Climate change effects on terrestrial and marine birds: Consequences for reproduction

Nadav Nur, Point Blue Conservation Science
Petaluma, CA

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Two Indicators of Climate Change Effects on Birds

Long-term studies by Point Blue Conservation Science reveal sensitivity of many species that breed in California to climate conditions.

• Cassin’s Auklet, a marine bird. Gulf of the Farallones.
  – Index of Reproductive Success (Updated).

• Song Sparrow, a terrestrial bird. Variety of habitats: Coastal scrub and tidal marsh (estuarine) habitat in San Francisco Bay region.

• Proposed: New Indicator:
  – Timing of breeding
  – Length of breeding season
  – Reproductive Success

Not only are these 2 species sensitive to climate variation, but modeling indicates are vulnerable to effects of climate change.
Point Blue Conservation Science

- Founded in 1965 as Point Reyes Bird Observatory
- 140 staff, seasonal and full time 2015 budget: $10 million
- Work to conserve birds, other wildlife and ecosystems through science, partnerships and outreach.

Conservation science for a healthy planet.
Cassin’s Auklets on the Farallon Islands

- Planktivorous (especially krill)
- Strongly responsive to ocean climate:
  - Reproductive success,
  - Adult survival, and
  - Survival to breeding age

Reproductive success important determinant of population growth, viability
Climate Change Indicator: Cassin’s Auklet Reproductive Success

Cassin’s Auklets respond to ocean conditions:

Climate Change Models Predict Increased Climate Variability

Increased Variability in Response: 70’s, 80’s-90’s, 2000’s – present
Cassin’s Auklets Reproductive Success: Importance of Prey

Annual Reproductive Success Reflects Prey, Reflects Oceanic Conditions
Summary: Cassin’s Auklet Climate Change Indicator

- Cassin’s Auklet Respond to Alterations in Food Web, reflected in warm-water events (e.g., 2005), delay in Upwelling (2006), major El Niño events.
- Such disturbances have been predicted to increase in frequency and/or magnitude due to climate change.
- Cassin’s Auklets have displayed increased variability in their response from 1970’s to the present. Both extreme positive and negative deviations seen recently.
Proposed Climate Change Indicator: Timing (and Success) of Song Sparrow Reproduction

• Song Sparrows studied intensively at Palomarin Field Station, 1980 – 2014. Coastal scrub habitat.
• Present year-round. Territorial.
• Song Sparrows have long breeding season. Lay March – July.
• Are multi-brooded. Can rear a second brood after successfully rearing a first brood.
• Rearing a second brood, or a replacement if first brood fails, is adaptive. More breeding attempts require a longer breeding season, which may be affected by climate.
Investigated
- “onset” of clutch completion (first 10 percentile),
- “cessation” (last 10 percentile of all nests) and
- duration of breeding season.
In relation to
- temperature (winter, spring);
- precipitation (fall, winter, spring).

- Temperature and precipitation have been shown to influence reproduction in this species.
- Climate models predict changes in temperature and precipitation.
Breeding is earlier as March Temp increases. P < 0.001. $R^2 = 0.37$. About 20 d difference.
No significant trend in date with year (later initiation in recent years?).
Cessation of Breeding

Breeding stops earlier as May Temp increases. $P < 0.0001$; $R^2 = 0.54$. 
Strong effect: About 40 d difference. 
Weak (NS) trend for temp vs year; no trend for cessation vs year.
Duration of breeding season decreases as May Temp increases. $P < 0.01$. $R^2 = 0.22$.

Trend for Maximum May Temp to decrease vs year, $P = 0.03$

No significant trend for duration to change over time.
Summary: Song Sparrow Timing of Breeding Indicator

• Temperature in March-May best predictive variable. Precipitation in spring also predictive. Wetter spring -> longer breeding season.
• Warmer temperatures lead to earlier onset, earlier termination of laying.
• Warmer temperature leads to shorter breeding period (fewer attempts).
• **Mechanism:** Warm, dry conditions affects vegetation (and prey?).
• Similar findings for tidal marsh Song Sparrows (earlier cessation, fewer attempts, under warm, dry conditions).
• How does this impact reproductive success?
• Proposed Next step!
Conclusions

- Timing and duration of breeding are potentially effective indicators of climate change for terrestrial and marine bird species.
- Important to combine indicators of timing with measures of reproductive success, such as survival of nests (affected by vegetation, predators).
- Value of long-term studies as basis for climate change indicators.
- Demographic models of climate change impacts indicate potential for significant long-term effects for Song Sparrows, Cassin’s Auklets.
- Adverse impacts of climate change not observed, in the short-term, for Song Sparrows. Important to monitor in the long term.
- Information from climate change indicators can inform management, with regard to vulnerability and resilience to climate change.
Thank you!

More info: nnur@pointblue.org

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