



Channel Islands Birds: A Gap Analysis of Specimen and Observation Data

Final Report

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INTRODUCTION

Colonialism and global exploration, and the pursuit of scientific discovery, led to a massive increase in scientific bird collections in the early 1800's (U.S. Fish and Wildlife Service 2018, Barber 1980). At the same time, millions of birds were killed for food, feathers, and the curiosity cabinets of the elite (Farber 1980, Western Foundation of Vertebrate Zoology 2021). Accompanying these trends, two important ornithology texts were published around 1830: John James Audubon's "Birds of America" series in 1827, and Thomas Nuttall's Manual of Ornithology of the U.S. and Canada in 1832 (US Fish and Wildlife Service 2018). Bird collections on the California Channel Islands follow global collection trends, with the first known specimens taken in 1846 (a black-necked grebe and a California gull), and collections increasing into the late 1800's and early 1900's.

Channel Islands National Monument was created in 1938, encompassing Anacapa and Santa Barbara Islands; this was extended to include San Miguel, Santa Rosa, and a portion of Santa Cruz Island with the creation of Channel Islands National Park in 1980 (National Park Service 2021), which initiated an ecological monitoring program shortly thereafter (Davis 1994). Other important influences on bird research and conservation on the Islands have included bald eagle and other raptor restoration and monitoring (e.g. Sharpe and Garcelon 2005), and seabird restoration and research programs initiated around the 1980's as conservation concerns grew surrounding the impacts of introduced mammals and of DDT contamination (e.g. Kiff et al. 1980, Carter et al. 1992, McChesney and Tershey 1998, Adams et al. 2004, Whitworth et al. 2014, Carter et al. 2018). A lawsuit was settled for illegal dumping with the Montrose Chemical Corporation and other companies in 2000, which has funded many of these projects.

The Channel Islands provide habitat for a diverse avifauna that is similar to, yet distinct from, that on the adjacent mainland (Collins and Jones 2015). Several common mainland breeding species, such as Greater Roadrunner, Hairy Woodpecker, Wrentit, Oak Titmouse, California Thrasher and California Towhee, are entirely absent from the Channel Islands. Other species that occur commonly on the adjacent mainland, such as Turkey Vulture, Ring-billed Gull, Elegant and Caspian Terns, Black-chinned Hummingbird, Downy and Nuttall's Woodpeckers, and until recently American Crow, are rare on the islands. The Channel Islands support important nesting areas for fourteen species of seabirds, a number of which reach their northern or southern breeding distributional limits there. Large breeding populations of Western Gulls, Cassin's Auklets, and Brandt's Cormorants occur on the islands. Most of the world's population of Scripps's Murrelet, more than 50% of the world's population of Ashy Storm-Petrel, and the only nesting populations of Brown Pelican along the west coast of the United States are found on the Channel Islands.

Of the 422 species of birds observed to date on the Channel Islands, 106 have or are suspected to have bred on one or more of the islands. Twenty species are not native to the islands and have either been introduced by humans or are escaped exotics that have shown up on one or more of the islands. Fourteen of the 67 native species of terrestrial birds that have nested on the islands are represented by endemic species or subspecies – forms that are found on the islands and nowhere else. The Island Scrub-Jay, which is confined to Santa Cruz Island, is the most distinct and only endemic species of bird on the Channel Islands. Most of the other described island endemics are only weakly differentiated both genetically and morphologically. Endemic populations that have been extirpated during historic times from individual islands include Island Loggerhead Shrike on San Miguel and Anacapa Islands, House Finch and Song Sparrow on Santa Barbara Island, and Bewick's Wren, Spotted Towhee, and Song Sparrow on San Clemente Island.

Recent Channel Islands bird research is uncovering some exciting patterns. For example, genetic and morphometric data reveal spatially replicated patterns of phenotypic divergence in the Island scrub-jay, where birds in pine habitat had longer, shallower bills than those in oak habitat (Langin et al. 2015).

For the song sparrow (*Melospiza melodia*), measurements of 1488 museum skins revealed an increasing body-size-corrected bill surface area from the California coast to the interior, with California Island populations having larger bills on

larger, warmer islands (Greenberg and Danner 2012). In addition, average body mass is over 10% higher than for comparable mainland populations (Danner et al. 2014).

A study of avian remains from fossil sites and prehistoric cave deposits has added 64 species to the fossil avian community of San Miguel and Santa Rosa Islands, making this the richest Late Pleistocene–Holocene coastal avifaunal assemblage recorded for California (Collins et al. 2018). This study revealed that at least four land birds (Burrowing Owl [*Athene cunicularia*], Island Scrub-Jay [*Aphelocoma insularis*], Bewick's Wren [*Thryomanes bewickii*], and Spotted Towhee [*Pipilo maculatus*]) that nested prehistorically on San Miguel have disappeared from the modern record there, and that the Island Scrub-Jay disappeared from Santa Rosa Island as well. The Scrub-Jay, Bewick's Wren, and Spotted Towhee disappearances from these islands are attributed to the destruction of island scrub and woodland habitats there by introduced animals.

Birds are the best-studied organisms on the Channel Islands, as they are the most easily observed (Diamond and Jones 1980). An enormous amount of data has been gathered for these birds, both from collected specimens and, more recently, vetted observational data available via online databases (iNaturalist and eBird). This study aims to synthesize those data, and identify spatial, temporal, and taxonomic gaps that can inform and help prioritize future research.

METHODS

Five data sources were used for these analyses, many of which are accessible through the Islands of the Californias Biodiversity Information System (Cal-IBIS) symbiota portal at www.cal-ibis.org. This all-taxa portal was created to consolidate Californian and Mexican Channel Islands biodiversity data for ready use by land managers, scientists, and others, and to facilitate the assessment and management of the islands as a whole archipelago. It is one of only a few all-taxa portals created for defined geographic areas in existence. To maintain this portal, data from other sources are periodically searched and data “snapshots” are imported. For birds, GBIF is the primary data set harvested. Other data sets are unique to this portal. Records from the other sources are searched via a series of name and spatial searches. Because data coming from different sources can be redundant, a series of operations are then performed to remove duplicates and clean the data prior to posting on the Cal-IBIS portal. Island records that do not contain either geographic coordinates or key island names may not be recovered through this process, as can records that are problematic for one reason or another.

The five data sources were downloaded as comma separated values (CSV) files, and include: 1) SBMNH's comprehensive collections database, 2) SBMNH's comprehensive observations database, 3) GBIF data for egg collections, 4) iNaturalist observation data, and 5) eBird observation data. These data sources are discussed further below.

Paul Collins has been maintaining comprehensive island bird specimen and observation Access databases for decades. The specimen database contains both records found in GBIF, and some that are not, therefore this is a more complete data set to use for our analyses than the GBIF data imported to Cal-IBIS alone. The exception is egg records, which have not been maintained in the databases; these were downloaded from GBIF to Cal-IBIS on the 22nd of January, 2021 and are referred to as “Cal-IBIS (eggs)”. The sightings database contains data harvested from historic field notes, published papers, island log books, gray literature reports, and other sources of unpublished island records by multiple observers for individual islands. These two SBMNH databases were imported to the Cal-IBIS portal in 2018 (with improvements in 2021); we refer to these as SBMNH Collections and SBMNH Observations.

Although iNaturalist and eBird records are a component of GBIF data, we discovered that not all records were being retrieved (likely an issue with the process to remove duplicates), and ultimately downloaded these separately. We will search for a solution to this problem in the future. Here we examine only “research grade” iNaturalist observations (www.iNaturalist.org). To be research grade, an observation must have a photographic voucher, a community-supported identification, and date and locality data. All iNaturalist observations data were downloaded on 14 July, 2021.

For iNaturalist data, some observations were “obscured” meaning that available locality data are intentionally offset from the actual observation location. This can occur if the user intentionally changes settings from “open” to “obscured.” The iNaturalist platform also automatically obscures all locality data for species of conservation concern. To get access to the unobscured locality data for these observations, researchers would need to contact the individual observers and/or get them to contribute their observations to a project for which the user gives permission to project staff to see unobscured locality data. As a result, getting access to the unobscured locality data is a significant time investment and beyond the scope of the current study.

All downloaded data (347,971 records) were cleaned to remove any erroneous records, then an Island Name field was generated from a combination of place names where given, and coordinates (using scripts in ArcGIS) where not. Year and month fields were standardized, and a Collection Type field was added to standardize the various ways that this was coded in the original data, via the collectionCode and basisOfRecord fields. These data were then synonymized as described below.

The American Ornithological Society’s checklist of North and Middle American birds was used to standardize records using current taxonomy (<http://checklist.americanornithology.org>). This database does not address subspecies, however, many of which are rare and endemic taxa to the islands. In addition, previous taxonomic synonyms are not provided on this website. Therefore, additional websites were used to indicate the most recent taxonomy for subspecies, including Avibase (<https://avibase.bsc-eoc.org>) and the Integrated Taxonomic Information System (<https://www.itis.gov/>), with Wikipedia helping to indicate other relevant resources and a list of island subspecies provided by Paul Collins. Because birds are so mobile and the presence of infraspecific taxa can be highly variable, we were unable to assume the identity of subspecies based on island (the way we were able to herpetofauna, for instance) when it was not indicated. Therefore, subspecies identities were used when indicated in the original records, but not assumed for others. This means that our datasets are sometimes split between the species and subspecies levels, which is not ideal for this type of analysis, but could not be helped. To alleviate this issue somewhat, when the vast majority of records did not indicate a subspecies but a few records did, all records for that taxon were generalized to the species level.

Once the dataset was finalized, summary graphs and tables were generated using R 4.1.0 (R Core Team, 2021), and the tidyverse (v1.3.1; Wickham et. al 2019). Heat maps showing spatial specimen collecting effort were generated using 1 km grid cells overlaid onto each of the islands. Prior to generating those maps, erroneous points using island centroids were removed. These were identified by combining the latitude and longitude of all vertebrate and invertebrate records into one field, calculating how many records had those coordinates, then checking those with large numbers of records to determine if they were centroids. Records removed are summarized in **Appendix A** to facilitate improvement of the original museum data.

RESULTS and DISCUSSION

Combined Birds

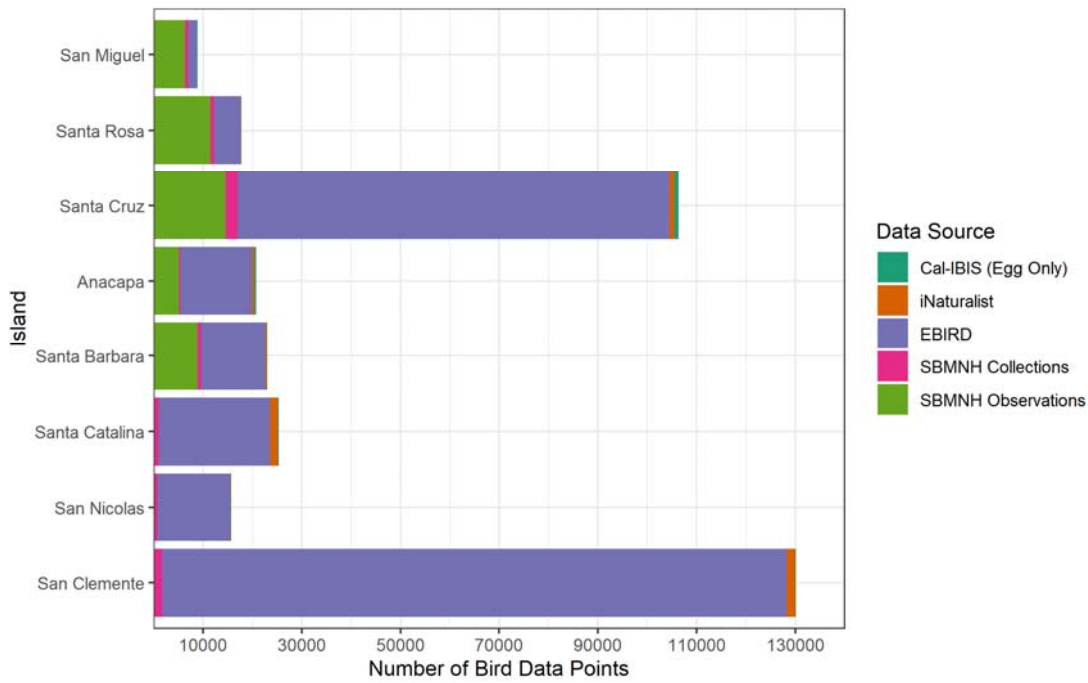
Figures Aves-1a and 1b show the absolute number and proportional number/island size, respectively, of bird occurrences on each island. SBMNH observation data shows that the southern islands haven’t been digitized yet. That work is currently underway by the SBMNH, under contract to TNC. The graphs that have been normalized by island size show that Santa Barbara and Anacapa Islands have been relatively well sampled for their size. These figures also show that eBird is a huge source of data, driven by both the large size and relative accessibility of the island (Santa Cruz) or the number of biologists active on that platform (San Clemente). When the data are as complete as for San Clemente Island, they are more useful for investigating patterns. On that island they are catching interesting vagrants, like several Asian taxa: the northern wheatear and red-flanked bluetail, bluethroat, and stonechat (from NW Alaska and the Aleutian Islands). These graphs also reveal that iNaturalist is clearly not as heavily utilized for bird observations as the eBird platform is. While collections

are a much smaller source of data, they can be more readily verified, and to a finer taxonomic level. Specimens are vital for being able to identify subspecific status both for the island endemics as well as for migrants and winter visitors that reach an island. Not all subspecies are easily identified from observations made by competent observers.

Figure Aves-2 shows the number of specimens by year over time, and reveals that from the 1970's on, an enormous amount of bird collection and observation work has been performed on the Channel Islands, from both research scientists and the general public. eBird data are available back through the 1960's, because scientists are entering data from their field notes. All data show a gap in the early 1940's during WWII. The egg data is incomplete, as it only contains the Western Foundation of Vertebrate Zoology's data. There are at least 37 other island egg collections, based on an inventory performed by Lloyd Kiff. This hard copy database will need to be digitized in order to gain a complete inventory of egg sets collected from the Channel Islands. Note that of the 4,223 island bird specimens, (52%) are from the endemic species (n=1) and subspecies (n=17), highlighting the focus on those rare forms.

Figure Aves-3 shows the data over time split by collection type. It reveals that the bulk of the egg collections were made between the 1900's - 1940's, while a secondary pulse of egg collections was driven by seabird research around the 1990's. Collections data show regular pulses, while digital observation data are a recent phenomenon.

(a)



(b)

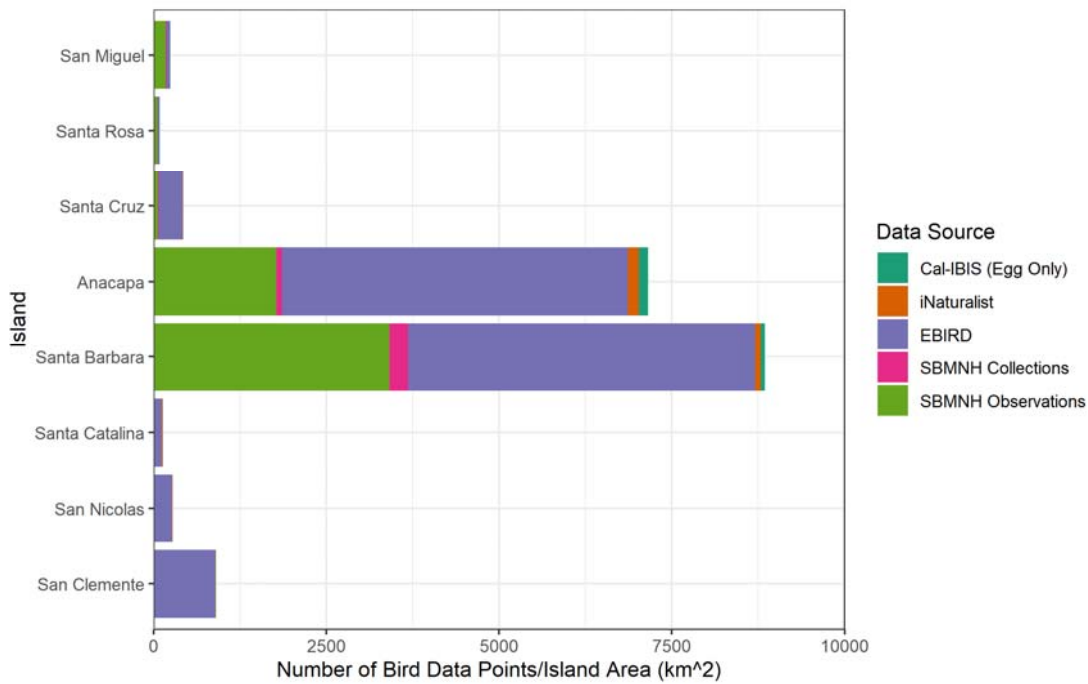


Figure Aves-1. The (a) absolute number and (b) proportional number/island size of bird occurrences on each island by data source reveals spatial gaps in the data. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

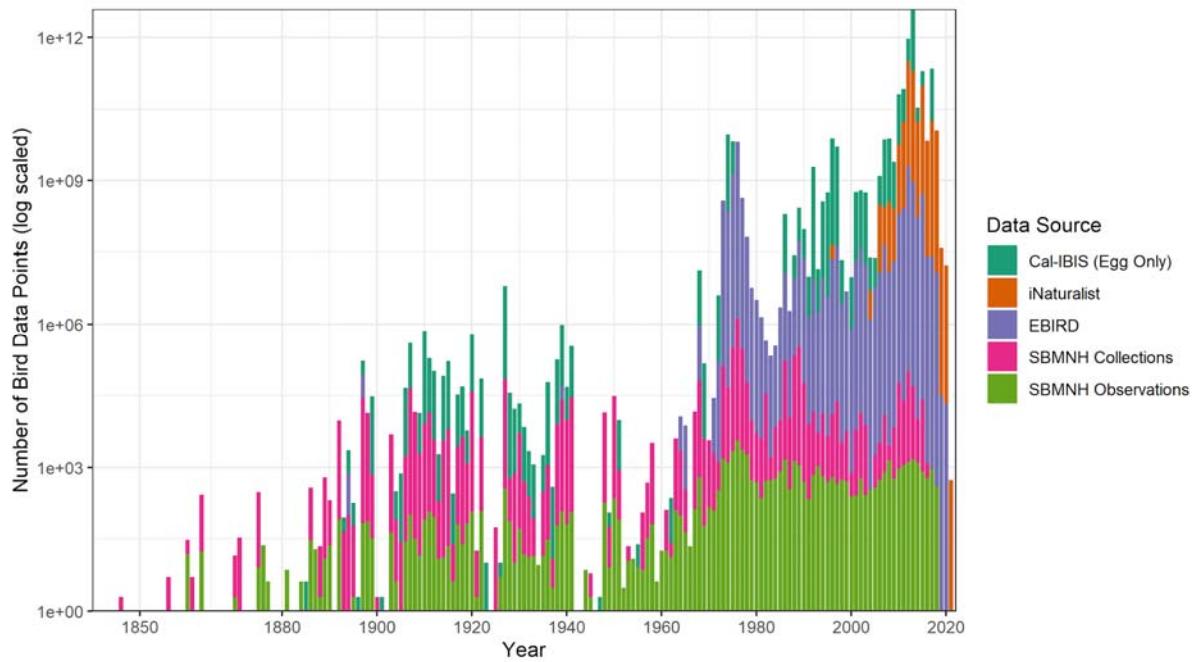


Figure Aves-2. The number of island bird occurrences by year and data source reveals temporal gaps in the data. Data were converted to a log 10 scale for better pattern visualization. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

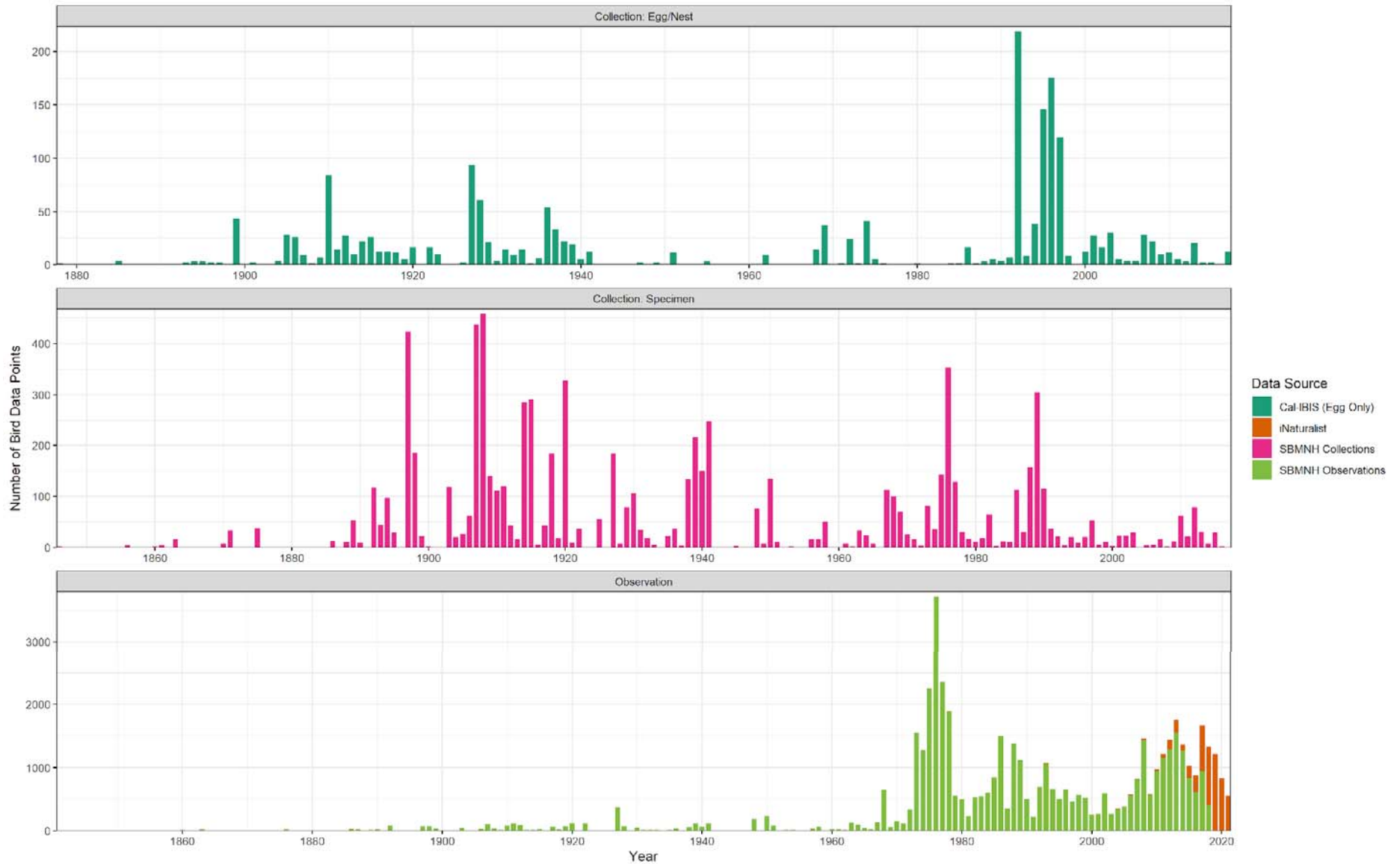


Figure Aves-3. The number of island bird data points by year and data source split by collection type. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by iNaturalist, and the Santa Barbara Museum of Natural History observations database. *Note:* the eBird dataset is not included here.

Figure Aves-4 shows the data by month and island, revealing that the smallest number of bird collections and observations occur in winter (when it is more difficult to get out to the islands) while spring and fall are well-sampled and summer is also somewhat undersampled on all but the most accessible islands. This phenomenon neglects the taxa that start seasonal migrations earlier— like shorebirds, which start in mid-late June and peak by late August/early September. Other examples of neglected groups are Neotropical migrants, which start late August and peak in late September then taper off, and eastern vagrants, which peak in June. In winter, we’re also missing the overwintering land birds for which the islands are very important, like the yellow-rumped warbler, hermit thrush, and fox sparrow.

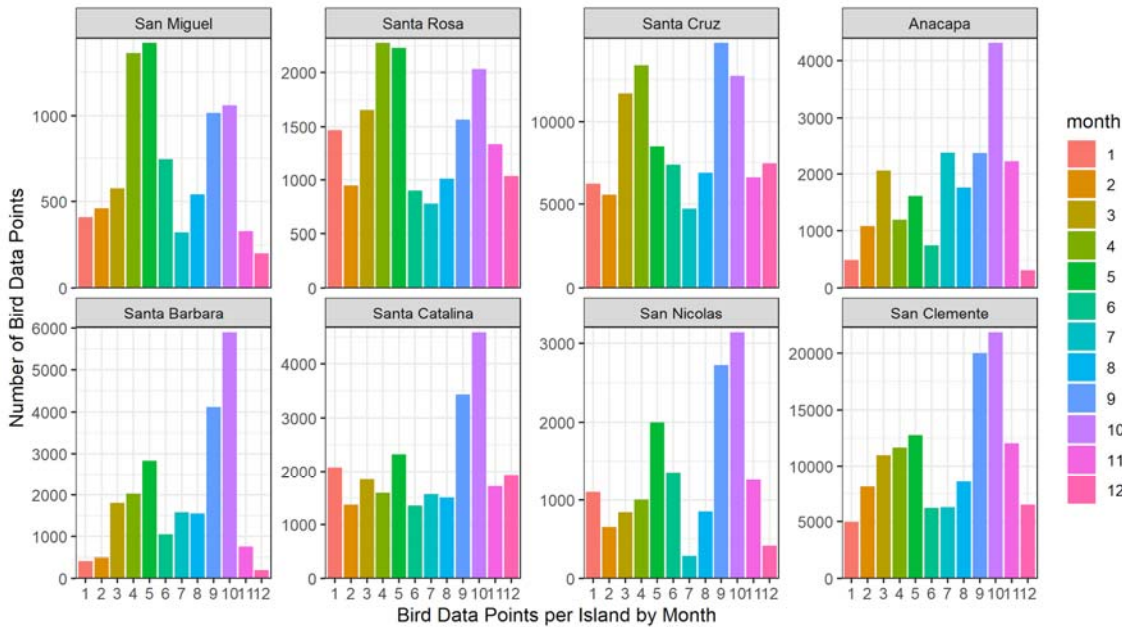
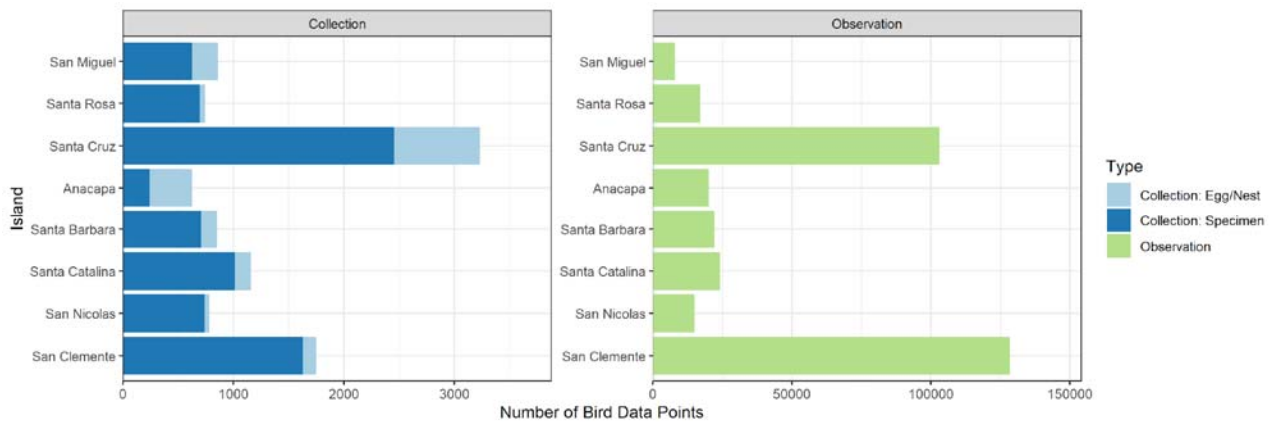


Figure Aves-4. The number of island bird specimens and observations sampled by month, by island, reveals seasonal gaps in the data. All data sources were combined for this analysis (Santa Barbara Museum of Natural History collections observations databases, Cal-IBIS, eBird, and iNaturalist).

Figure Aves-5 shows the number of bird specimens by collection type and island. It shows that eggs are a larger than average proportion of specimens on Santa Cruz and Anacapa Islands, and a smaller than average proportion on San Nicolas and Santa Rosa Islands. The collections data normalized by island area show that Anacapa and Santa Barbara Islands are relatively well-sampled, whereas Santa Rosa and Santa Catalina are particularly under-sampled for their size. Anacapa and Santa Barbara are again well represented in observation data, with Santa Cruz and San Clemente Islands ahead of the pack again due to larger size and relative accessibility (Cruz) and biologists active on digital platforms (Clemente).

Figures Aves-6 and Aves-7 show the distribution of iNaturalist and eBird data, respectively. These maps show that digital biodiversity platforms by these are limited by the accessibility of these locations. For instance, transportation is extremely limited on Santa Rosa Island, and most observation points are located near to Becher’s Bay, which is not far from camping and housing options and is where visitors enter the island. San Miguel Island is another example of one that is difficult to access. On the other hand, Santa Catalina is relatively accessible, and these platforms tend to show good spatial coverage. One other problem with these digital citizen science data is that not all data are georeferenced, and sometimes show as an island centroid when this is the case. This can occur when old field notes are entered, and is evident in the maps of Santa Rosa Island.

(a)



(b)

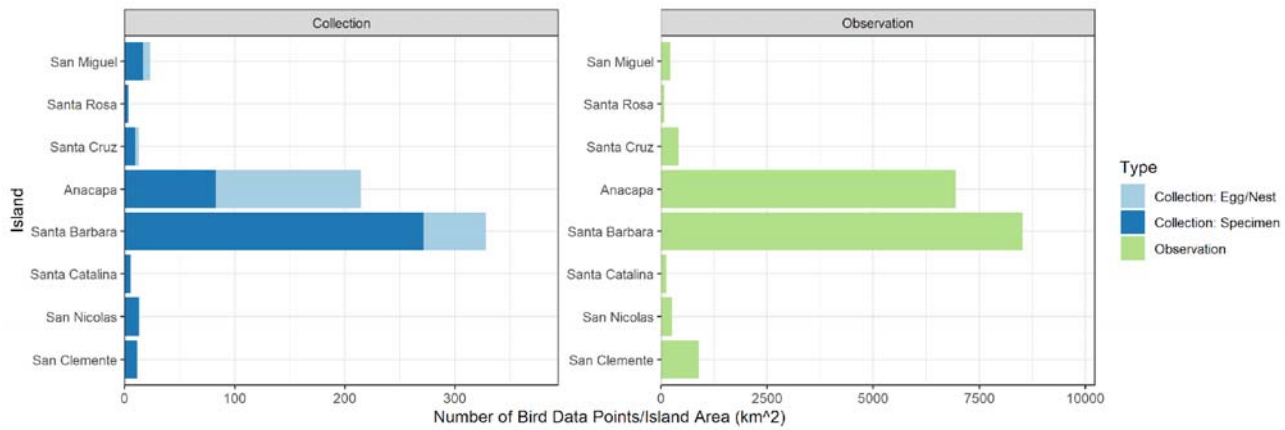
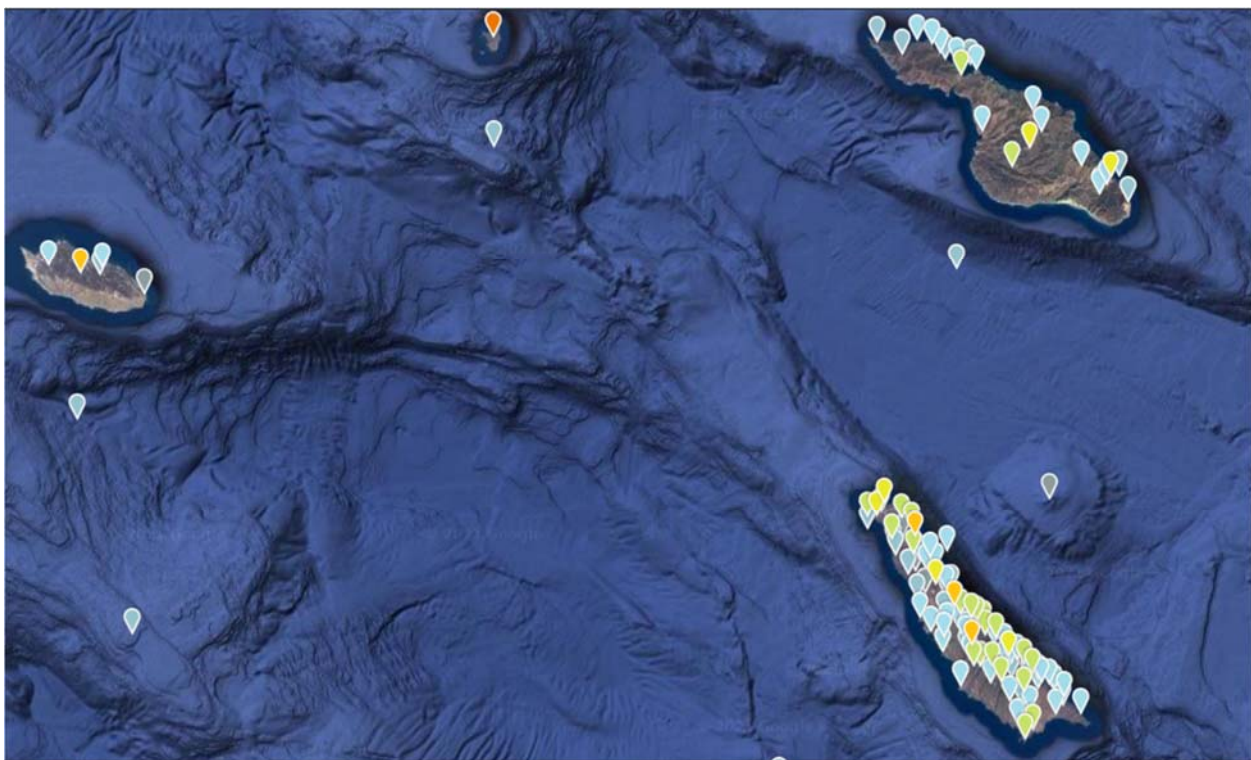


Figure Aves-5. The number of bird specimen data points by collection type and island. Figure (a) shows the absolute number and (b) proportional number/island size. Specimen collections are represented by the Cal-IBIS database for eggs and nests (light blue) and the SBMNH Collections database (darker blue).



(a)



(b)

Figure Aves-7. Distribution of eBird bird observations reveals spatial data gaps. Shown are: (a) the Northern Islands and (b) the Southern Islands.

Table **Aves-1** and **Figure Aves-8** show the spatial specimen collecting effect on the islands within 1 km grid cells. They show that there is a high (>88%) percentage of empty cells on the five largest islands (Santa Cruz, Santa Rosa, Santa Catalina, San Clemente, and San Nicolas), with the two smallest islands having the smallest percentage of empty cells, as would be expected (Anacapa at 29% and Santa Barbara at 46%), and San Miguel Island in between (at 74%). In general, the best sampled locations appear to be those that are easily accessible, including Prisoner’s Harbor and the Central Valley on Santa Cruz, Becher’s Bay on Santa Rosa, and developed areas on Santa Catalina, San Clemente, and San Nicolas islands. Birds have relatively good coverage of islets relative to other types of organisms, with both West Anacapa islet and Prince Islet (off of San Miguel) well sampled.

Table Aves-1. Spatial specimen collecting effort based on 1 km grid cells overlaid onto each of the eight California Channel Islands. While 3,896 Aves collection records had coordinates, only 3454 were used after removal of obvious island centroids.

Island	Island Collections	# of 1 km ² cells	Empty 1 km ² cells	% empty cells	Mean records/cell	Mean redundancy
Anacapa	132	14	4	28.6%	13.2	0.13
Santa Cruz	543	313	276	88.2%	14.7	0.66
Santa Rosa	25	263	249	94.7%	1.8	23.91
San Miguel	213	61	45	73.8%	13.3	0.34
Santa Catalina	85	250	230	92.0%	4.3	4.55
San Clemente	25	198	188	94.9%	2.5	14.14
San Nicolas	28	81	73	90.1%	3.5	4.05
Santa Barbara	50	11	5	45.5%	8.3	0.29

Table Aves-2 shows the number of specimens by type of collection, and reveals that the vast majority (77%) are non-egg specimens, whereas eggs and nests make up 23% of the specimens. Only the Western Foundation of Vertebrate Zoology eggs have been digitized, however, leaving several collections unaccounted for in these data.

Table Aves-2. Number of specimens by type of collection. All Egg/Nest data is from Cal-IBIS and all specimen data is from the SBMNH specimen database.

Bird Collection Type	n
Eggs/Nests	1,894
Specimens	8,110

Table Aves-3 shows the number of occurrence records for each island bird species by data source. There were over 340,000 occurrence records used in our analysis, and just over 280,000 of those records were from eBIRD. The majority of records are identified to species (99.98%), demonstrating great taxonomic resolution on collections and observations alike. There are few to no observation records for some of the endemic island subspecies. This may be because eBIRD does not have the option to identify below subspecies for many these endemic birds and some identifying traits may be hard to capture in a photograph.

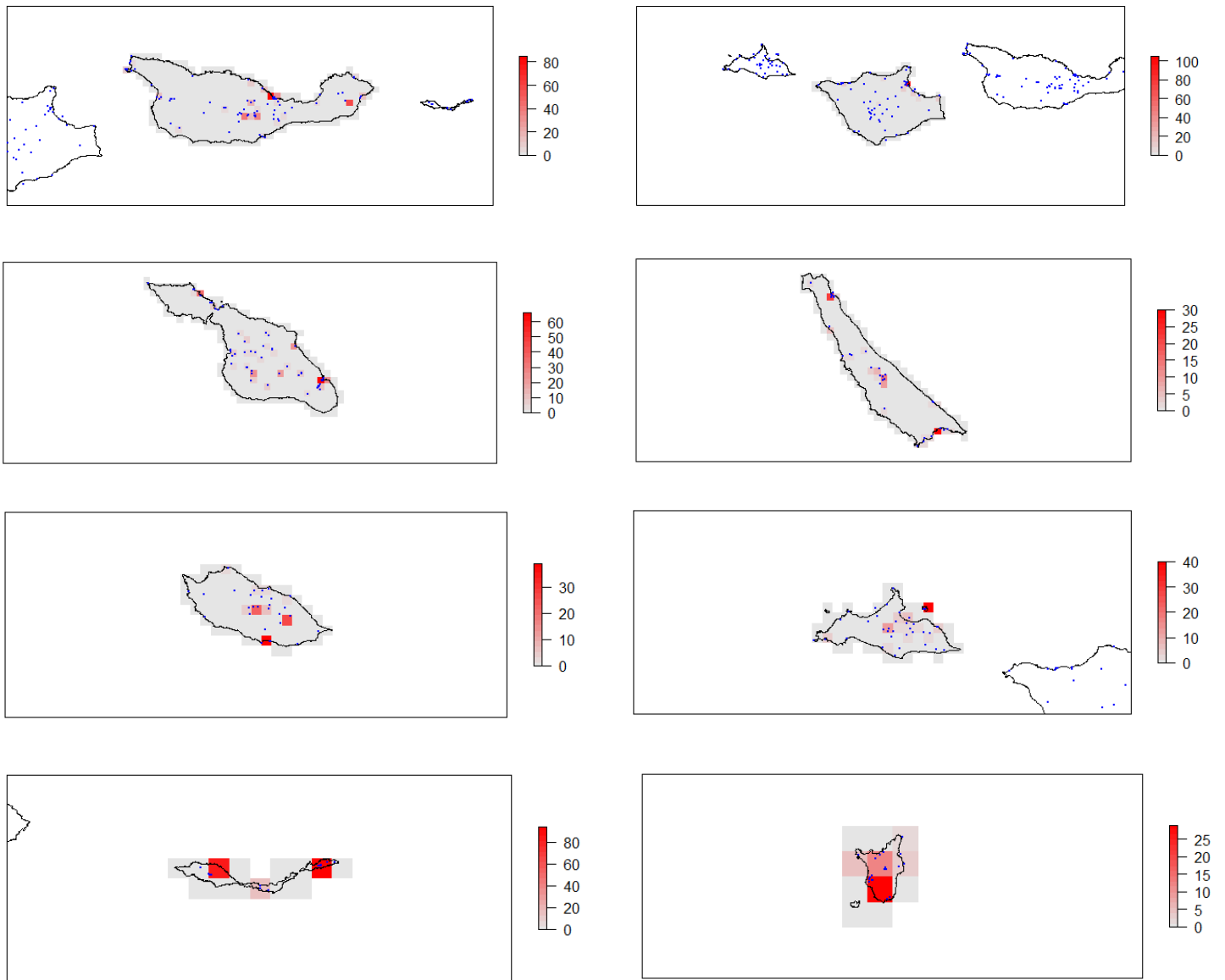


Figure Aves-8. Spatial specimen collecting effort based on 1 km grid cells overlaid onto each of the eight California Channel Islands. While 3,896 Aves collection records had coordinates, only 3454 were used after removal of obvious island centroids. Islands are shown (left to right, top to bottom) in decreasing order of size: Santa Cruz, Santa Rosa, Santa Catalina, San Clemente, San Nicolas, San Miguel, Anacapa, and Santa Barbara.

Table Aves-3. The number of occurrence records for each island bird species or subspecies by data source shows the relative proportion of specimens (Cal-IBIS Eggs; SBMNH Collections database) and observations (SBMNH Observations database, eBIRD and Research Grade iNaturalist) in each. The bird species are listed in phylogenetic order.

Order	Family	Species/Subspecies	Cal-IBIS (Eggs Only)	SBMNH Collections	SBMNH Observations	eBIRD	iNaturalist	total
Anseriformes	Anatidae	<i>Anser canagicus</i>	0	0	2	1	0	3
		<i>Anser caerulescens</i>	0	2	21	26	7	56
		<i>Anser rossii</i>	0	1	1	21	2	25
		<i>Anser anser</i>	0	0	0	0	1	1
		<i>Anser albifrons</i>	0	1	30	285	9	325
		<i>Branta bernicla</i>	0	0	68	217	4	289
		<i>Branta hutchinsii</i>	0	1	9	129	12	151
		<i>Branta canadensis</i>	0	0	46	20	1	67
		<i>Cygnus columbianus</i>	0	0	2	0	0	2
		<i>Aix sponsa</i>	0	0	6	0	0	6
		<i>Spatula discors</i>	0	0	27	125	1	153
		<i>Spatula cyanoptera</i>	0	1	36	209	2	248
		<i>Spatula clypeata</i>	0	1	9	83	3	96
		<i>Mareca strepera</i>	0	0	12	21	2	35
		<i>Mareca penelope</i>	0	0	0	9	0	9
		<i>Mareca americana</i>	0	3	61	105	3	172
		<i>Anas platyrhynchos</i>	0	0	129	1152	15	1296
		<i>Anas acuta</i>	0	5	67	401	6	479
		<i>Anas crecca</i>	0	1	69	480	5	555
		<i>Aythya valisineria</i>	0	0	1	6	1	8
		<i>Aythya americana</i>	0	0	2	15	2	19
		<i>Aythya collaris</i>	0	0	3	176	4	183
		<i>Aythya marila</i>	0	0	1	11	1	13
		<i>Aythya affinis</i>	0	0	11	49	3	63
		<i>Histrionicus histrionicus</i>	0	0	7	3	0	10
		<i>Melanitta perspicillata</i>	0	9	458	1499	26	1992
		<i>Melanitta fusca</i>	0	2	139	81	2	224
		<i>Melanitta americana</i>	0	0	17	10	0	27
		<i>Clangula hyemalis</i>	0	0	4	5	0	9
		<i>Bucephala albeola</i>	0	0	11	38	1	50
		<i>Bucephala clangula</i>	0	0	5	19	0	24
		<i>Lophodytes cucullatus</i>	0	0	1	5	1	7
		<i>Mergus merganser</i>	0	0	0	0	1	1
		<i>Mergus serrator</i>	0	1	78	194	2	275
<i>Oxyura jamaicensis</i>	0	2	28	629	9	668		

Order	Family	Species/Subspecies	Cal-IBIS (Eggs Only)	SBMNH Collections	SBMNH Observations	EBIRD	iNaturalist	total
Galliformes	Odontophoridae	<i>Callipepla californica californica</i>	0	6	0	0	0	6
Galliformes	Odontophoridae	<i>Callipepla californica catalinensis</i>	3	107	170	1303	77	1660
		<i>Callipepla gambelii</i>	0	6	0	1723	26	1755
	Phasianidae	<i>Meleagris gallopavo</i>	0	0	64	30	1	95
		<i>Phasianus colchicus</i>	0	1	13	1	0	15
		<i>Pavo cristatus</i>	0	0	21	2	0	23
		<i>Alectoris chukar</i>	0	12	4	2015	33	2064
Podicipediformes	Podicipedidae	<i>Podilymbus podiceps</i>	0	3	14	72	3	92
		<i>Podiceps auritus</i>	0	3	70	87	2	162
		<i>Podiceps grisegena</i>	0	0	6	6	1	13
		<i>Podiceps nigricollis</i>	0	24	228	1353	20	1625
		<i>Aechmophorus occidentalis</i>	0	3	222	874	7	1106
		<i>Aechmophorus clarkii</i>	0	0	34	80	2	116
Columbiformes	Columbidae	<i>Columba livia</i>	0	1	171	803	38	1013
		<i>Patagioenas fasciata</i>	0	3	65	158	1	227
		<i>Streptopelia roseogrisea</i>	0	0	2	0	0	2
		<i>Streptopelia decaocto</i>	0	0	151	1574	35	1760
		<i>Streptopelia chinensis</i>	0	0	5	358	21	384
		<i>Zenaida asiatica</i>	0	0	45	674	17	736
		<i>Zenaida macroura</i>	0	8	715	2811	24	3558
Cuculiformes	Cuculidae	<i>Coccyzus americanus</i>	0	2	4	5	1	12
		<i>Coccyzus erythrophthalmus</i>	0	1	0	1	0	2
Caprimulgiformes	Caprimulgidae	<i>Chordeiles acutipennis</i>	0	5	17	30	4	56
		<i>Chordeiles minor</i>	0	0	2	0	0	2
		<i>Phalaenoptilus nuttallii</i>	0	7	86	147	6	246
Apodiformes	Apodidae	<i>Cypseloides niger</i>	0	0	3	3	0	6
		<i>Chaetura pelagica</i>	0	0	0	8	2	10
		<i>Chaetura vauxi</i>	0	0	33	124	5	162
		<i>Aeronautes saxatalis</i>	0	11	295	1265	10	1581
	Trochilidae	<i>Archilochus colubris</i>	0	0	0	3	1	4
		<i>Archilochus alexandri</i>	0	0	13	12	0	25
		<i>Calypte anna</i>	2	27	357	3365	62	3813
		<i>Calypte costae</i>	0	2	40	123	4	169
		<i>Selasphorus calliope</i>	0	0	2	2	2	6
		<i>Selasphorus rufus</i>	0	4	37	85	3	129
		<i>Selasphorus sasin</i>	9	8	503	5181	40	5741
		<i>Selasphorus sasin sedentarius</i>	0	153	2	0	13	168
Gruiformes	Rallidae	<i>Rallus limicola</i>	0	2	41	85	2	130

Order	Family	Species/Subspecies	Cal-IBIS (Eggs Only)	SBMNH Collections	SBMNH Observations	EBIRD	iNaturalist	total
		<i>Porzana carolina</i>	0	2	31	136	5	174
		<i>Fulica americana</i>	0	2	92	896	10	1000
	Gruidae	<i>Antigone canadensis</i>	0	0	1	1	0	2
Charadriiformes	Recurvirostridae	<i>Himantopus mexicanus</i>	0	0	18	34	1	53
		<i>Recurvirostra americana</i>	0	2	4	31	2	39
	Haematopodidae	<i>Haematopus palliatus</i>	0	2	258	206	18	484
		<i>Haematopus bachmani</i>	37	51	955	3009	58	4110
	Charadriidae	<i>Pluvialis squatarola</i>	0	15	384	940	3	1342
		<i>Pluvialis dominica</i>	0	0	7	3	1	11
		<i>Pluvialis fulva</i>	0	3	8	161	9	181
		<i>Charadrius vociferus</i>	1	5	409	1107	24	1546
		<i>Charadrius semipalmatus</i>	0	8	78	495	11	592
		<i>Charadrius montanus</i>	0	7	6	0	0	13
		<i>Charadrius nivosus</i>	2	23	372	1271	29	1697
	Scolopacidae	<i>Bartramia longicauda</i>	0	0	2	1	0	3
		<i>Numenius phaeopus</i>	0	6	491	1427	12	1936
		<i>Numenius americanus</i>	0	0	129	86	5	220
		<i>Limosa fedoa</i>	0	2	105	128	0	235
		<i>Arenaria interpres</i>	0	33	158	317	3	511
		<i>Arenaria melanocephala</i>	0	105	574	1280	20	1979
		<i>Calidris canutus</i>	0	1	4	5	0	10
		<i>Calidris virgata</i>	0	7	54	56	1	118
		<i>Calidris pugnax</i>	0	0	0	1	0	1
		<i>Calidris acuminata</i>	0	0	0	1	0	1
		<i>Calidris alba</i>	0	29	337	1014	8	1388
		<i>Calidris alpina</i>	0	5	41	123	4	173
		<i>Calidris bairdii</i>	0	1	15	295	12	323
		<i>Calidris minutilla</i>	0	16	148	585	10	759
		<i>Calidris subruficollis</i>	0	0	2	38	2	42
		<i>Calidris melanotos</i>	0	8	36	270	12	326
		<i>Calidris pusilla</i>	0	0	0	1	0	1
		<i>Calidris mauri</i>	0	9	150	513	5	677
		<i>Limnodromus griseus</i>	0	0	14	59	3	76
		<i>Limnodromus scolopaceus</i>	0	5	66	196	11	278
		<i>Gallinago delicata</i>	0	1	46	208	8	263
		<i>Actitis macularius</i>	0	8	132	906	32	1078
		<i>Tringa solitaria</i>	0	2	15	105	5	127
		<i>Tringa incana</i>	0	98	556	993	25	1672

Order	Family	Species/Subspecies	Cal-IBIS (Eggs Only)	SBMNH Collections	SBMNH Observations	EBIRD	iNaturalist	total
		<i>Tringa flavipes</i>	0	1	7	42	3	53
		<i>Tringa semipalmata</i>	0	3	333	395	7	738
		<i>Tringa melanoleuca</i>	0	1	73	374	5	453
		<i>Phalaropus tricolor</i>	0	1	4	25	3	33
		<i>Phalaropus lobatus</i>	0	25	163	337	8	533
Charadriiformes	Scolopacidae	<i>Phalaropus fulicarius</i>	0	36	112	110	2	260
	Stercorariidae	<i>Stercorarius macormicki</i>	0	0	51	8	1	60
		<i>Stercorarius pomarinus</i>	0	1	73	328	14	416
		<i>Stercorarius parasiticus</i>	0	0	59	330	3	392
		<i>Stercorarius longicaudus</i>	0	0	11	11	4	26
	Alcidae	<i>Uria aalge</i>	57	16	126	282	12	493
		<i>Cephus columba</i>	60	63	621	1703	53	2500
		<i>Brachyramphus marmoratus</i>	0	0	4	1	0	5
		<i>Synthliboramphus scrippsi</i>	152	140	215	268	14	789
		<i>Synthliboramphus hypoleucus</i>	0	7	11	0	0	18
		<i>Synthliboramphus craveri</i>	0	0	6	3	3	12
		<i>Synthliboramphus antiquus</i>	0	11	17	9	3	40
		<i>Ptychoramphus aleuticus</i>	77	213	181	574	11	1056
		<i>Cerorhinca monocerata</i>	0	68	142	150	8	368
		<i>Fratercula corniculata</i>	0	1	19	0	0	20
		<i>Fratercula cirrhata</i>	6	8	52	0	0	66
	Laridae	<i>Rissa tridactyla</i>	0	8	41	120	1	170
		<i>Xema sabini</i>	0	3	20	8	2	33
		<i>Chroicocephalus philadelphia</i>	0	8	87	66	5	166
		<i>Leucophaeus atricilla</i>	0	1	0	1	0	2
		<i>Leucophaeus pipixcan</i>	0	0	5	3	0	8
		<i>Larus heermanni</i>	0	44	338	3022	37	3441
		<i>Larus canus</i>	0	3	65	142	3	213
		<i>Larus delawarensis</i>	0	0	88	55	6	149
		<i>Larus occidentalis</i>	297	123	565	9976	307	11268
		<i>Larus californicus</i>	0	14	186	2353	22	2575
		<i>Larus argentatus</i>	0	2	78	374	8	462
		<i>Larus argentatus smithsonianus</i>	0	2	0	0	0	2
		<i>Larus glaucoides</i>	0	0	19	61	2	82
		<i>Larus glaucescens</i>	0	2	103	382	10	497
		<i>Larus hyperboreus</i>	0	0	9	9	1	19
		<i>Hydroprogne caspia</i>	0	0	18	179	8	205
		<i>Chlidonias niger</i>	0	0	7	2	0	9

Order	Family	Species/Subspecies	Cal-IBIS (Eggs Only)	SBMNH Collections	SBMNH Observations	EBIRD	iNaturalist	total
		<i>Sterna hirundo</i>	0	0	18	17	3	38
		<i>Sterna paradisaea</i>	0	1	9	5	0	15
		<i>Sterna forsteri</i>	0	0	42	30	1	73
		<i>Thalasseus maximus</i>	0	24	250	2580	27	2881
		<i>Thalasseus elegans</i>	0	0	46	293	8	347
		<i>Rynchops niger</i>	0	0	4	18	1	23
Phaethontiformes	Phaethontidae	<i>Phaethon aethereus</i>	0	1	26	25	4	56
Gaviiformes	Gaviidae	<i>Gavia stellata</i>	0	1	82	116	2	201
		<i>Gavia pacifica</i>	0	14	255	846	16	1131
		<i>Gavia immer</i>	0	2	191	511	13	717
Procellariiformes	Diomedeidae	<i>Phoebastria immutabilis</i>	0	1	7	1	0	9
		<i>Phoebastria nigripes</i>	0	2	17	11	3	33
		<i>Phoebastria albatrus</i>	0	2	4	2	0	8
	Oceanitidae	<i>Oceanites oceanicus</i>	0	0	2	1	0	3
	Hydrobatidae	<i>Hydrobates furcatus</i>	0	1	6	0	0	7
		<i>Hydrobates leucorhous</i>	0	7	17	11	2	37
		<i>Hydrobates socorroensis</i>	0	0	2	0	0	2
		<i>Hydrobates homochroa</i>	483	67	98	94	2	744
		<i>Hydrobates melania</i>	0	7	46	14	3	70
		<i>Hydrobates microsoma</i>	0	0	15	2	0	17
	Procellariidae	<i>Fulmarus glacialis</i>	0	23	87	242	14	366
		<i>Pterodroma ultima</i>	0	0	0	1	0	1
		<i>Pterodroma cookii</i>	0	0	0	0	2	2
		<i>Bulweria fallax</i>	0	0	1	2	0	3
		<i>Ardenna bulleri</i>	0	0	20	64	1	85
		<i>Ardenna tenuirostris</i>	0	1	9	17	1	28
		<i>Ardenna grisea</i>	0	0	143	904	9	1056
		<i>Ardenna creatopus</i>	0	17	138	528	8	691
		<i>Ardenna carneipes</i>	0	0	6	11	0	17
		<i>Puffinus puffinus</i>	0	0	16	3	1	20
		<i>Puffinus opisthomelas</i>	0	13	79	832	15	939
Suliformes	Fregatidae	<i>Fregata magnificens</i>	0	0	8	0	0	8
	Sulidae	<i>Sula dactylatra</i>	0	0	9	178	11	198
		<i>Sula granti</i>	0	0	6	153	6	165
		<i>Sula nebouxii</i>	0	0	46	375	18	439
		<i>Sula leucogaster</i>	0	0	153	801	64	1018
		<i>Sula sula</i>	0	0	3	3	3	9
	Phalacrocoracidae	<i>Urile penicillatus</i>	56	48	594	6511	128	7337

Order	Family	Species/Subspecies	Cal-IBIS (Eggs Only)	SBMNH Collections	SBMNH Observations	EBIRD	iNaturalist	total
		<i>Urile pelagicus</i>	20	0	0	0	0	20
		<i>Urile pelagicus resplendens</i>	0	32	479	2969	33	3513
		<i>Nannopterum auritum</i>	33	9	431	3015	38	3526
Pelecaniformes	Pelecanidae	<i>Pelecanus erythrorhynchos</i>	0	0	9	0	0	9
		<i>Pelecanus occidentalis</i>	173	14	769	6706	209	7871
	Ardeidae	<i>Botaurus lentiginosus</i>	0	0	1	11	2	14
		<i>Ardea herodias</i>	0	9	361	1695	66	2131
		<i>Ardea alba</i>	0	1	39	249	16	305
		<i>Egretta thula</i>	0	0	45	159	7	211
Pelecaniformes	Ardeidae	<i>Egretta caerulea</i>	0	0	0	5	1	6
		<i>Egretta tricolor</i>	0	0	0	1	0	1
		<i>Bubulcus ibis</i>	0	1	52	72	2	127
		<i>Butorides virescens</i>	1	0	20	25	1	47
		<i>Nycticorax nycticorax</i>	0	0	16	227	47	290
		<i>Nyctanassa violacea</i>	0	0	0	11	3	14
	Threskiornithidae	<i>Plegadis chihi</i>	0	0	8	45	2	55
Cathartiformes	Cathartidae	<i>Cathartes aura</i>	0	0	62	135	0	197
Accipitriformes	Pandionidae	<i>Pandion haliaetus</i>	14	9	189	1580	71	1863
	Accipitridae	<i>Elanus leucurus</i>	1	0	91	485	9	586
		<i>Aquila chrysaetos</i>	7	0	106	15	0	128
		<i>Circus hudsonius</i>	0	1	532	912	17	1462
		<i>Accipiter striatus</i>	0	7	199	581	10	797
		<i>Accipiter cooperii</i>	0	1	151	272	1	425
		<i>Accipiter gentilis</i>	0	0	2	0	0	2
		<i>Haliaeetus leucocephalus</i>	92	20	285	1288	89	1774
		<i>Parabuteo unicinctus</i>	0	0	0	0	1	1
		<i>Buteo lineatus</i>	0	0	9	2	1	12
		<i>Buteo platypterus</i>	0	0	1	39	2	42
		<i>Buteo swainsoni</i>	0	0	8	0	0	8
		<i>Buteo jamaicensis</i>	2	8	559	3495	65	4129
		<i>Buteo lagopus</i>	0	0	10	14	3	27
		<i>Buteo regalis</i>	0	0	1	0	0	1
Strigiformes	Tytonidae	<i>Tyto alba</i>	0	38	460	541	11	1050
	Strigidae	<i>Psiloscoops flammeolus</i>	0	1	1	0	0	2
		<i>Bubo virginianus</i>	0	0	6	0	0	6
		<i>Athene cunicularia</i>	0	52	531	762	24	1369
		<i>Asio otus</i>	0	3	49	63	4	119
		<i>Asio flammeus</i>	0	3	204	84	5	296

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		<i>Aegolius acadicus</i>	1	5	92	201	5	304
Coraciiformes	Alcedinidae	<i>Megaceryle alcyon</i>	0	7	168	643	13	831
Piciformes	Picidae	<i>Jynx torquilla</i>	0	0	0	1	0	1
		<i>Melanerpes lewis</i>	0	4	47	32	2	85
		<i>Melanerpes formicivorus</i>	0	11	217	2765	121	3114
		<i>Sphyrapicus varius</i>	0	1	5	9	0	15
		<i>Sphyrapicus nuchalis</i>	0	2	8	13	0	23
		<i>Sphyrapicus ruber</i>	0	11	90	144	1	246
		<i>Dryobates pubescens</i>	0	0	3	0	0	3
		<i>Dryobates nuttallii</i>	0	0	38	0	0	38
		<i>Colaptes auratus</i>	0	61	535	3851	38	4485
Falconiformes	Falconidae	<i>Caracara plancus</i>	0	0	9	7	1	17
		<i>Falco sparverius</i>	2	28	883	5698	51	6662
		<i>Falco columbarius</i>	0	2	158	611	10	781
		<i>Falco peregrinus</i>	82	9	985	2441	46	3563
		<i>Falco mexicanus</i>	0	0	15	3	0	18
Passeriformes	Tyrannidae	<i>Myiarchus tuberculifer</i>	0	0	2	3	2	7
		<i>Myiarchus cinerascens</i>	0	14	284	953	14	1265
		<i>Tyrannus melancholicus</i>	0	0	1	10	1	12
		<i>Tyrannus vociferans</i>	0	1	20	116	4	141
		<i>Tyrannus crassirostris</i>	0	0	0	1	0	1
		<i>Tyrannus verticalis</i>	0	13	150	750	7	920
		<i>Tyrannus tyrannus</i>	0	0	6	27	5	38
		<i>Tyrannus forficatus</i>	0	0	8	11	0	19
		<i>Contopus cooperi</i>	0	0	71	183	4	258
		<i>Contopus sordidulus</i>	0	9	111	598	8	726
		<i>Contopus virens</i>	0	0	1	0	0	1
		<i>Empidonax traillii</i>	0	10	52	261	3	326
		<i>Empidonax minimus</i>	0	1	3	21	2	27
		<i>Empidonax hammondii</i>	0	2	12	113	6	133
		<i>Empidonax wrightii</i>	0	1	7	78	1	87
		<i>Empidonax oberholseri</i>	0	1	7	20	0	28
		<i>Empidonax difficilis</i>	4	43	260	3114	47	3468
		<i>Empidonax difficilis difficilis</i>	0	14	0	0	0	14
		<i>Empidonax difficilis insulicola</i>	0	81	213	0	3	297
		<i>Sayornis nigricans</i>	4	1	733	4859	55	5652
		<i>Sayornis nigricans semiater</i>	0	44	0	0	0	44
		<i>Sayornis phoebe</i>	0	0	5	16	2	23

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		<i>Sayornis saya</i>	0	12	447	3572	49	4080
		<i>Sayornis saya saya</i>	0	30	0	0	0	30
		<i>Pyrocephalus rubinus</i>	0	0	6	92	9	107
	Vireonidae	<i>Vireo bellii</i>	0	0	1	24	3	28
		<i>Vireo bellii pusillus</i>	0	0	5	0	0	5
		<i>Vireo vicinior</i>	0	1	3	7	1	12
		<i>Vireo huttoni</i>	0	110	294	1599	6	2009
		<i>Vireo flavifrons</i>	0	0	0	5	1	6
		<i>Vireo cassinii</i>	0	3	8	148	3	162
		<i>Vireo solitarius</i>	0	1	10	6	0	17
		<i>Vireo plumbeus</i>	0	1	6	15	0	22
		<i>Vireo philadelphicus</i>	0	0	1	4	0	5
		<i>Vireo gilvus</i>	0	19	168	1400	10	1597
Passeriformes	Vireonidae	<i>Vireo olivaceus</i>	0	0	1	15	2	18
		<i>Vireo flavoviridis</i>	0	0	1	3	0	4
	Laniidae	<i>Lanius ludovicianus anthonyi</i>	8	137	542	0	67	754
		<i>Lanius ludovicianus mearnsi</i>	6	69	0	3625	117	3817
	Corvidae	<i>Gymnorhinus cyanocephalus</i>	0	0	0	2	0	2
		<i>Aphelocoma insularis</i>	56	489	182	4177	43	4947
		<i>Nucifraga columbiana</i>	0	5	15	6	0	26
		<i>Pica hudsonia</i>	0	0	42	4	0	46
		<i>Pica nuttalli</i>	0	0	1	0	0	1
		<i>Corvus brachyrhynchos</i>	0	0	19	408	4	431
		<i>Corvus corax</i>	5	130	608	10118	230	11091
	Alaudidae	<i>Eremophila alpestris</i>	0	0	127	4863	42	5032
		<i>Eremophila alpestris insularis</i>	0	709	371	0	0	1080
	Hirundinidae	<i>Riparia riparia</i>	0	0	7	18	3	28
		<i>Tachycineta bicolor</i>	0	0	34	268	9	311
		<i>Tachycineta thalassina</i>	0	0	35	61	2	98
		<i>Stelgidopteryx serripennis</i>	0	0	30	96	5	131
		<i>Progne subis</i>	0	0	14	23	3	40
		<i>Hirundo rustica</i>	0	23	739	3232	42	4036
		<i>Petrochelidon pyrrhonota</i>	0	0	30	164	4	198
	Aegithalidae	<i>Psaltriparus minimus</i>	0	40	154	1119	2	1315
	Phylloscopidae	<i>Phylloscopus fuscatus</i>	0	0	0	2	2	4
	Zosteropidae	<i>Zosterops simplex</i>	0	0	0	8	0	8
	Regulidae	<i>Corthylio calendula</i>	0	23	301	2811	23	3158
		<i>Regulus satrapa</i>	0	6	44	71	4	125

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	Bombycillidae	<i>Bombycilla cedrorum</i>	0	3	98	834	13	948
	Ptilonotidae	<i>Phainopepla nitens</i>	0	2	60	316	8	386
	Sittidae	<i>Sitta canadensis</i>	0	31	178	519	12	740
		<i>Sitta carolinensis</i>	0	1	18	6	0	25
		<i>Sitta pygmaea</i>	0	0	1	0	0	1
	Certhiidae	<i>Certhia americana</i>	0	1	18	16	2	37
	Poliophtilidae	<i>Poliophtila caerulea</i>	0	31	162	946	7	1146
	Troglodytidae	<i>Salpinctes obsoletus</i>	0	210	555	3706	44	4515
		<i>Catherpes mexicanus</i>	0	1	51	68	1	121
		<i>Troglodytes aedon</i>	0	16	223	1734	9	1982
		<i>Troglodytes pacificus</i>	0	4	27	21	0	52
		<i>Cistothorus platensis</i>	0	0	0	4	2	6
		<i>Cistothorus palustris</i>	0	2	18	73	3	96
		<i>Thryomanes bewickii</i>	5	29	190	3622	37	3883
		<i>Thryomanes bewickii catalinae</i>	0	54	0	0	0	54
Passeriformes	Troglodytidae	<i>Thryomanes bewickii leucophrys</i>	0	225	0	0	0	225
		<i>Thryomanes bewickii nesophilus</i>	0	186	379	0	5	570
	Mimidae	<i>Dumetella carolinensis</i>	0	0	4	31	4	39
		<i>Toxostoma rufum</i>	0	1	2	14	1	18
		<i>Toxostoma bendirei</i>	0	0	1	6	0	7
		<i>Oreoscoptes montanus</i>	0	6	49	812	8	875
		<i>Mimus polyglottos</i>	1	63	430	3855	89	4438
	Sturnidae	<i>Sturnus vulgaris</i>	2	23	631	4837	32	5525
	Cinclidae	<i>Cinclus mexicanus</i>	0	0	6	0	0	6
	Turdidae	<i>Sialia mexicana</i>	0	1	21	20	1	43
		<i>Sialia currucoides</i>	0	12	65	260	9	346
		<i>Myadestes townsendi</i>	0	1	17	161	4	183
		<i>Catharus ustulatus</i>	0	10	34	609	5	658
		<i>Catharus guttatus</i>	0	21	314	2529	19	2883
		<i>Catharus guttatus auduboni</i>	0	2	0	0	0	2
		<i>Catharus guttatus guttatus</i>	0	44	0	0	0	44
		<i>Catharus guttatus nanus</i>	0	49	0	0	0	49
		<i>Catharus guttatus slevini</i>	0	2	0	0	0	2
		<i>Turdus migratorius</i>	0	14	195	1126	12	1347
		<i>Ixoreus naevius</i>	0	8	159	323	5	495
	Muscicapidae	<i>Cyanecula svecica</i>	0	0	0	9	1	10
		<i>Tarsiger cyanurus</i>	0	1	0	2	2	5
		<i>Saxicola maurus</i>	0	0	0	2	0	2

Order	Family	Species/Subspecies	Cal-IBIS (Eggs Only)	SBMNH Collections	SBMNH Observations	EBIRD	iNaturalist	total
		<i>Oenanthe oenanthe</i>	0	0	0	7	2	9
	Estrildidae	<i>Lonchura punctulata</i>	0	0	3	7	4	14
	Passeridae	<i>Passer domesticus</i>	0	3	100	2039	27	2169
	Motacillidae	<i>Motacilla alba</i>	0	0	0	8	3	11
		<i>Anthus cervinus</i>	0	0	5	94	8	107
		<i>Anthus rubescens</i>	0	7	130	784	15	936
		<i>Anthus spragueii</i>	0	0	1	3	0	4
	Fringillidae	<i>Coccothraustes vespertinus</i>	0	0	5	1	0	6
		<i>Haemorhous mexicanus</i>	0	0	1	0	0	1
		<i>Haemorhous mexicanus clementis</i>	45	539	222	0	61	867
		<i>Haemorhous mexicanus frontalis</i>	15	324	493	10322	41	11195
		<i>Haemorhous purpureus</i>	0	0	108	187	9	304
		<i>Haemorhous purpureus californicus</i>	0	7	0	0	0	7
		<i>Haemorhous purpureus purpureus</i>	0	1	0	0	0	1
		<i>Haemorhous cassinii</i>	0	1	1	11	4	17
		<i>Acanthis flammea</i>	0	0	0	5	2	7
		<i>Loxia curvirostra</i>	0	26	41	26	0	93
Passeriformes	Fringillidae	<i>Carduelis carduelis</i>	0	0	0	1	0	1
		<i>Spinus pinus</i>	0	2	62	266	15	345
		<i>Spinus psaltria</i>	1	30	481	2595	17	3124
		<i>Spinus lawrencei</i>	0	1	56	195	8	260
		<i>Spinus tristis</i>	0	0	65	83	0	148
	Calcariidae	<i>Calcarius lapponicus</i>	0	1	4	150	11	166
		<i>Calcarius ornatus</i>	0	0	0	64	2	66
		<i>Calcarius pictus</i>	0	0	0	2	1	3
		<i>Plectrophenax nivalis</i>	0	0	0	15	0	15
	Passerellidae	<i>Peucaea cassinii</i>	0	0	0	6	2	8
		<i>Ammodramus savannarum</i>	0	0	97	170	4	271
		<i>Amphispiza bilineata</i>	0	0	7	117	4	128
		<i>Chondestes grammacus</i>	0	5	144	537	10	696
		<i>Calamospiza melanocorys</i>	0	1	3	106	6	116
		<i>Spizella passerina</i>	1	70	521	1723	20	2335
		<i>Spizella pallida</i>	0	0	38	347	11	396
		<i>Spizella atrogularis</i>	0	2	4	33	3	42
		<i>Spizella breweri</i>	0	2	25	337	5	369
		<i>Passerella iliaca</i>	0	113	168	1067	25	1373
		<i>Spizelloides arborea</i>	0	0	5	9	0	14
		<i>Junco hyemalis</i>	0	27	282	1610	15	1934

Order	Family	Species/Subspecies	Cal-IBIS (Eggs Only)	SBMNH Collections	SBMNH Observations	EBIRD	iNaturalist	total		
Passeriformes	Passerellidae	<i>Zonotrichia leucophrys</i>	0	93	411	4805	64	5373		
		<i>Zonotrichia atricapilla</i>	0	49	232	1761	16	2058		
		<i>Zonotrichia querula</i>	0	1	8	19	2	30		
		<i>Zonotrichia albicollis</i>	0	1	23	132	4	160		
		<i>Artemisiospiza nevadensis</i>	0	1	0	0	0	1		
		<i>Artemisiospiza belli</i>	0	0	10	0	50	60		
		<i>Artemisiospiza belli clementeae</i>	1	121	0	2805	2	2929		
		<i>Pooecetes gramineus</i>	0	1	40	669	17	727		
		<i>Passerculus sandwichensis</i>	0	11	474	1794	22	2301		
		<i>Passerculus sandwichensis alaudinus</i>	0	19	3	0	0	22		
		<i>Passerculus sandwichensis anthinus</i>	0	8	3	0	0	11		
		<i>Passerculus sandwichensis brooksi</i>	0	8	4	0	0	12		
		<i>Passerculus sandwichensis nevadensis</i>	0	5	2	0	0	7		
		<i>Passerculus sandwichensis rostratus</i>	0	9	10	0	0	19		
		<i>Melospiza melodia graminea</i>	29	279	582	3296	79	4265		
		<i>Melospiza lincolni</i>	0	30	102	1234	13	1379		
		<i>Melospiza georgiana</i>	0	1	13	21	0	35		
		<i>Aimophila ruficeps obscura</i>	0	116	216	946	2	1280		
		<i>Pipilo chlorurus</i>	0	1	49	368	8	426		
		<i>Pipilo maculatus</i>	0	0	104	0	0	104		
		<i>Pipilo maculatus clementae</i>	6	42	1	4497	31	4577		
		<i>Pipilo maculatus crucis</i>	1	119	205	0	47	372		
		<i>Pipilo maculatus megalonyx</i>	0	8	0	0	0	8		
		<i>Pipilo maculatus oregonus</i>	0	2	0	0	0	2		
		<i>Pipilo maculatus rosae</i>	1	8	181	0	9	199		
		Icteriidae		<i>Icteria virens</i>	0	1	28	56	6	91
		Icteridae		<i>Xanthocephalus xanthocephalus</i>	0	4	81	420	16	521
				<i>Dolichonyx oryzivorus</i>	0	1	15	227	11	254
				<i>Sturnella neglecta</i>	2	63	620	6641	49	7375
				<i>Icterus spurius</i>	0	0	7	17	2	26
				<i>Icterus cucullatus</i>	0	4	70	857	35	966
				<i>Icterus bullockii</i>	0	2	24	640	10	676
				<i>Icterus galbula</i>	0	4	41	90	5	140
		<i>Icterus parisorum</i>	0	0	8	49	4	61		
		<i>Agelaius phoeniceus</i>	0	15	157	376	8	556		
		<i>Agelaius tricolor</i>	0	2	14	18	3	37		
		<i>Molothrus aeneus</i>	0	0	1	1	0	2		
		<i>Molothrus ater</i>	0	26	202	1697	25	1950		

Order	Family	Species/Subspecies	Cal-IBIS (Eggs Only)	SBMNH Collections	SBMNH Observations	EBIRD	iNaturalist	total
		<i>Euphagus carolinus</i>	0	4	12	42	8	66
		<i>Euphagus cyanocephalus</i>	0	5	172	741	8	926
		<i>Quiscalus mexicanus</i>	0	0	10	7	1	18
	Parulidae	<i>Seiurus aurocapilla</i>	0	1	6	73	2	82
		<i>Helmitheros vermivorum</i>	0	0	0	1	0	1
		<i>Parkesia noveboracensis</i>	0	1	11	66	2	80
		<i>Vermivora chrysoptera</i>	0	0	0	2	0	2
		<i>Mniotilta varia</i>	0	0	7	118	9	134
		<i>Protonotaria citrea</i>	0	0	0	15	3	18
		<i>Leiothlypis peregrina</i>	0	5	37	219	10	271
		<i>Leiothlypis celata</i>	30	35	207	7649	59	7980
		<i>Leiothlypis celata sordida</i>	0	279	676	0	0	955
		<i>Leiothlypis luciae</i>	0	0	2	34	9	45
		<i>Leiothlypis ruficapilla</i>	0	0	57	561	8	626
		<i>Leiothlypis virginiae</i>	0	0	9	91	4	104
		<i>Oporornis agilis</i>	0	0	2	9	3	14
		<i>Geothlypis tolmiei</i>	0	9	36	332	0	377
		<i>Geothlypis philadelphia</i>	0	0	1	0	0	1
		<i>Geothlypis formosa</i>	0	0	13	2	0	15
		<i>Geothlypis trichas</i>	0	13	282	1327	4	1626
		<i>Setophaga citrina</i>	0	0	1	24	0	25
Passeriformes	Parulidae	<i>Setophaga ruticilla</i>	0	2	22	228	17	269
		<i>Setophaga tigrina</i>	0	0	2	32	6	40
		<i>Setophaga americana</i>	0	0	5	72	8	85
		<i>Setophaga magnolia</i>	0	4	5	99	4	112
		<i>Setophaga castanea</i>	0	0	2	30	3	35
		<i>Setophaga fusca</i>	0	1	2	44	3	50
		<i>Setophaga petechia</i>	0	15	100	1357	7	1479
		<i>Setophaga petechia brewsteri</i>	0	4	144	0	0	148
		<i>Setophaga pensylvanica</i>	0	1	6	58	8	73
		<i>Setophaga striata</i>	0	1	23	113	2	139
		<i>Setophaga caerulescens</i>	0	1	13	42	4	60
		<i>Setophaga palmarum</i>	0	4	52	297	15	368
		<i>Setophaga coronata</i>	0	39	353	4376	46	4814
		<i>Setophaga dominica</i>	0	0	3	12	2	17
		<i>Setophaga discolor</i>	0	0	3	55	3	61
		<i>Setophaga graciae</i>	0	0	2	0	0	2
		<i>Setophaga nigrescens</i>	0	7	106	737	13	863

Order	Family	Species/Subspecies	Cal-IBIS (Eggs Only)	SBMNH Collections	SBMNH Observations	EBIRD	iNaturalist	total
		<i>Setophaga townsendi</i>	0	19	175	1424	19	1637
		<i>Setophaga occidentalis</i>	0	5	57	423	11	496
		<i>Setophaga virens</i>	0	0	3	19	2	24
		<i>Cardellina canadensis</i>	0	1	1	19	3	24
		<i>Cardellina pusilla</i>	0	25	203	1841	17	2086
		<i>Myioborus pictus</i>	0	0	5	5	0	10
	Cardinalidae	<i>Piranga rubra</i>	0	1	25	90	11	127
		<i>Piranga olivacea</i>	0	1	6	48	6	61
		<i>Piranga ludoviciana</i>	0	11	151	1996	28	2186
		<i>Cardinalis sinuatus</i>	0	0	1	3	0	4
		<i>Pheucticus ludovicianus</i>	0	5	21	306	16	348
		<i>Pheucticus melanocephalus</i>	0	12	285	1531	26	1854
		<i>Passerina caerulea</i>	0	2	34	134	7	177
		<i>Passerina amoena</i>	0	8	203	1081	15	1307
		<i>Passerina cyanea</i>	0	1	9	182	9	201
		<i>Passerina ciris</i>	0	1	4	20	3	28
		<i>Spiza americana</i>	0	0	2	49	2	53
		unidentified to species	1	1	2	5	52	61
		all Aves samples	1894	8110	46479	286032	5456	347971
		species diversity	38	253	395	400	338	437

Endemic and Rare Taxa

A list of endemic and rare land birds that we are analyzing gaps for individually is presented in **Table Aves-4**. Graphs of yearly trends for each of these taxa did not appear to reveal trends beyond those found in general above, and were removed from the report for simplicity. EBIRD data is often not recorded below species, so there is no EBIRD data for many of the endemic subspecies found on the Channel Islands.

Figure Aves-9 shows data points per island for *Accipiter gentilis* (Northern Goshawk), *Buteo swainsoni* (Swainson's Hawk), and *Circus cyaneus* (Northern Harrier). It shows that the Northern Goshawk and Swainson's Hawk are both quite rare on the islands, with the Northern Goshawk only observed (not collected) twice, both times on San Miguel Island, and Swainson's Hawk observed (not collected) on all of the Northern Islands, between one and three times. The Northern Harrier, in contrast, has been observed on the five northernmost islands between ~5 and 200 times. It has not been collected either, however.

Figure Aves-10 shows data points per island for *Aythya americana* (Redhead), *Branta bernicla* (Brant), and *Histrionicus histrionicus* (Harlequin Duck). It shows that the Redhead has been observed twice on Santa Rosa Island and observed 13 times on San Clemente Island. The Brant has been observed on all the islands, between six times and ~130 times. The greatest number of observations have been on Santa Cruz Island, which is both large and partially accessible, and San Clemente Island, which has resident biologists actively using the platform. The smallest number of Brant observations was on San Miguel, Santa Barbara, Santa Catalina, and San Nicolas Islands. The Harlequin Duck has been observed only rarely (3-4 times each) on San Miguel, Santa Cruz, and Anacapa Islands. None of these taxa have collected specimens.

Figure Aves-11 shows the number of *Selasphorus sasin sedentarius* (Allen's Hummingbird) data points by island. It reveals that this bird has been collected on five islands (the largest four: Santa Cruz, Santa Rosa, Santa Catalina, and San Clemente) plus Anacapa Island between 5-75 times each. There are also two recorded observations on Santa Cruz, which oddly has the fewest number of total data points, for the largest island with plenty of its preferred habitat, coastal scrub-forest.

Table Aves-4. Endemic and Rare Land Birds of the Channel Islands

Order	Family	Scientific Name	Common Name	Endemic	Listed
Accipitriformes	Accipitridae	<i>Accipiter gentilis</i>	Northern Goshawk		CSSC
Accipitriformes	Accipitridae	<i>Buteo swainsoni</i>	Swainson's Hawk		ST
Accipitriformes	Accipitridae	<i>Circus cyaneus</i>	Northern Harrier		CSSC
Anseriformes	Anatidae	<i>Aythya americana</i>	Redhead		CSSC
Anseriformes	Anatidae	<i>Branta bernicla</i>	Brant		CSSC
Anseriformes	Anatidae	<i>Histrionicus histrionicus</i>	Harlequin Duck		CSSC
Apodiformes	Trochilidae	<i>Selasphorus sasin sedentarius</i>	Allen's Hummingbird	X	
Charadriiformes	Alcidae	<i>Brachyramphus marmoratus</i>	Marbled Murrelet		SE, FT
Charadriiformes	Alcidae	<i>Ptychoramphus aleuticus</i>	Cassin's Auklet		CSSC
Charadriiformes	Alcidae	<i>Synthliboramphus scrippsi</i>	Scripps's Murrelet		ST
Charadriiformes	Charadriidae	<i>Charadrius montanus</i>	Mountain Plover		CSSC
Charadriiformes	Charadriidae	<i>Charadrius nivosus</i>	Western Snowy Plover		FT, CSSC
Charadriiformes	Laridae	<i>Chlidonias niger</i>	Black Tern		CSSC
Charadriiformes	Laridae	<i>Rhynchops niger</i>	Black Skimmer		CSSC
Cuculiformes	Culicidae	<i>Coccyzus americanus</i>	Western Yellow-billed Cuckoo		SE
Falconiformes	Falconidae	<i>Falco peregrinus</i>	American Peregrine Falcon		SCD, FE
Galliformes	Odontophoridae	<i>Callipepla californica catalinensis</i>	Catalina California Quail	X	CSSC
Gaviiformes	Gaviidae	<i>Gavia immer</i>	Common Loon		CSSC
Passeriformes	Alaudidae	<i>Eremophila alpestris insularis</i>	Channel Islands Horned Lark	X	
Passeriformes	Cardinalidae	<i>Piranga rubra</i>	Summer Tanager		CSSC
Passeriformes	Corvidae	<i>Aphelocoma insularis</i>	Island Scrub-Jay	X	

Order	Family	Scientific Name	Common Name	Endemic	Listed
Passeriformes	Emberizidae	<i>Aimophila ruficeps obscura</i>	Santa Cruz Island Rufous-crowned Sparrow	X	CSSC
Passeriformes	Emberizidae	<i>Ammodramus savannarum</i>	Grasshopper Sparrow		CSSC
Passeriformes	Passerellidae	<i>Artemisiospiza belli clementeae</i>	San Clemente Bell's Sparrow	X	FT
Passeriformes	Emberizidae	<i>Melospiza melodia graminea</i>	Channel Island Song Sparrow	X	CSSC
Passeriformes	Emberizidae	<i>Passerculus sandwichensis rostratus</i>	Large-billed Savannah Sparrow		CSSC
Passeriformes	Emberizidae	<i>Pipilo maculatus clementae</i>	San Clemente Spotted Towhee	X	CSSC
Passeriformes	Emberizidae	<i>Pipilo maculatus rosae</i>	Santa Rosa Spotted Towhee	X	
Passeriformes	Emberizidae	<i>Pipilo maculatus crucis</i>	Santa Cruz Spotted Towhee	X	
Passeriformes	Hirundinidae	<i>Progne subis</i>	Purple Martin		CSSC
Passeriformes	Hirundinidae	<i>Riparia riparia</i>	Bank Swallow		ST
Passeriformes	Icteridae	<i>Agelaius tricolor</i>	Tricolored Blackbird		CSSC
Passeriformes	Icteridae	<i>Xanthocephalus xanthocephalus</i>	Yellow-headed Blackbird		CSSC
Passeriformes	Laniidae	<i>Lanius ludovicianus anthonyi</i>	Island Loggerhead Shrike	X	CSSC
Passeriformes	Laniidae	<i>Lanius ludovicianus mearnsi</i>	San Clemente Loggerhead Shrike	X	FE, CSSC
Passeriformes	Parulidae	<i>Icteria virens</i>	Yellow-breasted Chat		CSSC
Passeriformes	Parulidae	<i>Leiothlypis celata sordida</i>	Dusky Orange-crowned Warbler	X	
Passeriformes	Parulidae	<i>Leiothlypis luciae</i>	Lucy's Warbler		CSSC
Passeriformes	Parulidae	<i>Setophaga petechia brewsteri</i>	Yellow Warbler		CSSC
Passeriformes	Troglodytidae	<i>Thryomanes bewickii catalinae</i>	Santa Catalina Bewick's Wren	X	
Passeriformes	Troglodytidae	<i>Thryomanes bewickii leucophrys</i>	San Clemente Bewick's Wren	X	EXTINCT
Passeriformes	Troglodytidae	<i>Thryomanes bewickii nesophilus</i>	Northern Channel Islands Bewick's Wren	X	

Order	Family	Scientific Name	Common Name	Endemic	Listed
Passeriformes	Tyrannidae	<i>Contopus cooperi</i>	Olive-sided Flycatcher	X	
Passeriformes	Tyrannidae	<i>Empidonax difficilis insulicola</i>	Channel Islands Flycatcher	X	
Passeriformes	Tyrannidae	<i>Empidonax traillii</i>	Willow Flycatcher		SE, FE
Passeriformes	Tyrannidae	<i>Pyrocephalus rubinus</i>	Vermilion Flycatcher		CSSC
Passeriformes	Vireonidae	<i>Vireo bellii pusillus</i>	Least Bell's Vireo		SE, FE
Passeriformes	Vireonidae	<i>Vireo huttoni unitti</i>	Hutton's Vireo (unitti)	X	
Passeriformes	Vireonidae	<i>Vireo vicinior</i>	Grey Vireo		CSSC
Pelecaniformes	Pelecanidae	<i>Pelecanus erythrorhynchos</i>	American White Pelican		CSSC
Pelecaniformes	Pelecanidae	<i>Pelecanus occidentalis</i>	California Brown Pelican		SCD, FPD
Procellariiformes	Diomedidae	<i>Phoebastria albatrus</i>	Short-tailed Albatross		FE
Procellariiformes	Hydrobatidae	<i>Hydrobates furcatus</i>	Fork-tailed Storm-Petrel		CSSC
Procellariiformes	Hydrobatidae	<i>Hydrobates homochroa</i>	Ashy Storm-Petrel		CSSC
Procellariiformes	Hydrobatidae	<i>Hydrobates melania</i>	Black Storm-Petrel		CSSC
Strigiformes	Strigidae	<i>Asio flammeus</i>	Short-eared Owl		CSSC
Strigiformes	Strigidae	<i>Asio otus</i>	Long-eared Owl		CSSC
Strigiformes	Strigidae	<i>Athene cunicularia</i>	Burrowing Owl		CSSC

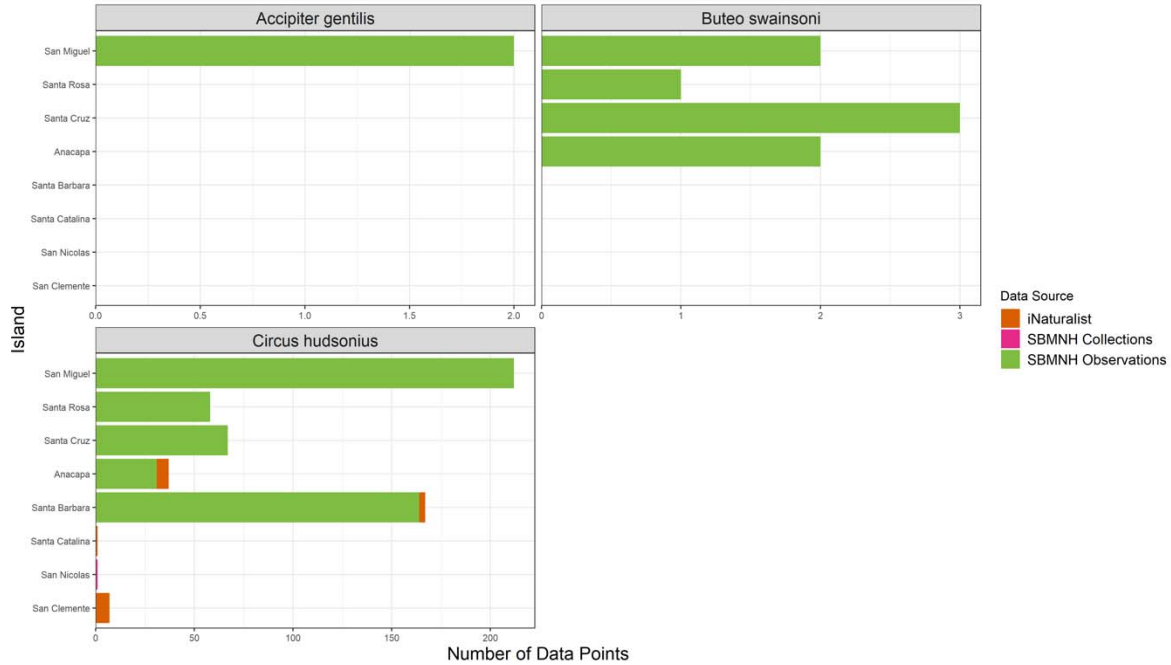


Figure Aves-9. The number of Accipitridae data points by island reveals island distribution and frequency of collections/observations. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

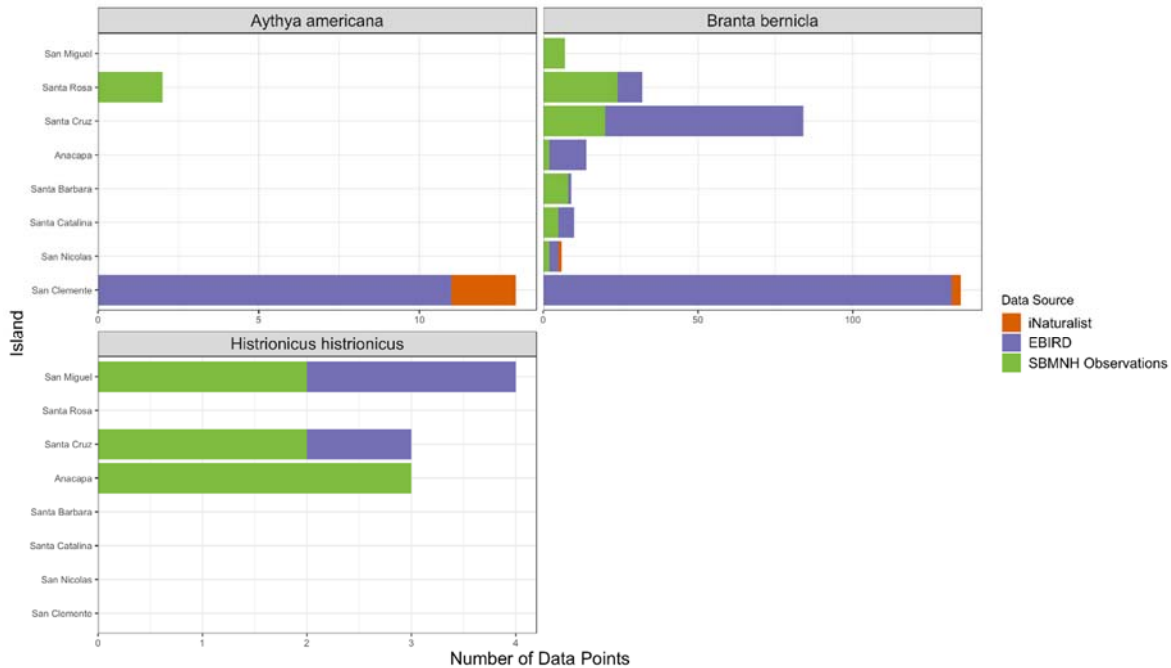


Figure Aves-10. The number of Anatidae data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

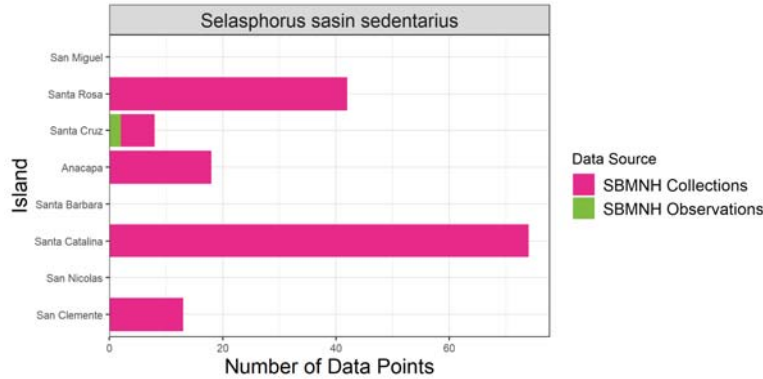


Figure Aves-11. The number of Allen’s hummingbird data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the SBMNH collections and observations databases.

Figure Aves-12 shows the number of data points by island for the Charadriiformes: *Brachyramphus marmoratus* (Marbled Murrelet), *Charadrius montanus* (Mountain Plover), *Charadrius nivosus* (Western Snowy Plover), *Chlidonias niger* (Black Tern), *Ptychoramphus aleuticus* (Cassin’s Auklet), *Rynchops niger* (Black Skimmer), and *Synthliboramphus scrippsi* (Scripps’s Murrelet). The highest number of data points by far are for the Western Snowy Plover and Cassin’s Auklet, due to a large number of observations on San Clemente for the Snowy Plover and on Santa Cruz and Anacapa for the Scripp’s Murrelet. This can be explained by the presence of biologists conducting survey work for these rare birds. The Cassins Auklet has been collected on all islands, with the greatest number of observations on Santa Cruz and Anacapa Islands (550-620 data points). It has the fewest number of observations and collections on San Nicolas, where it is limited by lack of a breeding population and to the abundance of a terrestrial carnivore (the Island Fox). The Western Snowy Plover is found on all but the smallest two islands (Anacapa and Santa Barbara), which do not have its required dune habitat. Of the islands it inhabits, it has the fewest data points on Santa Catalina Island, which has both little dune habitat and high human activity, both of which can damage its nests on the sand surface. The most data points for this taxon (next to San Clemente) are on Santa Rosa (~220).

Scripp’s Murrelets have data points on all of the islands, with a generally nice split between specimens and observations. The greatest number of both by far is on Santa Barbara and Anacapa Islands (150-250 data points); these volcanic islands have the small caves and crevices that are its preferred nesting habitat along with dense shrubs. The Black Tern has been observed on the four northern islands and San Clemente Island. By far the greatest number of observations (22) have been on San Miguel Island, which – given that island’s limited visitation – are likely from survey biologists. No island collections have been made of this taxon. The Black Skimmer had 16 observations on San Clemente Island, two observations on Santa Cruz Island, three on Catalina Island, and seven on Anacapa Island. Black Skimmers do not nest on any of the Channel Islands; similar to the Snowy Plover, they nest on open sand.

The two Charadriiformes with the fewest data points on the islands are the Marbled Murrelet and the Mountain Plover. The Marbled Murrelet had one observation each on San Clemente and Anacapa and three on Santa Cruz Island. The Mountain Plover has had two observations on San Miguel Island and four on Santa Rosa Island. It has been collected once on San Clemente Island and seven times on Santa

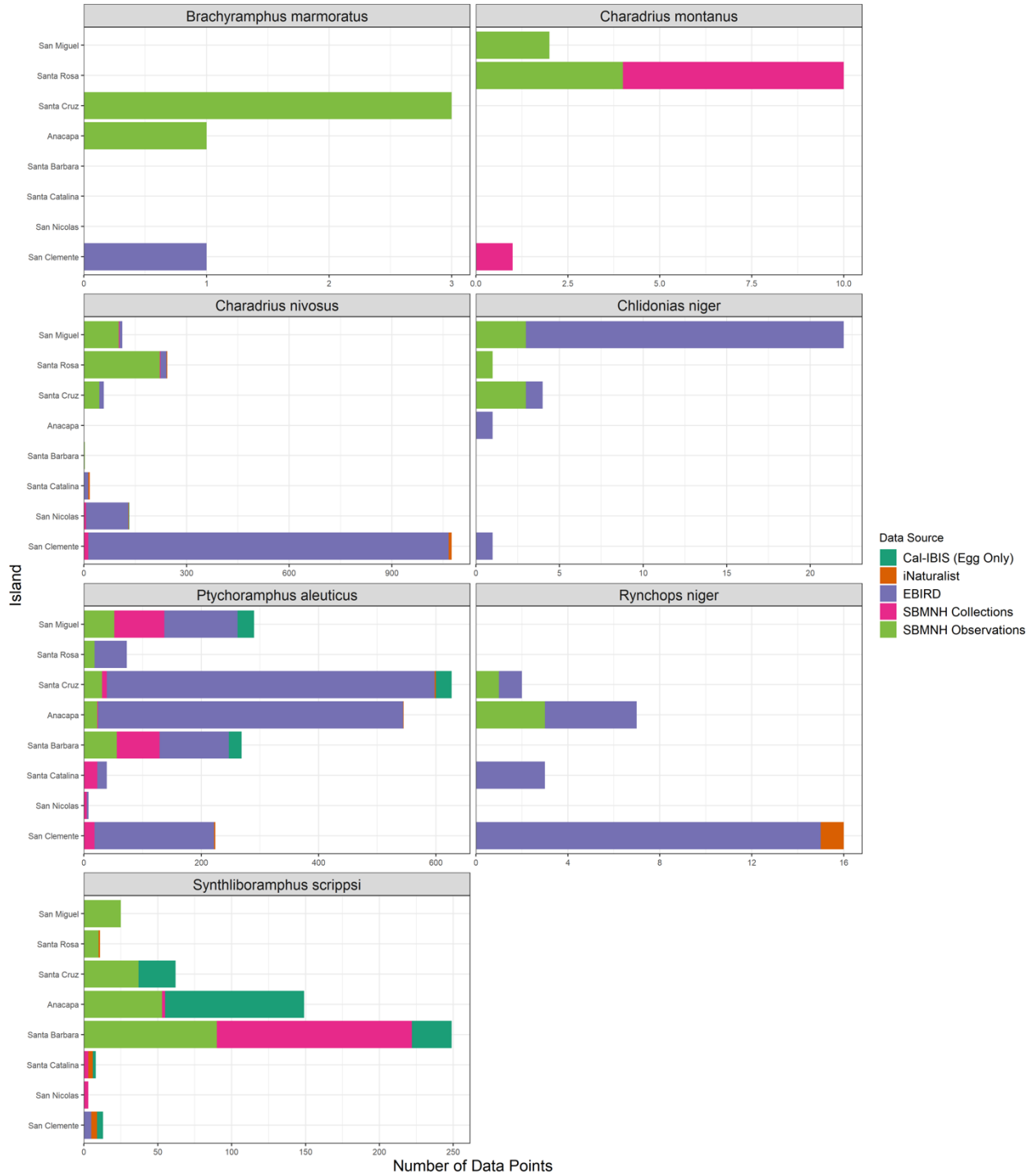


Figure Aves-12. The number of Charadriiformes data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

Rosa Island. Specimen collections are a gap for all of these birds except the Scripp's Murrelet, Mountain Plover, and Cassin's Auklet.

Figure Aves-13. shows the number of Western Yellow-Billed Cuckoo and American Peregrine Falcon data points by Island. It reveals that both taxa are lacking in collections. The Cuckoo has only been collected on Santa Cruz Island, whereas it occurs on San Miguel, Santa Cruz, Santa Barbara, Santa Catalina, and San Clemente Islands (observations are quite rare, however). There are no specimen collections documented for the Peregrine Falcon. There have been many observations of the Peregrine Falcon, however – which has been a bird of special interest since the DDT dumping –on most of the islands, although fewer than 100 observations have occurred on Santa Catalina and San Nicolas.

Figure Aves-14 presents the number of *Callipepla californica catalinensis* (Catalina California Quail) and *Gavia immer* (Common Loon) data points by island. It reveals both collections and observations of the Quail on Santa Rosa, Santa Cruz, and Santa Catalina (it is only native to the latter), with many observations on Cruz and Catalina. The Common Loon has only observations, but those have occurred on all of the islands between 20 and 300 times, the greatest being on Santa Cruz.

Figure Aves-15 presents *Aphelocoma insularis* (Island Scrub-Jay), *Piranga rubra* (Summer Tanager), *Eremophila alpestris* (Horned Lark) and *Eremophila alpestris insularis* (Channel Islands Horned Lark) data points by island. The Island Scrub-Jay is only found on Santa Cruz Island, and there are ample specimens and observations of this taxon. The Summer Tanager has only been collected on San Clemente Island, however, despite being observed on all but Anacapa Island. Those observations are fewest on San Miguel and Santa Rosa Islands.

The Horned Lark and Channel Islands Horned Lark are presented separately because eBird data, and some other observation data, do not identify this taxon to the subspecific level at which it is endemic. The Channel Islands Horned Lark is present on all of the islands and has been collected on all as well up to 300 times per island. San Clemente Island has the greatest number of collections, while Santa Catalina has the fewest. San Clemente Island has a whopping 3,500+ eBird observations!

Figure Aves-16 shows data points per island for *Passerculus sandwichensis rostratus* (Large-billed Savannah Sparrow), *Pipilo maculatus clementae* (San Clemente Spotted Towhee), *Pipilo maculatus crucis* (Santa Cruz Spotted Towhee), and *Pipilo maculatus rosae* (Santa Rosa Spotted Towhee). The majority of records for Large-billed Savannah Sparrow were obtained during the early 1900s on San Miguel and San Clemente Islands. There are a few recent sightings on San Miguel, and Santa Barbara islands. The San Clemente Spotted Towhee is extinct on San Clemente but still present and common on Santa Catalina as eBird sightings show. Birds reaching San Clemente Island today are undoubtedly migrants from mainland populations and not birds dispersing from Santa Catalina. Both of the other island endemic populations are represented by a greater number of sightings in eBird than by historic specimens and sightings.

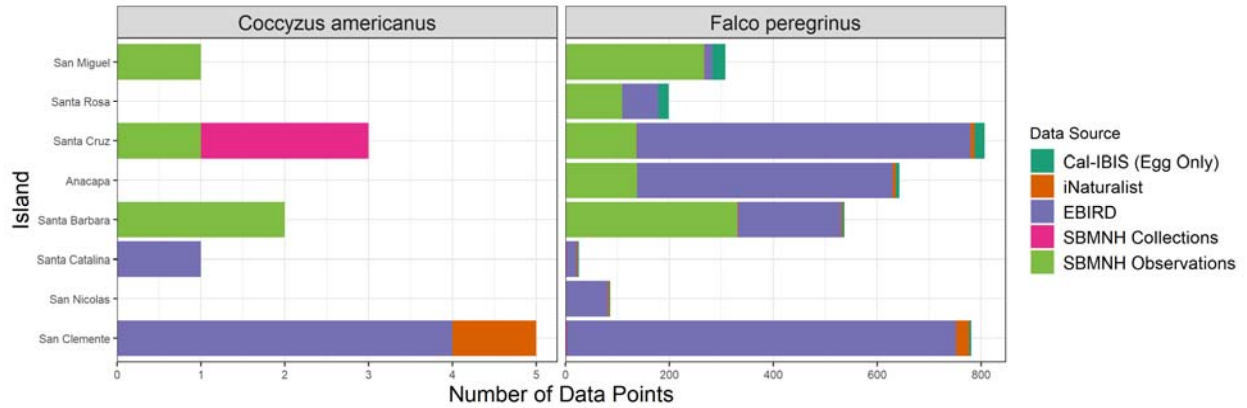


Figure Aves-13. The number of Western Yellow-Billed Cuckoo and American Peregrine Falcon data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

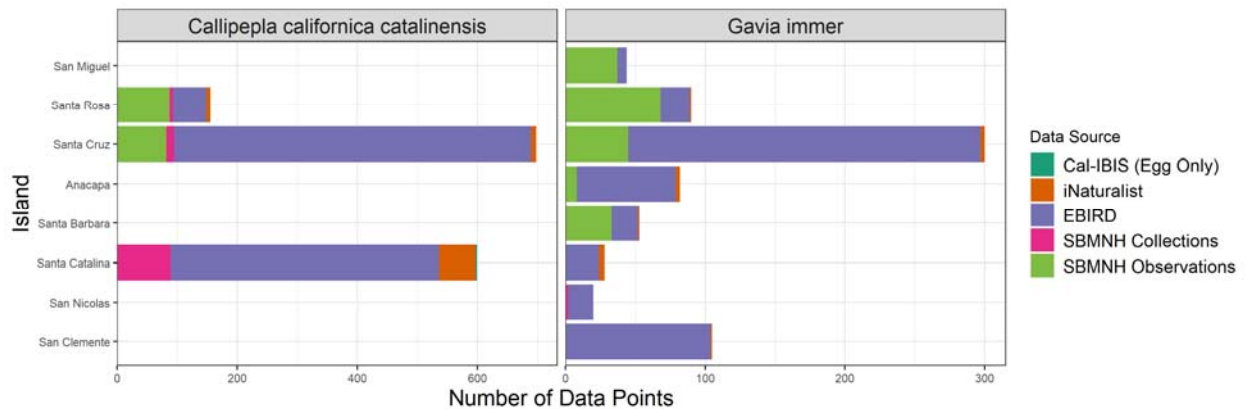


Figure Aves-14. The number of Catalina California Quail and Common Loon data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

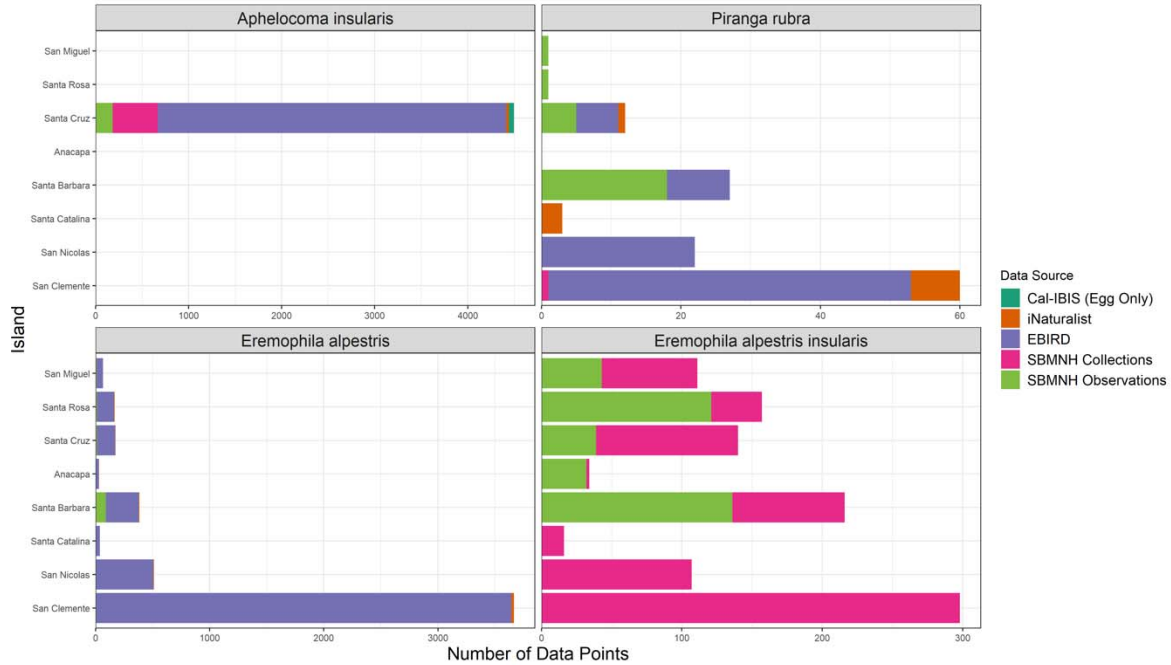


Figure Aves-15. The number of Island Scrub-Jay, Summer Tanager, Horned Lark and Channel Islands Horned Lark data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

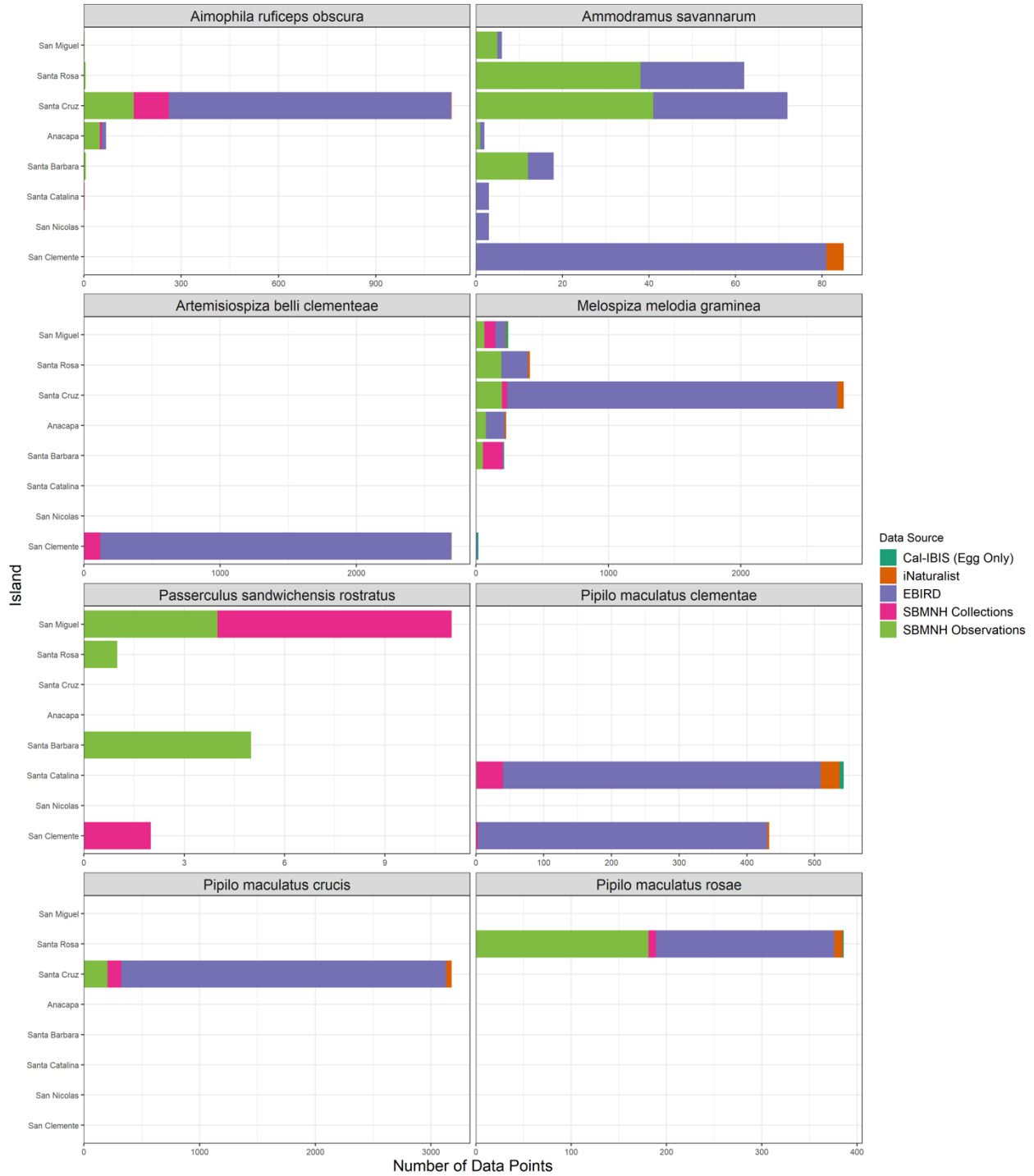


Figure Aves-16. The number of Emberizidae data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

Figure Aves-17 shows that there are no specimens from the islands for either of the sensitive species in the family Hirundinidae. Bank Swallow was more common historically on the northern islands than it is today. Purple Martins are uncommon seasonal migrants on four of the Channel Islands with the greatest number of records on San Clemente and Santa Cruz.

Figure Aves-18 shows that both sensitive species of blackbirds are most common on San Clemente based on eBird sightings, and less common on the northern islands and Santa Barbara. Only two specimens of Tricolored Blackbirds have been collected on Santa Rosa with most records for this species from Santa Barbara, and San Clemente. Only four Yellow-headed Blackbirds have been collected on three of the Channel Islands (Anacapa, Santa Cruz, and Santa Rosa), while it has been observed during migration on all of the Channel Islands.

Figure Aves-19 shows that the majority of records for both of the endemic subspecies of Loggerhead Shrike are from observations. Most of the collected specimens were collected prior to the 1940s. Sightings for the San Clemente Loggerhead Shrike have increased exponentially in eBird while extensive work has been underway to recover this island endemic.

Figure Aves-20 shows that based on historic records and recent eBird sightings, Orange-crowned Warblers are most common on Santa Cruz, Santa Catalina and San Clemente islands, Historic specimen records for *L. celata sordida* are fewest for San Miguel, Santa Barbara and San Nicolas and most common on Santa Catalina and Santa Cruz. Lucy's Warblers are rare on the Channel Islands with the majority of records in eBird on the southern Channel Islands. Yellow-breasted Chat is recorded on all of the Channel Islands with the fewest records on San Miguel, Santa Rosa and Santa Catalina. Most records of chats are from historic and recent sightings on San Clemente, Santa Barbara and Santa Cruz the three islands with the greatest amount on observer coverage. Chats have only been collected on Santa Catalina.

Figure Aves-21 shows that recent sightings in eBird of Bewick's Wrens are most common on Santa Cruz and Santa Catalina. Two of the endemic subspecies of Bewick's Wrens (*catalinae* and *leucophrys*) are both confirmed with historic specimens, however, the resident endemic population on San Clemente (*T. b. leucophrys*) is extinct. The endemic subspecies *T. b. nesophilus*, which occurs today on Santa Rosa, Santa Cruz, and Anacapa, is well represented with collected specimens and historic sightings. Based on a reassessment of morphologic characters, this endemic subspecies has been proposed to be included as a synonym of the subspecies found along the adjacent mainland. Modern genetic techniques are needed to further examine the phylogeographic status of this island subspecies to confirm whether it should be dropped and included with the mainland subspecies or kept as a separate subspecies.

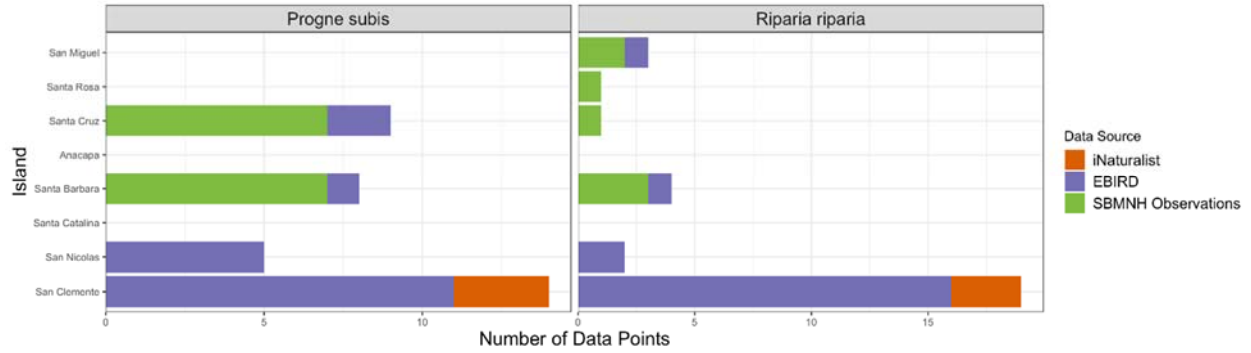


Figure Aves-17. The number of Hirundinidae data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

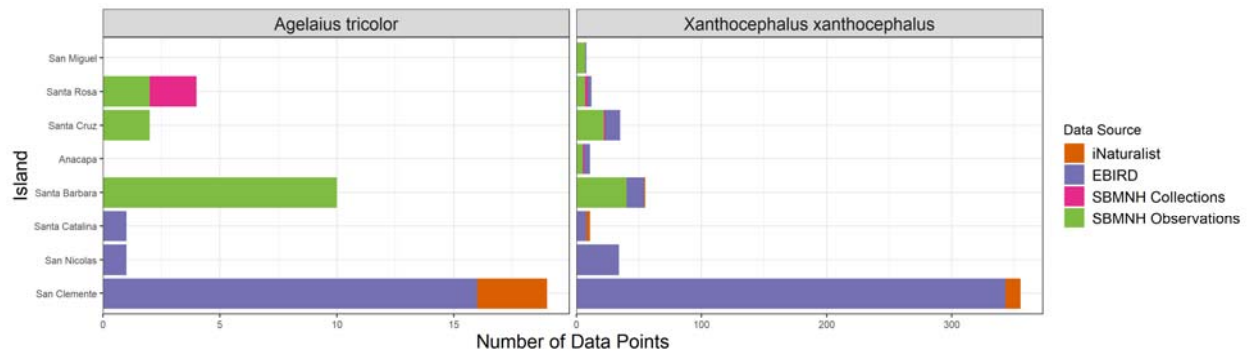


Figure Aves-18. The number of Icteridae data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

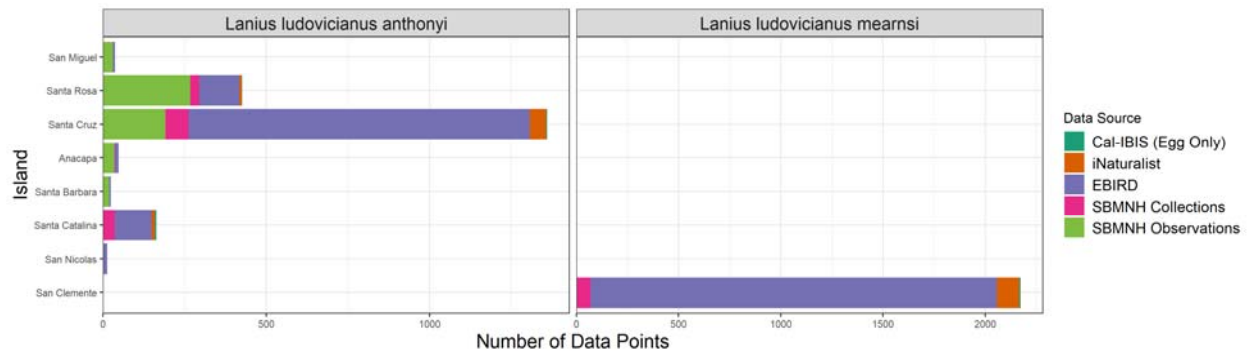


Figure Aves-19. The number of Island Loggerhead Shrike data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

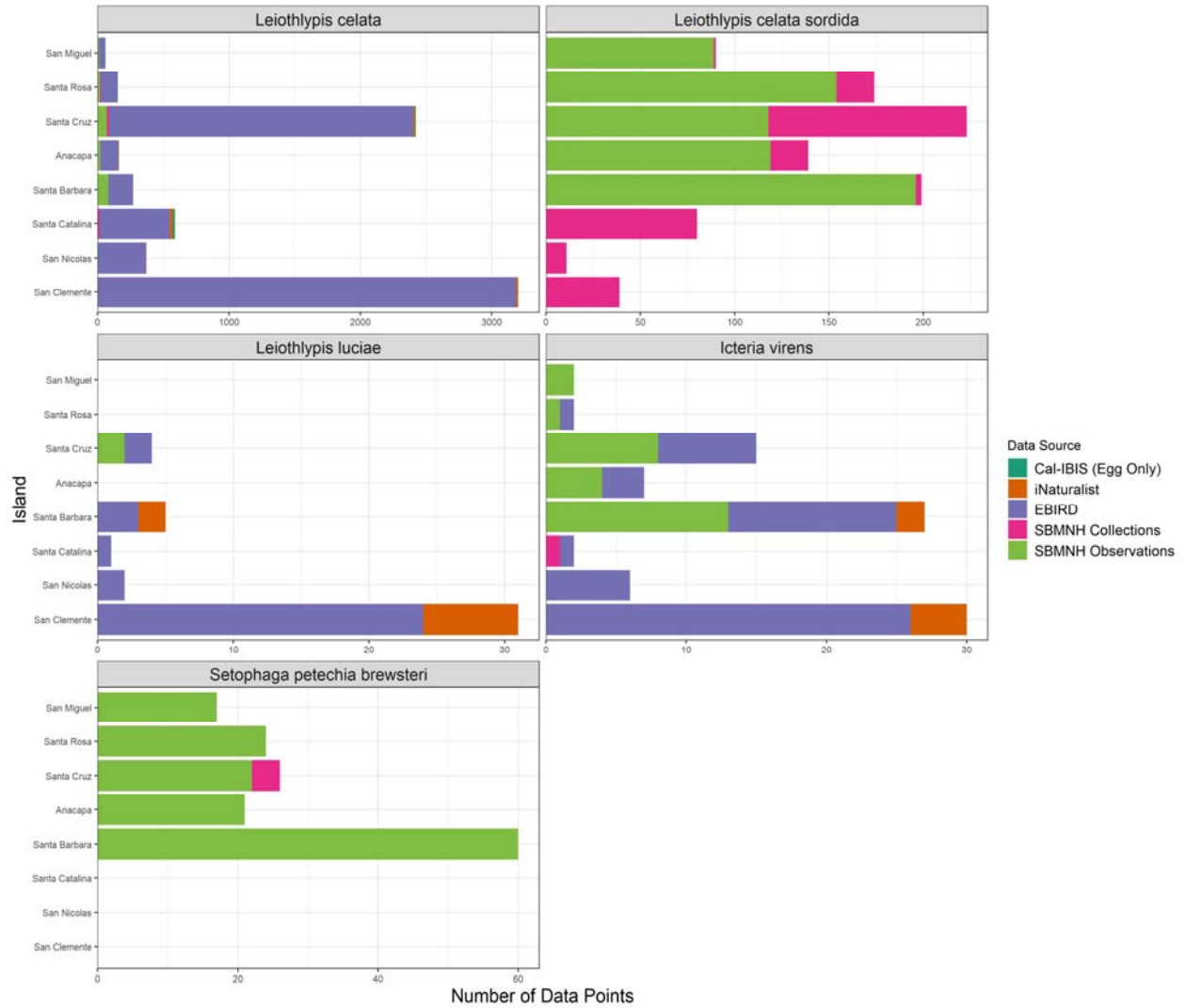


Figure Aves-20. The number of Paurildae data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

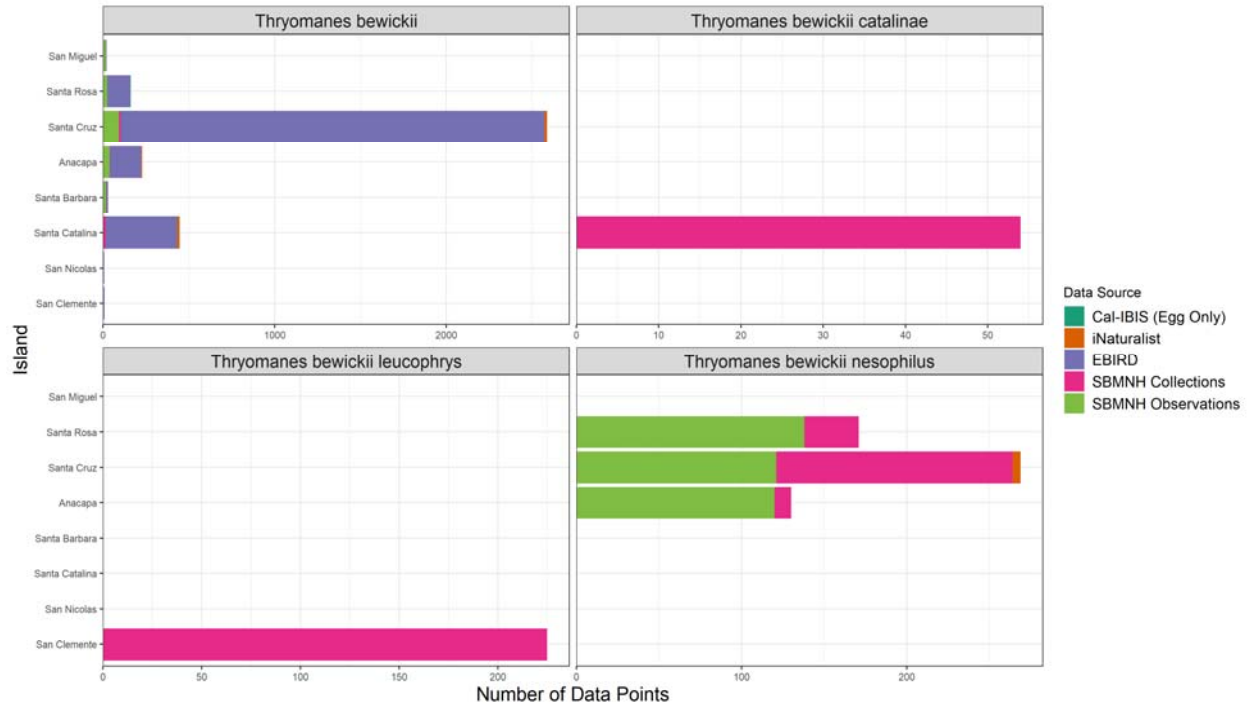


Figure Aves-21. The number of Bewick's Wren data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

Figure Aves-22 shows that the majority of eBird sightings for the Western Flycatcher (*Empidonax difficilis*) are from Santa Cruz, Santa Catalina and San Clemente, while the majority of historic sightings and specimens for the island endemic subspecies *E. d. insulicola* are from Santa Rosa, Santa Cruz and Santa Catalina. The fewest records for this flycatcher are on San Miguel, Anacapa, and San Nicolas, the three islands with the least amount of preferred woodland habitats. Most records for *Empidonax traillii* and *Contopus cooperi* on the Channel Islands are from eBird. No specimens of *Contopus cooperi* or *Pyrocephalus rubinus* have been collected from any of the Channel Islands. *Contopus cooperi* has been observed on all of the Channel Islands, but is most common on San Clemente, Santa Barbara and Santa Cruz and least common on Anacapa, Santa Rosa and Santa Catalina. Vermillion Flycatchers have been observed on three of the southern Channel Islands (San Clemente, San Nicolas and Santa Catalina), and on two of the northern Channel Islands (Santa Cruz and Anacapa). The majority of records for this rare flycatcher are eBird records.

Figure Aves-23 shows that Least Bell's Vireos (*Vireo bellii pusillus*) have only been recorded on San Miguel, Santa Cruz, and Santa Barbara, with very few specimens (1-2) in collections. There are no eBird records of this subspecies on any of the Channel Islands. A subspecies of Hutton's Vireo only known from Santa Catalina Island (*Vireo huttoni unitti*) has ~20 specimens in collections, but many observations, especially on eBird (~150). Gray Vireo (*Vireo vicinior*) is a very rare transient to the Channel Islands with sightings on five of the islands and a specimen collected on Santa Cruz. The greatest number of sightings are from Santa Cruz, San Clemente and Santa Barbara, three islands with the most observer coverage.

Figure Aves-24 shows that White Pelicans have only been recorded at Santa Cruz, Anacapa, and Santa Barbara islands, with nine of the ten records being historic sightings. The greatest number of eBird records for Brown Pelicans are from Santa Cruz, Anacapa and San Clemente islands where the species has been recorded nesting. The fewest records for this species are from the islands with the least amount of consistent observer coverage (San Miguel, Santa Rosa and San Nicolas). Data on breeding population size and winter roosts have not been recorded in the historic sighting database or entered into eBird.

Figure Aves-25 shows that Fork-tailed Storm-Petrels have only been observed at three of the northern Channel Islands (Santa Rosa, Santa Cruz and Anacapa) and a single specimen was recovered from San Nicolas. This is primarily a more northern species of storm-petrel that only rarely ranges south into the northern end of the Southern California Bight. The greatest number of records for Ashy Storm-Petrels are from islands where the species is known to breed (San Miguel, Santa Cruz, Anacapa and Santa Barbara). Intensive monitoring has taken place with breeding populations of this storm-petrel on Santa Cruz and Santa Barbara which added a significant number of egg records for Santa Cruz and observations for Santa Barbara. This species is primarily pelagic in its distribution except during the breeding season when it can be found close to an on islands where it nests. Black Storm-Petrels have been observed on all of the Channel Islands with specimens collected at Santa Barbara and San Clemente islands. The greatest number of observations are from waters near Anacapa, Santa Barbara and Santa Cruz. It is rarely observed near Santa Rosa or Santa Catalina. Short-tailed Albatrosses are casual in waters of the southern California Bight with only seven observations (3 recent , 4 historic) and two specimen records. They have been recorded at Santa Cruz, and Santa Barbara and were collected historically at Santa Catalina.

Figure Aves-26 shows the greater number of observations for the owls on Santa Barbara and San Clemente Islands is probably a result of focused trail surveys for owls over time on Santa Barbara Island, and focused road spotlight surveys for owls on San Clemente.

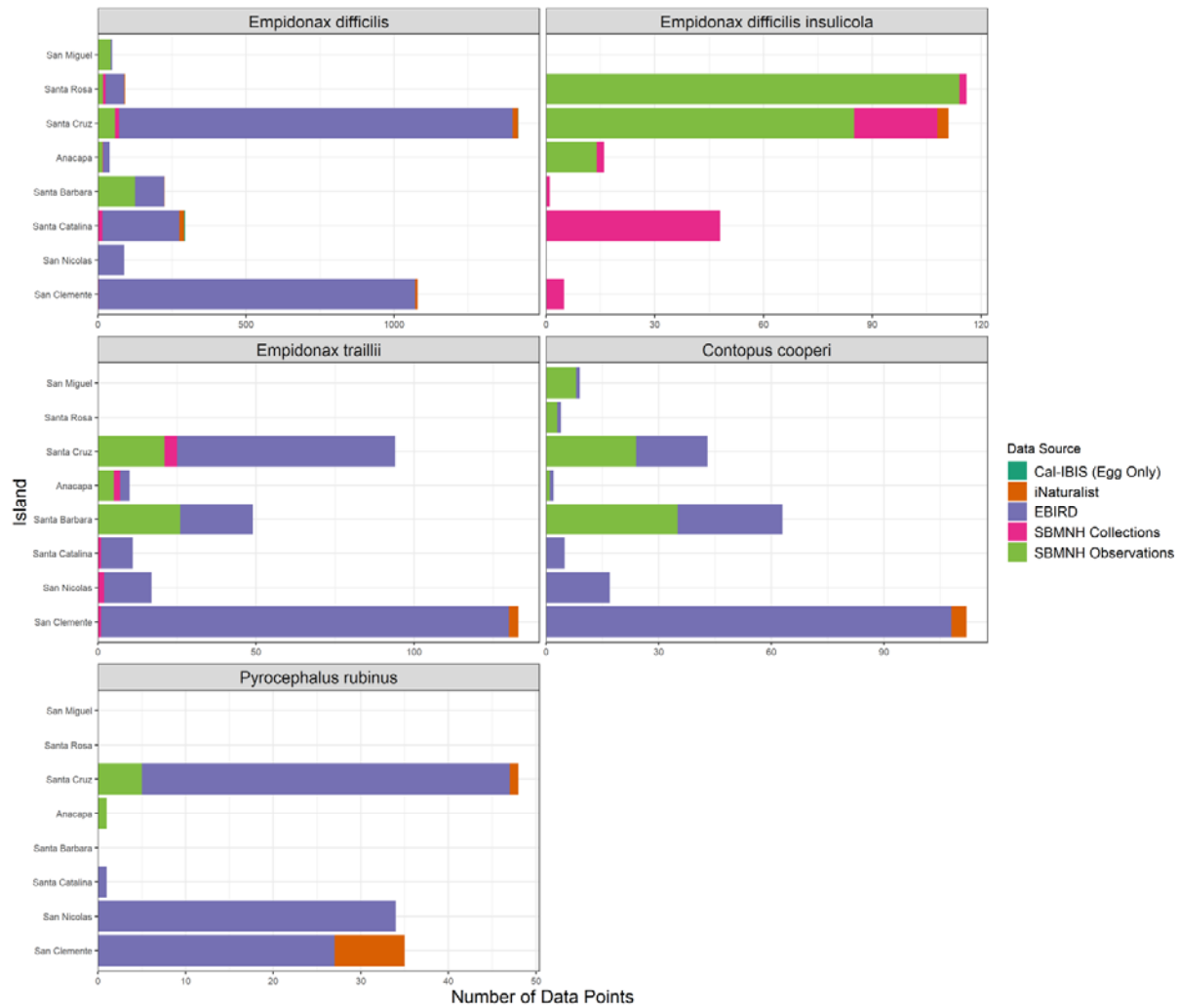


Figure Aves-22. The number of Tyrannidae data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

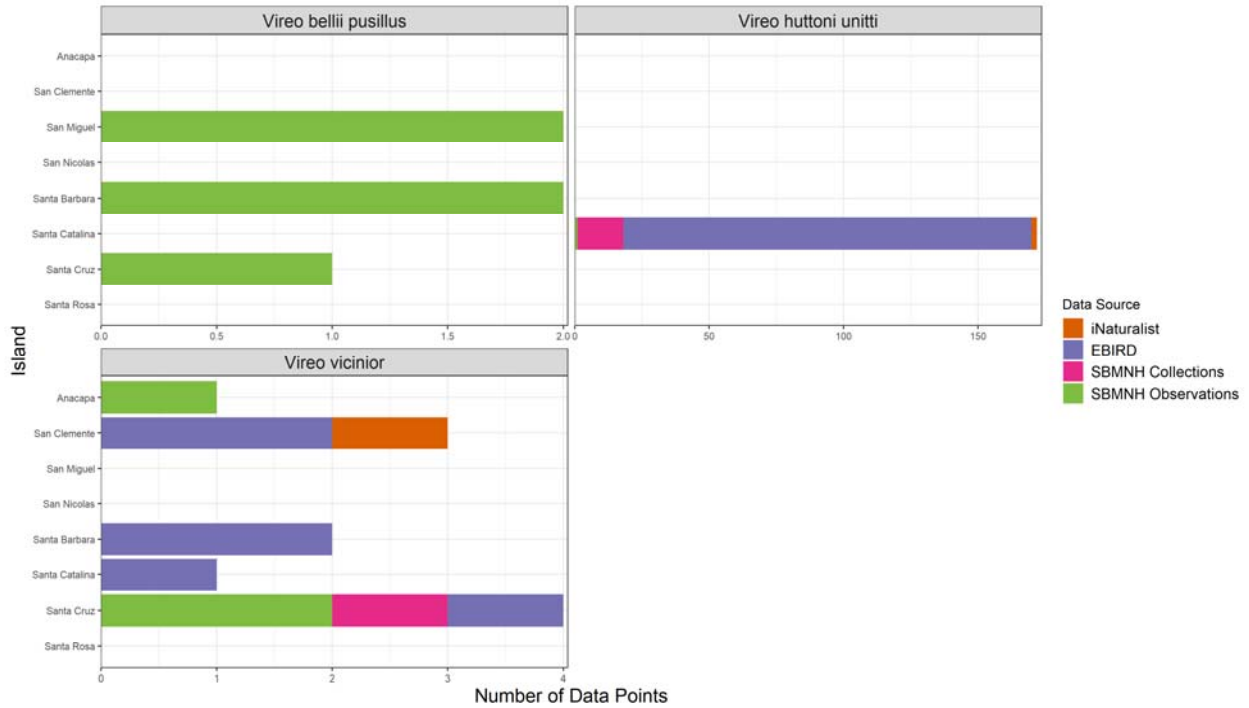


Figure Aves-23. The number of *Vireo* data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

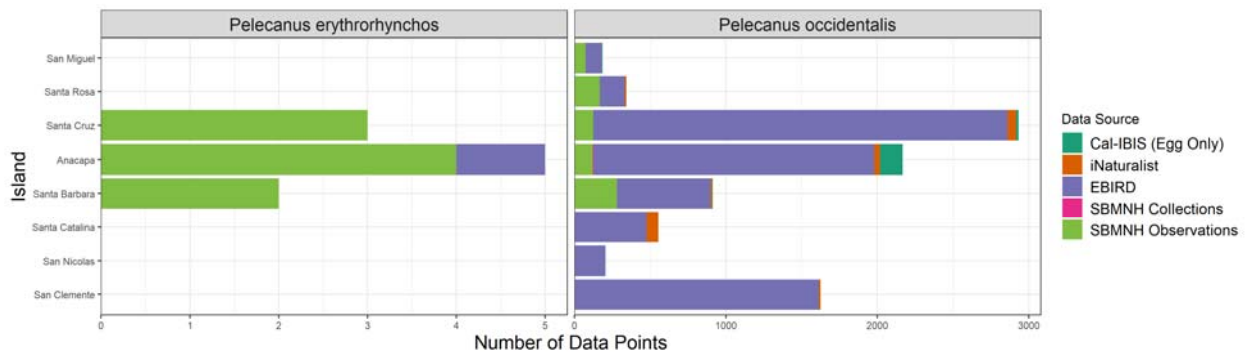


Figure Aves-24. The number of Pelican data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

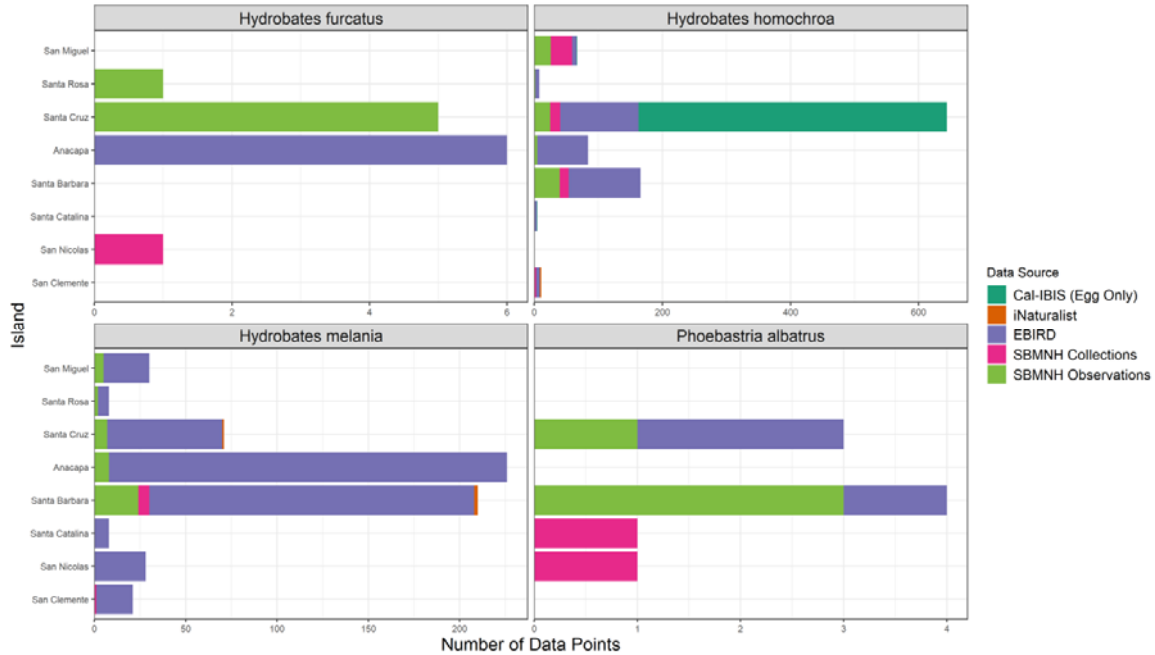


Figure Aves-25. The number of Procellariiformes data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

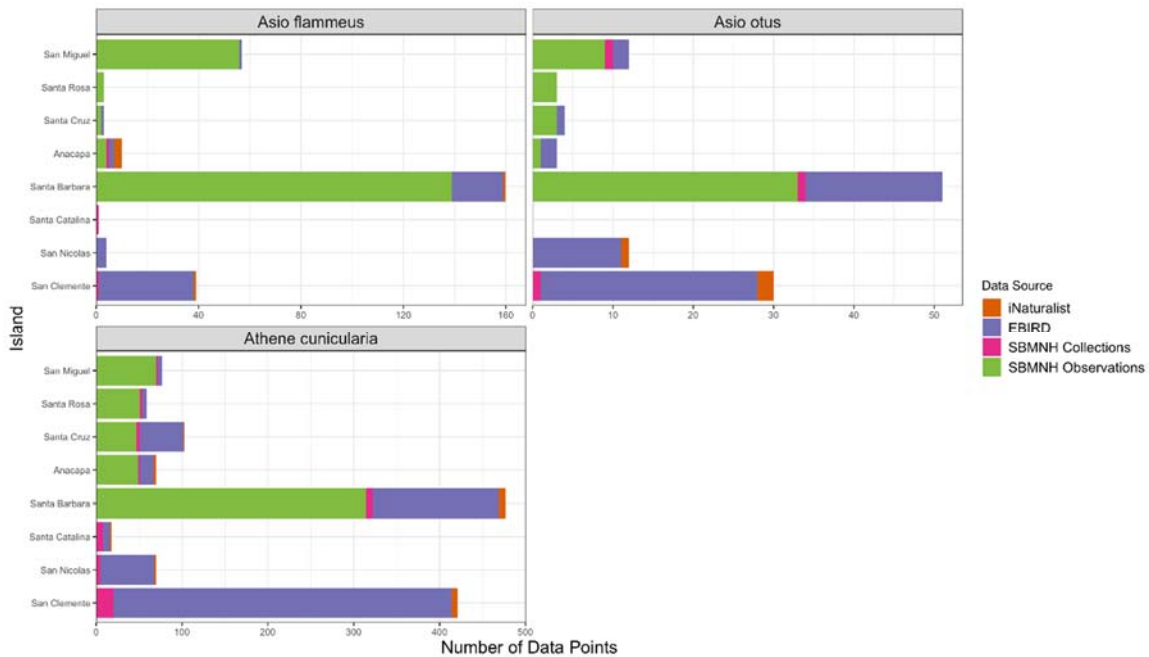


Figure Aves-26. The number of Owl data points by island reveals island distribution and collection/observation frequency. Specimens are represented by the Santa Barbara Museum of Natural History collections and Cal-IBIS databases, while observations are represented by eBird, iNaturalist, and the Santa Barbara Museum of Natural History observations database.

CONCLUSION AND RECOMMENDATIONS

1) While island endemics are well represented in the collected specimens, these samples were largely acquired during the early 1900's with only limited collecting from the 1970's through 1990's. Missing are frozen tissue collections for the majority of birds collected on the Channel Islands. These types of tissue samples will be critical for use in modern genetic studies taking place to better understand the phylogeographic history of endemic populations on the various islands.

2) Other species that have breeding populations on one or more of the Channel Islands have not been well collected with specimens (skins, and frozen tissues) to determine whether there are genetic variations between the various island populations and if there are any cryptic island endemic populations.

3) While there is a large amount of recent observational data available via eBird, it is concentrated on islands that are being accessed regularly by the public (Santa Cruz and Santa Catalina), or where there has been a long-term observational record for ornithologists working on recovery efforts for listed birds (e.g. San Clemente Island). Islands that are not visited as often by the public all have fewer records posted to eBird.

4) There are sightings data that are not currently available on digital platforms like eBird for a number of the islands. Several data sources are available that should be integrated onto digital platforms to make them more readily accessible to researchers and landscape managers interested in the avifauna on the islands: a) the landbird and seabird monitoring data for the National Park islands and for the non-Park islands, b) Christmas Bird surveys on several of the islands (Santa Cruz, and Santa Catalina) and c) USGS breeding bird surveys (on Santa Catalina).

Suggested Future Work

1) The database of egg records assembled by Lloyd Kiff should be digitized to get a more accurate inventory of these types of specimens available in Museum collections.

2) The historic bird sightings for the southern Channel Islands should be digitally captured into the SBMNH sighting database to get an accurate representation of observational records (historic and recent) for these four islands. This is currently underway via funding by TNC.

3) Another sample of specimens should be collected for all of the island endemics (species and subspecies), and this sampling should be repeated every 5-10 years to assess how species are responding to the dramatic ecological changes on the islands resulting from both invasive species removal and climate change. These specimens should include frozen tissue samples as well as scientific study skins and a subset of complete skeletons. Skeletal material for the island endemics is critical for being able to identify subfossil and fossil bird bone recovered from sites on the Channel Islands. There are currently few tissue samples or complete skeletons available in collections for any of the island endemics.

4) Additional focused monitoring is needed for birds that winter on the islands or in waters surrounding the Channel Islands. These surveys would help to better assess the importance of the Channel Islands as wintering habitat for certain species that remain on or in the vicinity of the islands through the winter. They would also provide observational data for the winter which is not as well covered with observational data as are the other seasons.

5) Breeding season monitoring surveys for birds that breed on the Channel Islands should continue on the Park islands and be expanded to the non-Park islands. These surveys are providing critical data to confirm how the breeding avifauna is adapting to changes in vegetation on the islands following the removal of herbivores and the subsequent passive recovery of island plant communities.

5) An inventory should be completed to determine the frozen tissue samples currently available for birds collected from the Channel Islands. The digital inventory of Channel Islands specimens assembled by SBMNH did not evaluate the availability of frozen tissues.

6) Mist net map stations run regularly during the migration and winter seasons would help to better define which subspecies of geographic variable species are reaching the islands during migration and in winter.

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