
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Owned by Washington Department of Natural Resources
- Inter-specific nesting allies (double-crested cormorants, glaucous-winged/western gulls) have successfully nested at site
- Site preparation may be moderate and include vegetation removal to increase available nesting habitat
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- Former Caspian tern colony at this site may have failed due to bald eagle disturbance and gull depredation
 - Glaucous-winged/western gulls nested under beach grass as a possible protective measure against bald eagles
- Location of site makes it susceptible to erosion during winter storms
- Possible harbor seal haul out site

- Possible California brown pelican roost location
- Western snowy plovers (threatened) known to occur at site
- Possible conflicts with ESA-listed fish species: bull trout (threatened), Upper Willamette River Chinook salmon (threatened), Lower Columbia River Chinook salmon (threatened), Upper Columbia River spring-run Chinook salmon (endangered), Snake River fall-run Chinook salmon (threatened), Snake River spring/summer-run Chinook salmon (threatened), Columbia River chum salmon (threatened), Lower Columbia River coho salmon (threatened), Pacific eulachon (threatened), Snake River sockeye salmon (endangered), Upper Willamette River steelhead (threatened), Lower Columbia River steelhead (threatened), Middle Columbia River steelhead (threatened), Upper Columbia River steelhead (threatened), Snake River steelhead (threatened) are within 80 km of site
 - Bull trout are the only ESA-listed fish species with designated critical habitat in Grays Harbor (i.e., at site)
 - Columbia River is ~ 80 km from site
 - Puget Sound is < 80 km from site. ESA-listed fish species from the Puget Sound were not included as birds would need to cross the Olympic Peninsula to access fish populations in Puget Sound

Grays Harbor – No Name Island

Pros:

- Close proximity to former Caspian tern nesting sites (Grays Harbor – Sand Island and Grays Harbor - Whitcomb Flats)
- Inter-specific allies have historically nested at site (glaucous-winged/western gulls)
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Owned by Washington Department of Natural Resources
- Site preparation may be moderate and include vegetation removal to increase available nesting habitat
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- No documentation of Caspian terns nesting at site
- Nearby Caspian tern colony may have failed due to bald eagle disturbance (Grays Harbor – Sand Island)
- Site preparation may be substantial and include increasing elevation of nesting area, which is currently low and tidally influenced
- Location of site makes it susceptible to erosion during winter storms
- Possible harbor seal haul out site
- Western snowy plovers (threatened) known to occur at site
- Possible California brown pelican roost location

- Possible conflicts with ESA-listed fish species: bull trout (threatened), Upper Willamette River Chinook salmon (threatened), Lower Columbia River Chinook salmon (threatened), Upper Columbia River spring-run Chinook salmon (endangered), Snake River fall-run Chinook salmon (threatened), Snake River spring/summer-run Chinook salmon (threatened), Columbia River chum salmon (threatened), Lower Columbia River coho salmon (threatened), Pacific eulachon (threatened), Snake River sockeye salmon (endangered), Upper Willamette River steelhead (threatened), Lower Columbia River steelhead (threatened), Middle Columbia River steelhead (threatened), Upper Columbia River steelhead (threatened), Snake River steelhead (threatened) are within 80 km of site
 - Bull trout are the only ESA-listed fish species with designated critical habitat in Grays Harbor (i.e., at site)
 - Columbia River is ~ 80 km from site
 - Puget Sound is < 80 km from site. ESA-listed fish species from the Puget Sound were not included as birds would need to cross the Olympic Peninsula to access fish populations in Puget Sound

Willapa Bay - Snag Islands

Pros:

- Near historical Caspian tern nesting site at Gunpowder Sands, Willapa Bay
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats
- No ESA-listed fish species have designated critical habitat at the site

Cons:

- Site preparation may be substantial and include increasing elevation of nesting area, which is currently low and tidally influenced
- Ownership includes state, local, and private entities
- Location of site makes it susceptible to erosion during winter storms
- Possible human disturbance due to close proximity to oyster beds
- Possible harbor seal haul out site
- Possible California brown pelican roost location
- Possible conflicts with ESA-listed fish species: bull trout (threatened), Upper Willamette River Chinook salmon (threatened), Lower Columbia River Chinook salmon (threatened), Upper Columbia River spring-run Chinook salmon (endangered), Snake River fall-run Chinook salmon (threatened), Snake River spring/summer-run Chinook salmon (threatened), Columbia River chum salmon (threatened), Lower Columbia River coho salmon (threatened), Oregon Coast coho salmon (threatened), Pacific eulachon (threatened), Snake River sockeye salmon (endangered), Upper Willamette River steelhead (threatened), Lower Columbia River steelhead (threatened), Middle Columbia River steelhead

(threatened), Upper Columbia River steelhead (threatened), Snake River steelhead (threatened) are within 80 km of site

- Columbia River estuary is < 50 km from the site

Willapa Bay – Gunpowder Sands

Pros:

- Former Caspian tern nesting site
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats
- No ESA-listed fish species have designated critical habitat at the site

Cons:

- Site preparation may be substantial and include increasing elevation of nesting area, which is currently low and tidally influenced
- Location of site makes it highly susceptible to erosion during winter storms
- Site may be difficult to access due to high surf near mouth of bay
- Possible harbor seal haul out site
- Possible conflicts with ESA-listed fish species: bull trout (threatened), Upper Willamette River Chinook salmon (threatened), Lower Columbia River Chinook salmon (threatened), Upper Columbia River spring-run Chinook salmon (endangered), Snake River fall-run Chinook salmon (threatened), Snake River spring/summer-run Chinook salmon (threatened), Columbia River chum salmon (threatened), Lower Columbia River coho salmon (threatened), Oregon Coast coho salmon (threatened), Pacific eulachon (threatened), Snake River sockeye salmon (endangered), Upper Willamette River steelhead (threatened), Lower Columbia River steelhead (threatened), Middle Columbia River steelhead (threatened), Upper Columbia River steelhead (threatened), Snake River steelhead (threatened) are within 80 km of site
 - Columbia River is < 50 km from site

Unknowns:

- Ownership is unknown

WASHINGTON - INTERIOR

Banks Lake – Goose Island

Pros:

- Site located on Columbia Plateau
 - Enhancing this site would provide an alternative nesting location for Caspian terns on the Columbia Plateau
- Former Caspian tern nesting site, no Caspian tern nesting since 2005
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Inter-specific allies have recently nested at site (primarily ring-billed gulls, with some California gulls)
- Site preparation may be moderate and include enhancement of nesting substrate on existing island
- High likelihood that Goose Island and Crescent Island Caspian terns could be attracted to this area due to proximity to these sites
- Owned by Bureau of Reclamation
- No ESA-listed fish species have designated critical habitat at the site

Cons:

- Possibly accessible by terrestrial mammalian predators as island is close to shore (~ 1 km)
- Possible human disturbance due to high recreational use of area
- Possible conflicts with ESA-listed fish species: bull trout (threatened), Upper Columbia River spring-run Chinook salmon (endangered), and Upper Columbia River steelhead (threatened) are within 80 km of site
 - Upper Columbia River is ~ 46 km from site (below Chief Joseph Dam)
 - Documented consumption of Columbia River salmonids at nearby Caspian tern nesting site on Banks Lake – Twining Island (PIT tag recoveries)
 - Specific conflicts with local sport fisheries and hatcheries may exist (Chief Joseph Fish Hatchery on mainstem Columbia River is < 46 km from site)
- Multiple uncertainties about this site remain

Unknowns:

- Additional monitoring required to determine factors limiting success of Caspian terns currently nesting at Banks Lake
- Forage fish availability is unknown

Banks Lake – Twining Island

Pros:

- Site located on Columbia Plateau
 - Enhancing this site would provide additional nesting habitat for Caspian terns on the Columbia Plateau
- Current Caspian tern nesting site
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Inter-specific allies have recently nested at site (ring-billed gulls and California gulls)
- Site preparation may be moderate and include enhancement of nesting substrate on existing island
- High likelihood that Goose Island and Crescent Island Caspian terns could be attracted to this area due to proximity to these sites
- Owned by Bureau of Reclamation
- No ESA-listed fish species have designated critical habitat at the site

Cons:

- Possibly accessible by terrestrial mammalian predators because of its close proximity to the mainland (~ 0.3 km)
- Possible human disturbance due to high recreational use of area
- Possible conflicts with ESA-listed fish species: bull trout (threatened), Upper Columbia River spring-run Chinook salmon (endangered), and Upper Columbia River steelhead (threatened) are within 80 km of site.
 - Upper Columbia River is ~ 48 km from site (below Chief Joseph Dam)
 - Documented consumption of Columbia River salmonids at site (PIT tag recoveries)
 - Specific conflicts with local sport fisheries and hatcheries may exist (Chief Joseph Fish Hatchery on mainstem Columbia River is < 48 km from site)
- Multiple uncertainties about this site remain

Unknowns:

- Additional monitoring required to determine factors limiting success of Caspian terns currently nesting at Banks Lake
- Forage fish availability is unknown

Sprague Lake – Harper Island

Pros:

- Current Caspian tern nesting site
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Inter-specific allies have recently nested at site (ring-billed gulls, California gulls, and double-crested cormorants)

- Site preparation may be moderate and include enhancement of nesting substrate on existing island
- Although site is privately owned, landowner may be interested selling or a land swap (D. Jacobson, Landowner, pers. comm.)
- No ESA-listed fish species have designated critical habitat at the site

Cons:

- Site is privately owned
- Caspian terns nesting at this site have failed to fledge young due to unknown causes in multiple years
- Foraging habitat and prey availability may limit the number of Caspian terns that could nest at this site
- Possible human disturbance due to high recreational use of area
- Possible conflicts with ESA-listed fish species: bull trout (threatened), Snake River fall-run Chinook salmon (threatened), Snake River spring/summer-run Chinook salmon (threatened), Snake River sockeye salmon (endangered), Snake River steelhead (threatened) are within 80 km of site.
 - Snake River is ~ 66 km from site (section between Lower Granite and Little Goose dams)

Unknowns:

- Additional monitoring required to determine factors limiting success of Caspian terns currently nesting at Sprague Lake
- Forage fish availability is unknown

OREGON - COASTAL

Tillamook Bay

Pros:

- Establishment of a Caspian tern colony on the Oregon coast
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- No documentation of nesting by Caspian terns or other colonial waterbirds at site
- Site preparation may be substantial as there is no natural habitat to enhance; artificial island construction or barge placement would be needed to provide nesting habitat
- Artificial island possibly used as harbor seal haul out site
- Possible conflicts with ESA-listed fish species: bull trout (threatened), Upper Willamette River Chinook salmon (threatened), Lower Columbia River Chinook

salmon (threatened), Upper Columbia River spring-run Chinook salmon (endangered), Snake River fall-run Chinook salmon (threatened), Snake River spring/summer-run Chinook salmon (threatened), Columbia River chum salmon (threatened), Lower Columbia River coho salmon (threatened), Oregon Coast coho salmon (threatened), Pacific eulachon (threatened), Snake River sockeye salmon (endangered), Upper Willamette River steelhead (threatened), Lower Columbia River steelhead (threatened), Middle Columbia River steelhead (threatened), Upper Columbia River steelhead (threatened), Snake River steelhead (threatened) are within 80 km of site

- Oregon Coast coho salmon (threatened) occur in Tillamook Bay
- Columbia River is ~ 80 km from site

Unknowns:

- Connectivity to Columbia Plateau Caspian tern colonies - surveys for banded Columbia Plateau Caspian terns have not been conducted

Coos Bay - Unnamed Island

Pros:

- Establishment of a Caspian tern colony on the Oregon coast
- Site preparation may be moderate and include vegetation removal and enhancement of nesting substrate on existing island
- Owned by Oregon Division of State Lands
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- No documentation of Caspian terns or other colonial waterbirds nesting at site
- Possible human disturbance due to close proximity to recreational area on mainland
- Possible access by terrestrial mammalian predators due to close proximity to mainland, especially at low tides (< 150 meters to mainland)
- Possible conflicts with ESA-listed fish species: Oregon Coast coho salmon (threatened) and Pacific eulachon (threatened) are within 80 km of site.
 - Oregon Coast coho salmon (threatened) occur in Coos Bay

OREGON - INTERIOR

Upper Klamath Lake - Williamson River Delta

Pros:

- Area is commonly used by Caspian terns and other colonial waterbirds as a roost site
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Surrounding area owned by The Nature Conservancy

Cons:

- Site preparation may be substantial as there is no natural habitat to enhance; nesting habitat would need to be created
- No documentation of Caspian terns or other colonial waterbirds nesting at site
- Documentation of predators (great horned owl) in area
- Site is within foraging distance (80 km) of previously constructed Caspian tern nesting islands in Upper Klamath Basin
- Possible conflicts with ESA-listed fish species: bull trout (threatened), Lost River sucker (endangered), and shortnose sucker (endangered) are within 80 km of site.
 - Lost River sucker and shortnose sucker occur at site

Unknowns:

- Forage fish availability – likely not limiting due to number of piscivorous waterbirds in area

Upper Klamath Lake - Upper Klamath NWR

Pros:

- Inter-specific allies have recently nested at site (American white pelicans and double-crested cormorants)
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Owned by Upper Klamath National Wildlife Refuge

Cons:

- No documentation of Caspian terns nesting at site
- Site preparation may be substantial due to current nesting areas within marshes; nesting habitat would need to be created either by substantial enhancement of current nesting habitat or creation of a new island
- Site may not be surrounded by water in extreme drought years
- Site may be difficult to access for research and monitoring due to surrounding marsh
- Possible terrestrial mammal access to area, especially in low water years

- Site is within foraging distance (80 km) of previously constructed Caspian tern nesting islands in Upper Klamath Basin
- Possible conflicts with ESA-listed fish species: bull trout (threatened), Lost River sucker (endangered), and shortnose sucker (endangered) are within 80 km of site
 - Lost River sucker and shortnose sucker occur at site

Unknowns:

- Forage fish availability – likely not limiting due to number of piscivorous waterbirds in area

IDAHO

Island Park Reservoir

Pros:

- Former Caspian tern nesting site
- Inter-specific allies have recently nested at site (ring-billed gulls and/or California gulls)
- Reservoir is owned by Bureau of Reclamation
- Site preparation may be moderate and include vegetation removal and/or habitat enhancement to increase available nesting habitat on existing island
- Water levels remain relatively stable during nesting season, preventing the island from being connected to the mainland and allowing access by terrestrial predators
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- No known ESA-listed fish species within 80 km of site

Cons:

- Island may be connected to mainland in extreme drought years
- Part of island is privately owned, other section is owned by Harriman State Park
- Possible human disturbance due to high recreational use of area

Unknowns:

- Forage fish availability is unknown

Minidoka NWR - Tern Island

Pros:

- Former Caspian tern nesting site
- Inter-specific allies have recently nested at site (California gulls, American white pelicans, and double-crested cormorants)
- Owned by Minidoka National Wildlife Refuge

- Water levels remain relatively stable during nesting season, preventing the island from being connected to the mainland
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- No known ESA-listed fish species within 80 km of site

Cons:

- All available nesting habitat is currently used by other nesting waterbirds
- Possible terrestrial mammal access due to close proximity to mainland (< 0.25 km)
- Site preparation may be moderate to substantial and include vegetation removal and/or habitat enhancement to increase available nesting habitat on existing islands; creation of new island is also a possibility as total area currently available on a three-island complex is < 2.25 acres

Unknowns:

- Forage fish availability is unknown

Bear Lake NWR - Unnamed Island

Pros:

- Former Caspian tern nesting site
- Inter-specific allies have recently nested at site (ring-billed gulls, California gulls, and double-crested cormorants)
- Owned by Bear Lake National Wildlife Refuge
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- No known ESA-listed fish species at the site

Cons:

- All available habitat is currently used by other nesting waterbirds
- Site preparation may be moderate to substantial and include vegetation removal and/or habitat enhancement to increase available nesting habitat on existing island; creation of new island would likely be needed as current location may be connected to mainland in low water years

Unknowns:

- Forage fish availability is unknown
- Exact location of historical Caspian tern nesting site is not known

UTAH

Great Salt Lake - Bear River Migratory Bird Refuge

Pros:

- Former Caspian tern nesting site
- Inter-specific allies have recently nested at site (California gulls)
- Owned by Bear River Migratory Bird Refuge, USFWS
- Banding data from Columbia Plateau Caspian terns indicates connectivity with site
- No known ESA-listed fish species within the potential foraging range of site
 - Lahontan cutthroat trout populations(s) maybe located in mountain streams but likely inaccessible to Caspian terns
 - 80 km potential foraging range does not overlap critical habitat or natural distribution of June Sucker; however, supplemental June sucker genetic reserve populations at Red Butte Reservoir and ponds at Ogden Nature Center are within 80 km

Cons:

- Site preparation may be moderate to substantial and include habitat enhancement to increase available nesting habitat or creation of new island
- New island may conflict with active management to reduce the number of California gulls nesting in the area to protect other nesting waterbirds
- Possible conflicts for nesting habitat with large number of California gulls in area

Unknowns:

- Forage fish availability is unknown

Great Salt Lake - Minerals Complex

Pros:

- Historical Caspian tern nesting site
- Inter-specific allies have recently nested at site (California gulls)
- Managed by Utah Division of Forestry, Fire, and State Lands
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- No known ESA-listed fish species within potential foraging range of site
 - Lahontan cutthroat trout populations(s) maybe located in mountain stream but are likely inaccessible to Caspian terns
 - 80 km potential foraging range does not overlap critical habitat or natural distribution of June sucker; however, supplemental June sucker genetic reserve populations at Red Butte Reservoir and ponds at Ogden Nature Center are within 80 km

Cons:

- Water levels may not be stable in all years
- Waterbirds currently nest on isolated dikes
- Possible conflicts for nesting habitat with a large number of California gulls in area
- Site preparation may be moderate to substantial and include habitat enhancement to increase available nesting habitat or creation of new island
- ESA-listed fish species within 80 km of site include Lahontan cutthroat trout (endangered) and June sucker (endangered)

Unknowns:

- Forage fish availability is unknown

Neponset Reservoir

Pros:

- Former Caspian tern nesting site
- Inter-specific allies have recently nested at site (American white pelican, double-crested cormorants, ring-billed gulls, California gulls)
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Site preparation may be moderate and include habitat enhancement to increase available nesting habitat on existing island(s)
- Human access to the lake is restricted
- Owned by the Church of Jesus Christ of Latter-day Saints
- No known ESA-listed fish species within potential foraging range of site
 - Lahontan cutthroat trout populations(s) maybe located in mountain stream but are likely inaccessible to Caspian terns
 - 80 km potential foraging range does not overlap critical habitat or natural distribution of June Sucker, however supplemental June Sucker genetic reserve populations at Red Butte Reservoir and ponds at Ogden Nature Center are within 80 km

Cons:

- Reservoir is shallow and islands may be connected to mainland in very low water years
- Limited access – no boat ramp
- Possible conflicts with local sport fisheries and hatcheries
- ESA-listed fish species within 80 km of site include Lahontan cutthroat trout (endangered) and June sucker (endangered)

Unknowns:

- Site not actively managed; data is lacking on mammal access to islands, avian predators in area, and water levels

- Forage fish availability is unknown

Utah Lake - Rock Island

Pros:

- Former Caspian tern nesting site
 - Inter-specific allies have recently nested at site (California gulls)
 - Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
 - Utah Lake has an overabundance of invasive common carp that may provide a food source for piscivorous waterbirds; presence of nesting terns may help manage carp problem in lake
- Owned by State of Utah

Cons:

- Site preparation may be moderate to substantial and include habitat enhancement to increase available nesting habitat on existing island or creation of new island
- Possible conflicts with ESA-listed fish species: June suckers (endangered) are within 80 km of site.
 - June suckers occur at site
 - Lahontan cutthroat trout (endangered) maybe located in mountain streams within 80 km, but are likely inaccessible to Caspian tern

Unknowns:

- Forage fish availability is unknown

CALIFORNIA – NORTH COAST

Humboldt Bay - Sand Island

Pros:

- Former Caspian tern nesting site
- Inter-specific allies have historically nested at site (double-crested cormorants)
- Site preparation may only require moderate modifications, such as increasing elevation of nesting area, which is currently low and tidally influenced
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats
- Owned by California State Lands Commission and managed by the Humboldt Bay Harbor Recreation and Conservation District

Cons:

- Possible human disturbance due to close proximity to oyster beds and high recreational use of area

- Possible conflicts with ESA-listed fish species: California Coastal Chinook salmon (threatened), Southern Oregon/North California coho salmon (threatened), Northern California steelhead (threatened), tidewater goby (endangered), Pacific eulachon (threatened) are within 80 km of site

Unknowns:

- Connectivity to Columbia Plateau Caspian tern colonies - surveys for banded Columbia Plateau Caspian terns have not been conducted
- Ownership is unknown

San Francisco Bay - Brooks Island

Pros:

- Current Caspian tern nesting site
- Inter-specific allies have recently nested at site (western gulls, California gulls)
- Banding data from Columbia Plateau Caspian terns indicates high connectivity with site
- Site preparation may only require minimal modification, such as vegetation removal and/or habitat enhancement to increase available nesting habitat
- Owned by the city of Richmond and managed under a long-term lease by the East Bay Regional Parks District
- Abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- Possible human disturbance due to close proximity to city of Richmond and marina
- Possible conflicts for nesting habitat with large number of California gulls on island
- Predators documented – rats, raccoons, and foxes
- Possible conflicts with ESA-listed fish species: Central Valley spring-run Chinook salmon (threatened), Sacramento winter-run Chinook salmon (endangered), Central California Coast coho salmon (endangered), Central California Coast steelhead (threatened), California Central Valley steelhead (threatened), Green Sturgeon (threatened), tidewater goby (endangered), Delta Smelt (threatened) are within 80 km of site
 - Critical habitat of California coastal Chinook salmon (threatened) is ~70 km north of site, but conflicts are unlikely as California coastal Chinook salmon are not documented to use San Francisco Bay
 - Most salmonids in the diet of Brooks Island Caspian terns were hatchery-reared, non-listed Chinook smolts that were released from net pens in San Pablo Bay

- Diet composition data collected from terns nesting in San Francisco Bay suggests that salmonids comprise a larger proportion of the diet at this site as compared sites at Agua Vista Park and other sites located in the southern portion of the bay

San Francisco Bay - San Francisco Waterfront (Agua Vista Park)

Pros:

- Current Caspian tern nesting site
- Inter-specific allies have recently nested at site (western gulls)
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to area
- Owned by Port of San Francisco
- Presumed abundant prey resources
- Local Audubon Chapter support

Cons:

- Possible human disturbance due to recreational use of area
- Site preparation may be substantial as there is no natural habitat to enhance; barge or pier would need to be provided as nesting habitat
- Possible conflicts with ESA-listed fish species: Central Valley spring-run Chinook salmon (threatened), Sacramento winter-run Chinook salmon (endangered), Central California Coast coho salmon (endangered), Central California Coast steelhead (threatened), California Central Valley steelhead (threatened), Green Sturgeon (threatened), tidewater goby (endangered), Delta Smelt (threatened) are within 80 km of site

San Francisco Bay - Hayward Regional Shoreline

Pros:

- History of Caspian tern nesting on similar island in proximity to Hayward Regional Shoreline
- Inter-specific allies have recently nested near proposed island site (least terns)
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to area
- Site preparation may only require moderate modification, such as vegetation removal, revetment to limit wave erosion, and/or habitat enhancement to increase available nesting habitat
- Owned by East Bay Regional Parks District
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats
- Predator fences and predator control previously instituted to protect nesting least terns

Cons:

- California least terns (endangered) nest on an island in an adjacent impoundment; perception that Caspian terns and California least terns are incompatible
- Possible conflicts with ESA-listed fish species: Central Valley spring-run Chinook salmon (threatened), Sacramento winter-run Chinook salmon (endangered), Central California Coast coho salmon (endangered), Central California Coast steelhead (threatened), California Central Valley steelhead (threatened), Green Sturgeon (threatened), tidewater goby (endangered), Delta Smelt (threatened) are within 80 km of site
 - Critical habitat of South-Central California steelhead (threatened) is < 80 km from site, but conflicts are unlikely as South-Central California steelhead are not documented to use San Francisco Bay

Monterey Bay - Elkhorn Slough

Pros:

- Current Caspian tern nesting site
- Caspian terns have nested at this site and several surrounding sites (Monterey Bay - Moss Landing, Monterey Bay - Salinas River mouth, and Monterey Bay - Parajo River Mouth) in multiple years
- Owned by California Department of Fish and Game
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats
- Previous Caspian tern diet study (Parkin 1998) found diet was diverse, with marine fish composing a major component and no ESA-listed fish observed

Cons:

- Site preparation may be moderate to substantial and include habitat enhancement to increase available nesting habitat at existing islands; creation of a new island or installation of a barge are also possibilities as current islands are sometimes connected to mainland during low tides
- Predators documented – raccoons, coyotes, weasels, gulls, owls
 - nesting Caspian terns failed due to mammal predation in 1996
 - barn owls and great horned owls documented in area
 - predator management would likely be required
- High levels of DDT and other pesticides have been documented in Caspian tern eggshells and chicks within Monterey Bay
- Western snowy plovers (threatened) nest on a nearby island
- Possible conflicts with ESA-listed fish species: Central California Coast coho salmon (endangered), Central California Coast steelhead (threatened), South-Central California Coast steelhead (threatened), and tidewater goby (endangered), are within 80 km of site

CALIFORNIA – SOUTH COAST

Los Angeles Harbor - Terminal Island (Pier 400)

Pros:

- Current Caspian tern nesting site
- Site preparation may only require minimal modifications, such as habitat enhancement and/or predator fences to increase available nesting habitat
- Mitigation site for California least terns; nearly 15-acre area that could accommodate a large number of nesting colonial waterbirds
- Inter-specific allies have recently nested at site (black skimmers, royal terns, and California least terns)
- Owned by Port of Los Angeles
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats
- No known ESA-listed fish species at the site

Cons:

- Caspian terns have been hazed from site to provide nesting habitat for California least terns (endangered)
- Predators documented at site – feral cats, peregrine falcons, crows
 - predator fence and/or predator management would likely be required, but protection of ESA-listed least terns also requires these improvements
- Possible conflicts with ESA-listed fish species: Southern California steelhead (endangered), tidewater goby (endangered), Santa Ana sucker (threatened), and unarmored threespine stickleback (endangered) are within 80 km of site

Huntington Beach - Bolsa Chica Ecological Reserve

Pros:

- Current Caspian tern nesting site (historically Caspian terns have nested at three different sites within the ecological reserve)
- Inter-specific allies have recently nested at site (black skimmers, Forster's terns, and California least terns)
- Owned by California Department of Fish and Game
- Reserve is already fenced and protected from human disturbance
- Banding data from Columbia Plateau Caspian terns indicates connectivity with site
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats
- No known ESA-listed fish species at the site

Cons:

- Site preparation may be moderate to substantial and include habitat enhancement to increase available nesting habitat; creation of a new nesting island would likely be needed as current islands were built to create nesting habitat for California least terns (endangered)
- Western snowy plover (threatened) and California least tern (endangered) nest on nearby islands
- Possible conflicts with ESA-listed fish species: Southern California steelhead (endangered), tidewater goby (endangered), and Santa Ana sucker (threatened) are within 80 km of site

Newport Beach - Upper Newport Bay Ecological Reserve

Pros:

- Documented Caspian tern roost site
- Inter-specific allies have recently nested at site (black skimmers, Forster's terns, and California least terns)
- Owned by California Department of Fish and Game
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats
- No known ESA-listed fish species at the site

Cons:

- No documentation of Caspian terns nesting at site
- Site preparation may be substantial and include creation of new island as current islands were built to create nesting habitat for California least terns (endangered)
- Light-footed clapper rail (endangered) and California least tern (endangered) nest on nearby islands
- Possible predator conflicts as terrestrial mammal access has been documented at nearby waterbird colonies
- Possible human disturbance due to high recreational use of area
- Possible conflicts with ESA-listed fish species: Southern California steelhead (endangered), tidewater goby (endangered), and Santa Ana sucker (threatened) are within 80 km of site

San Diego Bay - San Diego Bay NWR (Salt works)

Pros:

- Current Caspian tern nesting site
- Inter-specific allies have recently nested at site (gull-billed terns, elegant terns, black skimmers, royal terns, Forster's terns, and California least terns)
- Owned by San Diego Bay National Wildlife Refuge

- Banding data from Columbia Plateau Caspian terns indicates some connectivity to general area
- No known ESA-listed fish species within 80 km of site
- Presumed abundant prey resources due to proximity to marine, estuarine, and freshwater habitats

Cons:

- Site preparation may be moderate to substantial and include habitat enhancement to increase available nesting habitat or creation of a new island in a salt pond
- Western snowy plover (threatened) and California least tern (endangered) nest on nearby islands
- Predators documented – coyotes and feral dogs; however, U.S. Fish and Wildlife Service has an active predator control program on the Refuge

CALIFORNIA – INTERIOR NORTH

Clear Lake - Clear Lake NWR

Pros:

- Current Caspian tern nesting site
- Inter-specific allies have recently nested at site (American white pelicans, double-crested cormorants, great blue herons, California and/or ring-billed gulls)
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to area
- Owned by Clear Lake National Wildlife Refuge

Cons:

- Site preparation may be moderate to substantial and include habitat enhancement to increase available nesting habitat; creation of new island in west lobe of Clear Lake would likely be needed as current islands are connected to mainland during low water years
- Predators documented nearby – coyotes, bald eagles, golden eagle, prairie falcon
 - Electric fences were previously used to limit mammal access to natural islands in low water years
- Site is within foraging distance (80 km) of previously constructed Caspian tern nesting island in Tule Lake NWR
- Possible conflicts with ESA-listed fish species: Lost River sucker (endangered) and shortnose sucker (endangered) at site, Modoc sucker (endangered) are within 80 km of site
 - Bull trout (threatened) may be present in mountain streams within 80 km, but population(s) are likely inaccessible to Caspian terns

Unknowns:

- Forage fish availability is unknown

Meiss Lake - Butte Valley Wildlife Area

Pros:

- Former Caspian tern nesting site
- Inter-specific allies have recently nested at site (California gulls, ring-billed gulls, and Forster's terns)
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to area
- Owned by California Department of Fish and Game
- No known ESA-listed fish species at the site

Cons:

- Highly variable water levels - site not available in all years
 - terminal lake, water levels cannot be regulated
- Site preparation may be substantial as there is no natural habitat to enhance; nesting habitat would need to be created
- Predators documented in area – great horned owls, peregrine falcons, golden eagles, prairie falcons, coyotes, river otters, raccoons
- Site is within foraging distance (80 km) of previously constructed Caspian tern nesting island in Lower Klamath NWR
- Possible conflicts with ESA-listed fish species: Lost River sucker (endangered) and shortnose sucker (endangered) are within 80 km of site
 - Bull trout (threatened) may be present in mountain streams within 80 km, but population(s) are likely inaccessible to Caspian terns

Unknowns:

- Forage fish availability is unknown, but likely to be low in low water years

Goose Lake

Pros:

- Former Caspian tern nesting site
- Inter-specific allies have recently nested at site (ring-billed and California gulls)
- Banding data from Columbia Plateau Caspian terns indicates some connectivity to area
- Owned by California Department of Fish and Game
- Existing Caspian tern nesting islands are only available for terns to nest on in a fraction of years due to fluctuating lake levels
- Inland site located on the Pacific Flyway; a lot of movement of Columbia Plateau Caspian terns to the region of the site
- No known ESA-listed fish species at the site

Cons:

- Highly variable water levels – forage fish availability likely to vary widely as well
- Site preparation may be moderate to substantial and include habitat enhancement to increase available nesting habitat; creation of a new island in a deeper section of lake would likely be needed as current islands are connected to mainland during low water years
- Site is within foraging distance (80 km) of previously constructed Caspian tern nesting island at Crump Lake in the Warner Valley
- Predators documented in area – coyotes, bald eagles, golden eagles, prairie falcons
- Possible conflicts with ESA-listed fish species: Lost River sucker (endangered), shortnose sucker (endangered), Modoc sucker (endangered), Foskett speckled dace (threatened), and Warner sucker (threatened) are within 80 km of site
 - Modoc sucker critical habitat includes tributary streams of Goose Lake, but Modoc suckers have not been documented in the Goose Lake itself (at site).
 - Lahontan cutthroat trout (endangered) may be present in mountain streams within 80 km, but population(s) are likely inaccessible to Caspian terns
 - Bull trout (threatened) may be present in mountain streams within 80 km, but population(s) are likely inaccessible to Caspian terns
 - Foskett speckled dace are an unlikely prey given the small, lone spring they inhabit

Unknowns:

- Forage fish availability is unknown

APPENDIX 3:

SUMMARY OF POTENTIAL CONFLICTS WITH ESA-LISTED FISH FROM CASPIAN TERNS NESTING AT PROSPECTIVE ALTERNATIVE COLONY SITES

Possible impacts to ESA-listed fish populations (i.e., fish losses relative to population abundance) from Caspian tern predation at prospective colony sites may vary greatly depending on numerous factors, including availability of alternative prey, fish behavior and life history characteristics, foraging range of terns nesting at a specific colony, and other factors. Empirical data on Caspian tern diet composition and abundance of ESA-listed fish at prospective colony sites were generally lacking, with a few exceptions noted below. Given the data limitations, we examined the spatial overlap between critical habitat of ESA-listed fish species and an 80 km potential foraging range from prospective Caspian tern colonies. The longest documented foraging trip of a breeding Caspian tern extended 80 km (50 miles) from a breeding colony (Adrean 2011); however, the vast majority of foraging occurs much closer to the colony (Lyons et al. 2005, Anderson et al. 2005, Lyons et al. 2007, Adrean 2011).

Spatial overlap analysis indicated that prospective Caspian tern colonies located in interior or freshwater regions overlapped the fewest number of ESA-listed fish species. Conversely, coastal or marine sites often overlapped numerous ESA-listed fish species. In terms of possible impacts, however, ESA-listed fish maybe more densely concentrated at freshwater sites and thus more vulnerable to Caspian tern predation. At coastal sites, non-listed marine forage fish (e.g., anchovy, herring, surfperch, and others) are usually abundant and ESA-listed fish may be more dispersed in the ocean environment, factors that may buffer predation risks to ESA-listed fish in marine waters (Collis et al. 2012, Roby et al. 2002, Thompson et al. 2002, Loeffler 1996, Baltz et al. 1979, Smith and Mudd 1978).

Of the prospective sites with a high suitability ranking (H; Table 4), sites with little or no spatial overlap with ESA-listed fish were Salt Works in San Diego Bay NWR, Terminal Island in Los Angeles Harbor, Goose Lake in interior northern California, Harper Island in Sprague Lake, and Twining and Goose islands in Banks Lake (Tables 5-6). Salmonid PIT tags have been recovered from the colony on Twining Island in Banks Lake and indicate Upper Columbia River steelhead and Upper Columbia River spring-run Chinook are subject to low per capita (per bird) predation rates by terns nesting on Twining Island (BRNW 2011). The colony on Harper Island in Sprague Lake is within potential foraging range of ESA-listed salmonids from the Snake River but diet composition and salmonid PIT tag data are lacking. Similarly, no diet data is available for Salt Works, Terminal Island, and Goose Lake colony sites but ESA-listed fish are not known to be present at these sites, although a few ESA-listed species are within the potential foraging range of terns that nest at Terminal Island and Goose Lake (Table 5-6).

Additional prospective colony sites with a high suitability ranking and minimal potential conflicts with ESA-listed fish include Sand Island in Grays Harbor, Hayward Regional Shoreline in South San Francisco Bay, Agua Vista Park in Central San Francisco Bay, and Smith and Minor islands in the Strait of Juan de Fuca. Only one ESA-listed species is known to originate in Grays

Harbor: bull trout. Bull trout in Grays Harbor are anadromous and thus may be susceptible to tern predation, although susceptibility may be limited due to the abundance of non-listed marine forage fish. Although Agua Vista Park, Hayward Regional Shoreline, and Smith and Minor islands are within foraging range of a diversity of ESA-listed fish species (Tables 5-6), these sites are a considerable distance from the mouths of rivers/streams (where ESA-listed fish are more concentrated), making it less likely that any specific ESA-listed population would experience substantial impacts. Diet composition data from Agua Vista Park in Central San Francisco Bay and Eden Landing in South San Francisco Bay (near Hayward Regional Shoreline) collected during 2003 - 2009 indicated non-listed marine forage fish were the dominate prey type, with juvenile salmonids representing < 5% of the diet of terns on Agua Vista Park and < 1% of the diet of terns on Hayward Regional Shoreline (Collis et al. 2012). Evans et al. (2011) documented predation rates of less than 1% on hatchery ESA-listed spring-run Chinook by terns nesting on Brooks Island in Central San Francisco Bay, with no (zero) wild Chinook documented in the diet. Impacts on ESA-listed non-salmonid species by terns nesting in San Francisco Bay may also be marginal given gobies (both listed and non-listed species) and smelt (both listed and non-listed) represented < 5% of the diet of terns and juvenile sturgeon were not observed in the diet of terns nesting in San Francisco Bay (Collis et al. 2012).

Although there is no diet data for Caspian terns nesting at Smith and Minor islands in the Strait of Juan de Fuca, diet data from the Dungeness Spit colony, which is also located in the Strait of Juan de Fuca, indicated smelt (both listed and non-listed species) were < 10% of the diet and juvenile rock fish (both listed and non-listed species) were < 1% of the diet during 2005-2009 (BRNW 2012). Consumption of juvenile salmonids by terns nesting on Dungeness Spit, however, was higher (ca. 15 to 30% of the diet, depending on year). Dungeness Spit is in close proximity to the mouth of the Dungeness River (a salmonid bearing river) and thus may not be indicative of the salmonid consumption by terns nesting at Smith and Minor islands, which are a considerable distance (ca. 25 km) from mainland streams.

In summary, several of the prospective alternative colony sites with a high suitability ranking had little or no spatial overlap with ESA-listed fish species. Colony sites in Central and South San Francisco Bay and the Strait of Juan de Fuca in the Salish Sea, however, did overlap critical habitat of several ESA-listed fish species. Although spatial overlap suggests conflicts may be possible, potential impacts to ESA-listed fish populations may be marginal due to the abundance of non-listed marine forage fish and the distance of these sites to anadromous fish bearing rivers/streams. Additional data, however, is needed to validate these assumptions.

APPENDIX 4:

AGENCY CONTACTS AND ADDITIONAL SOURCES USED FOR INFORMATION PRESENTED IN THIS REPORT

STATE	Agency	Phone	E-mail	Region/Site	
ALASKA					
	Mary Anne Bishop*	Prince William Sound Science Center	(907) 424-5800	mbishop@pwssc.org	Copper River Delta
	Michelle Kissling*	USFWS, Juneau Office	(907) 780-1168	michelle_kissling@fws.gov	Icy Bay
	Brian McCaffery*	USFWS, Yukon Delta NWR	(907) 543-3151	yukondelta@fews.gov	Yukon Delta
	Robert Gill*	USGS, Alaska Science Center	(907) 786-7184	rgill@usgs.gov	Yukon Delta
	Gwen Baluss*	USFS, Tongas NF, Juneau Ranger District	(907) 586-8800	gwenbaluss@yahoo.com	Twin Glacier Lake
BRITISH COLUMBIA					
	Trudy Chatwin*	Min. of Forests, Lands and Natural Resource Operations	(250) 751-3150	Trudy.Chatwin@gov.bc.ca	BC (All)
	Richard Swanston*	Avid birder in the Fraser River Delta area	(250) 309-5545	rickswan@telus.net	Fraser River Delta
	Mike Pearson*	Pearson Ecological	(604) 785-7246	mike@pearsonecological.com	BC (All)
	Chris Di Corrado*	BC Breeding Bird Atlas	(604) 940-4711	cdicorrado@bsc-eoc.org	BC (All)
	Peter Davidson*	Bird Studies Canada	(877) 349-2473	pdavidson@birdscanada.org	BC (All)
	Harry Carter*	Carter Biological Consulting	(250) 370-7031	carterhr@shaw.ca	BC (All)
	Myke Chutter*	Min. of Forests, Lands and Natural Resource Operations	(250) 387-9797	myke.chutter@gov.bc.ca	BC (All)
	Leah Ramsay*	Conservation Data Center	(250) 387-9524	leah.ramsay@gov.bc.ca	BC (All)
	Doug Bertram*	Environment Canada		douglas.bertram@dfo-mpo.gc.ca	BC (All)
	Rob Butler*	BC Breeding Bird Atlas Coordinator	(604) 940-4672	rob.butler@ec.gc.ca	BC (All)
WASHINGTON					
	Jenny Hoskins*	USFWS, Region 1, Migratory Birds and Habitat Programs	(503) 231-6164	jenny_hoskins@fws.gov	Region 1 (WA/OR/ID/HI)
	Michael Lesky*	BOR, Natural Resource Specialist, Ephrata Field	(509) 754-0205	mlesky@usbt.gov	Banks/Potholes

STATE	Agency Office	Phone	E-mail	Region/Site	
	Keith Wolf*	Confederated Tribes of the Colville Reservation	(509) 422-5657	keith.wolf@colvilletribes.com	Banks (Chief Joseph Hatchery)
	Darin Hathaway*	Confederated Tribes of the Colville Reservation	(509) 422-7454	darin.hathaway@colvilletribes.com	Banks Lake
	Rich Finger*	Washington Department of Fish and Wildlife	(509) 750-0617	richard.finger@dfw.wa.gov	Columbia Plateau
	Don Jacobson*	D/J Land & Cattle Company, Inc. Landowner of Harper Is.	(509) 560-0331		Sprague Lake
	Lamont Glass	USFWS, McNary NWR, Manager	(509) 546-8300	lamont_glass@fws.gov	Mid-Columbia River
	Joel R. David	USFWS, Julia Butler Hansen Refuge, Manager	(360) 795-3915	Joel_David@fws.gov	Lower Columbia River
	Joel R. David	USFWS, Lewis and Clark NWR, Manager	(360) 795-3915	Joel_David@fws.gov	Columbia River Estuary
	Greg M. Hughes	USFWS, Mid-Columbia River NWR Complex, Manager	(509) 546-8300	Gregory_M_Hughes@fws.gov	Mid-Columbia River
	Kelly Chase	USFWS, Columbia NWR, Manager	(509) 488-2668	Kelly_Chase@fws.gov	Columbia Plateau
	Lamont Glass	USFWS, McNary NWR, Manager	(541) 922-4661	Lamont_Glass@fws.gov	Blalock Islands, Tri-cities area
	Lamont Glass	USFWS, Umatilla NWR, Manager	(541) 922-4661	Lamont_Glass@fws.gov	Blalock Islands, Tri-cities area
	Jean Takekawa	USFWS, Grays Harbor NWR, Manager	(360) 532-6237	Jean_Takekawa@fws.gov	Grays Harbor
	Chris Wills	WDNR	(360) 740-6813	Chris.wills@dnr.wa.gov	Grays Harbor
	Kevin Ryan*	USFWS, Washington Maritime NWR Complex, Manager	(360) 457-8451	kevin_ryan@fws.gov	Salish Sea
	Kevin Ryan*	USFWS, Dungeness NWR, Manager	(360) 457-8451	kevin_ryan@fws.gov	Dungeness
	Kevin Ryan*	USFWS, Protection Island NWR, Manager	(360) 457-8451	kevin_ryan@fws.gov	Protection Island
	Charles E. Stenvall	USFWS, Willapa NWR,	(360) 484-3482	Charlie_Stenvall@fws.gov	Salish Sea

STATE	Agency	Phone	E-mail	Region/Site
	Manager			
Joel R. David	USFWS, Julia Butler Hansen Refuge, Manager	(360) 795-3915	Joel_David@fws.gov	Lower Columbia River
OREGON				
Jenny Hoskins*	USFWS, Region 1	(503) 231-6164	jenny_hoskins@fws.gov	Region 1 (WA/OR/ID/HI)
Ron Cole	USFWS, Klamath Basin NWR Complex, Manager	(530) 667-2231	ron_cole@fws.gov	Klamath Basin
Tim Bodeen*	USFWS, Malheur NWR, Manager	(541) 493-2612	Tim_Bodeen@fws.gov	Malheur Lake
Lamont Glass	USFWS, Umatilla NWR, Manager	(541) 922-4661	Lamont_Glass@fws.gov	Blalock Islands, Tri-cities area
Joel R. David	USFWS, Julia Butler Hansen Refuge, Manager	(360) 795-3915	Joel_David@fws.gov	Lower Columbia River
Joel R. David	USFWS, Lewis and Clark NWR, Manager	(360) 795-3915	Joel_David@fws.gov	Columbia River Estuary
Roy W. Lowe	USFWS, Oregon Coast NWR Complex, Manager	(541) 867-4550	Roy_Lowe@fws.gov	Oregon Coast
NEVADA				
Marie Strassburger	USFWS, Region 8	(916) 414-6727	Marie_Strassburger@fws.gov	Region 8 (CA/NV)
Mike Goddard	USFWS, Stillwater NWR Complex, Manager	(775) 423-5128	mike_goddard@fws.gov	Stillwater Reservoir
Marie Strassburger	USFWS, Region 8	(916) 414-6727	Marie_Strassburger@fws.gov	Region 8 (CA/NV)
Donna Withers*	USFWS, Anaho Island NWR, Manager	(775) 423-5128, ext. 231	donna_withers@fws.gov	Pyramid Lake
Jenni Jeffers*	Nevada Dept. of Wildlife	(775) 423-3171, ext. 234	jjeffers@ndow.org	Carson Sink, Stillwater Point Reservoir
Bill Henry*	USFWS, Stillwater NWR Complex	(775) 423-5128	bill_henry@fws.gov	Carson Sink, Stillwater Point Reservoir
IDAHO				
Jenny Hoskins*	USFWS, Region 1	(503) 231-6164	jenny_hoskins@fws.gov	Region 1

STATE	Agency	Phone	E-mail	Region/Site	
				(WA/OR/ID/HI)	
	Colleen Moulton*	IDFG	(208) 287-2751	colleen.moulton@idfg.idaho.gov	Idaho (All)
	Rob Cavallaro*	IDFG	(208) 390-1512	rob.cavallaro@idfg.idaho.gov	Island Park Reservoir
	Martha Wackenhut	IDFG	(208) 232-4703	martha.wackenhut@idfg.idaho.gov	Minidoka NWR, Bear Lake NWR
	Jennifer Brown-Scott	USFWS, Deer Flat NWR, Manager	(208) 467-9278	Jennifer.Brownscoff@fws.gov	Deer Flat
	Annette de Knijf	USFWS, Bear Lake NWR, Manager	(208) 847-1757	annette_deknijf@fws.gov	Bear Lake
	Jeffrey Krueger	USFWS, Minidoka NWR, Manager	(208) 436-3589	jeffrey_krueger@fws.gov	Minidoka NWR
UTAH					
	Stephanie Jones	USFWS, Region 6	(303)236-4409	stephanie_jones@fws.gov	Region 6 (MT, UT, WY)
	John Cavitt*	Weber State University	(801) 626-6172	JCAVITT@weber.edu	Utah (Interior)
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