

# Marine Bird Breeding Population Trends in California: Ups and Downs Over Four Decades

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## INTRODUCTION

The Farallon Islands near the continental shelf-break off central California host the largest seabird community in the continental U.S. Breeding seabird populations at this offshore island, however, have exhibited sizeable declines over the last 30 years. Conversely, in recent decades seabird populations on inshore islands have increased in size and several new coastal colonies have formed and grown rapidly. New Brandt's Cormorant colonies have formed on Año Nuevo Island, Alcatraz Island and Vandenberg Marine Reserve. The Alcatraz Island colony is one of only two estuarine colony locations known for this species. Populations of Western Gulls, Pelagic Cormorants and Pigeon Guillemots have also increased inshore.

## METHODS

- Breeding population size determined by island, boat and aerial surveys
- Population trends were examined using quadratic and linear models

### Southeast Farallon Island (SEFI)



- 47 km off coast of San Francisco, 8km from continental shelf
- Granitic sea mount with marine terrace
- 44ha in area
- Largest seabird colony in the contiguous U.S., 11 breeding species
- Located in National Wildlife Refuge, Gulf of the Farallones NMS
- Monitoring began in 1970

### Año Nuevo Island (ANI)



- 1km off coast, 12km from northern submarine canyons of Monterey Bay
- Flat, sandy, shale terrace
- 3.3ha in area
- 7 breeding seabird species
- Located in Año Nuevo State Reserve, Monterey Bay NMS
- Monitoring began in 1989

### Alcatraz Island (ALCZ)



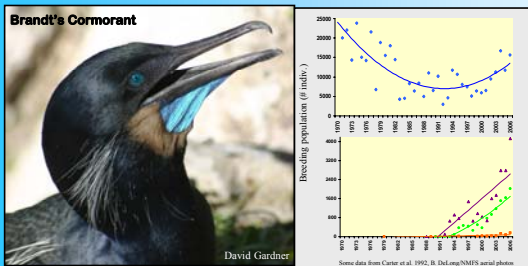
- 1.6km from San Francisco, in central SF Bay
- Sandstone island severely modified by humans
- 8.6ha in area
- 4 breeding seabird species
- Located in Golden Gate National Recreation Area
- High level of human disturbance
- Monitoring began in 1990

### Vandenberg Marine Reserve (VAN)



- Located at Vandenberg Marine Reserve
- Breeding over 10km of cliff and rocky coastline
- 5 breeding species
- Monitoring began in 1999

## RESULTS



### Brandt's Cormorant

- Significant population decline on SEFI from early 1970s to 1990s, then increasing in recent years ( $\beta_1 = -12.92, \beta_2 = 0.003, s.e.2=0.00, t=4.65, p < 0.00, R^2 = .489, n = 36$ )
- Significant population growth on ALCZ since 1991 when colony formed ( $\beta_1 = 130.52, \beta_2 = -0.03, s.e.2=0.01, t=-2.44, p < 0.03, R^2 = .080, n = 15$ )
- Significant population growth on ANI since 1989 when colony formed ( $\beta = 0.26, s.e.=0.05, t=4.81, p < 0.00, R^2 = .64, n = 15$ )
- Significant population growth on VAN since 1998 when colony formed ( $\beta = 0.20, s.e.=0.03, t=7.92, p < 0.00, R^2 = .875, n = 11$ )

### Pigeon Guillemot

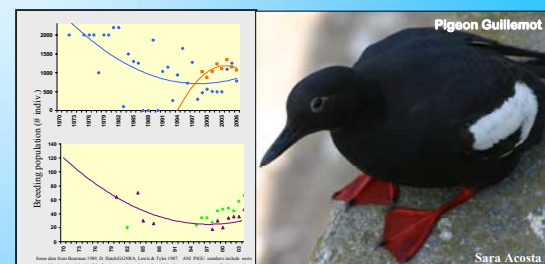
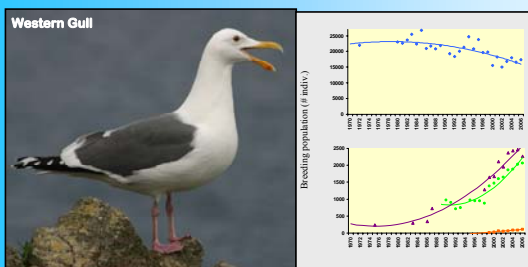
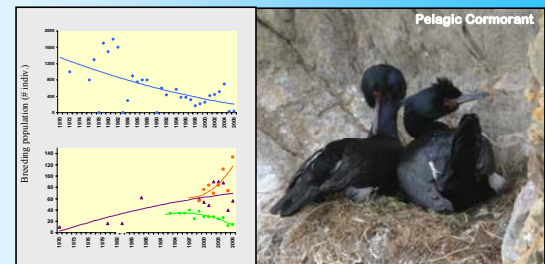
- Non-significant population decline on SEFI since early 1970s ( $\beta = -0.04, s.e.=0.01, t=-2.89, p < 0.01, R^2 = 0.23, n = 30$ )
- Non-significant population growth on ALCZ since 1997 ( $\beta = 0.02, s.e.=0.02, t=1.33, p < 0.21, R^2 = .138, n = 13$ )
- Non-significant population growth on ANI since early 1980s ( $\beta = 0.26, s.e.=0.02, t=1.33, p < 0.21, R^2 = .14, n = 13$ )
- Significant population increase on VAN until 2004 then decline No significant trend ( $\beta = 0.02, s.e.=0.02, t=1.53, p < 0.18, R^2 = .29, n = 8$ )

### Pelagic Cormorant

- Very sensitive to changing oceanic conditions, so they did not breed at all in several extreme warm-water years on SEFI
- Non-significant population decline on SEFI since early 1970s ( $\beta = -0.03, s.e.=0.04, t=-0.58, p < 0.56, R^2 = 0.012, n = 30$ )
- Significant population decline on ALCZ since 1993 ( $\beta_1 = 38.71, \beta_2 = -0.01, s.e.2=0.02, t=-2.57, p < 0.028, R^2 = .075, n = 13$ )
- Significant population growth on ANI since early 1970s ( $\beta = 0.05, s.e.=0.01, t=5.25, p < 0.00, R^2 = .73, n = 12$ )
- Significant population growth on VAN since monitoring first started in 1999 ( $\beta = 0.8, s.e.=0.03, t=2.76, p < 0.03, R^2 = .560, n = 8$ )

### Western Gull

- Population growth on SEFI from early 1970s to mid 1980s, but overall a significant decline ( $\beta_1 = 1.95, \beta_2 = -0.0005, s.e.2=0.0002, t=-2.15, p < 0.042, R^2 = .594, n = 27$ )
- Stable population size on ALCZ in 1990s, then significant population growth since 1999 ( $\beta_1 = -212.92, \beta_2 = 0.05, s.e.2=0.02, t=3.12, p < 0.012, R^2 = .087, n = 12$ )
- Significant population growth on ANI ( $\beta = 0.35, s.e.=0.04, t=9.44, p < 0.00, R^2 = .89, n = 13$ )
- Significant population growth on VAN ( $\beta = 0.24, s.e.=0.04, t=6.29, p < 0.001, R^2 = .868, n = 8$ )



## CONCLUSION

Ocean climate change, varying prey species, distribution of prey, and colony density have likely contributed to the observed offshore declines and near shore increases in breeding seabirds. New inshore colonies, VAN, ANI and ALCZ are very important in terms of their seabird diversity and breeding numbers (almost 1,500, 7,000 and 3,500 birds, respectively). The California Current System experienced warmer than average oceanographic conditions from the late 1970s until the late 1990s and again in 2005 and 2006. Seabirds in the central coast region preyed largely on rockfish in the 1970s and 1980s, but in the 1990s diet switched to anchovy, a species that occurs primarily inshore, by 2006 this was the dominant if not sole prey item, a species that occurs primarily inshore. Colony management issues such as erosion control and human disturbance have also shown to influence population numbers as seen in Pigeon Guillemot declines on ANI with loss of nest sites and increases on ALCZ as human disturbance has been minimized. Anomalous oceanographic years of 2005 and 2006 saw increases in Brandt's Cormorant productivity and decreases in Pelagic Cormorant productivity. Population trends may be driven by these anomalous years in the future.

## ACKNOWLEDGEMENTS

