**Summary of Information Needs and Research Priorities for Aleutian Tern Conservation**

ALTE Conservation Working Group*

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The Aleutian Tern is a poorly understood seabird species, but concern about its status has been prompted by verified reports of sustained inactivity where large breeding colonies numbering in several thousands were once well established (e.g., Kodiak, Copper River). It has consequently been listed as a species of high conservation concern by the North American Waterbird Conservation Plan, the U.S. Fish and Wildlife Service, and the Alaska Department of Fish and Game; is on Audubon's Alaska Watch List; and is a considered a Sensitive Species by the U.S. Forest Service Alaska Region.

In 2007, a group of agency and university personnel initiated an effort to review and evaluate information needs for the species. From that point through 2015 (Fig 1 below), a series of data collection efforts – from intensive population estimation and migration studies in the Yakutat, Alaska, area to more extensive statewide data gathering and colony counts –established a foundation to fill gaps in the understanding of basic ecology, distribution, wintering area and demography.


Fig 1. Timeline of Aleutian Tern study efforts in Alaska

Moving forward, to formalize establishment of a multiagency partnership and generate more of a science-driven conservation effort, the **purpose** of this document is to concisely describe:

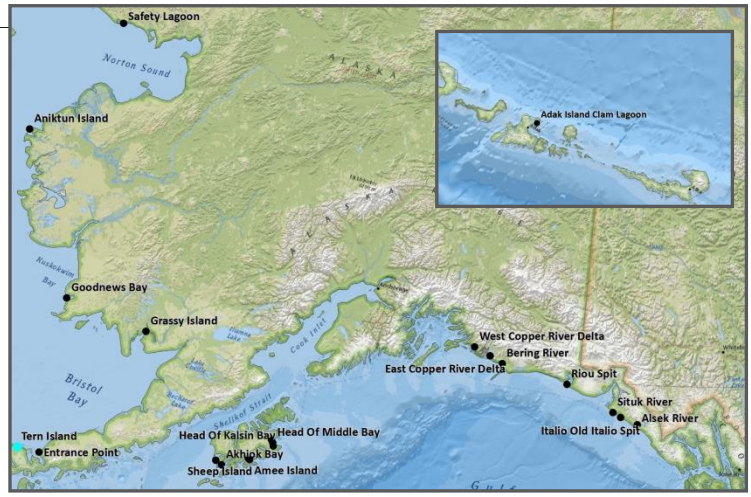
- What is known with respect to population status and potential stressors on populations
- Key information needs and priorities with respect to population biology and potential stressors
- Potential strategies to address the highest priority information needs over the next 5 years

## What do we know?

- *ALTE is not an abundant species, naturally and globally,* with a total global population size of approximately 31,140 individuals, among the lowest of any tern species; with 5,529 birds in Alaska and the remainder in eastern Siberia (Renner et al. 2015)
- *The general trend in numbers at known colony locations across the state of Alaska over the last half century is downward.* ALTE colonies distributed over several distinct coastal regions of Alaska have declined 8.1% annually since 1960, or 92.9% over three generations (Renner at al. 2015). To put this potential decline in perspective, one of the criteria for categorizing a species as Critically Endangered by the IUCN 237 Red List program (IUCN 2013) is a decline greater than 80% over 3 generations.
- *Where we have the best inference - large ALTE colonies with multiple recent observations – the majority of these are lower than that observed historically.* At 21 colonies with more than 200 individuals (Table 1, Figure 2), 73% of these large colonies have significantly fewer birds or are no longer active. The largest known breeding colony at the Situk River estuary (near the community of Yakutat in southeastern Alaska) appears to be an exception in that it has remained relatively stable (ca. 1500-2000) across more than a decade that it has been monitored and represents a rare opportunity for comparison to other declining colonies.

Table 1, Fig 2. Status and locations of 21 large (> 200 individuals) Aleutian Tern breeding colonies. ¾ of these colonies appear to have experienced declines or are inactive since 2000. "Defunct" status indicates colony was essentially inactive at most recent count, "Decline" indicates most recent count was lower, or at low end, of historical range, and "Stable" indicates a recent count within the historical range. *Indicates multiple counts were conducted since 2000.

| Colony Name | Historical Range of Counts Before 2000 (Last Year) | Most Recent Count, Since 2000 (Year) | Probable Status |
|---|---|---|---|
| Aleutian Islands | | | |
| Adak Island Clam Lagoon | 100 - 150 (1987) | 190 (2012) | Stable* |
| Bering Sea | | | |
| Aniktun Island | 0 – 300 (1997) | - | Unknown |
| Entrance Point | 16 – 1280 (1977) | 0 (2013) | Defunct |
| Goodnews Bay | 300 – 1200 (1994) | - | Unknown |
| Grassy Island | 200 (1984) | 2 (2012) | Defunct* |
| Safety Lagoon | 80 - 480 (1979) | 13 (2013) | Decline* |
| Tern Island | 175 – 225 (1977) | - | Unknown |
| Gulf of Alaska | | | |
| Alsek River | 6 – 200 (1994) | 178 (2013) | Stable* |
| Bering River | 2000 (1976) | 2 (2013) | Defunct* |
| East Copper R. Delta | 850 – 900 (1987) | 0 (2013) | Defunct* |
| Italio Spit | 24 (1980) | 300 (2013) | Stable* |
| Riou Spit | 150 – 428 (1995) | 134 (2008) | Stable |
| Situk River | 450 – 3000 (1996) | 2061 (2013) | Stable* |
| West Copper River Delta | 400 – 2428 (1978) | 100 (2009) | Decline* |
| Kodiak Archipelago | | | |
| Akhiok Bay | 0 – 1000 (1997) | 2 (2002) | Defunct |
| Amee Island | 0 – 3000 (1994) | 0 (2011) | Decline* |
| Kalsin Bay | 0 -320 (1978) | 22 (2013) | Decline* |
| Middle Bay | 0 – 600 (1986) | 46 (2013) | Decline* |
| Sheep Island | 0 – 735 (1994) | 70 (2009) | Decline* |
| Unamed Inland Colony Kodiak | 100 – 600 (1998) | 100 (2000) | Stable |
| Womans Bay | 200 – 250 (1986) | 0 (2012) | Defunct |




- *ALTE to do not have strict breeding-site fidelity, inter-annually*. Geolocation tracking devices reveal shifts in breeding locations of up to 50-km between years, and the near lack of re-sighting of marked and banded individuals (6 of ~300 individuals) over a decade of observations around Yakutat suggest that colony structure is loose even when colony numbers are relatively stable. We have also documented evidence of early season (May) "prospecting", mid-season (June) abandonment, within season fluctuations, and even 1-yr gaps in breeding, almost as more of a rule, not an exception in the Yakutat area. This variable and unknown breeding ecology complicates efforts to monitor population status.

- *Alaska ALTE have a previously unknown 32,000-36,000-km migration route to wintering range* in Southeast Asia and Oceania, where they spend 2/3rd of their annual life history (Fig 2; Goldstein et al, unpublished). Minimal information is available regarding conservation status and potential threats on wintering range and migration route.

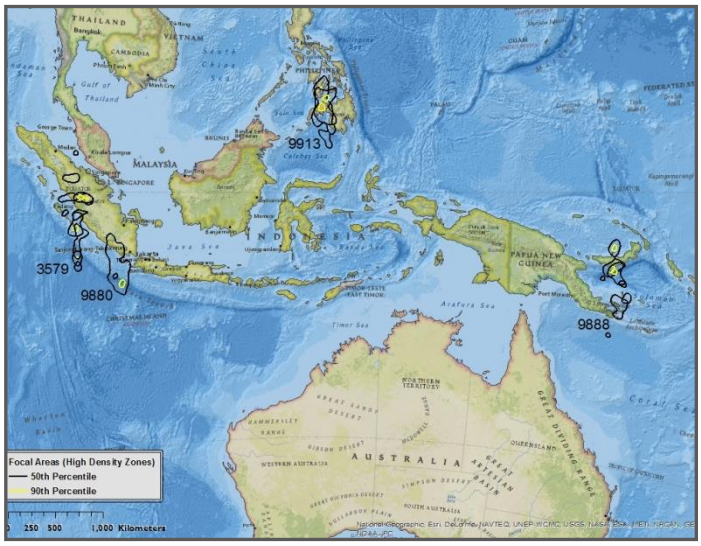



Fig 2. Extent of wintering grounds of Aleutian Terns based on 4 recovered geolocators (2010 – 2015; a 5th geolocator was recovered in 2015 and data not yet available). Zones represent wintering "hotspots" based on the highest density of locations, e.g. 50th percentile are all areas with 50th percentile kernel-density values and higher. Migration pathways not shown (Goldstein et al, unpublished).

## Information Needs & Priorities

Although many basic aspects of ALTE biology are poorly described, limited resources necessitate some prioritization of effort, based on what we currently know or can reasonably infer. The tables below are an attempt to systematically organize, identify and weigh key topics to potentially focus on under 2 interrelated categories of ALTE ecology: population-level (e.g. demographic, life history, etc.) parameters and potential population-level stressors (anthropogenic and/or natural). These summary tables should not be interpreted as *de facto* statements about the merit/utility of different research efforts or geographies.

Table 2. Review of population parameters and considerations for guiding future research priorities

| Parameter | Priority | Justification |
|---|---|---|
| Global intermixing (Siberia - Alaska) | Low | • There is no known precedent for this scale of intermixing between Alaskan and Siberian seabird breeding colonies |
| Status of Russian population | Low | • Information about Siberian populations – whether increasing, decreasing, or stable -- does not preclude concern about downward trends in Alaska populations and associated wintering grounds/stopovers |
| Decadal-scale population trends | Low | • Renner et al 2015 already established that colonies are trending downward over the last 5 decades<br>• There are no known records of large colonies that are minimally active have not been recently surveyed |
| Colony mixing | Low | • Interannual movements between colony locations have been documented from tracking data<br>• Intercolony dispersal is not as problematic for population analysis as establishment of breeding populations in unknown areas |
| Site fidelity | Low | • ALTE have already exhibited very mixed evidence for site fidelity between years in the decade they have been marked, surveyed, tracked and recaptured in the Yakutat area |
| Colony size (counting bias) | Low | • This has been given attention (Catterson et al. 2009; Renner et al. 2015) |
| Inter-annual variability in colony activity and size | Low | • There are records reflecting consecutive visits among years in the North Pacific Seabird Database, i.e. we know that colony size does appear to vary from one year to the next, typically within an order of magnitude<br>• Estimates of inter-annual population variability have been documented in Yakutat |
| Intra-annual variability in colony occupancy and size | **High** | • Within season detection error confounds nearly all ALTE records in the North Pacific Seabird Database, which is largely single visit<br>• Where >1 visit has occurred within a season (e.g., Yakutat) several years have exhibited fluctuations and early abandonments |
| Breeding activity in unsurveyed areas | **High** | • Without being able to exclude breeding activity in previously undocumented areas, interpretation of downward trends (Renner et al. 2015) is limited |
| Productivity / Colony Success | **High** | • Reproduction rates and nesting/fledgling success are poorly documented<br>• Mid and late season colony-wide abandonment have been documented |

- *Potential Stressors* – There is no known causality for declines but we can start excluding or prioritizing possible stressors for which we have inference. Table 3 (below) is intended to be an informed starting point for further discussion to debate, modify, defend and/or eliminate.

Table 3. Review of possible stressors and their likelihood of impacting Aleutian Tern populations in Alaska based on inferential and direct observations 2004-2015

| Potential Stressor | Priority | Justification |
|---|---|---|
| Direct human disturbance | Low | • There has not been any quantifiable or particular unique effects of intensive disturbance (due to our invasive research activity) over nearly a decade at the Situk River colony, Yakutat (Pyare et al 2013)<br>• Extent, frequency, and severity of human activities in Alaska are comparatively very low<br>• >2/3rd of all colonies are located 100s of miles from permanent human communities (S. Pyare, unpublished)<br>• The scale of declines occurs across 1000s of miles (Table 1; Renner et al 2015) |
| Exotic predators | Low | • Likely candidates (rats, feral cats) are historically absent from >95% of ALTE breeding range and only known to be present at 1 of the 20 largest colonies (Table 1; Mclory and Gotthardt 2008)<br>• Extinction events at large and remote/isolated colonies (Copper River Delta, Kodiak islands) with no such exotics<br>• Where present in the Alaska Maritime Refuge (Adak Island and Attu Island) ALTE colonies have persisted |
| Native predators | Low | • There are no significant range expansions or increases in population density of native predators (Mclory and Gotthardt 2008) at this geographic scale in Alaska<br>• More recent expansions of resident species like coyotes (*C. latrans*) have resulted in low predator densities, or preceded the recent period of ALTE declines (Renner et al 2015; Alaska Department of Fish and Game 2015) |
| Coastal habitat change | Low | • There have not been dramatic changes in coastal uplift or succession that have reduced the amount of potential nesting habitat available to ALTE across this vast Alaska coastline<br>• ALTE do not nest strictly in coastal fringe and exhibit plasticity in nesting microhabitats, frequently nesting in inland freshwater wetlands (Pyare et al. 2013, Renner et al. 2015, S. Oehlers unpublished) |
| Emerging infectious | Low | • Colonies were screened 2005-2007 for prevalence of infectious diseases in association with H1N1/avian influenza |

| | | |
|---|---|---|
| disease | | outbreaks (USFWS)<br>• No mortalities in the intensively studied Situk River colony (Yakutat) are associated with obvious signs of disease (Pyare et al 2013) |
| Egg harvesting | **High** | • Subsistence reports suggest migratory-bird egg harvesting is significant in Alaska (e.g. ½ million eggs, with unknown effects on the demography of small populations like ALTE<br>• Egg harvesting is too incompletely tracked, reported, and regulated to understand possible impacts |
| Contaminants (breeding & winter) | **High** | • Pthalates/PCBs are pervasive in marine waters of Alaska, with evidence of exposure on other vertebrates<br>• Exposure levels and effects on productivity are too unknown to currently exclude as a hypothesis |
| Change/variability in marine prey-base | **High** | • Well documented shifts on offshore oceanographic conditions could likely affect nearshore marine food webs<br>• The prey base (e.g. forage fish, zooplankton) of ALTE is largely unknown |
| Overwinter mortality (bycatch? overfishing?) | **High** | • ALTE migration routes and wintering range overlap intensively fished regions of central and southeast Asia<br>• Migration route includes the China Sea, one of the most altered and contaminated marine bodies known, and winter farther south in one of the least known marine areas<br>• Fall migration route passes through areas of high typhoon activity<br>• Wintering observations and lack of specificity in overwintering areas are too unknown to exclude as a hypothesis |

## **Next Steps**?

ALTE conservation planning is currently hampered because 1) much of the networking we have done so far has been irregular, informal, and/or limited to Alaska; 2) follow up visits are needed to confirm breeding status at and near former colony areas across the state, and ascertain overwintering areas; and 3) critical aspects of biology -- marine food-web dependencies and foraging, breeding success -- still remain too enigmatic to inform management and conservation; and 4) stressors, and their interaction, associated with ALTE population fluctuations have not yet been adequately evaluated.

High priority objectives for the next 5 years are to build on our early findings and the multiagency partnership to:

1. Formally establish an integrated ALTE Conservation Working Group, including:
    a) Reassembling and expanding the partnership to include resource management agencies (USFS, BLM, USFWS, ADFG, NPS), other agencies with marine and coastal jurisdiction (ADEC, NMFS), researchers (University of Alaska, Simon Fraser University), federal research agencies (NIH), and international partners (NFWF, Wildlife Conservation Society - Asia and North America programs, Russian partners, Audubon, and members of the Pacific Seabird Group or Waterbird Society).
    b) International networking with resource professionals, academic researchers, and local ornithological groups in at least 6 other countries in Asia (Indonesia, Singapore, Philippines, China), Australia, and Russia to gather information and facilitate field reconnaissance activities in known wintering grounds and flyways.
    c) Elevate the status of the group as a formal conservation/working group (possible near term target is the Feb PSG Meetings).
    d) Production of a peer reviewed publication or white paper, expanding on the information summarized above in this document.

2. Implement a more rigorous, demographic assessment at a focal subset of larger breeding colonies (Table 1), including:
    a. *Variability and Detection Error*: Conducing systematic counts with repeat visits, especially within years (2-4 visits/yr), over a multi-year (e.g. $\geq$3-yr) period. This would expand on a quick-count protocol conducted during single visits at colonies across the state in 2013 (Renner et al. 2015).
    b. *Distribution and Detection Error*: Doing repeat aerial surveys, in consort with counts above, at defined spatial scales from established colony locations (whether breeding was active or not); as well as some effort to conduct "completely" naïve surveys in possible coastline habitats where breeding is completely undocumented. These types of aerial surveys have been conducted periodically in the Yakutat and Copper River Delta areas.

c. *Productivity*: Initiating longitudinal histories of reproductive success at a focal set of large colonies with variable population status, in parallel with other high priority data collection efforts (below) on possible stressors (e.g. prey base, contaminants, etc.) and ecological conditions.

3. Increase understanding of at least 4 potential stressors (Table 3), including:
    a. *Egg Collecting*: Conducting reviews of subsistence reports, and targeted ethnographic-style interviews in select communities, to better describe the history and prevalence, frequency, and scale of possible tern egg collecting
    b. *Contaminants*: Analysis of non-invasively and invasively collected tissue samples to evaluate contaminant loads (bio-accumulating plastic based pthalates/PCBs) and sources across a range of colonies where (above) demographic information has also been collected. Contaminant pilot studies began in summer in 2015.
    c. *Variability in marine food web/prey base*: Investigating the composition and variability in marine prey base through stable isotope analysis of tissue samples (a pilot study which began in 2015), nest-based observations of food provisioning, trawl/sein based sampling, and remote sensing; in consort with other efforts to study colony status and life-history variables, especially reproductive biology.
    *d.* *Wintering Grounds*: Network with international organizations to identify partners, government and non-government, in known wintering hotspots (Fig 2) to conduct follow up visits, collect records and attempt to conduct observations of birds, do community outreach with local birding organizations, and enlist local NGO and local university researchers in a longer term effort to document ALTE activity.

## Primary Information Sources: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