Appendix A. 2023 Biological Assessment Addendum (pages 301-400)

PROJECT SUMMARY

Project Code: 2024-0000441
Project Name: Space X Boca Chica Launch Facility (Oct. 2023 Update)
Project Type: Airport - Maintenance/Modification
Project Description: The area defined is the Action Area for the 2022 BCO as the 13-mile radius surrounding the Vertical Launch Area at the Space X Launch Complex in Boca Chica, Texas. The scope of the proposed project is the operation of a deluge system at the orbital launch pad.
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@25.98788905,-97.15918020000001,14z

Counties: Cameron County, Texas

ENDANGERED SPECIES ACT SPECIES

There is a total of 17 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Gulf Coast Jaguarundi *Puma yagouaroundi cacomitli* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3945	Endangered
Ocelot *Leopardus (=Felis) pardalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4474	Endangered
West Indian Manatee *Trichechus manatus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. ***This species is also protected by the Marine Mammal Protection Act, and may have additional consultation requirements.*** Species profile: https://ecos.fws.gov/ecp/species/4469	Threatened

BIRDS

NAME	STATUS
Eastern Black Rail *Laterallus jamaicensis ssp. jamaicensis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10477	Threatened
Northern Aplomado Falcon *Falco femoralis septentrionalis* Population: Wherever found, except where listed as an experimental population No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1923	Endangered
Piping Plover *Charadrius melodus* Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/1864	Threatened

REPTILES

NAME	STATUS
Green Sea Turtle *Chelonia mydas* Population: North Atlantic DPS There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6199	Threatened
Hawksbill Sea Turtle *Eretmochelys imbricata* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3656	Endangered
Kemp's Ridley Sea Turtle *Lepidochelys kempii* There is **proposed** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/5523	Endangered
Leatherback Sea Turtle *Dermochelys coriacea* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1493	Endangered
Loggerhead Sea Turtle *Caretta caretta* Population: Northwest Atlantic Ocean DPS There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1110	Threatened

CLAMS

NAME	STATUS
Mexican Fawnsfoot *Truncilla cognata* There is **proposed** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/7870	Proposed Endangered
Salina Mucket *Potamilus metnecktayi* There is **proposed** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/8753	Proposed Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

FLOWERING PLANTS

NAME	STATUS
South Texas Ambrosia *Ambrosia cheiranthifolia* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3331	Endangered
Texas Ayenia *Ayenia limitaris* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4942	Endangered

CRITICAL HABITATS

There is 1 critical habitat wholly or partially within your project area under this office's jurisdiction.

NAME	STATUS
Piping Plover *Charadrius melodus* https://ecos.fws.gov/ecp/species/6039#crithab	Final

BALD & GOLDEN EAGLES

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Bald and Golden Eagle Protection Act of 1940.
2. The Migratory Birds Treaty Act of 1918.

3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

THERE ARE NO BALD AND GOLDEN EAGLES WITHIN THE VICINITY OF YOUR PROJECT AREA.

MIGRATORY BIRDS

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
American Golden-plover *Pluvialis dominica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
American Oystercatcher *Haematopus palliatus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8935	Breeds Apr 15 to Aug 31
Audubon's Shearwater *Puffinus lherminieri* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 1 to Aug 5
Black Scoter *Melanitta nigra* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Black Skimmer *Rynchops niger* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5234	Breeds May 20 to Sep 15

NAME	BREEDING SEASON
Black-legged Kittiwake *Rissa tridactyla* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Brown Pelican *Pelecanus occidentalis* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Jan 15 to Sep 30
Chimney Swift *Chaetura pelagica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 25
Common Loon *gavia immer* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/4464	Breeds Apr 15 to Oct 31
Cory's Shearwater *Calonectris diomedea* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Dickcissel *Spiza americana* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds May 5 to Aug 31
Gull-billed Tern *Gelochelidon nilotica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9501	Breeds May 1 to Jul 31
Hudsonian Godwit *Limosa haemastica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
King Rail *Rallus elegans* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8936	Breeds May 1 to Sep 5
Lesser Yellowlegs *Tringa flavipes* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Long-billed Curlew *Numenius americanus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/5511	Breeds elsewhere

NAME	BREEDING SEASON
Long-tailed Duck *Clangula hyemalis* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/7238	Breeds elsewhere
Magnificent Frigatebird *Fregata magnificens* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds elsewhere
Marbled Godwit *Limosa fedoa* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9481	Breeds elsewhere
Painted Bunting *Passerina ciris* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Apr 25 to Aug 15
Pomarine Jaeger *Stercorarius pomarinus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Prothonotary Warbler *Protonotaria citrea* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Apr 1 to Jul 31
Red-breasted Merganser *Mergus serrator* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Red-headed Woodpecker *Melanerpes erythrocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Sep 10
Red-necked Phalarope *Phalaropus lobatus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Reddish Egret *Egretta rufescens* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/7617	Breeds Mar 1 to Sep 15
Ring-billed Gull *Larus delawarensis* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere

NAME	BREEDING SEASON
Royal Tern *Thalasseus maximus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Apr 15 to Aug 31
Ruddy Turnstone *Arenaria interpres morinella* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds elsewhere
Sandwich Tern *Thalasseus sandvicensis* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Apr 25 to Aug 31
Short-billed Dowitcher *Limnodromus griseus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Sooty Tern *Onychoprion fuscatus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Mar 10 to Jul 31
Sprague's Pipit *Anthus spragueii* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8964	Breeds elsewhere
Surf Scoter *Melanitta perspicillata* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Swallow-tailed Kite *Elanoides forficatus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8938	Breeds Mar 10 to Jun 30
White-winged Scoter *Melanitta fusca* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds elsewhere
Willet *Tringa semipalmata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Apr 20 to Aug 5
Wilson's Plover *Charadrius wilsonia* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Apr 1 to Aug 20

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read the supplemental information and specifically the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

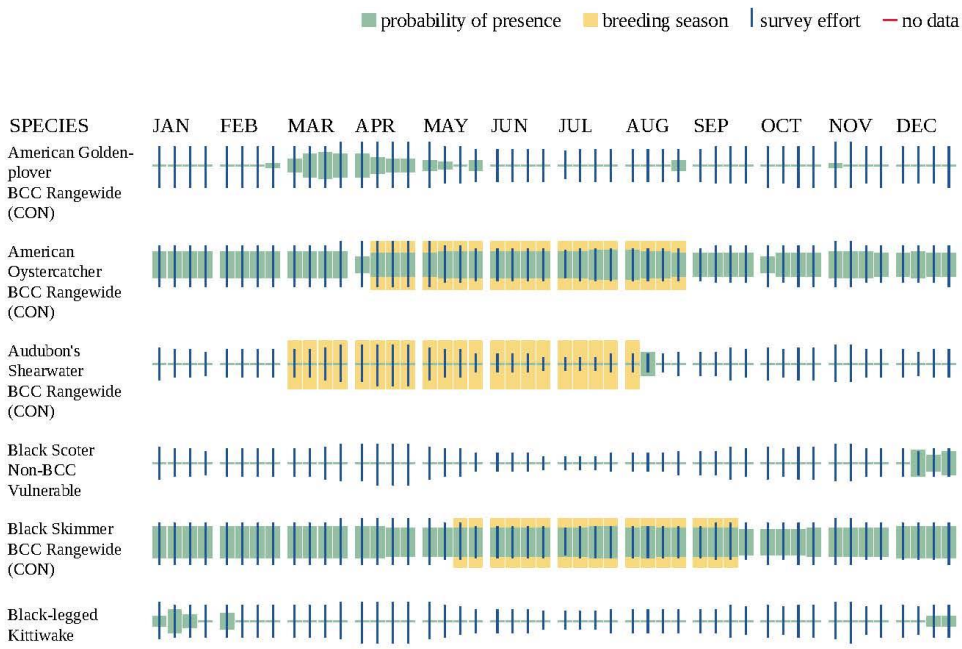
Probability of Presence (▪)

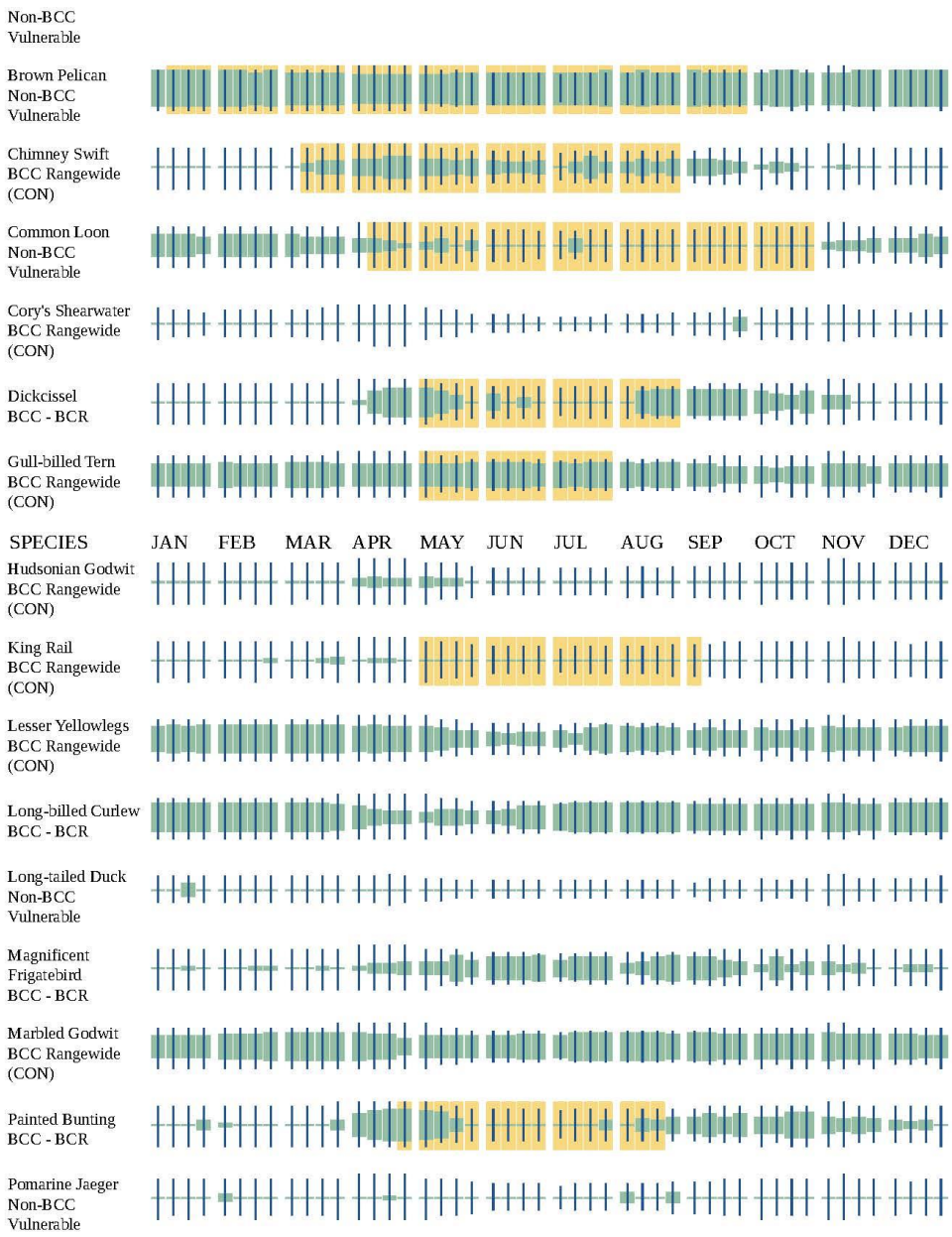
Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

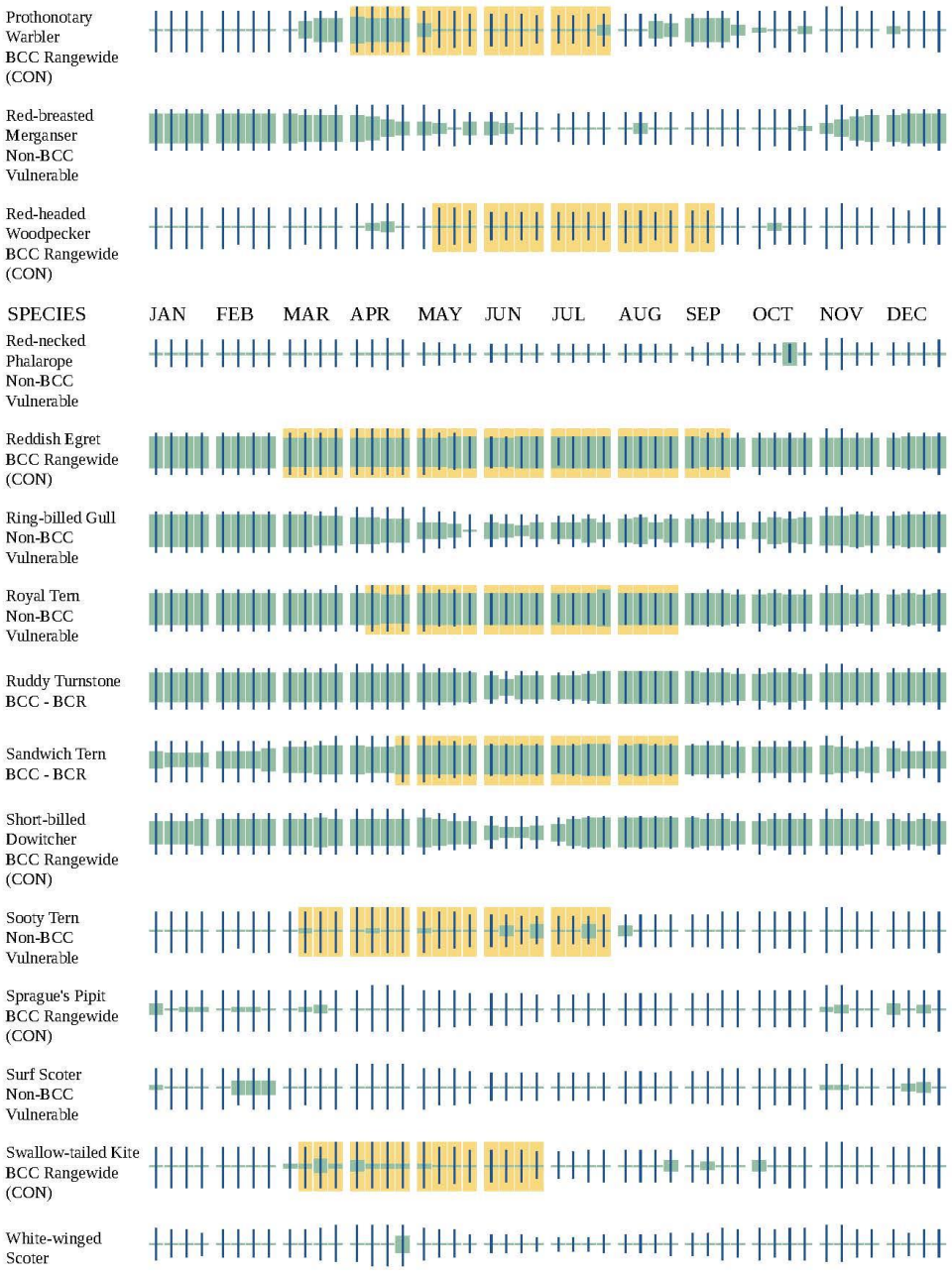
Breeding Season (▪)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

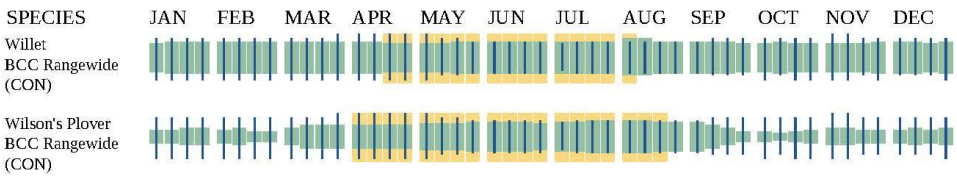
No Data (–)
A week is marked as having no data if there were no survey events for that week.




Non-BCC
Vulnerable
Brown Pelican
Non-BCC
Vulnerable
Chimney Swift
BCC Rangewide
(CON)
Common Loon
Non-BCC
Vulnerable
Cory's Shearwater
BCC Rangewide
(CON)
Dickcissel
BCC - BCR
Gull-billed Tern
BCC Rangewide
(CON)
SPECIES
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Hudsonian Godwit
BCC Rangewide
(CON)
King Rail
BCC Rangewide
(CON)
Lesser Yellowlegs
BCC Rangewide
(CON)
Long-billed Curlew
BCC - BCR
Long-tailed Duck
Non-BCC
Vulnerable
Magnificent
Frigatebird
BCC - BCR
Marbled Godwit
BCC Rangewide
(CON)
Painted Bunting
BCC - BCR
Pomarine Jaeger
Non-BCC
Vulnerable


Prothonotary Warbler BCC Rangewide (CON)
Red-breasted Merganser Non-BCC Vulnerable
Red-headed Woodpecker BCC Rangewide (CON)
SPECIES
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
Red-necked Phalarope Non-BCC Vulnerable
Reddish Egret BCC Rangewide (CON)
Ring-billed Gull Non-BCC Vulnerable
Royal Tern Non-BCC Vulnerable
Ruddy Turnstone BCC - BCR
Sandwich Tern BCC - BCR
Short-billed Dowitcher BCC Rangewide (CON)
Sooty Tern Non-BCC Vulnerable
Sprague's Pipit BCC Rangewide (CON)
Surf Scoter Non-BCC Vulnerable
Swallow-tailed Kite BCC Rangewide (CON)
White-winged Scoter

Non-BCC
Vulnerable



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

COASTAL BARRIERS

Projects within the John H. Chafee Coastal Barrier Resources System (CBRS) may be subject to the restrictions on Federal expenditures and financial assistance and the consultation requirements of the Coastal Barrier Resources Act (CBRA) (16 U.S.C. 3501 et seq.). For more information, please contact the local Ecological Services Field Office or visit the CBRA Consultations website. The CBRA website provides tools such as a flow chart to help determine whether consultation is required and a template to facilitate the consultation process.

UNIT	NAME	TYPE	SYSTEM UNIT ESTABLISHMENT DATE	FLOOD INSURANCE PROHIBITION DATE
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	11/15/1993	11/16/1991
T12	Boca Chica	UNKNOWN	10/18/1982	10/1/1983
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	10/18/1982	10/1/1983
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990

UNIT	NAME	TYPE	SYSTEM UNIT ESTABLISHMENT DATE	FLOOD INSURANCE PROHIBITION DATE
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	11/16/1990	11/16/1990
T12	Boca Chica	UNKNOWN	10/18/1982	10/1/1983
T12P	Boca Chica	UNKNOWN	N/A	11/16/1991
T12P	Boca Chica	UNKNOWN	N/A	11/16/1991
T12P	Boca Chica	UNKNOWN	N/A	11/16/1991
TX-22P	Andy Bowie	UNKNOWN	N/A	11/16/1991

MARINE MAMMALS

Marine mammals are protected under the Marine Mammal Protection Act. Some are also protected under the Endangered Species Act[1] and the Convention on International Trade in Endangered Species of Wild Fauna and Flora[2].

The responsibilities for the protection, conservation, and management of marine mammals are shared by the U.S. Fish and Wildlife Service [responsible for otters, walruses, polar bears, manatees, and dugongs] and NOAA Fisheries[3] [responsible for seals, sea lions, whales, dolphins, and porpoises]. Marine mammals under the responsibility of NOAA Fisheries are **not** shown on this list; for additional information on those species please visit the Marine Mammals page of the NOAA Fisheries website.

The Marine Mammal Protection Act prohibits the take of marine mammals and further coordination may be necessary for project evaluation. Please contact the U.S. Fish and Wildlife Service Field Office shown.

1. The Endangered Species Act (ESA) of 1973.
2. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a treaty to ensure that international trade in plants and animals does not threaten their survival in the wild.
3. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

NAME

West Indian Manatee *Trichechus manatus*
Species profile: https://ecos.fws.gov/ecp/species/4469

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

Due to your project's size, the list below may be incomplete, or the acreages reported may be inaccurate. For a full list, please contact the local U.S. Fish and Wildlife office or visit https://www.fws.gov/wetlands/data/mapper.HTML

ESTUARINE AND MARINE WETLAND

- E2EM1P
- E2AB1N
- E2SS1P
- E2USMs
- E2USM
- E2SS3P
- E2USMx
- E2SS3Ns
- E2EM1Ps
- E2USN
- E2AB1M
- E2USP
- E2SS3N
- E2EM1Px
- E2EM1N
- E2USNs
- E2AB3Ms
- E2SS3Ps
- E2AB3M
- E2AB1Ns

ESTUARINE AND MARINE DEEPWATER

- E1UBLx
- E1AB3L
- E1UBL

IPAC USER CONTACT INFORMATION

Agency: SWCA Environmental Consultants
Name: Jennifer Brinkworth
Address: 2008 Riverside Avenue
City: Jacksonville
State: FL
Zip: 32204
Email jennifer.brinkworth@swca.com
Phone: 9043847020

APPENDIX C

Final Biological Monitoring Annual Report

Final: Biological Monitoring Annual Report for the SpaceX Boca Chica Launch Site Construction and Seasonal Avian Monitoring – July 2022 to June 2023

JULY 2023

PREPARED FOR

Space Exploration Technologies Corporation

PREPARED BY

SWCA Environmental Consultants

FINAL: BIOLOGICAL MONITORING ANNUAL REPORT FOR THE SPACEX BOCA CHICA LAUNCH SITE CONSTRUCTION AND SEASONAL AVIAN MONITORING – JULY 2022 TO JUNE 2023

Prepared for

Space Exploration Technologies Corporation
1 Rocket Road
Hawthorne, California 90250
Attn: Kelsey Condell

SWCA Environmental Consultants
4407 Monterey Oaks Boulevard,
Building 1, Suite 110
Austin, Texas 78749
(512) 476-0891
www.swca.com

SWCA Project No. 73821

July 2023

CONTENTS

Appendices

Figures

Tables

1 INTRODUCTION

On behalf of Space Exploration Technologies Corporation (SpaceX), SWCA Environmental Consultants (SWCA) conducted 12 months of Construction and Seasonal Avian Monitoring (avian monitoring) in the vicinity of the SpaceX Boca Chica facilities from July 2022 through June 2023. The SpaceX facilities at Boca Chica include Starbase and the Vertical Launch Area (VLA) located near the Gulf Coast and along the U.S.-Mexico border, approximately 20 miles east-northeast of the city of Brownsville in Cameron County, Texas. The avian monitoring surveys are a component of the SpaceX Boca Chica Launch Site Biological Monitoring Plan and are focused within a 3-mile buffer of the VLA (SpaceX 2022). Figure 1 shows the general location of the project area and 3-mile buffer of the VLA.

SpaceX has commissioned avian monitoring in the project area annually since 2015. This avian monitoring focuses on five species: Piping Plover (*Charadrius melodus*), Snowy Plover (*C. nivosus*), Wilson's Plover (*C. wilsonia*), Rufa Red Knot (*Calidris canutus rufa*), and Northern Aplomado Falcon (*Falco femoralis septentrionalis*). Each of these species is listed as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS), the Texas Parks and Wildlife Department, or both. Table 1 provides a background summary of the five target species that are the focus of the avian monitoring.

Avian monitoring from 2015 through 2021 was performed by researchers from the University of Texas Rio Grande Valley (UTRGV). SWCA began performing avian monitoring in July 2022, implementing a modified protocol and sampling design after coordination with the USFWS. Appendix A provides a summary of the modifications to the monitoring protocol and sampling design. The changes were intended to produce more consistent and evenly distributed sampling across months and years to reduce uncertainty in statistical analyses while maintaining comparability to the UTRGV-collected data to the extent practicable.

This document summarizes the monthly avian monitoring performed by SWCA from July 2022 through June 2023. Additional statistical analyses are planned once data on covariates such as weather and anthropogenic factors are available.

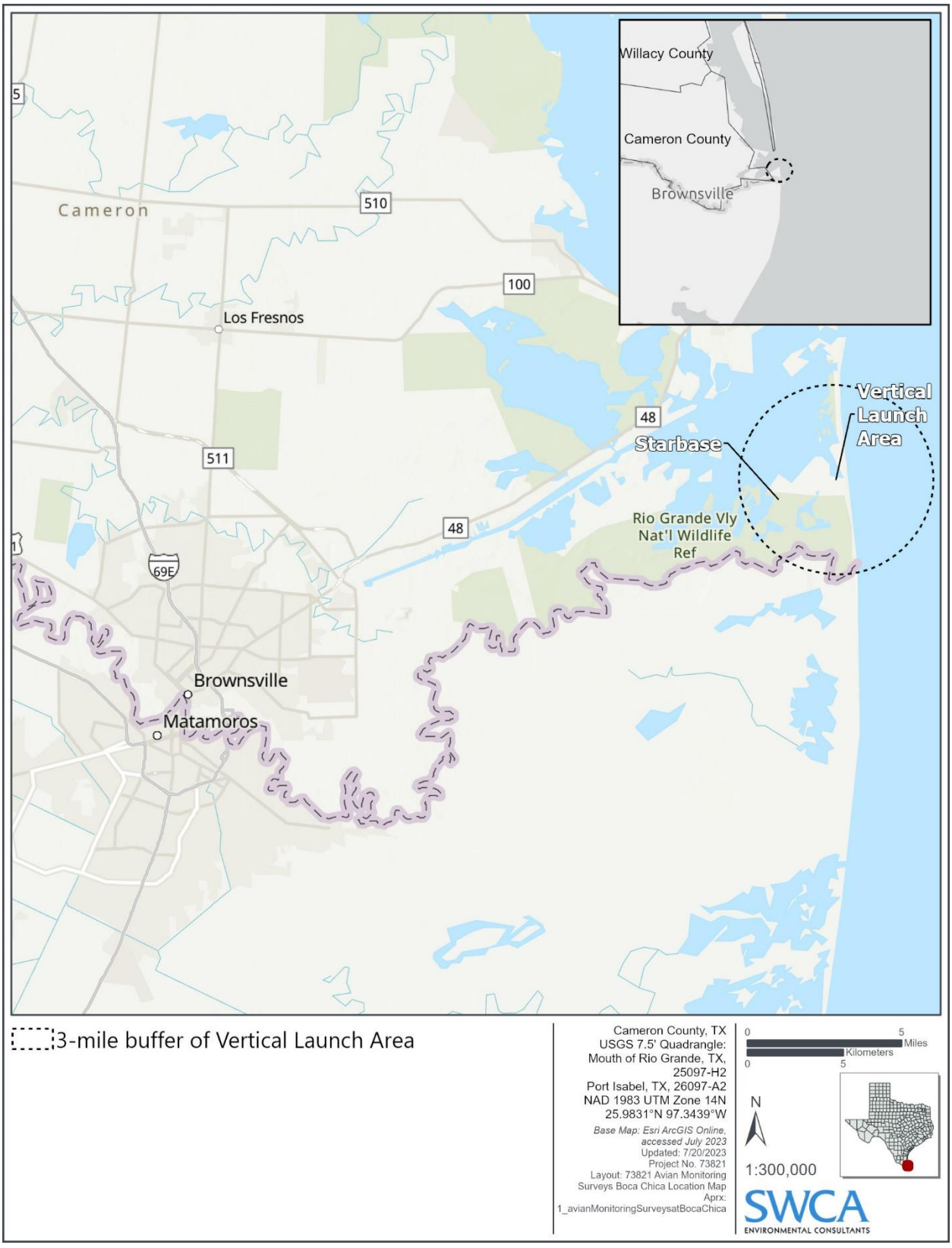


Figure 1. Project area location.

Table 1. Target Species Background Information

Species *Scientific Name*	**Federal Listing Status***	**Breeding Range†**	**Wintering Range†**	**Occurrence Status in Cameron County‡**	**Timing on Texas Gulf Coast‡**
Piping Plover *Charadrius melodus*	Threatened	Occurs in several breeding populations in the U.S. and Canada, including Northern Great Plains, Great Lakes, and Atlantic. Individuals wintering in Texas largely belong to Northern Great Plains populations that primarily breed from southern Canada south to Nebraska. Not known to nest in Texas.	Winters along the southern Atlantic Coast, Gulf of Mexico, and Caribbean. Individuals wintering on the Texas Gulf Coast primarily belong to the Northern Great Plains Population.	Migrant, Winter Resident	Fall migrants arrive as early as late June, with primary migration occurring between July and early September. Spring migration occurs between late March and early May.
Wilson's Plover *Charadrius wilsonia*	Not Listed	Breeds in the U.S., Central American, Caribbean, and South America. In the U.S., breeds throughout Gulf Coast, and Atlantic Coast from Virginia south. Known to nest in Texas.	Winters in low numbers in the U.S. and is most abundant wintering along southern Florida coasts. Most individuals from Gulf Coast winter outside U.S. in Central America, Caribbean, and South America.	Breeding Resident, Migrant, Rare Winter Resident	Present on the Gulf Coast mostly from Mid-February to late September/ early November
Snowy Plover *Charadrius alexandrinus*	Not Listed	Occurs in several breeding populations at both coastal and inland locations in the U.S., Central America, and South America, including throughout the Gulf Coast. Nests in Texas.	In coastal Texas, the wintering range overlaps the breeding range.	Occurs Year-round, Breeding Resident, Migrant, Winter Resident	May be present year-round; spring migrants present March through early May; Fall migrants present late July through October.
Rufa Red Knot *Calidris canutus rufa*	Threatened	Breeds in Holarctic. Individuals that occur in Texas are part of the *C. c. rufa* subspecies that breeds in low latitudes of Arctic Canada. Does not nest in Texas.	Members of the *C. c. rufa* subspecies winter from the Gulf of Mexico to the southern tip of South America.	Migrant, Rare Winter Resident	Spring migration occurs between late March and late May. Fall migration occurs from early August to early November.
Northern Aplomado Falcon *Falco femoralis septentrionalis*	Endangered	Breeds from southern U.S., through Central America. Nests in Texas.	Year-round resident in its range, species exhibits some local nomadic movements outside breeding season. In Texas, occurs in South Texas Coastal Prairies and as a vagrant in the Trans-Pecos.	Permanent Resident	Year-round permanent resident

[1] USFWS (2023).

[2] Piping Plover – Elliott-Smith and Haig (2020); Wilson's Plover – Zdravkovic et al. (2020); Snowy Plover – Page et al. (2020); Red Knot – Baker et al. (2020); Northern Aplomado Falcon – Keddy-Hector et al. (2020).

[3] Lockwood and Freeman (2014).

2 PROTOCOLS AND SAMPLING DESIGN

SWCA conducted avian monitoring surveys along the following four monitoring routes:

- **Boca Chica Beach (BCB)**—Located on the Gulf of Mexico, this route covers a segment of the publicly accessible Boca Chica Beach and includes beach and dune habitat. This route is approximately 6.0 miles long and is accessible by passenger truck and/or on foot, depending on conditions.
- **South Bay (SB)**—Located north of the VLA and along portions of South Bay. This route follows the inland side of the dunes and includes dune, marsh, coastal prairie, tidal flats, and coastal lagoon habitat. This route is approximately 2.8 miles long and is accessible by an all-terrain vehicle (ATV) and/or on foot, depending on conditions. This route includes five Aplomado Falcon Monitoring Points.
- **Boca Chica Flats (BCF)**—Located along the north side Boca Chica Boulevard (Texas State Highway 4) and adjacent to the Starbase facility. Habitats include dune, marsh, coastal prairie, tidal flats, and coastal lagoon habitat. This route is approximately 4.5 miles long and is accessible by ATV and/or on foot, depending on conditions.
- **Las Palomas (LP)**—Located South of Boca Chica Boulevard, this route follows the edges of a large wind-tidal flat. Habitats include dune, marsh, coastal prairie, tidal flat, and coastal lagoon habitat. This route is approximately 10.7 miles long and may be accessible by ATV and/or on foot, depending on conditions. This route includes 10 Aplomado Falcon Monitoring Points.

For consistency, SWCA standardized the mode of travel used to traverse monitoring routes to the extent practicable by using the most efficient mode of travel appropriate for the route. Where and when practicable, SWCA used a truck (or other 4-wheel drive vehicle) on Boca Chica Beach and ATVs to traverse the other routes. When conditions were not practicable for accessing routes by vehicle, SWCA used pedestrian surveys to complete monitoring routes, assuming that field conditions were otherwise suitable for survey. Table 2 provides a summary of the length, planned survey rate, and potential transport methods for each route. Figure 2 depicts the locations of the four survey routes.

Table 2. Monitoring Routes

Monitoring Route	Route Length	Planned Survey Rate	Planned Survey Duration	Potential Modes of Transport
Boca Chica Beach (BCB)	6.0 miles	0.5 hour/mile	3.0 hours	Truck, Pedestrian
Boca Chica Flats (BCF)	4.3 miles	1.0 hour/mile	4.5 hours	ATV, Pedestrian
Las Palomas (LP)	10.7 miles	1.0 hour/mile	11.0 hours	ATV Pedestrian
South Bay (SB)	2.8 miles	1.0 hour/mile	3.0 hours	ATV Pedestrian
Total	**23.8 miles**	**–**	**21.5 hours**	

The avian monitoring protocol involves experienced biologists traveling designated monitoring routes with a spotting scope, binoculars, laser rangefinder, and compass, recording observations of target birds. For the plovers and Red Knot, the monitors stop whenever birds are visible from the route and record the observations. Biologists recorded details such as location, time, number of individuals, whether individuals were banded, behavior, habitat, and nearby species. For the Northern Aplomado Falcon, the monitors stop at designated Aplomado Falcon Monitoring Points to perform the surveys. Biologists stopped and scanned for falcons with binoculars and spotting scopes and recorded details such as location, time, behavior, and presence of stick nests. Ten falcon monitoring points are located along the Las Palomas Route and five falcon monitoring points are located along the South Bay Route (see Figure 2).

Figure 2. Location of monitoring routes.

Not all of the potential shorebird habitat along a route can be surveyed due to access issues (e.g., routes may become flooded, or partially flooded, and inaccessible) and visibility issues (e.g., views may be obstructed by vegetation such as black mangroves [*Avicennia germinans*] lining channels and lagoons or *Salicornia* species growing on flats; temperature distortion, humidity, haze, and other weather conditions may reduce observable distance). The routes provide representative samples of the different types of habitats in the area that are utilized by the target species. The SpaceX Biological Monitoring Plan and Appendix A provide additional details on the protocols and sampling design utilized during the avian monitoring surveys.

SWCA attempted to maintain consistent survey rates throughout each monitoring route using a 1.0-hour-per-mile-of-survey rate for the Boca Chica Flats, Las Palomas, and South Bay routes and a 0.5-mile-per-hour rate of survey on the Boca Chica Beach route. Due to logistics, route conditions, mode of transport, presence of target species or banded individuals, and other variables, the total survey time and survey rate varied from the proposed rates and durations identified in Table 2. Table 3 provides a summary of the level of effort expended conducting avian monitoring surveys overall and for each monitoring route. Appendix B provides a summary of the monthly survey effort for each monitoring route and includes additional survey details. Appendix C provides a summary and results of the Aplomado Falcon Monitoring Point surveys.

Table 3. Summary of Avian Monitoring Effort for the Period Between July 2022 and June 2023

Monitoring Route	Number of Completed Surveys	Number of Completed Falcon Monitoring Point Surveys	Total Distance Surveyed	Planned Total Survey Hours	Actual Total Survey Hours
Boca Chica Beach	12	–	68.6 miles*	36 hours	39 hours 38 minutes
Boca Chica Flats	11*	–	47.3 miles	49 hours 30 minutes	49 hours 30 minutes
Las Palomas	11*	110	117.7 miles	121 hours	120 hours 35 minutes
South Bay	11*	55	30.8 miles	33 hours	35 hours 18 minutes
Total	**45**	**165**	**264.4 miles**	**239 hours 30 minutes**	**245 hours 1 minute**

* During the November 2022 surveys, extreme weather and flooding resulted in the cancelation of much of the survey. No surveys were conducted on the BCF, LP, and SB routes; a portion of the BCB route was surveyed between Mile Markers 2.8 and 0.2.

Most of UTRGV's protocols were maintained by SWCA to generate comparable data. However, the following changes or clarifications were made in coordination with USFWS and SpaceX: [1]

- **Modifications to sampling frequency**—SWCA surveyed each of the four monitoring routes once every month. UTRGV conducted surveys along its routes at rates that varied from zero to 11 times per month.
- **Modifications to the monitoring routes**
  - The monitoring routes were more specifically delineated and, where appropriate, adjusted to be closer to the edge of dune habitat (i.e., higher ground) to allow for more consistent access, a more consistent visual field (i.e., area surveyed), and to minimize disturbance to tidal flat habitat caused by using ATVs.

[1] See Appendix A, the July 22, 2022, Technical Memo from Michael Heimbuch (SWCA) to SpaceX re: Acknowledgements and Updates to the SpaceX Boca Chica Launch Site Biological Monitoring Plan following the July 15, 202,2 Kick-off Meeting / SWCA Project No. 73821.

- The starting or end points of the routes were adjusted slightly to either lengthen or shorten a route based on prior typical observations of avian activity and to help balance survey effort among routes. Combined, the monitoring routes increased from 20.5 to 23.8 miles (16%).

Table 4 and Figure 3 illustrate the survey frequency and monitoring route changes between UTRGV and SWCA survey design.

Table 4. Number of Monitoring Surveys Sampled by Year and Month

Year / Month	2015	2016	2017	2018	2019	2020	2021	2022	2023
Jan	--	--	6	--	5	3	--	--	4
Feb	--	--	5	--	2	--	5	--	4
Mar	9	--	3	3	7	1	7	--	4
Apr	5	--	4	2	7	--	6	--	4
May	2	--	11	6	3	1	2	--	4
Jun	--	--	4	2	2	--	1	--	N/A
Jul	--	--	3	3	2	--	2	4	N/A
Aug	--	--	2	1	2	2	2	4	N/A
Sep	--	--	2	3	1	3	4	4	N/A
Oct	--	1	1	4	3	7	5	4	N/A
Nov	--	--	1	5	5	5	3	1	N/A
Dec	--	7	2	3	2	1	--	4	N/A
Total	**16**	**8**	**44**	**32**	**41**	**23**	**37**	**21**	**20**

Notes: Dashes indicate that no surveys were performed. 2015 was pre-construction sampling. An expanded post-construction monitoring program kicked off in 2017. Data collection in 2020 was curtailed because of COVID-19. No samples were collected in the first half of 2022. SWCA began sampling in July 2022. Surveys in November 2022 were curtailed because of extreme weather and flooding; only the Boca Chica Beach route was completed.

3 RESULTS

SWCA surveyed each of the four routes every month from July 2022 through June 2023, with the exception of November 2022. Due to severe weather conditions, only 2.6 miles of the 6.0-mile-long Boca Chica Beach route, and none of the other three routes, were surveyed in November 2023.

Figure 4 summarizes the number of Red Knots and plovers observed by SWCA, separated by target species. Different species dominated the total count at different times of the year, which is expected for migratory species. SWCA observed one Northern Aplomado Falcon during the 12 months of avian monitoring surveys. This observation occurred on April 24, 2023, from the northernmost Aplomado Falcon Monitoring Point on the South Bay Route (see Figure 2). SWCA observed this individual several times for a total of approximately 45 minutes, and observed the individual hunting, feeding, and using different perches in the vicinity of the initial observation. No Northern Aplomado Falcons were detected during the UTRGV avian monitoring conducted from 2015 through 2021. As only one Northern Aplomado Falcon was observed throughout the 12 months of surveys, this species is not discussed further in this report.

Figure 3. Location of monitoring routes and comparison to previous UTRGV monitoring routes and Aplomado Falcon monitoring points.

SWCA's survey data are consistent with the natural, varied cycles of the target species. The data suggest an elevated abundance of Piping Plovers during the winter, which coincides with their winter-resident status. SWCA did not record any Piping Plovers during the May and June surveys, which is expected since the birds should be on their breeding grounds during this period. Wilson's Plovers were only observed in the summer and spring months, which coincides with their use of the Gulf as a breeding ground. Snowy Plovers were observed year-round, suggesting this species is a permanent resident of the study area. Red Knot observations were sporadic, varied, and limited to the spring and fall migration periods, which coincides with their migration pattern and previous studies of this species in the region.

SWCA recorded target and non-target species of birds observed during each of the avian monitoring surveys to make species lists for each monitoring route. Overall, SWCA biologists recorded 170 species throughout the 12 months of avian monitoring. SWCA observed the highest species diversity (141 species) on the Las Palomas route, which is expected given the much greater amount of time spent on this route than any of the others (see Table 3). SWCA observed the lowest diversity on the Boca Chica Beach route (61 species). SWCA biologists observed the highest species diversity (78 species) in March 2023 during the survey of the Las Palomas monitoring route, which coincided with the spring migration period. Table 5 provides a summary of the number of species observed on each monitoring route. Appendix E provides a taxonomic list of all species identified while conducting the avian monitoring surveys.

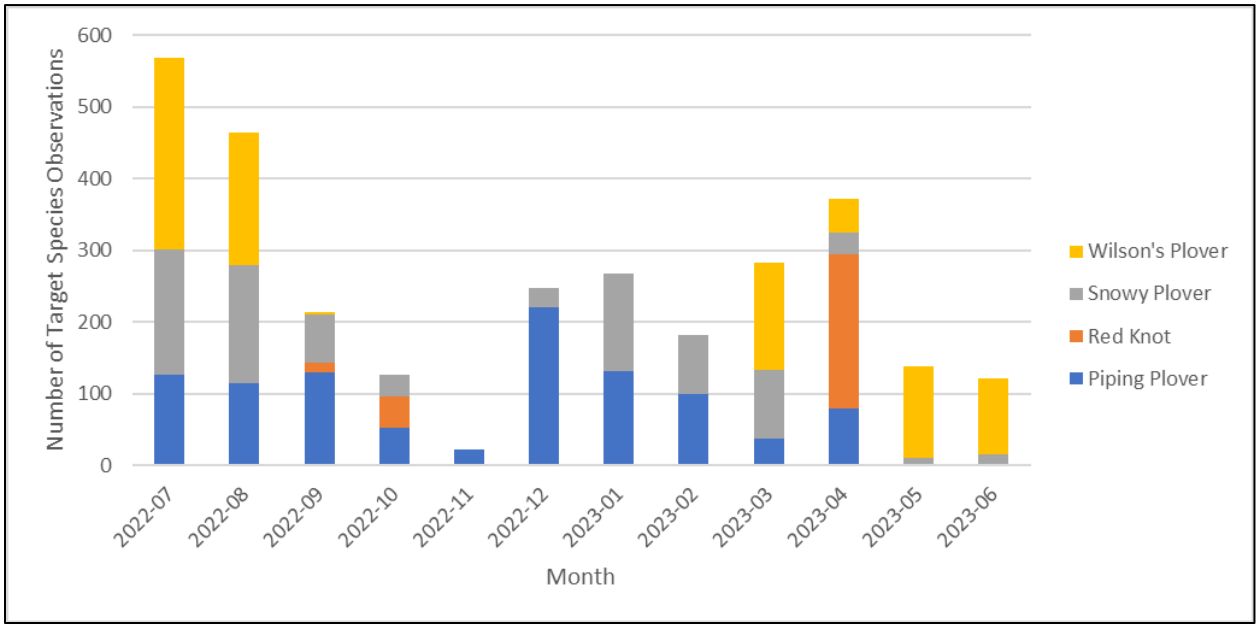


Figure 4. Number of target species observations (July 2022–June 2023).

Table 5. Number of Avian Species Observed During Avian Monitoring Surveys

Month/Year	Number of Species Observed on Monitoring Route			
	Boca Chica Beach	Boca Chica Flats	Las Palomas	South Bay
July 2022	22	40	50	35
August 2022	21	43	62	33
September 2022	21	42	64	53
October 2022	30	47	65	40
November 2022*	16	N/A	N/A	N/A
December 2022	24	55	51	42
January 2023	23	64	74	42
February 2023	21	53	64	42
March 2023	24	50	78	54
April 2023	18	67	63	55
May 2023	17	40	70	41
June 2023	17	31	42	13
Total Number of Species	**61**	**128**	**141**	**118**

* During the November 2022 surveys, extreme weather and flooding resulted in the cancelation of much of the survey. No surveys were conducted on the BCF, LP, and SB routes; a portion of the BCB route was surveyed between Mile Markers 2.8 and 0.2.

Figure 5 presents the target species survey results displayed as the rate of observations per mile surveyed. Dividing the number of target species observations by the number of miles surveyed normalizes the observations by sampling effort. This is performed to correct for partial survey events (like November 2022). Concerning November 2022, presenting the data as a rate demonstrates that the relative abundance of Piping Plovers along the monitoring routes in November was relatively similar to the abundance observed in other fall and winter months, despite few overall observations.

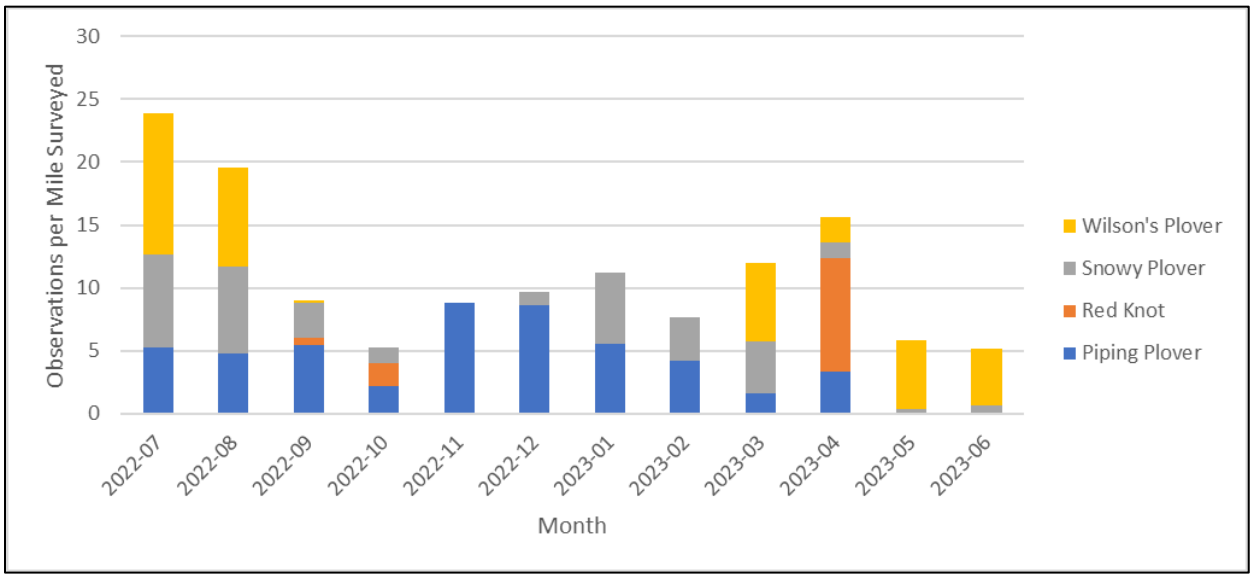


Figure 5. Number of observations per mile surveyed.

Figures 6 through 9 provide the rate of target species observations per mile surveyed, separated by species and route. For each species, the number of observations per mile differs from those shown in Figure 5 since the number of target species observations in Figures 6 through 9 is divided by the lengths of the individual monitoring routes on which they were observed, rather than the total length of the entire survey (i.e., the monitoring routes are separated rather than combined). The benefit of presenting the data like this is to provide for a more direct comparison of a species' relative abundance between routes. For example, in December 2022, 158 Piping Plovers were observed along the Las Palomas (LP) route and 35 were observed along the South Bay (SB) route. The relative number of observations of Piping Plovers are as numerous along the SB route as they are along the LP route when corrected for different monitoring route lengths; the difference in total observations is due to the length of the route rather than the relative abundance of birds.

Additionally, Figure 6 includes the November 2022 survey, whereas Figures 7 through 9 do not. The rationale for presenting the data this way is as follows. Piping Plover (see Figure 6) was the only target species observed during the November 2022 sampling event, during which the only monitoring route surveyed was a section of Boca Chica Beach. It was possible to determine a reasonable observation rate within Boca Chica Beach for the Piping Plover observed during this incomplete survey. While no other target species were observed on Boca Chica Beach during November 2022, it was not reasonable to identify the observation rates of other species during the monitoring visit that month as zero since it is possible that they would have been observed if the survey had been completed in full.

Missing columns in Figures 6 through 9 indicate that the associated target species were not observed during that month's monitoring visit.

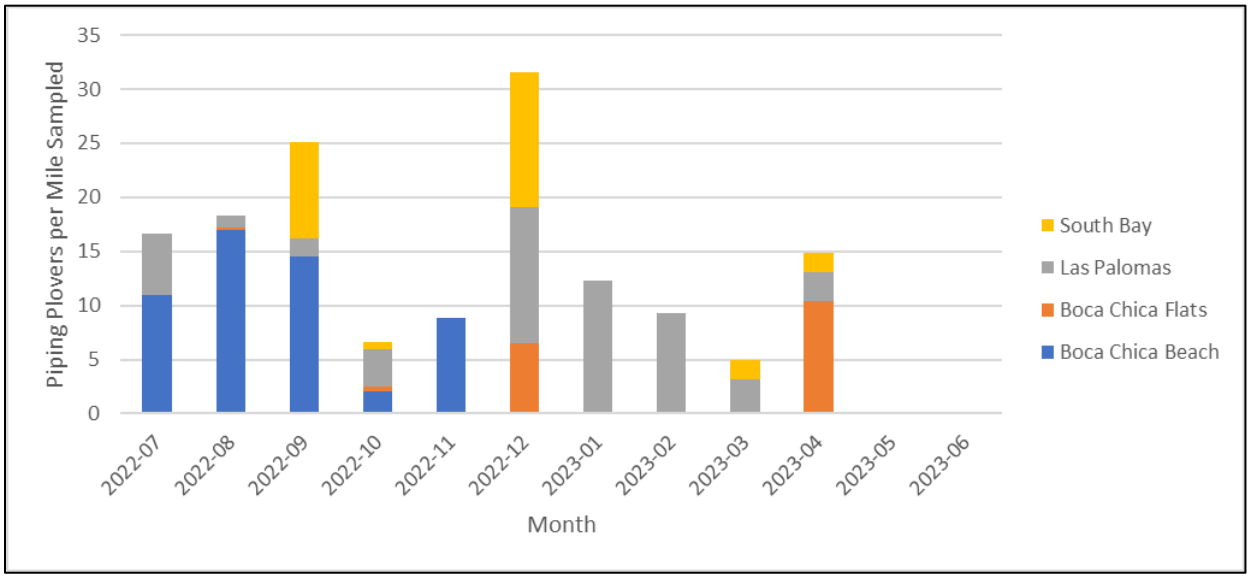


Figure 6. Piping Plover observations per mile surveyed.

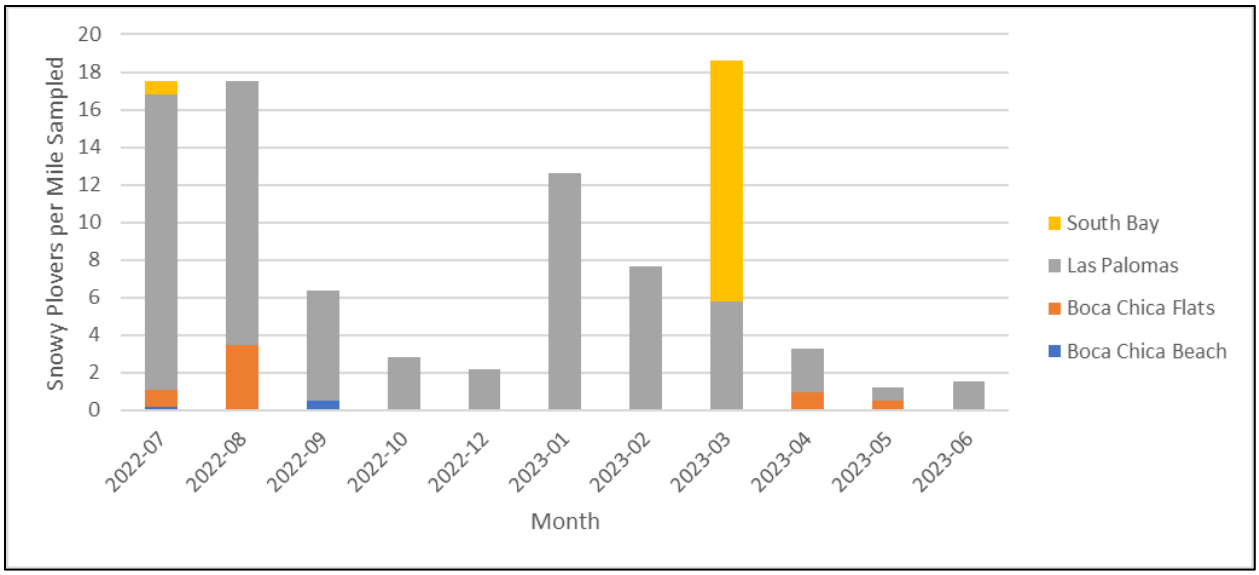


Figure 7. Snowy Plover observations per mile surveyed.

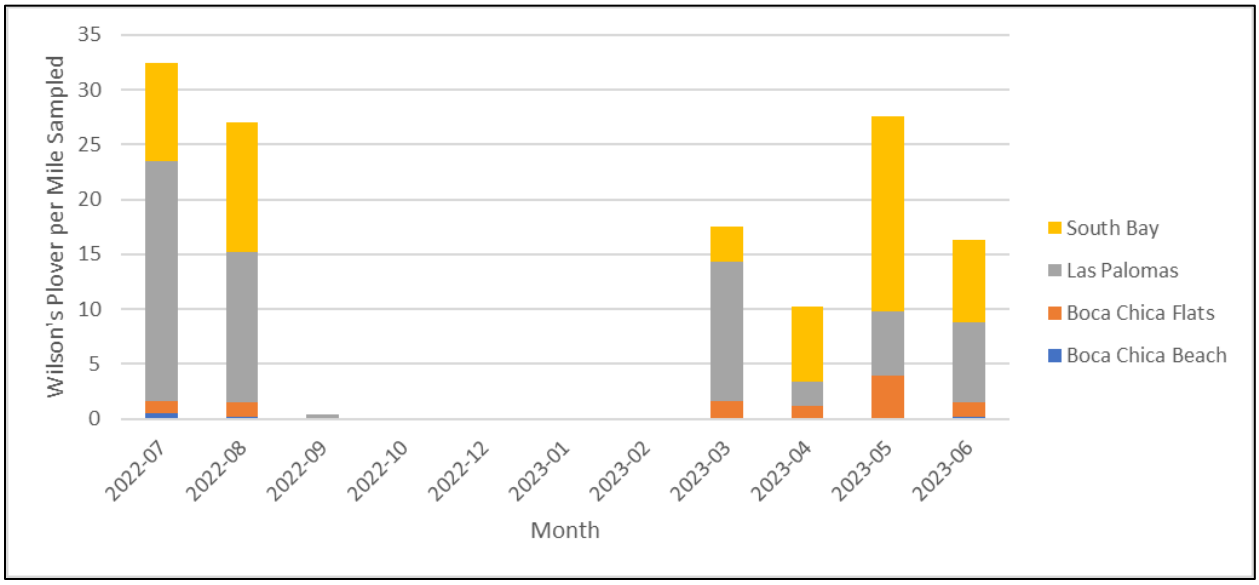


Figure 8. Wilson's Plover observations per mile surveyed.

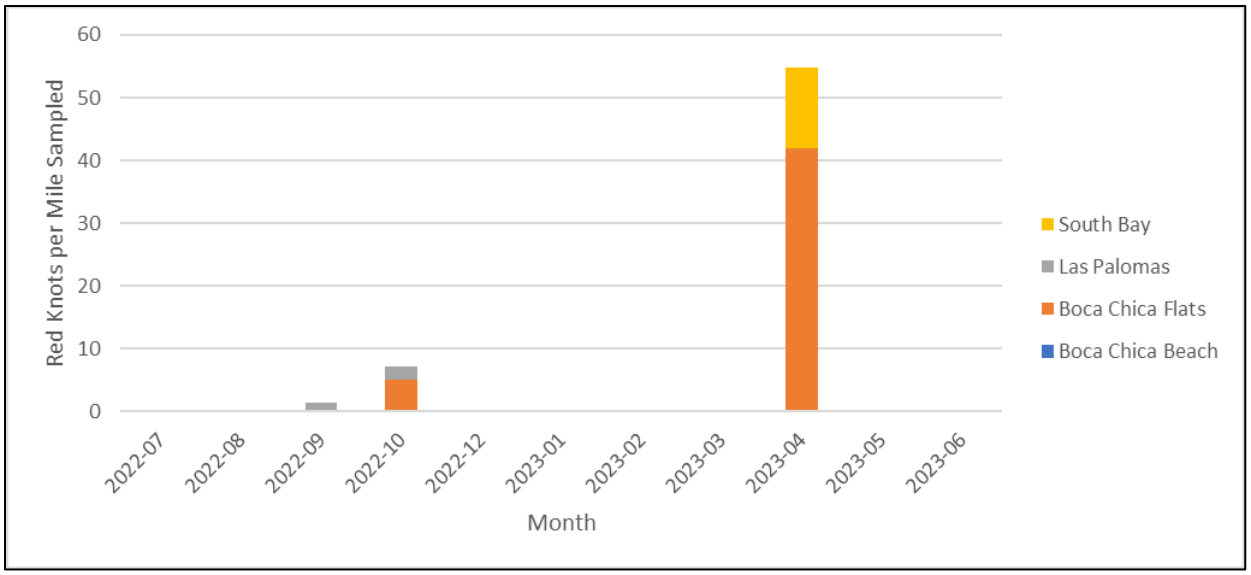


Figure 9. Red Knot observations per mile surveyed.

3.1 Spatial Distribution of Observed Birds

The data collection protocols include information necessary to map the location of birds.[2] Figures 10 through 13 show the locations of the observed birds in SWCA's sampling from July 2022 through June 2023. Overall, the highest observation rate of birds were in two locations, along Boca Chica Beach and along the interior edges of the dunes in the Boca Chica Flats (see Figure 10–13).

Piping Plovers were observed throughout the length of Boca Chica Beach that was monitored, comprising the majority of target species observed along the beach. They were also concentrated along the interior edge of the dunes closest to the beach. Most of the Piping Plovers were observed more than 1 mile from the VLA, but some of the largest groups were within 1 mile of the VLA. These groups were located to the north-northeast and southwest of the VLA. A few Piping Plovers were observed near the Starbase facility. Relatively few were observed in other portions of the monitoring area.

Unlike Piping Plovers, Snowy Plovers were not observed frequently along the beach. Otherwise, the distribution of observed Snowy Plovers was generally similar to the Piping Plover. Most Snowy Plovers were observed more than 1 mile from the VLA.

Like Snowy Plovers, Wilson's Plovers were not observed frequently along the beach. Their distribution within the mudflats was different than both Piping Plover and Snowy Plover. Rather than being concentrated mainly along the interior of the mudflats nearest the beach, Wilson's Plovers were observed in other portions of the mudflat habitat. In addition, Wilson's Plovers were spread out further north and south than the other two plover species. While Wilson's Plovers were observed within 1 mile of the VLA, most, including the largest groups, were observed between 2 and 3 miles away.

Red Knots were observed sporadically and infrequently. There was significant variation in group size, with groups ranging from a few to over 100 individuals. None were observed along the beach or within 1 mile of the VLA. Most were observed more than 2 miles from the VLA, to the south and east. Several large groups were observed near the Starbase facility.

[2] Specifically, the monitor took GPS coordinates associated with each bird observation (which contains one or more birds), as well as the distance and bearing to the observed bird(s).

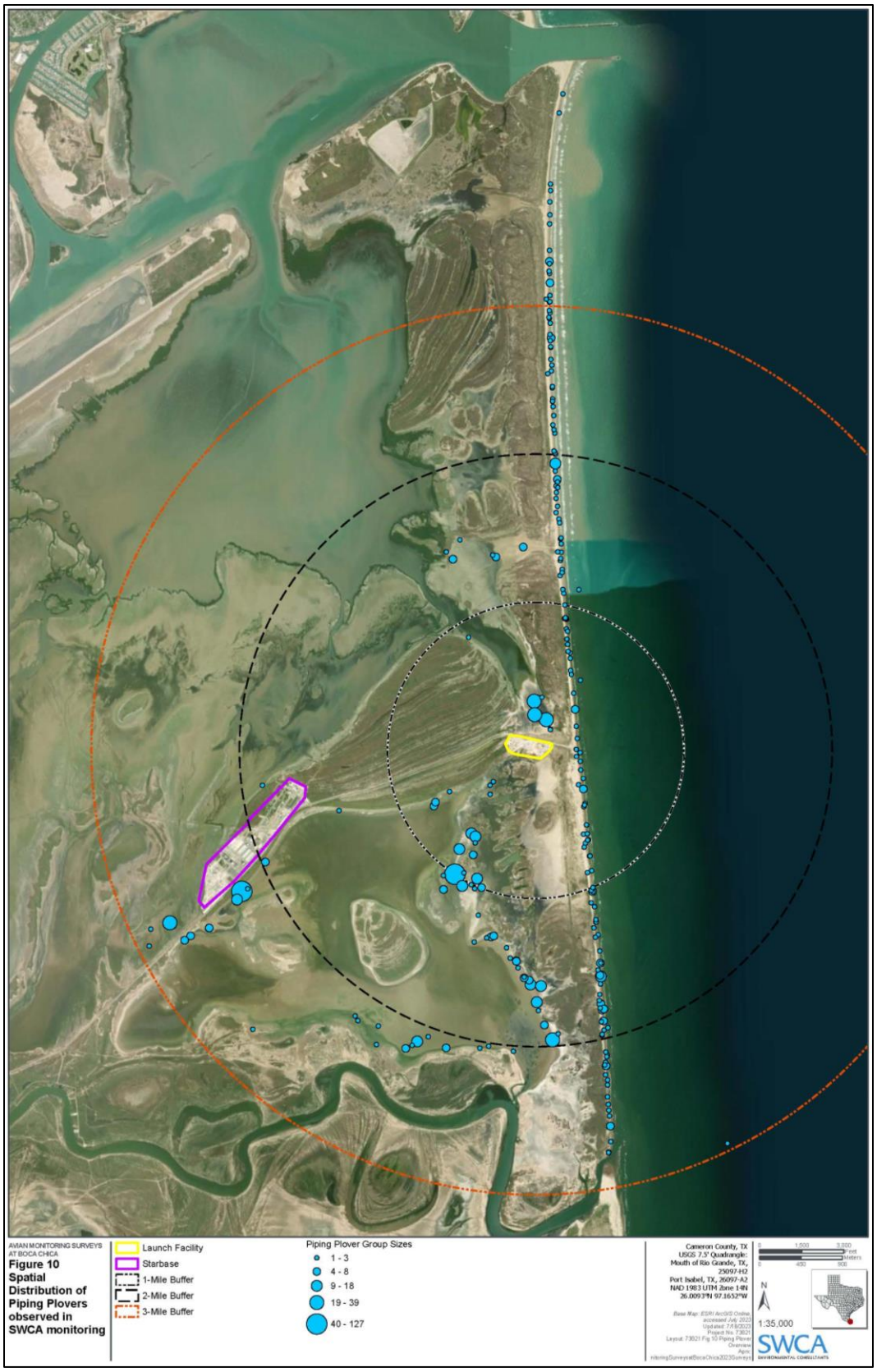


Figure 10. Spatial distribution of Piping Plovers observed in SWCA monitoring.

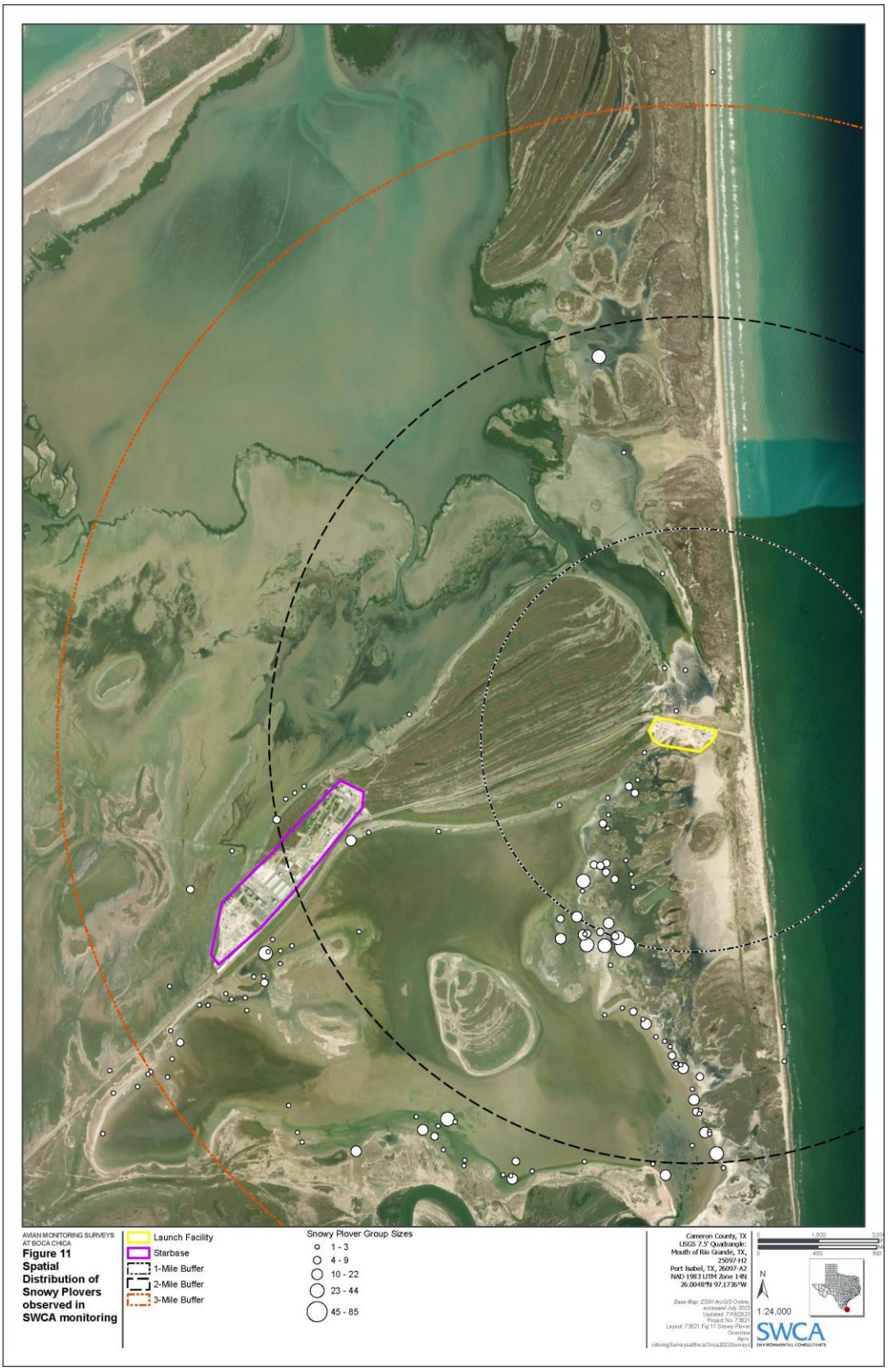


Figure 11. Spatial distribution of Snowy Plovers observed in SWCA monitoring.

Figure 12. Spatial distribution of Wilson's Plovers observed in SWCA monitoring.

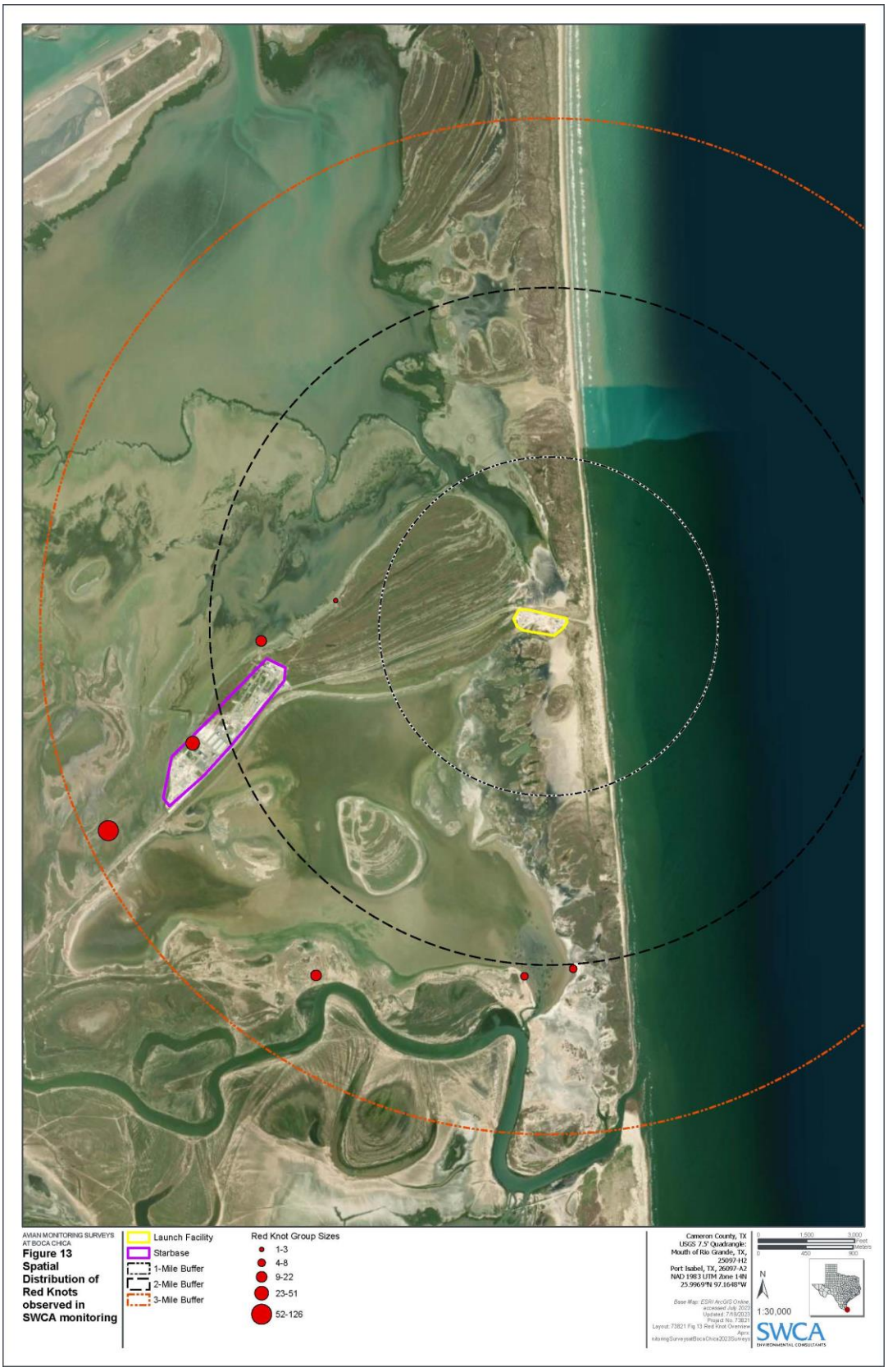


Figure 13. Spatial distribution of Red Knots observed in SWCA monitoring.

3.2 Trends Analysis

SWCA (2022) presented results of preliminary trends analyses for the four target shorebird species based on the UTRGV survey results. Trends in the number of birds observed in the UTRGV field data (2015–2021) were analyzed using regression analysis. Two basic model structures were used to investigate potential trends across years. One model treated *Year* as a continuous variable, allowing a statistical test of potential trends occurring across the entire data set. The other model treated *Year* as a discrete variable, allowing investigation of trends across a subset of the years. Three different types of count models—Poisson, negative binomial, and zero-inflated Poisson—were used to investigate the sensitivity of the estimated trends (or lack thereof) to model structure and assumptions. No attempt was made to choose the "best" model for each species. Sensitivity analysis was also performed on subsets of data as appropriate.

The general conclusions in the 2022 trends analysis included the following:

- There was little to no strong evidence of trends, either increasing or decreasing, for any of the target species.
- Although the overall conclusions were robust with respect to different model specifications, there was a moderate to high amount of sensitivity, which appeared to be caused at least in part by the uneven distribution of sampling across routes, months, and years.
- Additional years of data and a more uniform sampling design would be helpful to future trend analyses.

This trend analysis incorporates the 2022 through 2023 data collected by SWCA. The additional year of data with a consistent sampling design over time (i.e., monitoring every route once per month) allows a more thorough statistical investigation of trends. While the basic approach remains the same (fitting regression models to the avian monitoring data), the following improvements have been made over the previous analysis:

1. **A focus on negative binomial models**. After combining the datasets collected by UTRGV and SWCA, the distribution of counts for each species was found to exhibit overdispersion (i.e., the variance for each species was substantially greater than the mean). The assumption that a distribution's mean is equal to its variance underpins Poisson regression models, and while this assumption can be "bent" in certain cases, the use of the Poisson distribution in this case was not appropriate. We chose to model the count data using negative binomial regression models because the negative binomial distribution is defined by two parameters that can mitigate the effect of overdispersion (i.e., it is more flexible than the Poisson distribution and can be fit to different "shapes" of data).
2. **Interaction terms were investigated**. The previous analysis included only main effects for year, month, and route (i.e., no interaction terms). This implies an assumption that the effects of year, month, and route are independent of each other (i.e., they do not interact). This assumption was adopted in part because of the uneven sampling in the university data, in which insufficient sampling was performed for some combinations of months and routes to produce viable estimates of interaction terms. However, it is apparent in the SWCA data that the patterns in avian abundance differ by month-route combinations.[3] The updated trends analysis includes interactions between month and route when appropriate, which improves model fit, explanatory power, and the ability to test for trends across years.

[3] For example, from 2022 to 2023, Piping Plovers were most often found along the beach from July to November, but were rarely observed along the beach in other months.

3. **A preferred "best" model was identified for each species**. A set of predictors was selected to best determine whether observations of the target species changed year-over-year, while controlling for other sources of variation in the data. While other model selection criteria (AIC, likelihood ratio tests, prediction error) were used to assess and compare models, selecting predictors that reflected the design of the study and the differences in abundance due to known biological differences in site selection over time and space were given more weight. In other words, known or suspected sources of variation were treated as block groups to isolate the variation in abundance due to time (year).

An additional aspect of the modeling involved testing for differences in observations made by the two teams, UTRGV and SWCA. Although SWCA followed the UTRGV methods (excluding sampling design) to the extent appropriate and practical, there were some differences (see Section 2). Including a variable to control for a potential team effect in the models allows a statistical test of whether SWCA's observations vary systematically from the UTRGV's observations, controlling for other factors. If there is a difference between the two teams' observations, then the model controls for that difference when estimating the trend across years. This reduces the chance that differences caused by the two teams affect the investigation of a trend over years, which is the main focus of the analysis.

For Piping Plover and Wilson's Plover, the preferred model predicts bird observations as a function of team (UTRGV or SWCA), monitoring route, month, year, and an interaction between monitoring route and month. While it was possible to fit a model with the same predictors for Snowy Plover, high standard errors for parameter estimates reduced our confidence in the model's usefulness to determine a change over time. Therefore, the preferred model for Snowy Plover predicted counts as a function of team, monitoring route, month, and year (i.e., no interaction terms).

As discussed further below, observing Red Knots appears to be a relatively rare and somewhat random event. Due to limited non-zero observations and overall unbalanced sampling, it was not possible to reliably control for suspected sources of variability when modeling Red Knot observations. The preferred model for Red Knot predicted counts as a function of year. Despite limited confidence that this model estimates the true effect of time on the abundance of Red Knots and likely overestimates that parameter, the model provides a better assessment of the trend than a simple visual assessment of the data.

3.2.1 Results – Piping Plovers

As with the previous trend analysis, a biological year rather than a calendar year was used for each species, if appropriate. Relatively few Piping Plovers were observed in May or June (Figure 14). The biological year for Piping Plovers is therefore defined as July 1 through June 30, which avoids splitting the overwintering population across years. Note that in the discussion and results below, years refer to the beginning of the biological year. For example, 2018 refers to July 1, 2018, through June 30, 2019.

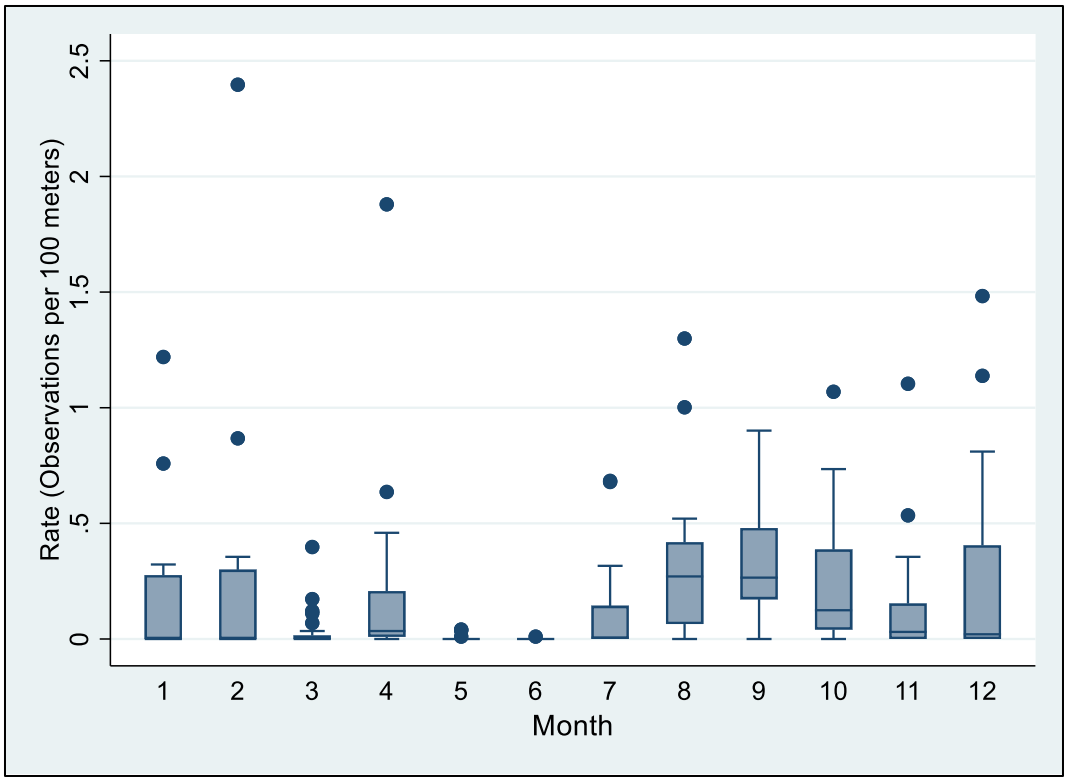


Figure 14. Rate of Piping Plover observations by month.

Figure 15 shows the distribution of Piping Plover observations across biological years. The y-axes measure observations as a rate (observations per 100 meters), which standardizes the data for differences in distances monitored on different monitoring days. The left panel shows a standard box plot, and the right panel shows means and 95% confidence intervals. It is apparent that the distributions are right-skewed (meaning a relatively higher frequency of small values and a relatively lower frequency of larger values), as the medians are close to the 25th percentiles, there are numerous outside values, and the means are larger than the medians. There is a potential upward trend visible in the means; however, it is not consistent across the years. Instead of a consistent trend, the means cycle up and down.

The potential to interpret trends in these graphs is limited by variation in the routes monitored over time (see Section 2). The regression modeling attempts to correct for these sources of variation so that potential trends can be better investigated.

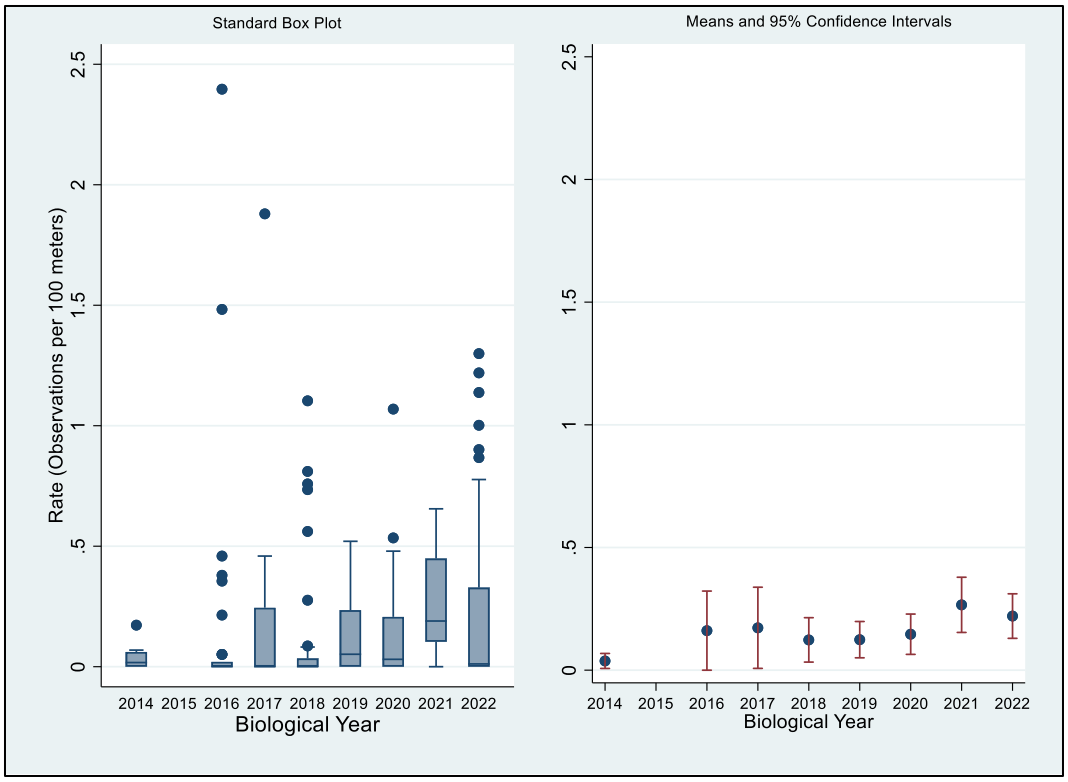


Figure 15. Distribution of Piping Plover observations across years.

Table 6 shows key results for three regression model variations. The two other models are presented because they aid interpretation of the preferred model. Model 1, the preferred model, treats *Year* as a continuous variable and includes a variable to distinguish observations made by the two teams. Model 2 is similar to Model 1 but does not include the *Team* variable. Model 3 treats *Year* as a series of discrete variables, one for each year. The *Team* variable cannot be included in Model 3 because it is perfectly correlated with the discrete year variables. All models include variables representing different months, survey routes, and the interactions of month and survey route.[4] As noted above, these variables control for important seasonal and spatial differences in observations.

Table 6. Selected Regression Model Results

Explanatory Variable	Model 1 (Preferred)	Model 2	Model 3
Year (Continuous)	0.0044 (0.0662)	0.1206‡ (0.0459)	--
Team			
SWCA	0 (Reference Category)	--	--
UTRGV	-0.9681‡ (0.3682)	--	--
Year (Discrete Categories)			
2014			0 (Reference Category)
2015	--	--	No data

[4] Results for these variables are not shown for brevity.

Explanatory Variable	Model 1 (Preferred)	Model 2	Model 3
2016	--	--	0.7291 (0.6819)
2017	--	--	-0.0824 (0.7153)
2018	--	--	-0.7618 (0.6394)
2019	--	--	-0.7133 (0.6692)
2020	--	--	0.0475 (0.5727)
2021	--	--	0.2369 (0.6532)
2022	--	--	0.9223* (0.5427)

Note: Estimated coefficients with standard errors in parentheses; Dashes indicate a model does not include a variable.
* Indicates statistical significance at the 90% confidence level.
† Indicates statistical significance at the 95% confidence level.
‡ Indicates statistical significance at the 99% confidence level.

The preferred model finds that there is a statistically significant difference ($p = 0.009$) between observations made by the two teams. Specifically, the UTRGV team is estimated to have observed 62% fewer Piping Plover than the SWCA team, controlling for other factors.[5]

The preferred model finds a small increasing trend of 0.4% per year that is not statistically significant ($p = 0.948$). Model 2, which does not include the Team variable, finds an increasing trend of 12.8% per year that is statistically significant ($p = 0.009$), which demonstrates the importance of controlling for team Model 3 does not find a consistent trend across years. Figure 16 compares the estimated trends across years for the three models.

[5] The percent change in the negative binomial model is exp(coefficient)-1. For the team variable in Model 1, exp(-0.9681)-1 = -0.62.

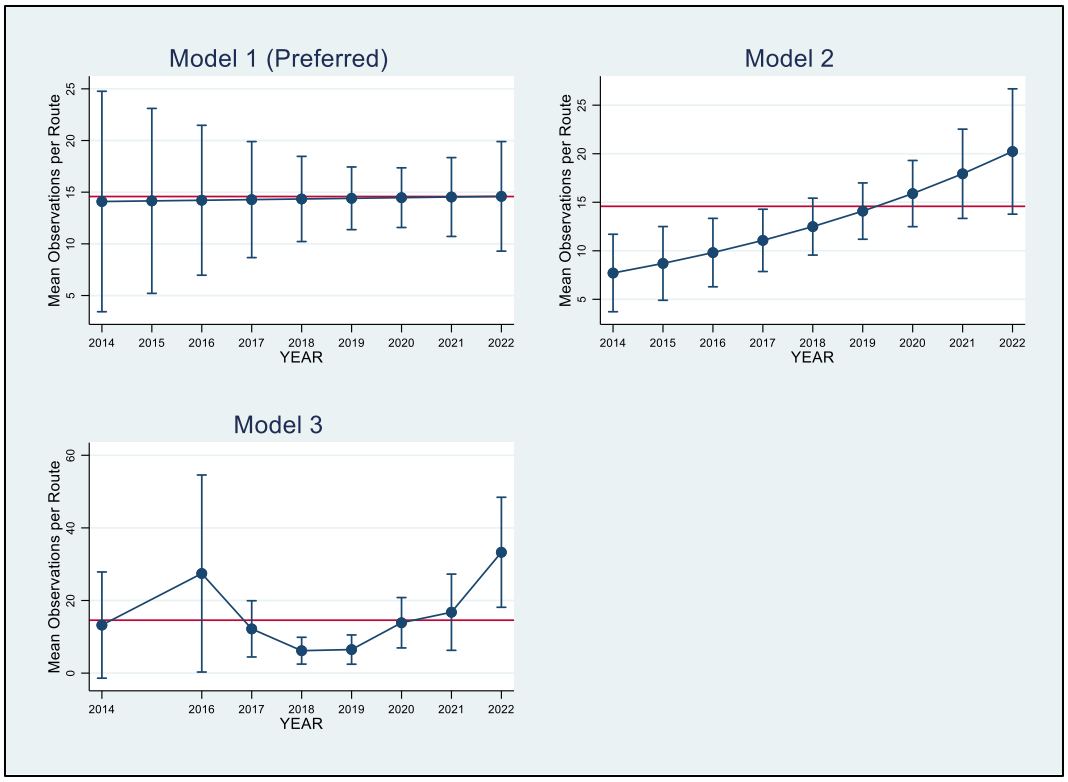


Figure 16. Comparison of trends estimated by three model variations.

The blue lines and dots represent the estimated mean numbers of Piping Plover observed per monitoring route sampled, with 95% confidence intervals. The red line is the overall mean of the data (14.6).

The Preferred Model and Model 3 both have no discernable trend across years, which is consistent with the means for each year presented in Figure 15. While Model 2 does estimate an increasing trend, this appears to be the result of not controlling for the team effect rather than any evidence about trends; the model does not fit the patterns in the data over years. Overall, there is no strong evidence of trends across years, either increasing or decreasing, for Piping Plover observed during avian monitoring.

Although the overall conclusion is similar to the 2022 trends analysis for Piping Plover, the additional SWCA data and improved modeling leads to more confidence. In the 2022 analysis, most models with continuous *Year* variables estimated declining trends that were not statistically significant. It was hypothesized that these trends may have been the result of higher-than-average observations in 2016 and 2017. It appears that the previously estimated downward (but not statistically significant) trends have been eliminated, in part, because 2021 and 2022 had above-average observations compared to 2018 through 2020.

3.2.2 Results – Snowy Plovers

Snowy Plovers were observed consistently throughout most of the year, with the lowest counts from May through September (Figure 17). As with Piping Plovers, the biological year is defined as July 1 through June 30 to avoid splitting up the overwintering population.

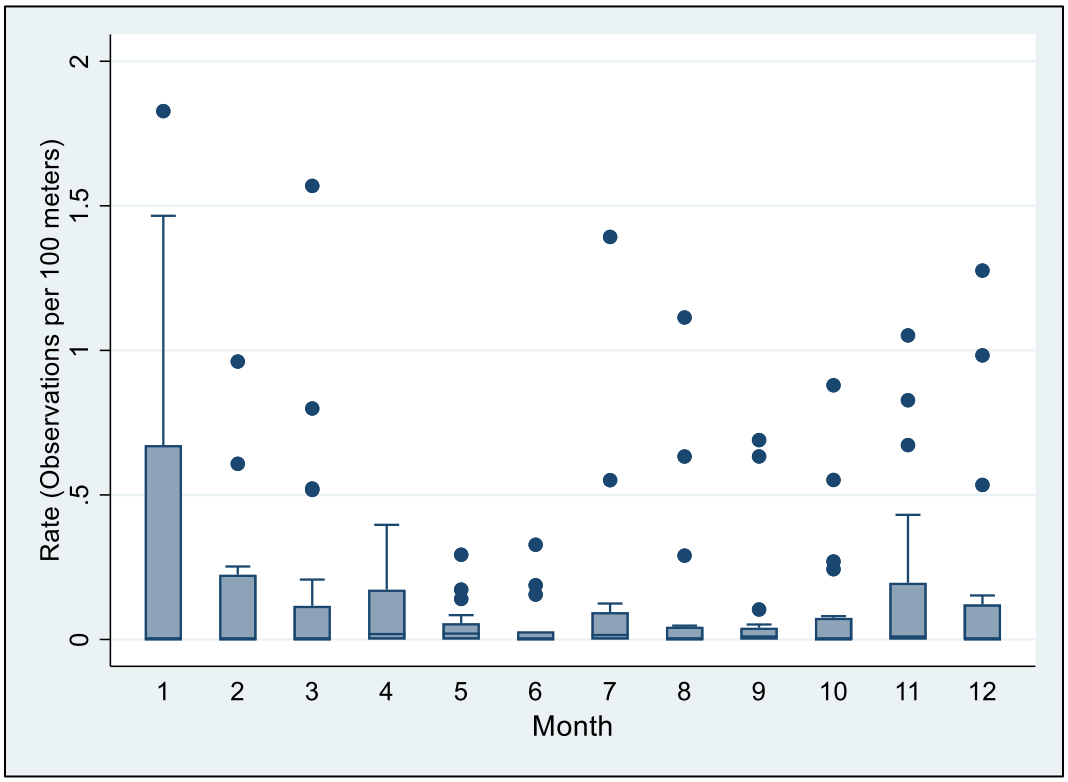


Figure 17. Rate of Snowy Plover observations by month.

Figure 18 shows the distribution of Snowy Plover observations across biological years. As with Figure 15, the y-axes measure observations as a rate (observations per 100 meters), which standardizes the data for differences in distances monitored on different monitoring days. The left panel shows a standard box plot, and the right panel shows means and 95% confidence intervals. It is apparent that the distributions are right-skewed (meaning a relatively higher frequency of small values and a relatively lower frequency of larger values), as the medians are close to the 25th percentiles, there are numerous outside values, and the means are larger than the medians. There is no discernable trend visible in the means.

The potential to interpret trends in these graphs is limited by variation in the routes monitored over time (see Section 2). The regression modeling attempts to correct for these sources of variation so that potential trends can be better investigated.

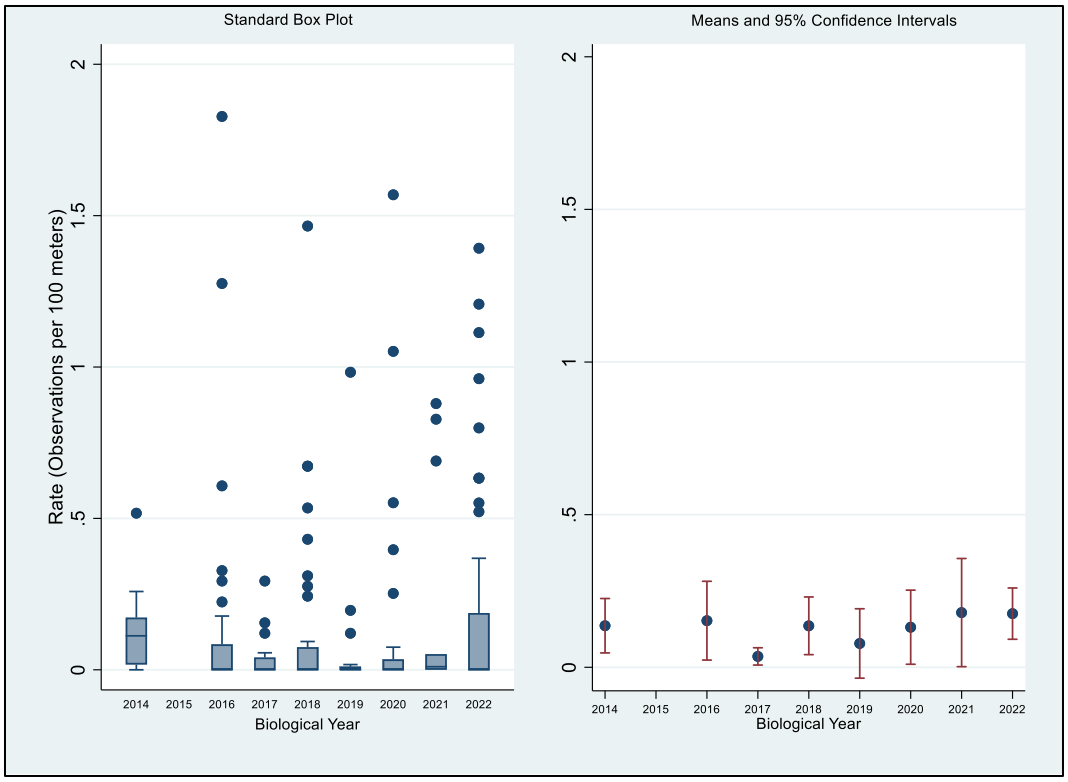


Figure 18. Distribution of Snowy Plover observations across years.

The preferred model finds that the difference between teams (that UTRGV observes 21.4% fewer Snowy Plovers) is not statistically significant (p = 0.538). The preferred model finds a declining trend of 6.1% per year that is not statistically significant (p = 0.353). Model 2, which does not include the *Team* variable, finds a declining trend of 3.3% per year that is not statistically significant (p = 0.473). Model 3 does not find a consistent trend across years, and none of the individual *Year* coefficients are statistically different than the reference category. Figure 19 compares the estimated trends across years for the three models.

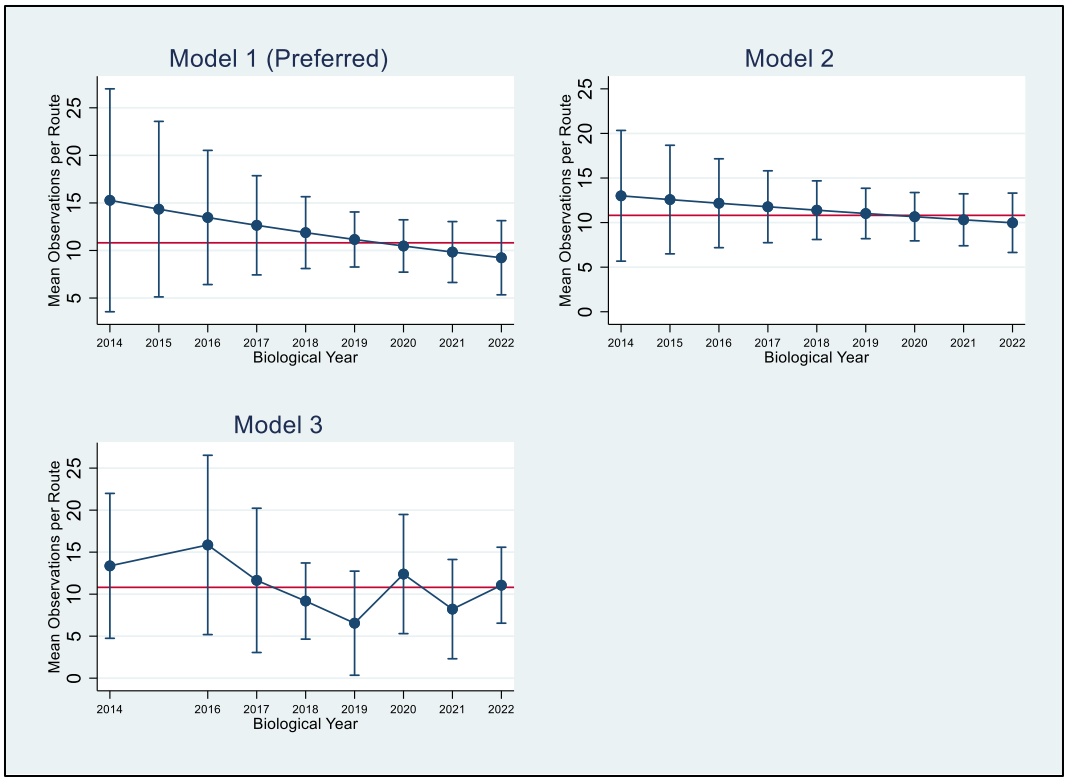


Figure 19. Comparison of trends estimated by three model variations.

The blue lines and dots represent the estimated mean numbers of Snowy Plover observed per monitoring route sampled, with 95% confidence intervals. The red line is the overall mean of the data (10.8).

While the Preferred Model and Model 2 both estimate a declining trend across years, the trends are small relative to the uncertainty in the estimates. This is consistent with the 2022 trends analysis, in which the negative binomial model found a declining trend that was not statistically significant. For all models, the confidence intervals are wide and overlap zero. In Model 3, observations are estimated to decline from 2016 through 2019, and then bounce around thereafter, which is consistent with the means presented in Figure 18. Overall, there is no strong evidence of trends across years, either increasing or decreasing, for Snowy Plover observed during avian monitoring.

3.2.3 Results – Wilson's Plovers

Wilson's Plovers were observed March through September (Figure 20). Therefore, a calendar year is appropriate for Wilson's Plovers.

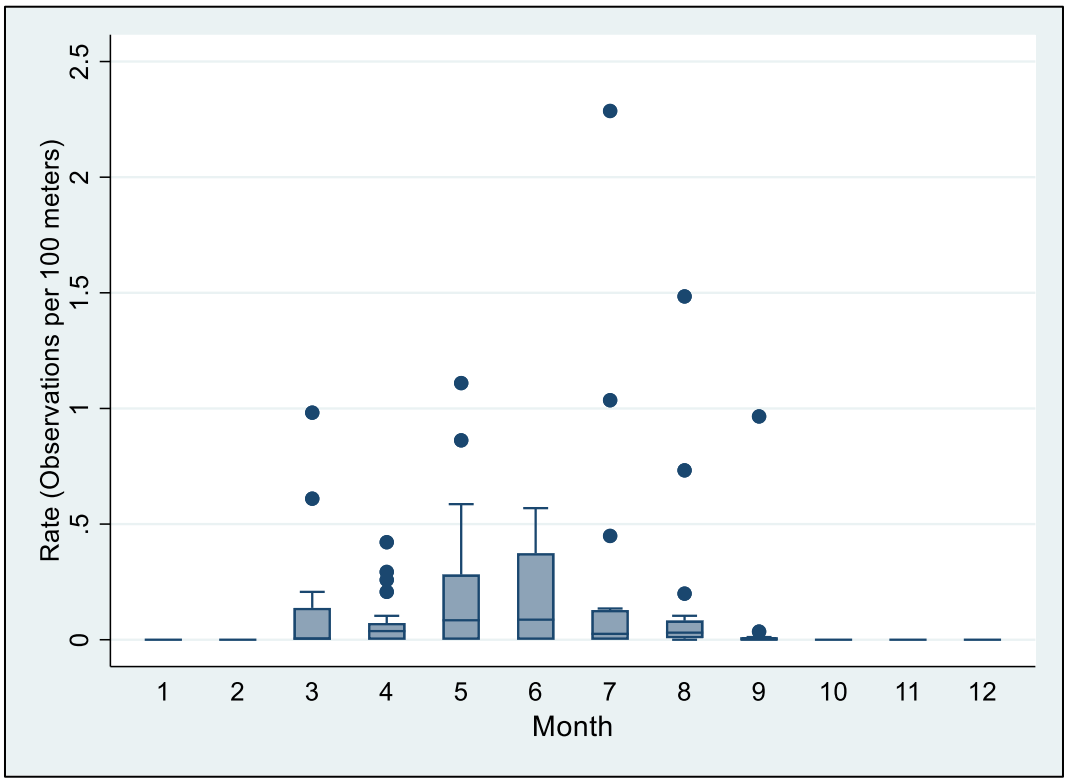


Figure 20. Rate of Wilson's Plover observations by month.

Figure 21 shows the distribution of Wilson's Plover observations across years. The y-axes measure observations as a rate (observations per 100 meters), which standardizes the data for differences in distances monitored on different monitoring days. The left panel shows a standard box plot, and the right panel shows means and 95% confidence intervals. It is apparent that the distributions are right-skewed (meaning a relatively higher frequency of small values and a relatively lower frequency of larger values), as the medians are close to the 25th percentiles, there are numerous outside values, and the means are larger than the medians. There is no discernable trend visible in the means; although 2021 through 2023 are above average, observations cycle up and down.

The potential to interpreted trends in these graphs is limited by variation in the routes monitored over time (see Section 2). The regression modeling attempts to correct for these sources of variation so that potential trends can be better investigated.

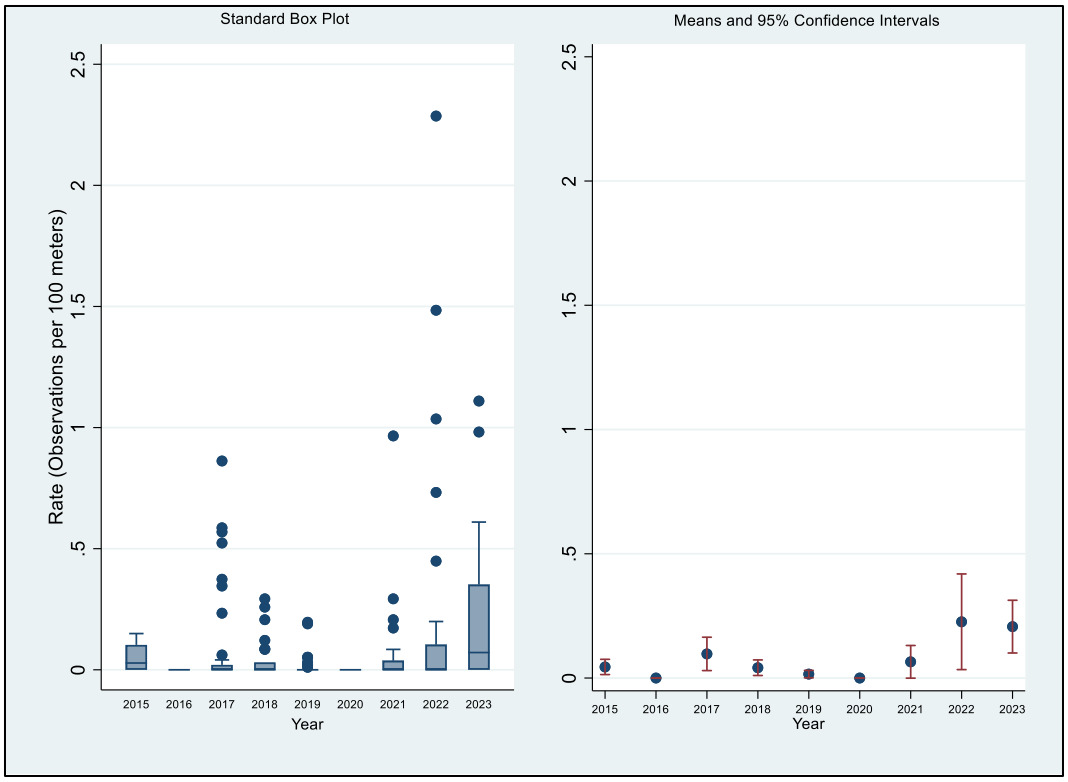


Figure 21. Distribution of Wilson's Plover observations across years.

The preferred model finds that there is a statistically significant difference ($p = 0.042$) between observations made by the two teams. Specifically, the UTRGV team is estimated to observe 55% fewer Wilson's Plover than the SWCA team, controlling for other factors.

The preferred model finds an increasing trend of 4.3% per year that is not statistically significant ($p = 0.522$). Model 2, which does not include the team variable, finds an increasing trend of 15.2% per year that is statistically significant ($p < 0.0001$), which demonstrates the importance of controlling for team. Model 3 does not find a consistent trend across years. Figure 22 compares the estimated trends across years for the three models.

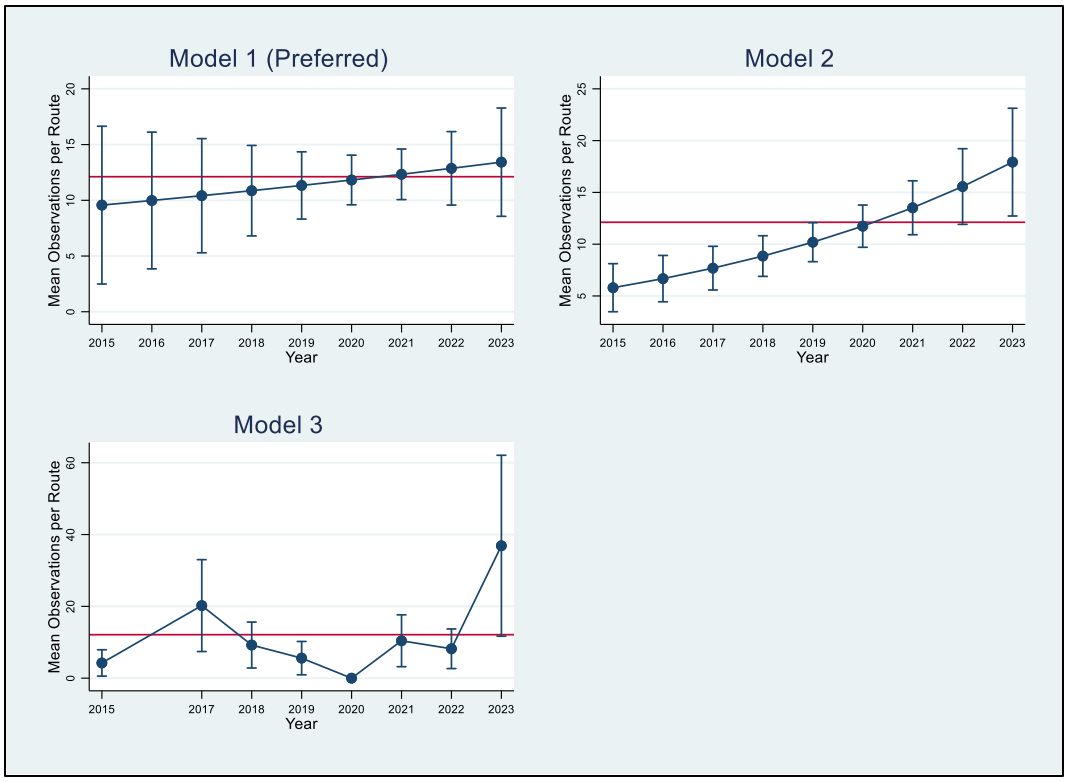


Figure 22. Comparison of trends estimated by three model variations.

The blue lines and dots represent the estimated mean numbers of Wilson's Plover observed per monitoring route sampled, with 95% confidence intervals. The red line is the overall mean of the data (9.5).

The Preferred Model and Model 2 both estimate increasing trends, while Model 3 estimates no trend. Model 3 is most consistent with the means presented in Figure 21. It appears that the increasing trends in the two continuous models are caused in part by the higher-than-average observations in 2023; when 2023 data is omitted, the trends are no longer estimated. Overall, there is no strong evidence of trends across years, either increasing or decreasing, for Wilson's Plover observed during avian monitoring. These findings are consistent with the 2022 trends analysis. Note that 2023 is only a partial year of data. Because no observations of Wilson's Plover were made in January and February (not just in 2023, but in any year sampled), 2023 only includes four months (March–June). Once the remainder of 2023 data are available, 2023 may or may not remain higher-than-average compared to other years.

3.2.4 Results – Red Knot

Red Knots were observed in two distinct periods, March through May, and September through December. The biological year for Red Knot is defined as March through February.

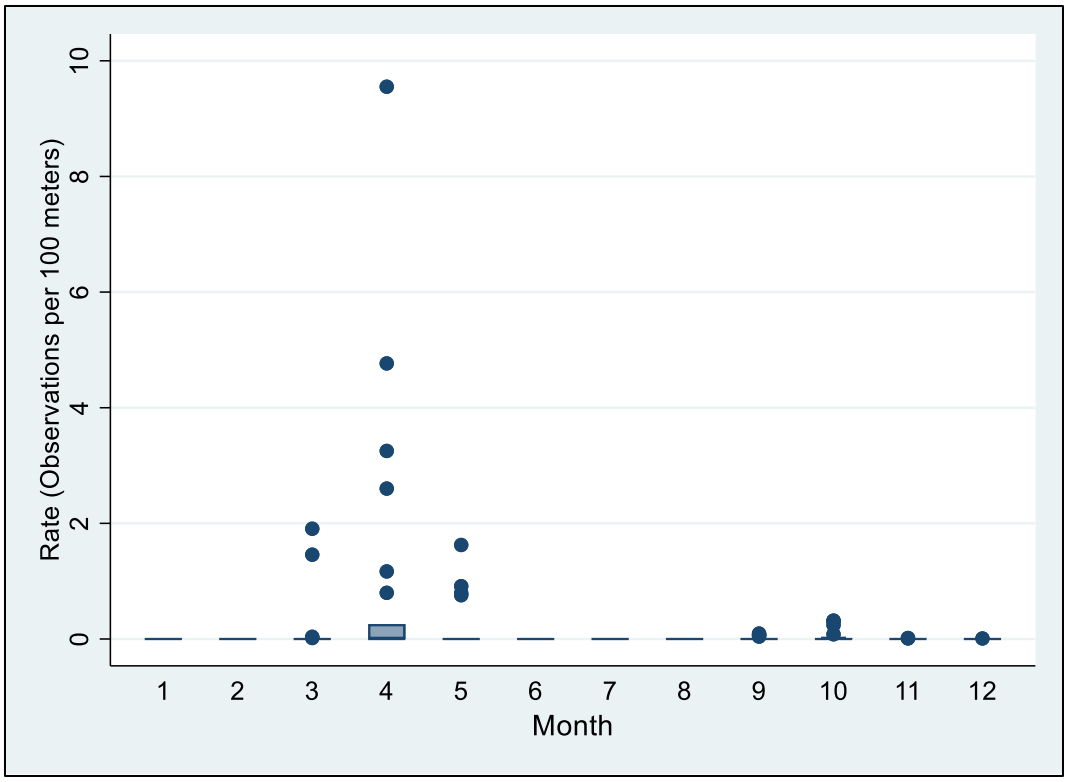


Figure 23. Rate of Red Knot observations by month.

Figure 24 shows the distribution of Red Knot observations across biological years. The y-axes measure observations as a rate (observations per 100 meters), which standardizes the data for differences in distances monitored on different monitoring days. The left panel shows a standard box plot, and the right panel shows means and 95% confidence intervals. It is apparent that the distributions are right-skewed (meaning a relatively higher frequency of small values and a relatively lower frequency of larger values), as the medians are close to the 25th percentiles, there are numerous outside values, and the means are larger than the medians. There is no discernable trend visible in the means.

The potential to interpret trends in these graphs is limited by variation in the routes monitored over time (see Section 2) and as a consequence of this species occurring in the Study Area as a pass-through migrant rather than as a permanent or seasonal resident, which reduces the chances of this species being encountered on any given day compared to the three species of plovers. The regression modeling attempts to correct for these sources of variation so that potential trends can be better investigated.

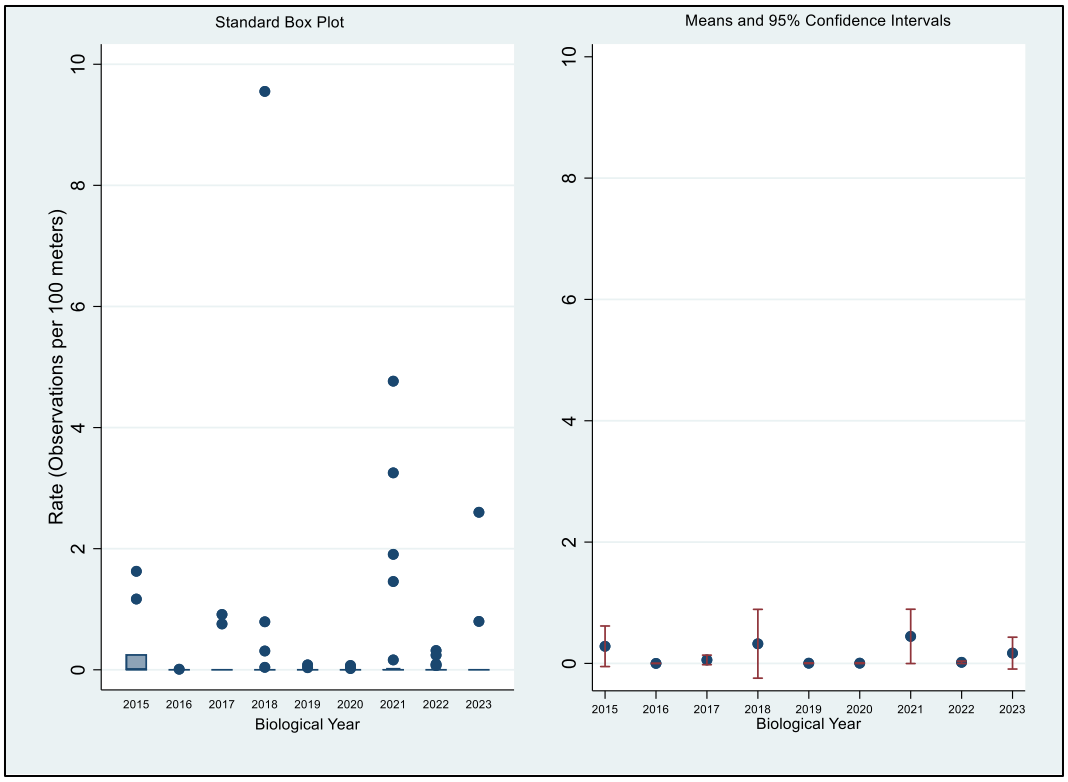


Figure 24. Distribution of Red Knot observations across years.

Figure 25 shows the distribution of observed Red Knots by month and year during the peak observation period of March through May. This figure highlights the random nature of Red Knot observations. Often, observations in any one month are made up of a small number of observations containing large groups of Red Knots. The random nature of Red Knot observations makes statistical analysis of potential trends challenging. The preferred model only includes *Year* as an explanatory variable; there are too few non-zero observations to include other explanatory variables.

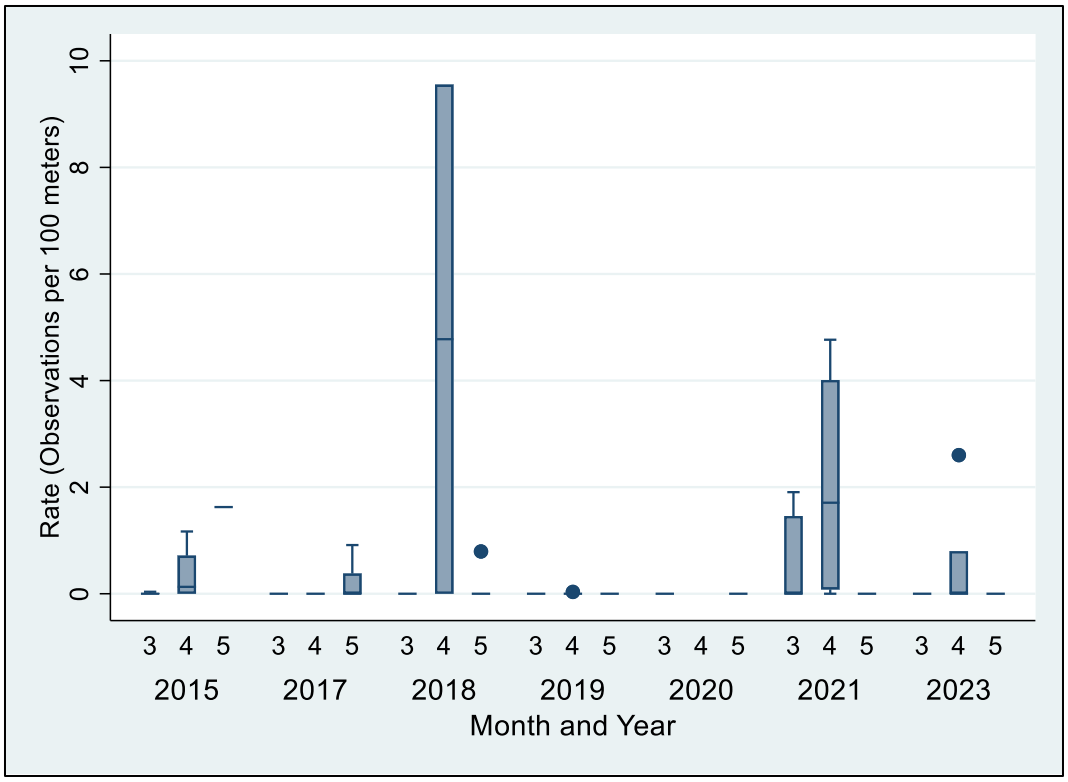


Figure 25. Distribution of Red Knot observations across years and selected months.

The preferred model finds an increasing trend of 9.8% per year that is not statistically significant (p = 0.436). There is no Model 2 for Red Knot, as Model 1 already excludes the *Team* variable. Model 3 does not find a consistent trend across years. Because there are no other explanatory variables, Model 3 essentially reproduces the pattern of means presented in Figure 25. Figure 26 compares the estimated trends across years for the two models.

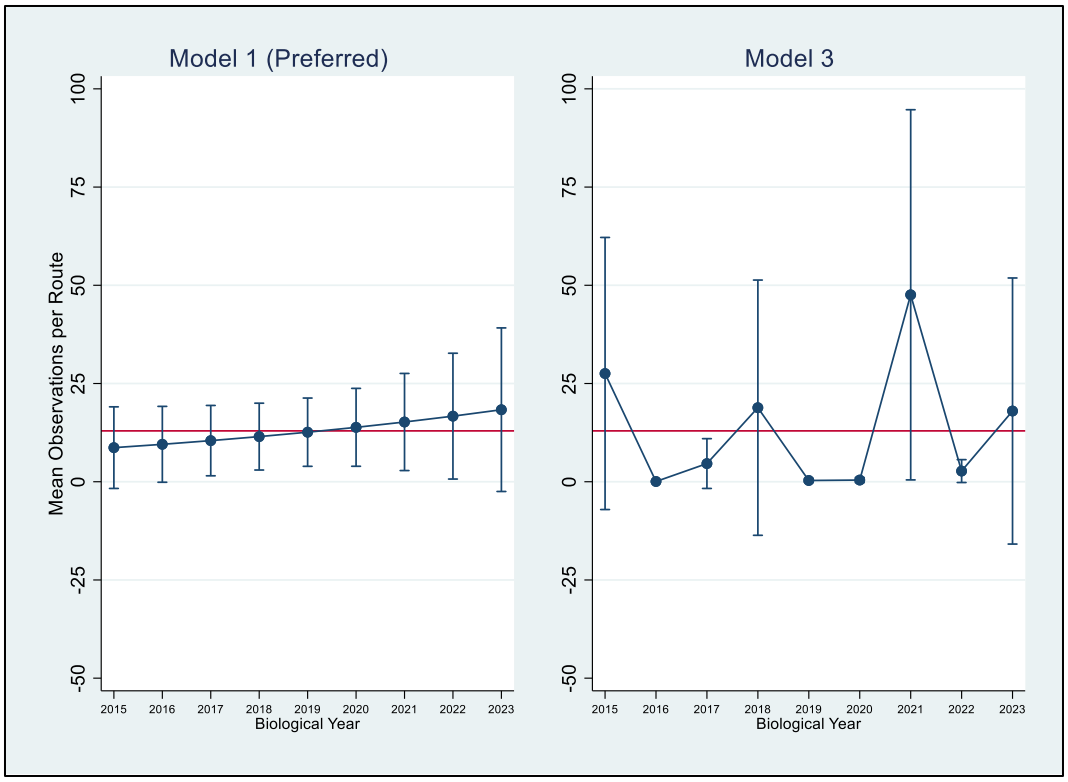


Figure 26. Comparison of trends estimated by two model variations.

The blue lines and dots represent the estimated mean numbers of Red Knots observed per monitoring route sampled, with 95% confidence intervals. The red line is the overall mean of the data (12.9).

Overall, there is no strong evidence of trends across years, either increasing or decreasing, for Red Knots observed during avian monitoring.

3.2.5 Summary Results – Trends Analysis

The overall conclusion is the same as in the 2022 trends analysis—there is little or no strong evidence of trends, increasing or decreasing, for the target species. The additional year of data collected with a more uniform sampling design allowed improved modeling, which increases confidence in the conclusion of a lack of trends compared to the 2022 analysis. Additional data following the SWCA protocol are expected to further increase confidence in future trend analyses.

3.3 Investigating Other Potential Covariates

Investigating the effects of other potential covariates, including the effect of SpaceX activity, tides, and weather conditions, was considered. However, with only 1 year of SWCA data, there is not a sufficient number of observations and variation in conditions to simultaneously control for seasonality (i.e., using sampling month) and investigate these factors.

3.4 Band Resights of Target Species

SWCA attempted to resight any banded individuals of target species encountered during the avian monitoring surveys. SWCA recorded 54 observations of banded individuals including 48 Piping Plover observations, three Snowy Plover observations, and three Wilson's Plover observations.

Of the 48 observations of banded Piping Plover, 20 observations included complete band combination resights with the alpha-numeric code from the upper leg flag; these observations represented 11 unique individuals. Based on the partial resights of banded Piping Plovers, there may have been an additional 10 unique individuals represented by the band resight data from the July 2022 through June 2023 avian monitoring. Additional information on the banding methodologies (e.g., the use of nestling combinations) and combinations of banded Piping Plovers previously observed in the area may allow for additional confirmation of unique individuals from the partially resighted band combinations.

The three Snowy Plover band resights represent two unique individuals. SWCA observed full combinations on these two individuals and resighted one individual during two avian monitoring visits (August 2022 and March 2023). SWCA observed up to three banded Wilson's Plovers; however, only one individual was banded with a uniquely identifiable band combination.

Appendix D provides details for each observation of a banded individual of a target species encountered during the surveys or observed incidentally while conducting the surveys. When possible, SWCA attempted to photograph banded individuals, Appendix D also provides representative photographs (voucher specimens) of banded individuals, as available.

4 LITERATURE CITED

Baker, A., P. Gonzalez, R.I.G. Morrison, and B.A. Harrington. 2020. Red Knot (*Calidris canutus*), version 1.0. In *Birds of the World* (S.M. Billerman, Editor). Ithaca, New York: Cornell Lab of Ornithology. Available at: https://doi.org/10.2173/bow.redkno.01. Accessed July 2023.

Elliott-Smith, E., and S.M. Haig. 2020. Piping Plover (*Charadrius melodus*), version 1.0. In *Birds of the World* (A.F. Poole, Editor). Ithaca, New York: Cornell Lab of Ornithology. Available at: https://doi.org/10.2173/bow.pipplo.01. Accessed July 2023.

Keddy-Hector, D.P., P. Pyle, and M.A. Patten. 2020. Aplomado Falcon (*Falco femoralis*), version 1.0. In *Birds of the World* (P.G. Rodewald, Editor). Ithaca, New York: Cornell Lab of Ornithology. Available at: https://doi.org/10.2173/bow.aplfal.01. Accessed July 2023.

Lockwood, M.W., and B. Freeman. 2014. *The Texas Ornithological Society Handbook of Texas Birds*. 2nd edition. College Station: Texas A&M University Press.

Page, G.W., L.E. Stenzel, J.S. Warriner, J.C. Warriner, and P.W. Paton. 2020. Snowy Plover (*Charadrius nivosus*), version 1.0. In *Birds of the World* (A.F. Poole, Editor). Ithaca, New York: Cornell Lab of Ornithology. Available at: https://doi.org/10.2173/bow.snoplo5.01. Accessed July 2023.

Space Exploration Technologies Corporation (SpaceX). 2022. SpaceX Boca Chica Launch Site Biological Monitoring Plan. Revision 3: August 26, 2022.

U.S. Fish and Wildlife Service (USFWS). 2023. Information for Planning and Consultation. Available at: https://ipac.ecosphere.fws.gov/. Accessed July 2023.

Zdravkovic, M.G., C.A. Corbat, and P.W. Bergstrom. 2020. Wilson's Plover (*Charadrius wilsonia*), version 1.0. In *Birds of the World* (P.G. Rodewald, Editor). Ithaca, New York: Cornell Lab of Ornithology. Available at: https://doi.org/10.2173/bow.wilplo.01. Accessed July 2023.

This page intentionally left blank.

APPENDIX A

Technical Memorandum: Updates following the July 2022 Kick-off Meeting

SWCA ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.®

4407 Monterey Oaks Boulevard
Building 1, Suite 110
Austin, Texas 78749
Tel 512.476.0891 Fax 512.476.0893
www.swca.com

TECHNICAL MEMORANDUM

To: Space Exploration Technologies
Spaceport Way
Cape Canaveral, Florida 32920

From: Michael Heimbuch, Project Biologist

Date: July 22, 2022

Re: **Draft: Acknowledgements and Updates to the SpaceX Boca Chica Launch Site Biological Monitoring Plan following the July 15, 2022 Kick-off Meeting / SWCA Project No. 73821**

On July 15th, 2022, Space Exploration Technologies (SpaceX) hosted an onsite kick-off meeting with U.S. Fish and Wildlife biologists and the environmental consults that will be initiating the avian monitoring portion of the *SpaceX Boca Chica Launch Site Biological Monitoring Plan*, SWCA Environmental Consultants and Raba-Kistner Consultants Inc. During the onsite kick-off meeting, SpaceX, USFWS, and the environmental consultants discussed the monitoring plan and proposed changes to the plan that would standardize survey methods, while retaining consistency with the previous monitoring to allow for comparisons. Kick-off meeting discussions included proposed modifications to the survey routes, changes to the aplomado falcon monitoring, types of data that will be collected, changes to the annual report due date, safety, and potential methods for accessing and traversing routes.

ACKNOWLEDGMENTS AND UPDATES TO THE SURVEY ROUTES AND AVIAN MONITORING PLAN:

- USFWS agreed that the use of ATVs or UTVs was appropriate for the wind-tidal flat routes (i.e., Boca Chica Flats, Las Palomas, and South Bay), provided we limit their use to as close as possible to the edge of the dunes.
    - The USFWS agreed that given the nature and length of the routes in open exposed wind-tidal flats, and amount of field equipment that will be required, that ATVs and UTVs are appropriate methods of traversing the routes considering the safety of the surveyors.
- USFWS agreed that certain refinements to the survey routes were appropriate to maintain consistency with prior field efforts (i.e., shorten the Boca Chica Flats and South Bay routes and lengthen the Las Palomas route)
- USFWS agreed that collection of information on survey co-variates (such as weather, wind, and tidal conditions; survey effort and methods; and human activity) was appropriate for data analysis and context.

- USFWS acknowledged that survey findings from 2022-2023 may not be entirely consistent with the findings of prior years due to a change in personnel and refinements/standardization of the survey methods and level of effort.

- USFWS agreed that the annual report due date could be changed to allow for analysis of a full 12 months of seasonal monitoring (i.e., July or August 2023). SpaceX will provide brief monthly visit summaries following each visit.

- USFWS understands and acknowledges that the survey routes presented in the SpaceX Boca Chica Launch Site Biological Monitoring Plan Revised May 10, 2022 (i.e., Boca Chica Flats, Las Palomas, South Bay, and Boca Chica Beach) are the approximate routes established by the University of Texas Rio Grande Valley (UTRGV). These approximated routes required modification to ensure they can be reliably accessed, avoid disturbing sensitive areas (e.g., algal flats and dunes), provide coverage for the target areas, and are consistent with previous surveys (based on the UTRGV route maps and locations of bird observations).

- With input from the USFWS, SWCA Environmental Consultants (SWCA) refined these routes based on a variety of factors including habitat conditions, route accessibility, consistency with previous surveys, and area coverage. SWCA utilized information collected during the onsite reconnaissance on July 15, 2022, and aerial imagery to refine the routes. In general, routes were adjusted to be closer to the edge of dune habitat (i.e., higher ground) to allow for more reliable route access even during flooded or muddy conditions, while avoiding vegetated areas. To the extent practicable, routes were delineated to avoid sensitive features such as vegetated dune habitat or algal flats. Using 2022 aerial imagery, SWCA refined the placement of the routes to fall within the footprint of existing disturbances (i.e., tire tracks) caused by motorized vehicles to reduce the impacts of using motorized vehicles during the surveys.

Specific modifications to each of the routes are described below:

- **Las Palomas** –
  - Due to the presence of bird observations outside the approximated survey route, the southern portion of the route was extended to make a nearly complete circle of the wind-tidal flat.
  - The Las Palomas Route was shifted upland to follow the edges of dunes to allow for consistent accessibility, while avoiding sensitive algal flats and vegetated dunes.
  - The Las Palomas aplomado falcon points were shifted to fall along the update route, but within the same vicinity of their previous UTRGV locations. Points were shifted to provide better coverage of dune habitat and line of sight.
  - The route was refined to be located within the footprint of well-worn vehicle tracks, where practicable.

- **South Bay** –
  - Aplomado falcon survey points along this route were shifted to be along the updated routes but were in proximity to their original locations. Points were shifted to provide better coverage of dune habitat and line of sight.
  - Due to the habitat conditions in the northern portion of the route (i.e., presence of muddy areas that are prone to flooding) and lack of UTRGV bird observations, this portion of the route was shifted, and a small portion removed. Due to the adjustment in the northern portion of the route, the most northern aplomado falcon survey point on this route was removed as the route no longer occurs near the survey point.

  - The South Bay Route was shifted to follow the edges of dunes to allow for consistent accessibility, while avoiding sensitive dune and algal flat habitat.

- **Boca Chica Flats** –
  - The UTRGV approximated route shows the route jutting out into the wind-tidal flats near the SpaceX Starbase; however, the UTRGV bird observation data only shows a single bird observation from this portion of the route. Therefore, this "jut out" was removed and the route shifted to follow the edge of the dunes to avoid disturbing the wind-tidal flat habitat and allow for year-round consistent route access.
  - The eastern portion of the approximated Boca Chica Route doubles back through the dunes, this portion of the route was used by UTRGV for a continuous monitoring survey for the aplomado falcon. Because this monitoring is outside the protocol for the project and survey route located within sensitive dune habitat, this portion of the route was removed.
  - In general, the Boca Chica Route was shifted upland to follow the edges of dunes to allow for consistent accessibility.

- **Boca Chica Beach** –
  - The Beach Route was shifted away from the ocean and closer to the dunes to be within the well-worn vehicle path used by the public for access along the beach.
  - The route was refined so that it no longer crosses the Rio Grande River, which is inaccessible.

SWCA will collect the following types of data for each survey:

- SpaceX will provide weather information from their onsite weather monitoring system for the survey period, or if not available, the NOAA weather station at Port Isabel (the nearest weather station to the survey routes). Weather data will be provided hourly during survey dates and times. Data will include:
  - Temperature
  - Wind Speed
  - Wind Direction
  - Humidity
  - Barometric Pressure

- SWCA will collect the following information for each survey route:
  - Date
  - Route name
  - Name of surveyor
  - Mode of transport
  - Survey start time
  - Survey end time
  - Information about the direction of travel along route
  - Information about the accessibility of the route and conditions (using mile markers to denote any sections where access is not possible)
  - SWCA will also record the tracks of their survey movements using a handheld GPS unit
  - Overall list of avian species observed during the survey

- SWCA will collect the following information for each bird observation:
  - Species (i.e., aplomado falcon, piping plover, red knot, snowy plover, Wilson's plover)
  - Time of observation

- Number of individuals
- Observer GPS location (using handheld GPS unit)
- Distance from observer to bird location (using laser rangefinder)
- Bearing from observer to bird location (using compass)
- General behavior of the bird (e.g., loafing, nesting, foraging, flying)
- Basic habitat conditions near the bird (e.g., mud flat, beach, dunes)
- If a banded individual is observed outside of a survey or while returning through a previously surveyed portion of a route, SWCA will collect all the above information for a bird observation but will not include that observation with the regular data for the route. SWCA will submit this information as an incidental observation.

SWCA plans to use the following level of effort for each survey route so that data collection remains consistent throughout surveys and route conditions or accessibility. Table 1 provides a summary of the level of effort applied to each route including the potential modes of transportation used to survey the route. Table 1 also provides a comparison of the previous monitoring routes provided by University of Texas Rio Grande Valley (UTRGV). Attachment 1 shows the proposed routes and proposed aplomado falcon survey points in addition to the previous routes and aplomado falcon survey points provided by UTRGV.

Table 1. Comparison of Survey Route Summaries and Proposed Level of Effort.

Route	Route Length (miles)		Time by Mode of Transport		Total Survey Time	
	UTRGV	Proposed	UTRGV	Proposed	UTRGV	Proposed
Boca Chica Beach	6	6	Truck = 1 hr ATV = 2 hrs	Truck = 1 hr ATV = 2 hrs	3 hrs (0.5 hr/mile)	3 hrs (0.5 hr/mile)
South Bay	2.5	2.8	ATV = 1 hrs Walk = 2.5 hrs	ATV = 1 hr Walk = 2.8 hrs	3 hrs (1 hr/mile)	3 hrs (1 hr/mile)
Boca Chica Flats	6	4.3	ATV = 2 hrs Walk = 6 hrs	ATV = 2 hrs Walk = 4.3 hrs	6 hrs (1 hr/mile)	4.5 hrs (1 hr/mile)
Las Palomas	6	10.7	ATV = 2 hrs Walk = 6 hrs	ATV = 3+ hrs Walk = 10.7 hrs	6 hrs (1 hr/mile)	11 hrs (1 hr/mile)
Totals	**20.5 miles**	**23.8 miles**	**–**	**–**	**18 hours**	**21.5 hours**

NEW PROPOSED CHANGES:

- Due to the modifications to the routes, specifically the lengthening of the Las Palomas Route, it will not be possible to complete the survey according to the current protocol of "will be completed by 1300 h" during certain portions of the year when sunrise is at its latest. For consistency, we propose changing the protocol to "completed within 6 hours of sunrise" as that keeps the time allowance consistent throughout the year, even as the sunrise time changes, and allows enough time to complete all of the survey routes according to protocol.

- In addition to collecting the number of individuals for each avian observation, SWCA will provide an indication of whether the number is an estimate (for larger flocks) or an exact count of the individuals.

APPENDIX A

University of Texas Rio Grande Valley Survey Routes and Proposed Survey Routes

Figure A-1. University of Texas Rio Grande Valley Avian Monitoring Routes

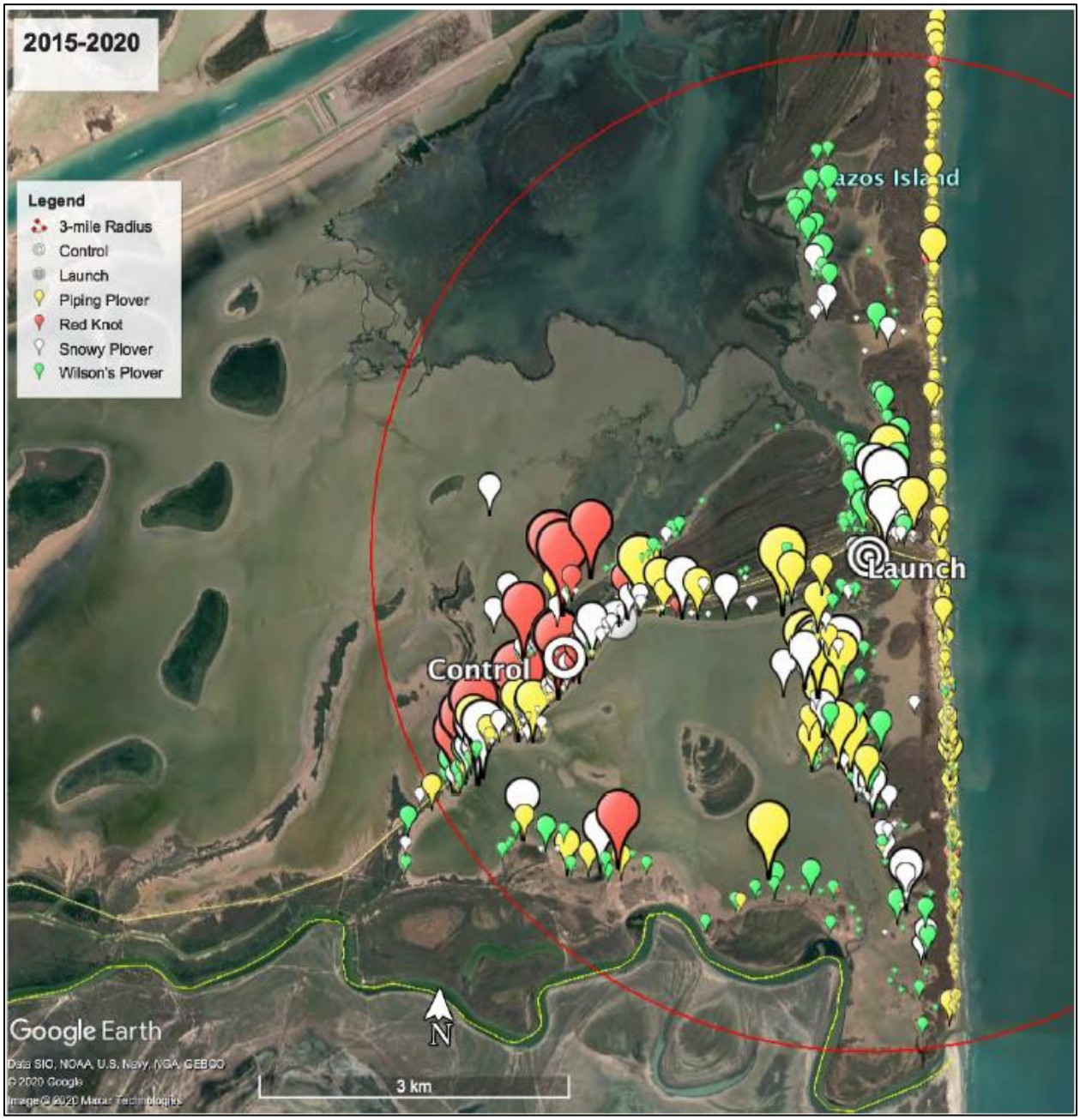


Figure A-2. University of Texas Rio Grande Valley Avian Monitoring Results 2015–2020

Figure A-3. Comparison of the University of Texas Rio Grande Valley Avian Survey Routes and Aplomado Falcon Monitoring Points to the Proposed Survey Routes and Proposed Aplomado Falcon Monitoring Point Locations.

This page intentionally left blank.

APPENDIX B

Summary of Monitoring Effort and Survey Details

Table B-1. Summary of Boca Chica Beach (BCB) Monitoring Route Surveys

Visit Number	Survey Date	Transport Type	Surveyor	Direction of Travel	Start Time	End Time	Total Survey Time	Start Mile Marker	End Mile Marker	Site Conditions and Survey Notes:
1	7/28/2022	Truck	TF	S	6:58	9:33	2:35	2.7	0.0	Low water levels, about 150 ft from the dunes to the water.
1	7/28/2022	Truck	TF	N	9:55	11:25	1:30	2.7	6.0	Low water levels, about 150 ft from the dunes to the water.
2	8/24/2022	Walk	MH	S	7:06	8:20	1:14	2.7	1.6	Low water levels, lots of exposed beach between dunes and water. Broke up route to accommodate testing closure schedule conflicts.
2	8/24/2022	Truck/Walk	TF	N	7:06	8:20	1:14	0.0	1.6	Low water levels. Broke up route to accommodate testing closure schedule conflicts.
2	8/24/2022	Truck	TF	N	8:26	10:04	1:38	2.7	6.0	Low water levels. Broke up route to accommodate testing closure schedule conflicts.
3	9/23/2022	Truck/Walk	MH	S	7:28	10:48	3:20	6.0	0.0	Water is high, near the dunes in some locations, higher than last survey.
4	10/21/2022	Truck	TF	N	7:29	10:10	2:41	2.8	6.0	Low water levels.
4	10/21/2022	Truck	TF	S	10:25	12:00	1:35	2.8	0.0	Low water levels.
5	11/18/2022	Walk	TF	S	10:10	12:53	2:43	2.8	0.2	Water levels extremely high with waves crashing up to the dunes in most places on the beach. Partial survey due to extreme weather conditions.
6	12/16/2022	Truck/Walk	TF	N	8:11	9:45	1:34	2.8	0.0	Low water levels.
6	12/16/2022	Truck	TF	S	9:56	11:30	1:34	2.8	6.0	Low water levels.
7	1/27/2023	Truck/Walk	MH	N	8:00	11:00	3:00	0.0	6.0	Low water levels. Maintenance crews with heavy equipment operating on beach
8	2/24/2023	Truck	MH	N	7:44	10:44	3:00	0.0	6.0	Low water levels.
9	3/24/2023	Truck	MH	S	7:57	10:57	3:00	6.0	0.0	Low water levels.
10	4/23/2023	Truck	MH	N	9:45	12:45	3:00	0.0	6.0	High water levels, waves up to the dunes in many locations. Surveyed during weekend due to launch activity – beach activity and traffic moderate, similar to weekday levels.
11	5/19/2023	Truck	MH	S	7:40	10:40	3:00	6.0	0.0	Below average water level, tide low, a lot of washed-up seaweed.
12	6/23/2023	ATV	MH	S	7:27	10:27	3:00	6.0	0.0	Low tide with above average exposed beach, beach sands soft, little debris or seaweed washed up. Maintenance crews with heavy equipment operating on beach.

Table B-2 Summary of Boca Chica Flats (BCF) Monitoring Route Surveys

Visit Number	Survey Date	Transport Type	Surveyor	Direction of Travel	Start Time	End Time	Total Survey Time	Start Mile Marker	End Mile Marker	Site Conditions and Survey Notes:
1	7/27/2022	ATV	MH	W	9:53	11:58	2:05	2.0	0.0	Low water levels, dry flats. Survey route broken up to accommodate changes in testing closure schedule.
1	7/28/2022	ATV	MH	E	6:56	9:21	2:25	2.0	4.3	Low water levels, dry flats. Survey route broken up to accommodate changes in testing closure schedule.
2	8/22/2022	ATV	MH	W	11:25	12:55	1:30	4.3	3.0	Low water levels and drier on flats than previous survey. Survey route broken up to accommodate changes in testing closure schedule.
2	8/24/2022	ATV	MH	W	8:44	11:44	3:00	3.0	0.0	Lower water levels than last survey and drier on the west side, relatively higher water levels on east side. Survey route broken up to accommodate changes in testing closure schedule.
3	9/25/2022	ATV	MH	E	7:31	12:15	4:44	0.0	4.3	Water level is higher than previous surveys, much closer to bollards on the west end of the route, standing pools of water present on flats.
4	10/23/2022	ATV	MH	W	7:49	12:19	4:30	4.3	0.0	Water levels much lower than last time, standing water out on mud flats.
5	November 2022		–	–	–	–	–	–	–	No survey conducted on Boca Chica Flats Route in November 2022 due to extreme weather and flooding.
6	12/18/2022	ATV	TF	W	8:05	12:35	4:30	4.3	0.0	High water levels covering portions of route, few visible mudflats.
7	1/29/2023	Walk	TF	W	8:15	12:35	4:20	4.3	0.0	Water levels almost normal but standing pools of water and muddy.
8	2/26/2023	ATV	TF	W	7:59	12:29	4:30	4.3	0.0	Low water levels, dry flats.
9	3/26/2023	ATV	MH	E	8:12	12:42	4:30	0.0	4.3	Low water levels, dry flats.
10	4/22/2023	ATV	TF	E	7:15	10:38	3:23	0.0	3.3	West end with a lot of exposed dry mud flats. Average water levels.
10	4/22/2023	ATV	TF	E	12:00	13:03	1:03	3.3	4.3	Rising water levels, on return to site water levels had risen and there were almost no mudflats exposed. Due to launch, access was restricted for this portion of the route. Returned to survey later once the closure had ended.
11	5/21/2023	ATV/Walk	MH	W	7:23	11:53	4:30	4.3	0.0	Water levels above average, some standing pools of water on flats.
12	6/25/2023	ATV	MH	E	6:54	11:24	3:30	0.0	4.3	Below average water levels, dry conditions on flats.

Table B-3. Summary of Las Palomas (LP) Monitoring Route Surveys

Visit Number	Survey Date	Transport Type	Surveyor	Direction of Travel	Start Time	End Time	Total Survey Time	Start Mile Marker	End Mile Marker	Site Conditions and Survey Notes:
1	7/29/2022	ATV	MH	W	7:07	12:59	5:52	5.3	0.0	Relatively low water levels, dry flats, at least 75 ft between route and water.
1	7/29/2022	ATV	TF	E	7:07	12:47	5:40	5.3	10.7	Relatively low water levels, dry flats, at least 75 ft between route and water.
2	8/23/2022	ATV	MH	W	7:12	12:45	5:33	5.4	0.0	Low water levels and drier flats than previous survey. Survey route broken up to accommodate changes in testing closure schedule
2	8/23/2022	ATV	TF	E	7:12	12:42	5:30	5.4	10.7	Low water levels and drier flats than previous survey.
3	9/24/2022	ATV	MH	W	7:16	12:47	5:31	5.4	0.0	Water level is higher than the last time, water levels rose during the survey, some standing pools of water out on flats.
3	9/24/2022	ATV	TF	E	7:17	12:50	5:33	5.4	10.7	Water level is higher than the last time, water levels rose during the survey, some standing pools of water out on flats.
4	10/22/2022	ATV	MH	E	7:42	13:12	5:30	5.4	10.7	Water levels moderately higher than typical, lower than previous visit, still exposed mud flats middle of bay, dry flats.
4	10/22/2022	ATV	TF	W	7:40	13:11	5:31	5.4	0.0	Water levels moderately higher than typical, lower than previous visit, still exposed mud flats middle of bay, dry flats.
5	November 2022		–	–	–	–	–	–	–	No survey conducted on South Bay Route in November 2022 due to extreme weather and flooding.
6	12/17/2022	Walk/UTV	MH	W	8:32	13:10	4:38	5.1	0.2	Water level about average level, but portions of the route on southern/southwestern had above average levels due to wind direction, some area with standing pools of water out on flats. Logistic issues resulted in delayed start and altered timing and division of survey.
6	12/17/2022	ATV	TF	E	7:30	11:21	3:51	5.1	10.7	Water level about average level, but portions of the route on southern/southwestern had above average levels due to winds, some area with standing pools of water out on flats.
6	12/17/2022	ATV	TF	E	12:10	13:10	1:00	2.1	0.0	Water level about average level, but portions of the route on southern/southwestern had above average levels due to winds, some area with standing pools of water out on flats. Logistic issues resulted in TF surveying portion of route due timing constraints.
7	1/28/2023	ATV	MH	E	7:37	13:07	5:30	5.4	10.7	Water levels near average, little standing water, portions of exposed flats muddy due to recent rains or receding water.

Visit Number	Survey Date	Transport Type	Surveyor	Direction of Travel	Start Time	End Time	Total Survey Time	Start Mile Marker	End Mile Marker	Site Conditions and Survey Notes:
7	1/28/2023	ATV	TF	W	7:37	13:05	5:28	5.4	0.0	Water levels near average, little standing water, portions of exposed flats muddy due to recent rains or receding water.
8	2/25/2023	ATV	MH	W	7:13	12:53	5:40	5.4	0.0	Low water levels, dry flats.
8	2/25/2023	ATV	TF	E	7:12	12:43	5:31	5.4	10.7	Low water levels, dry flats.
9	3/25/2023	ATV	MH	E	7:45	13:14	5:29	5.7	10.7	Low water levels, dry flats.
9	3/25/2023	UTV	TF	W	7:45	13:23	5:38	5.4	0.0	Low water levels, dry flats.
10	4/22/2023	ATV	MH	W	7:15	12:45	5:30	5.4	0.0	Above average/relatively higher water levels, but some good, exposed mudflats. Dry flats.
10	4/23/2023	ATV	TF	E	7:27	13:10	5:43	5.4	10.7	Conditions started with relatively low water levels, dry flats, change in wind direction and incoming storm raised water levels significantly while exiting site.
11	5/20/2023	ATV	MH	E	7:09	12:39	5:30	5.4	10.7	Dry conditions on flats, moderately low water levels, a lot of mud flat areas exposed.
11	5/20/2023	ATV	TF	W	7:08	12:34	5:28	5.4	0.0	Dry conditions on flats, moderately low water levels, a lot of mud flat areas exposed.
12	6/24/2023	ATV	MH	E	7:02	12:32	5:30	5.4	10.7	Below average water levels, exposed flats near middle of route, dry conditions on flats.
12	6/24/2023	ATV	AT	W	7:02	12:33	5:31	5.4	0.0	Below average water levels, exposed flats near middle of route, dry conditions on flats.

Table B-4. Summary of South Bay (SB) Monitoring Route Surveys

Visit Number	Survey Date	Transport Type	Surveyor	Direction of Travel	Start Time	End Time	Total Survey Time	Start Mile Marker	End Mile Marker	Site Conditions and Survey Notes:
1	7/27/2022	ATV	MH	N	7:31	9:32	2:01	0.0	1.3	Low water level, with little standing water on flats. Survey route broken up to accommodate changes in testing closure schedule.
1	7/28/2022	ATV	MH	N	9:43	11:36	1:53	1.3	2.8	Low water levels, dry flats with little standing water. Survey route broken up to accommodate changes in testing closure schedule.
2	8/22/2022	ATV	MH	N	7:56	10:57	3:01	0.0	2.8	Low water levels and drier flats than previous survey.
3	9/25/2022	ATV	TF	N	7:45	10:59	3:14	0.0	2.8	Higher water levels than last visit but still relatively low and dry flats.
4	10/23/2022	ATV	TF	N	7:50	10:40	2:50	0.0	2.8	Water levels much lower than last time, some standing water out on mud flats.
5	November 2022	–	–	–	–	–	–	–	–	No survey conducted on South Bay Route in November 2022 due to extreme weather and flooding.
6	12/18/2022	Walk	MH	N	7:58	11:13	3:15	0.0	2.8	Above average water levels with portions of route under water, but still exposed mud flats.
7	1/29/2023	Walk	MH	N	8:17	11:17	3:00	0.0	2.8	Water levels almost normal but standing pools of water and muddy.
8	2/26/2023	ATV	MH	N	8:01	11:01	3:00	0.0	2.8	Low water levels, dry flats.
9	3/26/2023	UTV	TF	N	8:18	11:38	3:20	0.0	2.8	Low water levels, dry flats.
10	4/24/2023	Walk	MH	N	7:22	10:22	3:00	0.0	2.8	High water levels, very wet, inundated to the dunes. Water levels above knee in places.
11	5/21/2023	ATV	TF	N	7:25	11:07	3:42	0.0	2.8	Relatively dry conditions on flats, little standing water.
12	6/25/2023	ATV	AT	N	7:08	10:10	3:02	0.0	2.8	Below average water levels, dry conditions on flats.

This page intentionally left blank.

APPENDIX C

Summary of Aplomado Falcon Monitoring Points Surveys and Results

Figure 1. Location of Monitoring Routes and Aplomado Falcon Monitoring Points

Table C-1. Results of the Las Palomas Monitoring Route Aplomado Falcon Monitoring Point Surveys

Survey Date*	Survey Visit Number	Observer†	Monitoring Point Number‡	Start Time	End Time	Aplomado Falcon Detected? (Y/N)
7/29/2022	1	MH	AP01	9:39	9:49	N
7/29/2022	1	MH	AP02	9:00	9:10	N
7/29/2022	1	MH	AP03	8:05	8:15	N
7/29/2022	1	MH	AP04	7:10	7:20	N
7/29/2022	1	TF	AP05	7:17	7:27	N
7/29/2022	1	TF	AP06	7:34	7:44	N
7/29/2022	1	TF	AP07	7:58	8:08	N
7/29/2022	1	TF	AP08	8:53	9:03	N
7/29/2022	1	TF	AP09	10:33	10:43	N
7/29/2022	1	TF	AP10	11:59	12:09	N
8/23/2022	2	MH	AP01	9:41	9:51	N
8/23/2022	2	MH	AP02	9:19	9:29	N
8/23/2022	2	MH	AP03	8:18	8:29	N
8/23/2022	2	MH	AP04	7:19	7:29	N
8/23/2022	2	TF	AP05	7:32	7:42	N
8/23/2022	2	TF	AP06	7:50	8:00	N
8/23/2022	2	TF	AP07	8:18	8:28	N
8/23/2022	2	TF	AP08	10:15	10:25	N
8/23/2022	2	TF	AP09	11:33	11:43	N
8/23/2022	2	TF	AP10	12:30	12:40	N
9/24/2023	3	MH	AP01	9:14	9:24	N
9/24/2023	3	MH	AP02	8:37	8:47	N
9/24/2023	3	MH	AP03	8:01	8:10	N
9/24/2023	3	MH	AP04	7:20	7:30	N
9/24/2023	3	TF	AP05	7:36	7:46	N
9/24/2023	3	TF	AP06	8:02	8:12	N
9/24/2023	3	TF	AP07	8:29	8:39	N
9/24/2023	3	TF	AP08	10:26	10:36	N
9/24/2023	3	TF	AP09	11:39	11:49	N
9/24/2023	3	TF	AP10	12:38	12:48	N
10/22/2022	4	TF	AP01	9:43	9:53	N
10/22/2022	4	TF	AP02	8:50	9:00	N
10/22/2022	4	TF	AP03	8:08	8:18	N
10/22/2022	4	TF	AP04	7:42	7:52	N
10/22/2022	4	MH	AP05	8:00	8:10	N
10/22/2022	4	MH	AP06	8:40	8:50	N
10/22/2022	4	MH	AP07	9:24	9:34	N
10/22/2022	4	MH	AP08	11:14	11:24	N

Survey Date*	Survey Visit Number	Observer†	Monitoring Point Number‡	Start Time	End Time	Aplomado Falcon Detected? (Y/N)
10/22/2022	4	MH	AP09	12:15	12:25	N
10/22/2022	4	MH	AP10	13:00	13:10	N
12/17/2022	6	MH	AP01	11:20	11:30	N
12/17/2022	6	MH	AP02	10:54	11:04	N
12/17/2022	6	MH	AP03	9:11	9:21	N
12/17/2022	6	TF	AP04	8:18	8:28	N
12/17/2022	6	TF	AP05	7:46	7:56	N
12/17/2022	6	TF	AP06	8:59	9:09	N
12/17/2022	6	TF	AP07	9:19	9:29	N
12/17/2022	6	TF	AP08	10:03	10:13	N
12/17/2022	6	TF	AP09	10:53	11:03	N
12/17/2022	6	TF	AP10	11:11	11:21	N
1/28/2023	7	TF	AP01	9:43	9:53	N
1/28/2023	7	TF	AP02	8:46	8:56	N
1/28/2023	7	TF	AP03	8:19	8:29	N
1/28/2023	7	TF	AP04	7:38	7:49	N
1/28/2023	7	MH	AP05	8:03	8:13	N
1/28/2023	7	MH	AP06	8:39	8:49	N
1/28/2023	7	MH	AP07	9:05	9:15	N
1/28/2023	7	MH	AP08	10:33	10:43	N
1/28/2023	7	MH	AP09	12:10	12:20	N
1/28/2023	7	MH	AP10	12:56	13:06	N
2/25/2023	8	MH	AP01	9:40	9:50	N
2/25/2023	8	MH	AP02	8:56	9:06	N
2/25/2023	8	MH	AP03	8:24	8:34	N
2/25/2023	8	MH	AP04	7:31	7:41	N
2/25/2023	8	TF	AP05	7:31	7:41	N
2/25/2023	8	TF	AP06	7:50	8:00	N
2/25/2023	8	TF	AP07	8:17	8:27	N
2/25/2023	8	TF	AP08	10:17	10:27	N
2/25/2023	8	TF	AP09	11:31	11:41	N
2/25/2023	8	TF	AP10	12:31	12:41	N
3/25/2023	9	TF	AP01	9:50	10:00	N
3/25/2023	9	TF	AP02	9:01	9:11	N
3/25/2023	9	TF	AP03	8:32	8:42	N
3/25/2023	9	TF	AP04	7:47	7:56	N
3/25/2023	9	MH	AP05	8:20	8:30	N
3/25/2023	9	MH	AP06	9:13	9:23	N
3/25/2023	9	MH	AP07	9:40	9:50	N

Survey Date*	Survey Visit Number	Observer†	Monitoring Point Number‡	Start Time	End Time	Aplomado Falcon Detected? (Y/N)
3/25/2023	9	MH	AP08	11:40	11:50	N
3/25/2023	9	MH	AP09	12:38	12:48	N
3/25/2023	9	MH	AP10	13:04	13:14	N
4/22/2023	10	MH	AP01	9:42	9:52	N
4/22/2023	10	MH	AP02	9:12	9:22	N
4/22/2023	10	MH	AP03	8:18	8:28	N
4/22/2023	10	MH	AP04	7:32	7:42	N
4/23/2023	10	TF	AP05	7:45	7:55	N
4/23/2023	10	TF	AP06	8:04	8:14	N
4/23/2023	10	TF	AP07	8:34	8:44	N
4/23/2023	10	TF	AP08	10:31	10:41	N
4/23/2023	10	TF	AP09	12:18	12:28	N
4/23/2023	10	TF	AP10	12:55	1:05	N
5/20/2023	11	TF	AP01	9:08	9:18	N
5/20/2023	11	TF	AP02	8:28	8:38	N
5/20/2023	11	TF	AP03	8:02	8:12	N
5/20/2023	11	TF	AP04	7:31	7:41	N
5/20/2023	11	MH	AP05	7:30	7:40	N
5/20/2023	11	MH	AP06	8:00	8:10	N
5/20/2023	11	MH	AP07	8:26	8:36	N
5/20/2023	11	MH	AP08	10:30	10:40	N
5/20/2023	11	MH	AP09	11:27	11:37	N
5/20/2023	11	MH	AP10	12:21	12:31	N
6/24/2023	12	AT	AP01	9:16	9:26	N
6/24/2023	12	AT	AP02	8:40	8:50	N
6/24/2023	12	AT	AP03	7:56	8:06	N
6/24/2023	12	AT	AP04	7:27	7:37	N
6/24/2023	12	MH	AP05	7:35	7:45	N
6/24/2023	12	MH	AP06	8:07	8:17	N
6/24/2023	12	MH	AP07	8:36	8:46	N
6/24/2023	12	MH	AP08	10:29	10:39	N
6/24/2023	12	MH	AP09	11:32	11:42	N
6/24/2023	12	MH	AP10	12:17	12:27	N

* During the November 2022 Avian Monitoring Surveys, extreme weather and flooding resulted in the cancellation of most of the survey. SWCA did not conduct surveys of the Las Palomas route and did not conduct any Aplomado Falcon Monitoring Point Surveys in November 2022.

†MH = Michael Heimbuch; TF = Timothy Freiday; AT = Arron Tuggle

‡The Las Palomas Route include 10 Aplomado Falcon Monitoring Points numbered AP01 – AP10.

Table C-2. Results of the South Bay Monitoring Route Aplomado Falcon Monitoring Point Surveys

Survey Date*	Survey Visit Number	Observer†	Monitoring Point Number‡	Start Time	End Time	Aplomado Falcon Detected? (Y/N)
7/27/2022	1	MH	AP01	8:09	8:19	N
7/27/2022	1	MH	AP02	9:01	9:10	N
7/27/2022	1	MH	AP03	9:22	9:32	N
7/28/2022	1	MH	AP04	10:02	10:12	N
7/28/2022	1	MH	AP05	11:14	11:24	N
8/22/2022	2	MH	AP01	8:05	8:15	N
8/22/2022	2	MH	AP02	8:44	8:54	N
8/22/2022	2	MH	AP03	8:08	9:18	N
8/22/2022	2	MH	AP04	9:38	9:48	N
8/22/2022	2	MH	AP05	10:33	10:43	N
9/25/2022	3	TF	AP01	8:26	8:36	N
9/25/2022	3	TF	AP02	8:41	8:51	N
9/25/2022	3	TF	AP03	9:14	9:25	N
9/25/2022	3	TF	AP04	9:58	10:08	N
9/25/2022	3	TF	AP05	10:33	10:43	N
10/23/2022	4	TF	AP01	8:14	8:24	N
10/23/2022	4	TF	AP02	8:30	8:40	N
10/23/2022	4	TF	AP03	9:15	9:25	N
10/23/2022	4	TF	AP04	9:41	9:51	N
10/23/2022	4	TF	AP05	10:06	10:16	N
12/18/2022	6	MH	AP01	9:09	9:19	N
12/18/2022	6	MH	AP02	9:36	9:46	N
12/18/2022	6	MH	AP03	10:02	10:12	N
12/18/2022	6	MH	AP04	10:36	10:46	N
12/18/2022	6	MH	AP05	10:58	11:08	N
1/29/2023	7	MH	AP01	8:37	8:47	N
1/29/2023	7	MH	AP02	9:18	9:28	N
1/29/2023	7	MH	AP03	9:39	9:49	N
1/29/2023	7	MH	AP04	10:10	10:20	N
1/29/2023	7	MH	AP05	10:40	10:50	N
2/26/2023	8	MH	AP01	8:25	8:35	N
2/26/2023	8	MH	AP02	8:48	8:58	N
2/26/2023	8	MH	AP03	9:10	9:20	N
2/26/2023	8	MH	AP04	9:48	9:58	N
2/26/2023	8	MH	AP05	10:30	10:40	N
3/27/2023	9	TF	AP01	8:53	9:03	N
3/27/2023	9	TF	AP02	9:08	9:18	N
3/27/2023	9	TF	AP03	9:25	9:35	N
3/27/2023	9	TF	AP04	10:24	10:34	N

Survey Date*	Survey Visit Number	Observer†	Monitoring Point Number‡	Start Time	End Time	Aplomado Falcon Detected? (Y/N)
3/27/2023	9	TF	AP05	11:13	11:23	N
4/24/2023	10	MH	AP01	7:52	8:02	N
4/24/2023	10	MH	AP02	8:28	8:38	N
4/24/2023	10	MH	AP03	8:50	9:00	N
4/24/2023	10	MH	AP04	9:27	9:37	N
4/24/2023	**10**	**MH**	**AP05**	**9:56**	**10:06**	**Y§**
5/21/2023	11	TF	AP01	7:53	8:03	N
5/21/2023	11	TF	AP02	8:30	8:40	N
5/21/2023	11	TF	AP03	8:57	9:07	N
5/21/2023	11	TF	AP04	9:41	9:51	N
5/21/2023	11	TF	AP05	10:41	10:51	N
6/25/2023	12	AT	AP01	7:20	7:37	N
6/25/2023	12	AT	AP02	7:52	8:03	N
6/25/2023	12	AT	AP03	8:16	8:26	N
6/25/2023	12	AT	AP04	8:56	9:06	N
6/25/2023	12	AT	AP05	9:30	9:42	N

* During the November 2022 Avian Monitoring Surveys, extreme weather and flooding resulted in the cancellation of most of the survey. SWCA did not conduct surveys of the South Bay route and did not conduct any Aplomado Falcon Monitoring Point Surveys in November 2022.

†MH = Michael Heimbuch; TF = Timothy Freiday; AT = Arron Tuggle

‡The South Bay Route includes 5 Aplomado Falcon Monitoring Points numbered AP01 – AP05.

§ During the April 24, 2023 survey of AP05, SWCA observed one Aplomado Falcon. See Section 4 of the *Biological Monitoring Annual Report for the SpaceX Boca Chica Launch Site Construction and Seasonal Avian Monitoring – July 2022 to June 2023* for details on this observation.

APPENDIX D

Target Species Band Resights and Voucher Specimens

Table D-1. Banded Piping Plovers Observed During the Avian Monitoring Surveys

Date	Observer*	Route†	Time	Latitude	Longitude	Distance (Yards)	Bearing (Degrees)	Band Combination				Behavior	Habitat	Other Individuals or Species Nearby‡	Notes
								Upper Left	Lower Left	Upper Right	Lower Right				
7/28/2022	TF	BCB	7:27	+25° 59.28660000'	-097° 08.97066000'	75	170	No Band	USGS/White	Red Flag	Black	Foraging, Antagonistic	Intertidal Zone	1 Unbanded PIPL	Red Flag blank. See Photograph 1 for voucher specimen.
7/28/2022	TF	BCB	8:09	+25° 58.50204000'	-097° 08.89758000'	62	175	Yellow Flag (9X6)	Dark Blue/ White	USGS	Black	Foraging, Resting	Intertidal Zone, Beach	3 Unbanded PIPL, SNPL, WIPL, SEPL, SAND	See Photographs 2 and 3 for voucher specimen.
7/28/2022	TF	BCB	8:25	+25° 58.28028000'	-097° 08.88276000'	27	185	USGS	Orange/ Orange	Yellow Flag (A11)	Black/Black	Foraging, Resting	Beach	5 Unbanded PIPL, SEPL	See Photographs 4 and 5 for voucher specimen. Yellow flag believed to read A11.
7/28/2022	TF	BCB	9:17	+25° 57.62334000'	-097° 08.84880000'	82	170	Yellow Flag	Black/Black	USGS	Black/ Dark Blue	Foraging, Antagonistic	Intertidal Zone	3 Unbanded PIPL	Could not determine number or lettering on yellow flag. See Photograph 6 for voucher specimen. Appears to be PIPL #36B
7/28/2022	TF	BCB	10:12	+26° 00.85212000'	-097° 09.11280000'	27	40	No Band	Pink/Pink	Red Flag	Black	Foraging	Intertidal Zone	–	Red Flag appears blank. Pink bands may be faded red bands, black band may be dark green. See Photograph 7 for voucher specimen.
7/28/2022	TF	BCB	10:25	+26° 00.98232000'	-097° 09.12006000'	66	20	No Band	Yellow/ Dark Blue	Red Flag	Black	Foraging	Intertidal Zone	–	Red Flag appears blank. See Photograph 8 for voucher specimen.
7/28/2022	TF	BCB	10:50	+26° 01.54254000'	-097° 09.15126000'	36	15	USGS	Light Blue/ Orange	Yellow Flag (K12)	White	Resting	Beach	–	Bands appear very faded; Orange may be white or other faded orange. See Photographs 9 for voucher specimen.
7/28/2022	TF	BCB	11:21	+26° 02.41626000'	-097° 09.16776000'	41	15	Yellow Flag (N79)	White/ Light Blue	USGS	Yellow/Black	Foraging, Antagonistic	Intertidal Zone	2 Unbanded PIPL, SAND, WILL	See Photograph 10 for voucher specimen. Bands faded, Yellow band could be another faded color like Orange.
7/28/2022	TF	I	11:56	+26° 03.11982000'	-097° 09.15504000'	28	45	Yellow Flag (X41)	Orange/ White	USGS	Black/Yellow	Foraging	Intertidal Zone	1 Other Banded PIPL and 1 Unbanded PIPL; SAND	Incidental observation outside survey route. Total 3 PIPL in group.
7/28/2022	TF	I	11:56	+26° 03.11982000'	-097° 09.15504000'	28	45	Yellow Flag (13J)	No Band	USGS	No Band	Foraging	Intertidal Zone	1 Other Banded PIPL and 1 Unbanded PIPL; SAND	Incidental observation outside survey route. Total 3 PIPL in group.
7/29/2022	TF	LP	10:04	+25° 58.72812000'	-097° 09.60510000'	45	170	No Band	White/White	Red Flag	Black	Foraging	Mud Flat	7 Unbanded PIPL, PEEP, SEPL, WIPL	Red Flag blank. See Photograph 11 for voucher specimen.
7/29/2022	TF	LP	11:29	+25° 58.34670000'	-097° 09.27750000'	80	225	Yellow Flag (9X6)	Dark Blue/ White	USGS	Black	Resting, Foraging	Mud Flat	1 Other Banded PIPL and 16 Unbanded PIPL, SEPL, PEEP, Dowitcher Species	Two banded PIPL in group. See Photographs 2 and 3 for voucher specimen.
7/29/2022	TF	LP	11:29	+25° 58.34670000'	-097° 09.27750000'	80	225	Yellow Flag	No Band	USGS	Black	Resting, Foraging	Mud Flat	1 Other Banded PIPL and 16 Unbanded PIPL, SEPL, PEEP, Dowitcher Species	Two banded PIPL in group. Could not determine number or lettering on yellow flag. See Photographs 12 and 13 for voucher specimen.
7/29/2022	TF	LP	11:47	+25° 58.20006000'	-097° 09.25140000'	225	160	Blue Flag	Unknown	USGS	Unknown	Resting, Preening, Foraging	Mud Flat	25 Unbanded PIPL, SEPL, BBPL, WILL, PEEP	Could not determine number or lettering on blue flag. See Photograph 14 for voucher specimen.
8/23/2022	TF	LP	12:12	+25° 58.20264000'	-097° 09.25704000'	39	190	USGS	Orange/ Black	Red Flag	White/ Dark Blue	Foraging	Mud Flat	4 Unbanded PIPL, WESA, SEPL, WILL, BBPL	Could not determine number or lettering on red flag. Resight difficult. Orange very faded, could be white. See Photographs 15 and 16 for voucher specimens.
8/24/2022	TF	BCB	7:33	+25° 57.70386000'	-097° 08.85402000'	16	10	Yellow Flag (36B)	Black/Black	USGS	Black/ Dark Blue	Foraging	Beach	SAND, RUTU	See Photographs 17 for voucher specimen.
8/24/2022	MH	BCB	7:36	+25° 59.29128000'	-097° 08.97720000'	57	142	No Band	USGS	Orange Flag	Black	Foraging	Beach	1 Unbanded PIPL, SAND	Orange flag appears blank.
8/24/2022	TF	BCB	7:59	+25° 58.18074000'	-097° 08.87982000'	45	10	Yellow Flag	Unknown	Unknown	Unknown	Foraging, Antagonistic	Beach	1 Other Banded PIPL and 6 Unbanded PIPL, SAND, RUTU	This banded plover was aggressive towards the other PIPL, there was another banded PIPL that was chased away before it could be fully resighted. Two banded plovers in group. Could not determine number or lettering on yellow flag.
8/24/2022	TF	BCB	7:59	+25° 58.18074000'	-097° 08.87982000'	45	10	USGS	Dark Blue/ Dark Blue	Yellow Flag	White/ Dark Blue	Foraging, Antagonistic	Beach	1 Other Banded PIPL and 6 Unbanded PIPL, SAND, RUTU	Another banded plover was aggressive towards the PIPL in group, chased away this PIPL before it could be fully resighted. Two banded plovers in group. Could not determine number or lettering on yellow flag.
8/24/2022	MH	BCB	8:15	+25° 58.80468000'	-097° 08.93256000'	48	147	USGS	No Band	Yellow Flag (B04)	Black	Foraging	Beach	1 Unbanded PIPL, SAND, RUTU, WILL	–

Date	Observer*	Route†	Time	Latitude	Longitude	Distance (Yards)	Bearing (Degrees)	Band Combination				Behavior	Habitat	Other Individuals or Species Nearby‡	Notes
								Upper Left	Lower Left	Upper Right	Lower Right				
8/24/2022	TF	BCB	9:04	+26° 01.00272000'	-097° 09.11904000'	80	10	No Band	Yellow/ Dark Blue	Red Flag	Black	Foraging	Beach	1 Unbanded PIPL, LETE, RUTU, SAND	Red flag blank. See Photographs 18 and 19 for voucher specimen. See also Photograph 8, these appear to have same band combination.
8/24/2022	TF	BCB	9:22	+26° 01.32936000'	-097° 09.13914000'	49	5	Yellow Flag (9X6)	Dark Blue/ White	USGS	Black	Foraging	Beach	SAND	See Photographs 2 and 3 for voucher specimen.
8/24/2022	TF	BCB	9:33	+26° 01.53750000'	-097° 09.14874000'	24	75	USGS	Light Blue/ Orange	Yellow Flag (K12)	White	Foraging	Beach	1 Unbanded PIPL, SAND	The Orange band underneath the light blue band may be a faded color or white. See Photograph 9 for voucher specimen.
8/24/2022	TF	BCB	9:55	+26° 02.43372000'	-097° 09.17130000'	25	70	USGS	Red	No Band	Dark Green	Foraging	Beach	SAND	See Photograph 19 for voucher specimen.
8/24/2022	TF	BCB	9:59	+26° 02.47242000'	-097° 09.17322000'	29	80	Yellow Flag (N79)	White/ Light Blue	USGS	Yellow/Black	Foraging	Beach	1 Unbanded PIPL, SAND	Bands faded, Yellow band could be another faded color like Orange. See Photograph 10 for voucher specimen
9/23/2022	MH	BCB	7:49	+26° 02.46150000'	-097° 09.17064000'	26	229	Yellow Flag (N79)	White/ Light Blue	USGS	Yellow/Black	Foraging	Intertidal Zone	SAND, WILL	See Photograph 10 for voucher specimen. Bands faded, Yellow band could be another faded color like Orange.
9/23/2022	MH	BCB	8:17	+26° 02.00310000'	-097° 09.16848000'	31	321	USGS	Red	No Band	Dark Green	Foraging	Intertidal Zone	–	See Photograph 20 for voucher specimen.
9/23/2022	MH	BCB	8:33	+26° 01.56198000'	-097° 09.15180000'	34	138	USGS	Light Blue/ Orange	Yellow Flag (K12)	White	Resting	Beach	1 Unbanded PIPL, WILL, LAGU, RUTU	The Orange band underneath the light blue band may be a faded color or white. See Photograph 9 for voucher specimen.
9/23/2022	MH	BCB	8:45	+26° 01.44786000'	-097° 09.14592000'	19	139	Yellow Flag (21E)	Dark Blue /Orange	USGS	Red/Orange	Foraging, Resting	Beach	SAND, WILL	See Photographs 21 and 22 for voucher specimen.
9/23/2022	MH	BCB	8:52	+26° 01.31976000'	-097° 09.14124000'	15	127	Yellow Flag (9X6)	Dark Blue/ White	USGS	Black	Resting	Beach	SAND	See Photographs 2 and 3 for voucher specimen.
9/23/2022	MH	BCB	9:03	+26° 00.97194000'	-097° 09.12036000'	23	238	No Band	Yellow/ Dark Blue	Red Flag	Black	Resting	Beach	–	Red flag blank. No USGS band observed. See Photographs 18 and 19 for voucher specimen. See also Photograph 8, these appear to have same band combination.
9/23/2022	MH	BCB	9:19	+26° 00.74934000'	-097° 09.10740000'	16	132	No Band	Pink/Pink	Red Flag	Black	Resting	Beach	RUTU	Red flag blank. See Photograph 23 for voucher specimen. No USGS band observed.
9/24/2022	TF	LP	12:18	+25° 58.47762000'	-097° 09.35556000'	58	180	USGS	Light Blue/ Yellow	Yellow Flag (2U2)	White/ Dark Green	Foraging	Mud Flat	1 Other Banded PIPL and 5 Unbanded PIPL, PEEP	Two banded PIPL in group. Dark Green may be a Black band. See Photograph 24 for voucher specimen.
9/24/2022	TF	LP	12:18	+25° 58.47762000'	-097° 09.35556000'	58	180	Yellow Flag (36B)	Black/Black	USGS	Black/ Dark Blue	Foraging	Mud Flat	1 Other Banded PIPL and 5 Unbanded PIPL, PEEP	Two banded PIPL in group. See Photographs 17 for voucher specimen.
9/25/2022	TF	SB	8:07	+25° 59.89986000'	-097° 09.21000000'	272	325	USGS	No Band	Green Flag	No Band	Foraging	Mud Flat	2 Other Banded PIPL, 12 Unbanded PIPL, and 9 Unknown PIPL; PEEP	Three banded PIPL in group. Due to distance was only able to get resight on one banded PIPL. In total there were 24 PIPL in group. Green Flag blank.
11/18/2022	TF	BCB	12:21	+25° 58.21440000'	-097° 08.89434000'	34	165	USGS	Light Blue/ Yellow	Yellow Flag (2U2)	White/ Dark Green	Foraging	Intertidal Zone	1 Unbanded PIPL, SAND, RUTU	Dark Green may be a Black band. See Photograph 24 for voucher specimen.
12/17/2022	TF	LP	8:43	+25° 59.01702000'	-097° 11.21820000'	45	180	Unknown	Unknown	Unknown	Unknown	Foraging	Mud Flat	2 Banded PIPL, 115 Unbanded PIPL, and 10 Unknown PIPL; SEPL, BBPL, LESA, WILL, WESA	Two banded PIPL in group. Due to wind, rains, and shifting flock was not able to resight banded individuals. In total, 127 PIPL in group.
12/17/2022	TF	LP	9:20	+25° 59.51700000'	-097° 09.96702000'	74	170	Unknown	Orange/ Orange	Unknown	Black/Black	Foraging	Mud Flat	4 Unbanded PIPL, SEPL, DUNL, WESA, LESA	Banded PIPL flew before able to get full resight.
12/18/2022	MH	SB	8:12	+25° 59.94954000'	-097° 09.18708000'	86	315	Yellow Flag (436)	Yellow/ Dark Blue	USGS	Orange/Red	Foraging	Mud Flat, Algal Flat	3 Other Banded PIPL, 20 Unbanded PIPL, and 4 Unknown PIPL; SEPL, WESA, DUNL	Four banded PIPL in group. In total, 28 PIPL in group. Red band very faded, could be another color. See Photograph 25 for voucher specimen.
12/18/2022	MH	SB	8:12	+25° 59.94954000'	-097° 09.18708000'	86	315	Unknown	Black	Light Blue Flag	Yellow/ Dark Green	Foraging	Mud Flat, Algal Flat	3 Other Banded PIPL, 20 Unbanded PIPL, and 4 Unknown PIPL; SEPL, WESA, DUNL	Four banded PIPL in group. In total, 28 PIPL in group. Light blue flag appears blank.

Date	Observer*	Route†	Time	Latitude	Longitude	Distance (Yards)	Bearing (Degrees)	Band Combination				Behavior	Habitat	Other Individuals or Species Nearby‡	Notes
								Upper Left	Lower Left	Upper Right	Lower Right				
12/18/2022	MH	SB	8:12	+25° 59.94954000'	-097° 09.18708000'	86	315	Unknown	Dark Blue/ Orange	Unknown	Red/Orange	Foraging	Mud Flat, Algal Flat	3 Other Banded PIPL, 20 Unbanded PIPL, and 4 Unknown PIPL; SEPL, WESA, DUNL	Four banded PIPL in group. In total, 28 PIPL in group. Potentially PIPL #21E based on combination.
12/18/2022	MH	SB	8:12	+25° 59.94954000'	-097° 09.18708000'	86	315	Unknown	Black	Red Flag	No Band	Foraging	Mud Flat, Algal Flat	3 Other Banded PIPL, 20 Unbanded PIPL, and 4 Unknown PIPL; SEPL, WESA, DUNL	Four banded PIPL in group. In total, 28 PIPL in group. Red flag appeared blank.
1/28/2023	MH	LP	10:08	+25° 59.33874000'	-097° 09.76062000'	88	120	Unknown	Yellow/ Dark Blue	Red Flag	Black	Foraging	Mud Flat, Algal Flat	1 Other Banded PIPL and 14 Unbanded PIPL; SEPL, WESA, DUNL	Dark Blue may have been Dark Green. Two banded PIPL in group. In total,16 PIPL in group. Misty rains made resighting difficult, not confident in colors. Red flag appeared blank. See Photographs 8, 18, and 19, appears to be same combination
1/28/2023	MH	LP	10:08	+25° 59.33874000'	-097° 09.76062000'	88	120	Unknown	Unknown	Orange Flag	Unknown	Foraging	Mud Flat, Algal Flat	1 Other Banded PIPL and 14 Unbanded PIPL; SEPL, WESA, DUNL	Two banded PIPL in group. In total,.16 PIPL in group. Misty rains made resighting difficult; bird flew before able to get full resight. Orange flag appeared blank, PIPL flew before able to get complete resight.
1/28/2023	MH	LP	10:54	+25° 59.12868000'	-097° 09.79998000'	115	208	Unknown	Yellow/ Dark Blue	Unknown	Unknown	Foraging	Mud Flat	2 Other Banded PIPL, 46 Unbanded PIPL, 37 Unknown PIPL; SNPL, SAND, DUNL, WESA, SEPL	May have been Dark Green, this may have been same individual as 10:08 sighting, seen with similar banded bird. Three banded PIPL in group. In total, 86 PIPL in group.
1/28/2023	MH	LP	10:54	+25° 59.12868000'	-097° 09.79998000'	115	208	Orange Flag (?)	Unknown	Orange Flag (?)	Unknown	Foraging	Mud Flat	2 Other Banded PIPL, 46 Unbanded PIPL, 37 Unknown PIPL; SNPL, SAND, DUNL, WESA, SEPL	Orange Flag was on upper leg but couldn't determine which side. Three banded PIPL in group. In total, 86 PIPL in group. This may have been same individual as 10:08 sighting, seen with similar banded bird.
1/28/2023	MH	LP	10:54	+25° 59.12868000'	-097° 09.79998000'	115	208	Unknown	Black	Unknown	Unknown	Foraging	Mud Flat	2 Other Banded PIPL, 46 Unbanded PIPL, 37 Unknown PIPL; SNPL, SAND, DUNL, WESA, SEPL	Three banded PIPL in group. In total, 86 PIPL in group. Was standing on one leg in the water, could only see a single black band on lower left leg.
1/28/2023	TF	LP	11:24	+25° 58.17516000'	-097° 10.54752000'	377	85	Blue Flag	Unknown	Unknown	Unknown	Foraging	Mud Flat	1 Unbanded PIPL, SEPL, WESA, DUNL	Could not get full resight due to distance.
3/25/2023	MH	LP	11:14	+25° 59.33772000'	-097° 09.75282000'	136	126	Unknown	Black/Yellow	Dark Green Flag	Dark Green/ Yellow	Foraging	Algal Flat	11 Unbanded PIPL, WIPL, SNPL, PEEP, SEPL, DUNL, SAND	Could not see USGS band, potentially on upper left leg. Dark green flag appeared blank. See Photograph 26 and 27 for voucher specimen.

* MH = Michael Heimbuch; TF = Timothy Freiday

† BCB = Boca Chica Beach Route; LP = Las Palomas Route; SB = South Bay Route; I = Incidental

‡ BBPL = Black-bellied Plover; DUNL = Dunlin; LAGU = Laughing Gull; LETE = Least Tern; LESA = Least Sandpiper; PEEP = Species of Peep Sandpiper; PIPL = Piping Plover; RUTU = Ruddy Turnstone; SAND = Sanderling; SEPL = Semipalmated Plover; SNPL = Snowy Plover; WESA = Western Sandpiper; WILL = Willet; WIPL = Wilson's Plover

Table D-2. Banded Snowy Plovers Observed During the Avian Monitoring Surveys

Date	Observer*	Route†	Time	Latitude	Longitude	Distance (Yards)	Bearing (Degrees)	Band Combination				Behavior	Habitat	Other Individuals or Species Nearby	Notes
								Upper Left	Lower Left	Upper Right	Lower Right				
8/24/2022	MH	BCF	10:10	+25° 59.53992000'	-097° 11.14176000'	126	225	USGS	Red/Red	Red	Blue	Foraging	Sand Flat, Mud Flat	4 Unbanded SNPL, PEEP, SAND	Appears to be faded red and blue or dark blue band. This individual was resighted again on 3/25/2023 with voucher specimen photograph and better view of band combination. See Photograph 28 for voucher specimen.
3/25/2023	MH	LP	8:48	+25° 59.47014000'	-097° 10.78170000'	68	165	USGS	Red/Red	Red	Blue	Foraging	Mud Flat	PEEP, DUNL, WILL	Appears to be faded red and blue or dark blue bands. See Photograph 28 for voucher specimen.
4/22/2023	MH	LP	8:40	+25° 58.41498000'	-097° 11.92074000'	91	218	USGS	Yellow/Dark Blue	Red	White	Foraging	Water, Algal Flat	1 Unbanded SNPL	See Photograph 29 and 30 for voucher specimens. Appears to be a red band on upper right, not a flag.

* MH = Michael Heimbuch

† BCF = Boca Chica Flats Route; LP = Las Palomas Route

‡ DUNL = Dunlin; PEEP = Species of Peep Sandpiper; SNPL = Snowy Plover; WILL = Willet

Table D-3. Banded Wilson's Plovers Observed During the Avian Monitoring Surveys

								Band Combination							
Date	**Observer***	**Route†**	**Time**	**Latitude**	**Longitude**	**Distance (Yards)**	**Bearing (Degrees)**	**Upper Left**	**Lower Left**	**Upper Right**	**Lower Right**	**Behavior**	**Habitat**	**Other Individuals or Species Nearby**	**Notes**
7/29/2022	TF	LP	7:42	+25° 59.46240000'	-097° 10.37262000'	45	145	USGS	No Band	No Band	No Band	Foraging	Mud Flat	WILL, BASA	–
7/29/2022	TF	LP	7:50	+25° 59.49522000'	-097° 10.11096000'	40	125	USGS	No Band	No Band	No Band	Foraging	Mud Flat	LESA	–
4/22/2023	MH	LP	10:05	+25° 58.26492000'	-097° 11.39712000'	31	32	Black Band, White Letters (LE)	No Band	USGS	No Band	Foraging	Mud Flat	LESA; DUNL	See Photographs 31 and 32 for voucher specimens.

* MH = Michael Heimbuch; TF = Timothy Freiday

† LP = Las Palomas Route

‡ BASA = Baird's Sandpiper; DUNL = Dunlin; LESA = Least Sandpiper; PEEP = Species of Peep Sandpiper; PIPL = Piping Plover; RUTU = Ruddy Turnstone; SAND = Sanderling; SEPL = Semipalmated Plover; SNPL = Snowy Plover; WESA = Western Sandpiper; WILL = Willet; WIPL = Wilson's Plover

Photograph 1. Voucher specimen of banded piping plover observed on July 28, 2022, on the Boca Chica Beach Route.

Photograph 2. Voucher specimen of banded piping plover observed on July 28, 2022; August 24, 2022; and September 23, 2022, on the Boca Chica Beach Route; also observed on July 29, 2022, on the Las Palomas Route

Photograph 3. Voucher specimen of banded piping plover observed on July 28, 2022; August 24, 2022; and September 23, 2022, on the Boca Chica Beach Route; also observed on July 29, 2022, on the Las Palomas Route

Photograph 4. Voucher specimen of banded piping plover observed on July 28, 2022, on the Boca Chica Beach Route.

Photograph 5. Voucher specimen of banded piping plover observed on July 28, 2022, on the Boca Chica Beach Route.

Photograph 6. Voucher specimen of banded piping plover observed on July 28, 2022, on the Boca Chica Beach Route.

Photograph 7. Voucher specimen of banded piping plover observed on July 28, 2022, on the Boca Chica Beach Route.

Photograph 8. Voucher specimen of banded piping plover observed on July 28, 2022, on the Boca Chica Beach Route.

Photograph 9. Voucher specimen of banded piping plover observed on July 28, 2022, and August 24, 2022, and September 23, 2022, on the Boca Chica Beach Route.

Photograph 10. Voucher specimen of banded piping plover observed on July 28, 2022, August 24, 2022, and September 23, 2022, on the Boca Chica Beach Route.

Photograph 11. Voucher specimen of banded piping plover observed on July 29, 2022, on the Boca Chica Flats Route.

Photograph 12. Voucher specimen of banded piping plover observed on July 29, 2022, on the Boca Chica Flats Route.

Photograph 13. Voucher specimen of banded piping plover observed on July 29, 2022, on the Boca Chica Flats Route.

Photograph 14. Voucher specimen of banded piping plover observed on July 29, 2022, on the Boca Chica Flats Route.

Photograph 15. Voucher specimen of banded piping plover observed on August 23, 2022, on the Las Palomas Route.

Photograph 16. Voucher specimen of banded piping plover observed on August 23, 2022, on the Las Palomas Route.