FIRST WINTER MOVEMENTS OF JUVENILE BLACK SKIMMERS HATCHED FROM THE SAN DIEGO BAY NATIONAL WILDLIFE REFUGE, CALIFORNIA

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INTRODUCTION

The length of the juvenile period in seabirds, defined as the time of independence from parents to sexual maturity can be variable in length ranging from 1-7 years depending upon the species (Weimerskirch 2002). Occurrences within this juvenile period have the potential to shape population demographics (Jenouvrier et al. 2005, Janssen et al 2005, Lewison et al. 2012, Manness and Anderson 2013). For example, Thomas and Coulson (1988) found that 38% of the overall variance in lifetime reproductive success in Black-legged Kittiwakes *Rissa trydactla* could be attributed to juvenile or pre-breeding mortality. Juvenile and non-breeding adult components of seabird populations can also play a role in buffering breeding adult mortality from stochastic events by replacement the following breeding season (Votier et al. 2008). Despite the critical importance of understanding occurrences during the juvenile period, there is a decided lack of knowledge of dispersal and survival rates of many seabird species during this part of the life cycle.

The Black Skimmer *Rhyncops niger* is a long-lived, medium-sized waterbird, most closely related to the Black-legged Kittiwake (*Rissa tridactyla*) which is considered a resident of coastal southern California (Shuford and Gardali 2008). These birds are colonial nesters which have a specialized foraging technique by which they skim along the surface of the water with the laterally flattened lower mandible inserted in the water to collect fish and some invertebrates in the top six inches of the water column (Leavitt 1957, Burger and Gochfeld 1990). Foraging grounds for the skimmer include shallow areas of bays, estuaries, sheltered inlets or coves of near shore waters, and river channels (Gochfeld and Burger 1994).

There are a total of eight coastal breeding locations within southern California, seven of which are situated along the Pacific coast. The South Bay Unit of the San Diego Bay National

Wildlife Refuge, also referred to as the Saltworks, typically is the largest of the breeding colonies hosting 250-500 breeding pairs annually. Nesting phenology of the skimmer is comparable to other tern and gull species with an average 28 day incubation period followed by a 28-30 day pre-fledge period (Erwin 1977, Burger 1992). Fledglings, or fully volant young, will continue to remain with parents until the parents along with their young depart the breeding colony typically from late August to late September.

The juvenile period for the Black Skimmer is undocumented for the most part, although general consensus is that the juvenile stage, defined as the time period of independence from parents until sexual maturity, is typically two years in length (Gochfeld and Burger 1994). Individuals begin to return to a breeding colony during their second year and become reproductively active during the third year; although some individuals may become mature and begin breeding at age two (Gochfeld and Burger 1994, Molina 1996). Parental care after the post-fledgling period is largely unknown but it is suspected that there is some care for the skimmer young until they learn to forage adequately for themselves which may be four to six weeks (Burger 1992). Taylor (1997) found skimmer juveniles to have the highest mortality rate in the first few months of life which suggest there is little extended parental care once juvenile skimmers become independent. Specific non-breeding habitats that juvenile skimmers use during the first year is not well documented, but juveniles have been frequently observed wintering among adults at winter roost locations along the coast (C. Collins pers com).

During the non-breeding or winter season, skimmers breeding in southern California disperse along the coastline from Santa Barbara, California south to Baja Sur, Mexico in large wintering flocks (Shuford and Gardali 2008). In southern California, the flocks are often found to be roosting on urban beaches above the high tide line or on mudflats in nearby estuaries (Shuford

and Gardali 2008, Figure 1). The nearest winter flock location to the Saltworks in San Diego County is at Mission Bay Park which is located approximately 15 miles northwest of the Saltworks in San Diego County (Figure 2). Mission Bay Park is the largest man-made aquatic park in southern California, consisting of 4,235 acres, of approximately 46% land and 54% water. The skimmer winter flock at Mission Bay typically consists of 70-175 individuals and persists at this location from November through March (Goodenough Pers. Obs.). While the flock location appears to be consistent over time, the identity and source of individuals constituting the flock remain unknown.

The persistent winter roosting location at Mission Bay provides a unique opportunity to explore survival and movements of juvenile skimmers produced from the Saltworks and document links between breeding and non-breeding locations for the Black Skimmer. Mark-recapture methodology was used to document Saltworks juvenile Black Skimmer use of Mission Bay Park as a winter roost location from 01 November 2012 through 15 March for 2013 and 01 November 2013 through 31 March 2014. Identity and origin of skimmers were determined by reading unique band numbers from bands which were placed on skimmer chicks at natal locations. The collected band information will be combined with ongoing research on skimmer movements and survival conducted in Los Angeles and Santa Barbara Counties in other periods of the year (C. Collins and P. Knapp unpub data).

METHODS

Weekly productivity counts are conducted at the Saltworks by the San Diego Bay National Wildlife Refuge from February to September annually as a part of their inventory and monitoring program for sensitive species breeding on the refuge. These productivity surveys include

counting the identity and number of breeding species present, number of nests, and documenting overall reproductive success. The Black Skimmer is included in the monitoring program at the Saltworks.

For this mark-recapture project, Black Skimmer chicks were banded opportunistically during the weekly nesting productivity checks at the Saltworks in 2012 and 2013 along the nesting dikes. Chicks were banded with a USFWS metal band on the left tarsus and a white plastic color band on the right tarsus. Skimmer chicks were monitored until they attained flight and departed the Saltworks.

From November to March each year, Black Skimmers consistently formed a wintering flock within Mission Bay Park. Actual locations of the flock within Mission Bay depended upon tide and disturbance level on a daily basis (Figure 2). Tides higher than five feet influenced the skimmers to roost along the waterfront on Crown Point North and South, North Cove, and Quivera Basin. If tides were below five feet, the skimmers also roosted on the exposed unvegetated mudflats of the University of California San Diego- Kendall Frost Marsh (Figure 2). These locations are within a one mile distance of each other.

Black Skimmer identity and natal source were documented via unique USFWS bands placed on the tarsus during the chick period. An observer with a Nikon 80mm spotting scope would slowly approach the roosting flock until they were within 25-30 meters where the observer would then read the band numbers on the skimmer legs. Efforts to read bands on skimmers in the winter flocks began in November each year and continued through March of each year. Band reading sessions ranged from 30 minutes to 2.5 hours depending upon the number of banded birds present, level of disturbance, and environmental conditions. For both

winters, the flock location in San Diego County was monitored for banded skimmers. Los Angeles and Santa Barabara County were similarly monitored for skimmers (C.T. Collins and P. L. Knapp, Unpub. Data).

RESULTS

A total of 127 skimmer chicks were banded at the Saltworks from June 25 to July 30 (48 in 2012 and 79 in 2013). Fledgling rates were lower in 2012 as compared to 2013 (Table 1); and as such, a smaller number of chicks were banded in 2012 as compared to 2013. The total number of skimmer juveniles recaptured over both winter periods was 56 (n = 8 in 2012 and n = 47 in 2013).

Winter 2012

Eight Saltworks juveniles were identified during fifteen recapture attempts in Mission Bay during the winter of 2012 (16.7% of 2012 banded chicks, Table 2). An additional 18 recapture attempts occurred in Orange County but no Saltworks juveniles were identified (Collins and Knapp unpub data). Other unbanded juvenile skimmers were present at Mission Bay during recapture events (2-4 per recapture attempt); but without bands, identity of the juveniles could not be determined.

Winter 2013

In winter 2013, similar recapture efforts occurred at Mission Bay (n = 15). Greater effort of recapture occurred in Los Angeles and Santa Barabara Counties during winter 2013 (n = 65 Los Angeles County, n = 2 in Santa Barbara County, Table 2). A total of 47 Saltworks juveniles were recaptured for the 2013 winter season (59% of the total number of chicks banded). Of the 47

individuals identified, 59% were identified at Mission Bay, 95% were identified in Los Angeles County, and 17% were indentified in Santa Barabara County (Table 2). Several individuals were sighted at more than one winter flock location which accounts for percentages greater than 100%.

Locations of Saltworks juveniles were different in winter 2013 as compared to 2012. Whereas Saltworks juveniles were only documented in Mission Bay for winter 2012, juveniles in winter 2013 were documented at multiple locations over the winter period; although a small percentage of skimmer juveniles were documented solely at Mission Bay (6%). The majority (96%) were documented in Los Angeles County (Table 2). Movements spanning a distance of greater than 213 miles between winter roost locations were documented. Furthermore, there was considerable movement among winter locations within a season. For example, a juvenile documented in Los Angeles County was observed in Santa Barbara County three days later and then documented again in Los Angeles County a day later. There was also considerable exchange of juveniles between the Mission Bay and Los Angeles winter flock locations with individuals identified in Los Angeles County during one week being documented at Mission Bay the next week.

DISCUSSION

Following the breeding season, skimmers depart nesting areas and relocate to roost locations along the Pacific coast. What drives this relocation is unknown although there is suggestion that food resource availability, levels of disturbance, predation pressure, or a combination of these factors influence choices made by individual birds to stay in particular locations. The data collected here also highlight considerable annual variability in presence by Saltworks juveniles

between the two winters. Saltworks juveniles were only observed at Mission Bay in winter 2012; whereas in winter 2013, there was substantial movement between wintering flock locations between the three southern California counties- a distance of greater than 200 miles one way. Considering how substantial the differences were among winters, the observations of no Saltworks juveniles in winter 2012 may have been driven by the disparity in the number of banded birds between 2012 and 2013. Fewer juveniles survived to fledgling status in 2012 as compared to 2013 [n = 20-30 in 2012, n = 110 in 2013].

This variation may be a result of annual juvenile mortality, but it may also be because there were additional locations in Mexico that Saltworks juveniles could have wintered within. In winter 2013, I documented a greater than 200 mile movement of Saltworks juveniles from Mission Bay north to Long Beach and Santa Barbara. USGS band recoveries from previous adult skimmer research have documented adult skimmers hatched from Orange County wintering south along the Baja California peninsula and south along the western coast continental Mexico (Gazzaniga 1995). Gazzaniga (1995) found considerable movements by Black Skimmers among breeding locations in southern California. It is reasonable to assume that at least some individuals move between southern California and Mexico, but there is still some question as to whether longer distances are travelled which remain undocumented.

The continued persistence of flocks at particular locations during the non-breeding season suggests that these locations are not random and are important to wintering skimmers. Resident species like the Black Skimmer may not migrate long distances, or only a portion may be migratory, but may instead move in response to environmental gradients and available food resources (Sillet et al. 2000). Food resources during the winter months can be highly variable and a system of interconnected resting locations could provide skimmers with a level of stability to

deal with variation in food resources and other environmental influences along the Pacific coast. An established roosting flock location may also provide juveniles with some level of stability as they perfect their specialized foraging technique. The repeated documentation of 2013 Saltworks juveniles within the three monitored locations- often moving between Long Beach and Mission Bay-supports the suggestion that the winter flock locations are connected somehow.

This research is planned through winter 2014, but I suggest continuing research beyond this time period to monitor seasonal variability in juvenile survival and use of winter flock locations and to implement additional movement research to better explore the possible explanations for winter flock locations connectivity and degree of migratory individuals within the population with the use of modern technology, e.g. satellite telemetry and genetics, to encompass the entire range of the Black Skimmer along the Pacific coast.

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GRAPHICS

Figure 1: A map of the locations of winter band resight attempts in southern California. 1= Santa Barabara, 2= Long Beach, 3= Bolsa Chica State Ecological Reserve (breeding location and not generally used for winter roosting), and 4= Crown Point, Mission Bay.

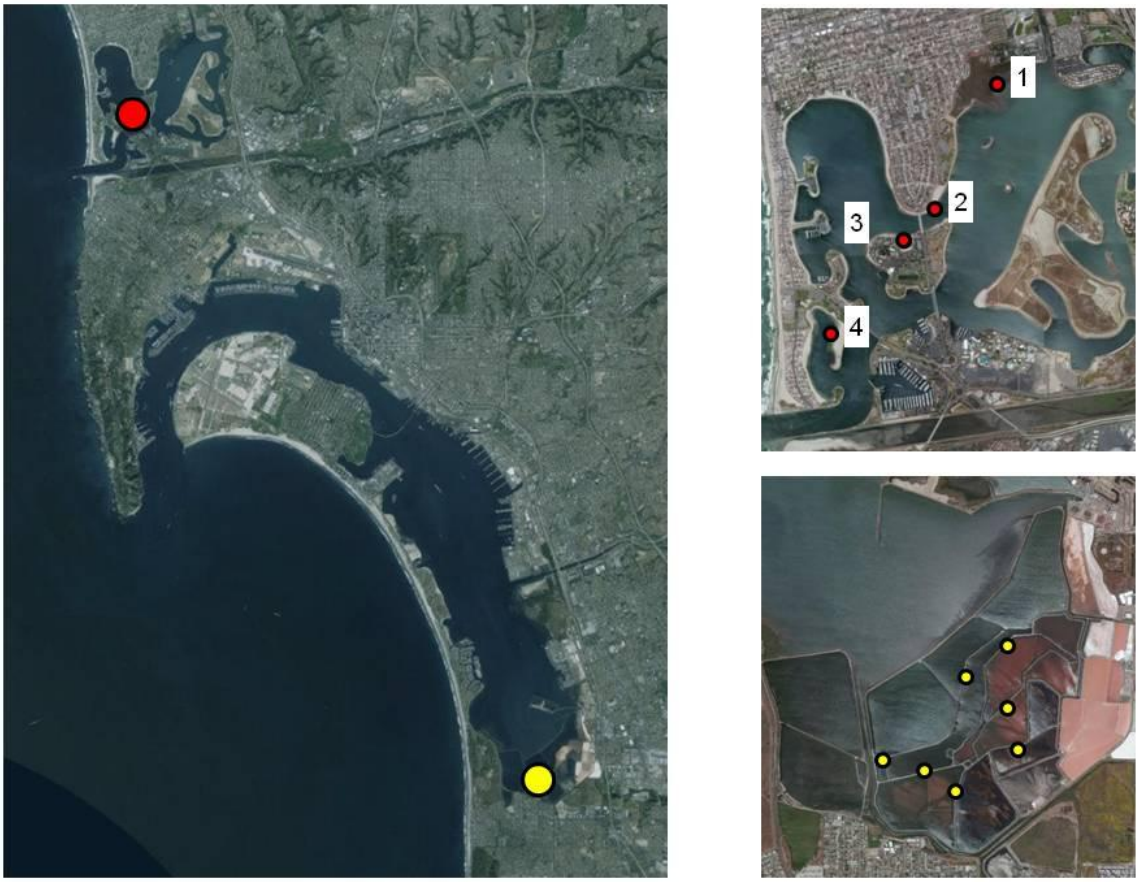

Figure 2: Map of San Diego and Mission Bays (left). Red symbol indicates winter roosting flock of Black Skimmers within Mission Bay. Close up view of known flock locations within Mission Bay (upper right). 1= Kindall-Frost Uinversity of California San Diego Research Reserve, 2= Crown Point, 3= North Cove, and 4= Quivira Basin. Yellow symbol indicates Black Skimmer breeding location in San Diego Bay. Black Skimmers roost along several dikes within the South Bay Unit of the San Diego Bay National Wildlife Refuge (lower right). Yellow symbols only indicate general location of breeding sub-colonies.

Table 1: Black Skimmer fledglings produced at the Saltworks, 2012-2013 and estimated fledge to breeding pair ratio

Year	**No. Fledges**	**Fledge to Pair Ratio**
2012	40-50	0.19 to 0.24
2013	111	0.38

Table 2: Number of Black Skimmer juveniles marked and recaptured during winter 2012 and winter 2013 in San Diego, Los Angeles, and Santa Barbara Counties, California.

Year	No. Banded	No. Recaptured	% Marked Recaptured	% Recaptured in MB	% Recaptured in LB	% Recaptured in SB
2012	48	8	0.17 (8)	1.0 (8)	0	0
2013	79	47	0.59 (28)	0.47 (22)	0.96 (45)	0.17 (8)

MB= Mission Bay, LB= Long Beach, SB= Santa Barbaba. Parentheses indicate number of individuals observed at the locations.