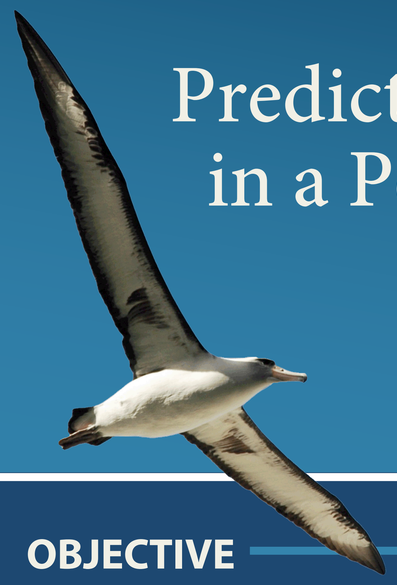
Predicting Resilience to Ecosystem Change in a Pelagic, Far-ranging, Generalist Forager



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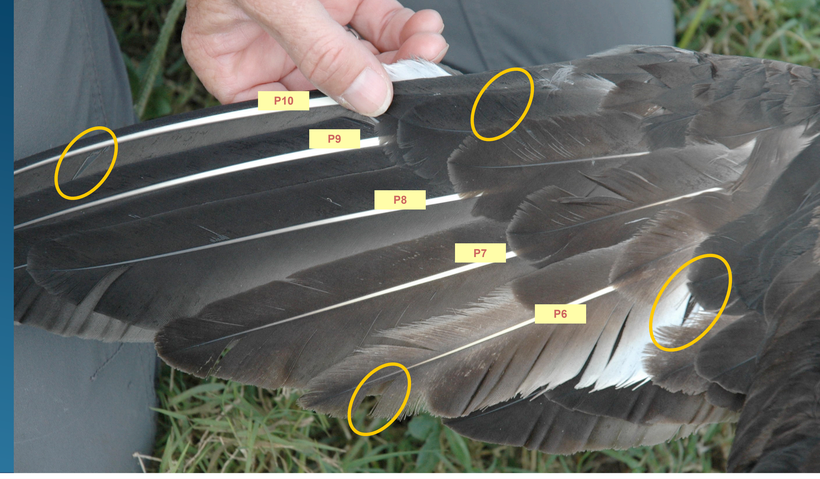


OBJECTIVE

Use a standardized measure of "ecosystem use" ($\delta^{15}N$ and $\delta^{13}C$) from carefully targeted feathers, across a breadth of sampling categories, to ask:

How resilient are Laysan Albatross (*Phoebastria immutabilis*) to changing ecosystem dynamics?

METHODS

Targeting Feathers Samples

- Targeted sampling locations for feathers P6 and P10 based on molt timing described in *Edwards 2008*
- **Four consecutive, targeted time periods for each bird**

Sampling Categories

1. **Current breeders** (2007) on Midway Atoll with known fledging success in 2006 & 2007 ($n > 100$)
2. **Historic breeders** (1899-1924) on NW Hawaiian colonies ($n = 15$)
3. Fisheries bycaught birds from the **Alaska** groundfish longline **fisheries** ($n = 33$)
4. Fisheries bycaught birds from the **Hawaiian** swordfish and tuna **fisheries** ($n = 15$)

Stable Isotopes: $\delta^{15}N$ $\delta^{13}C$

Change for at least three reasons:

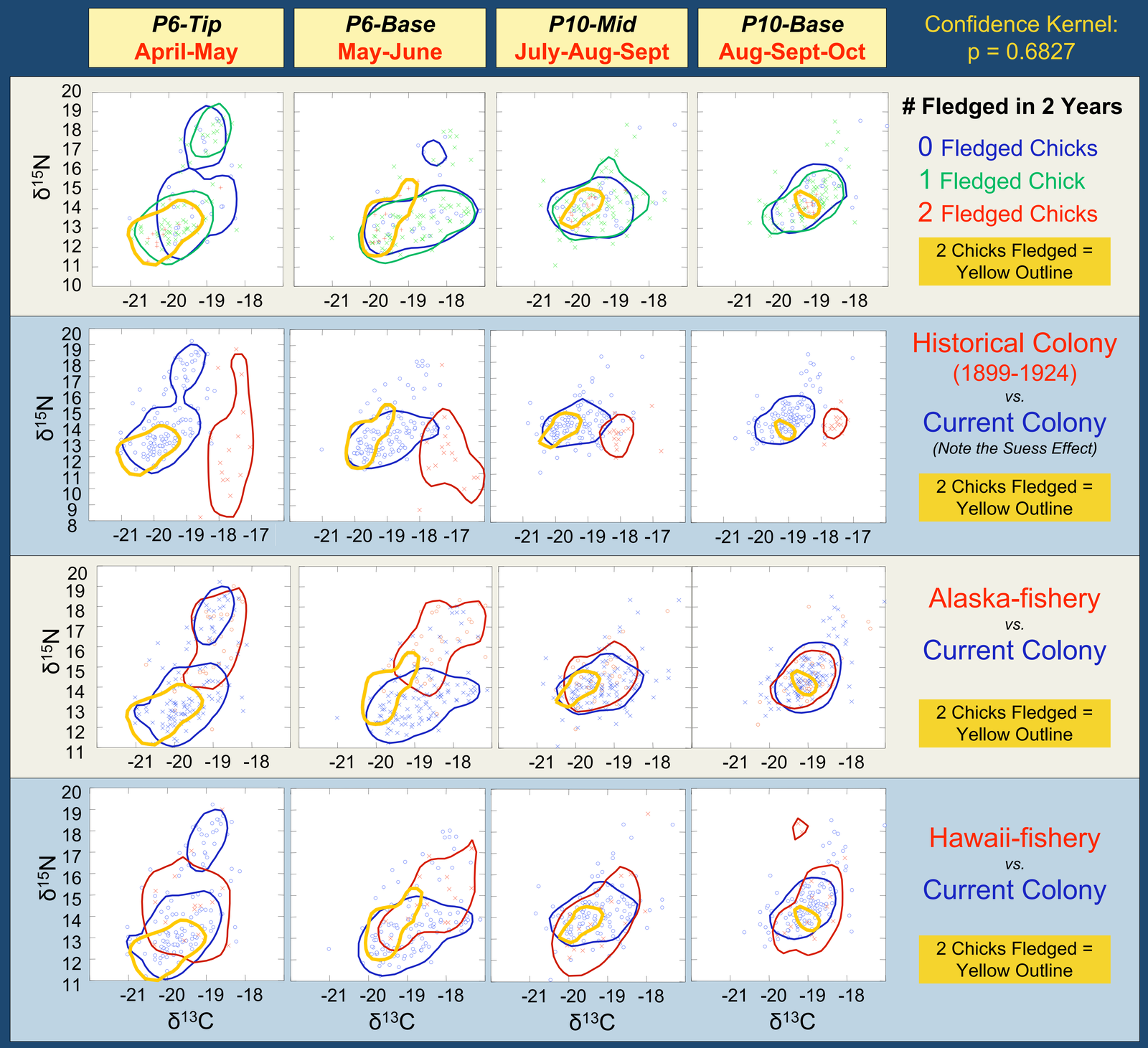
- **Trophic Level**: ~3‰ for $\delta^{15}N$ and ~1‰ for $\delta^{13}C$
- **Location**: $\delta^{15}N$ in the central North Pacific is lower by about 4 ‰ compared to the continental shelf (Wu et al. 1997)
- **Ocean accumulation of industrial carbon** ("Suess Effect"): decreased $\delta^{13}C$ by ~1.0

RESULTS

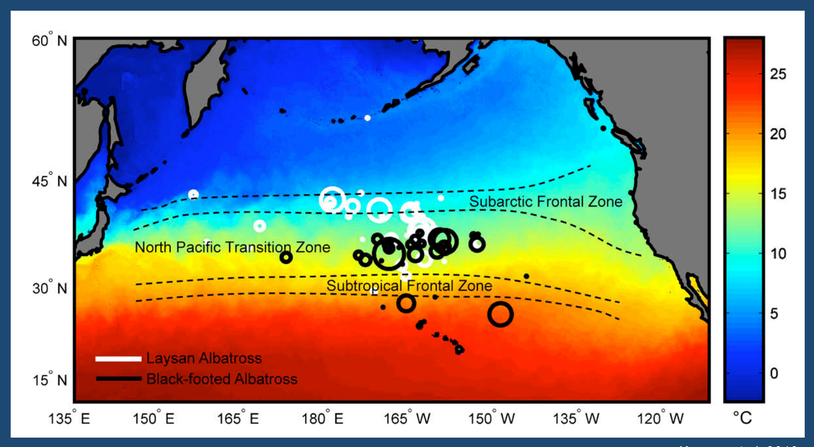
- Seasonal Variation Exists: Highly variable foraging strategies in April/May. Much less variation in Aug/Sept/Oct.
- To fledge 2 chicks in 2 years requires a narrow foraging strategy (both diet breadth and foraging location) = "optimal foraging strategy". Narrow diet breadth apparent in all seasons.
- "Optimal strategy" apparently has not changed over past 100 years.
- Diet breadth greater historically (see lowest values of $\delta^{15}N$).
- Fisheries-associated birds are foraging generalists (both diet breadth and foraging location) = "buffer foraging strategy".
- Fisheries-associated birds are not the most successful breeders.
- N values above ~15.5 likely associated with foraging on or near the continental shelf. N values below ~15.5 likely associated with foraging in pelagic waters of the central North Pacific (e.g, the NPTZ).

CONCLUSIONS

1. Foraging strategies have shifted over the last 100 years and include gains (fisheries-associated food = bait, discards, offal) and losses (lack of $\delta^{15}N$ values below 11).
2. "Optimal foraging strategies" (defined by those foragers with the highest 2-year fledging success) have likely remained consistent over the last 100 years.
3. A great breadth of foraging strategies, combined with observed changes in buffer strategies over the last 100 years suggests resilience to shifting ecosystem dynamics.
4. Yet, if climate change affects the narrowly-defined, optimal foraging strategy, the population may rapidly lose resiliency.

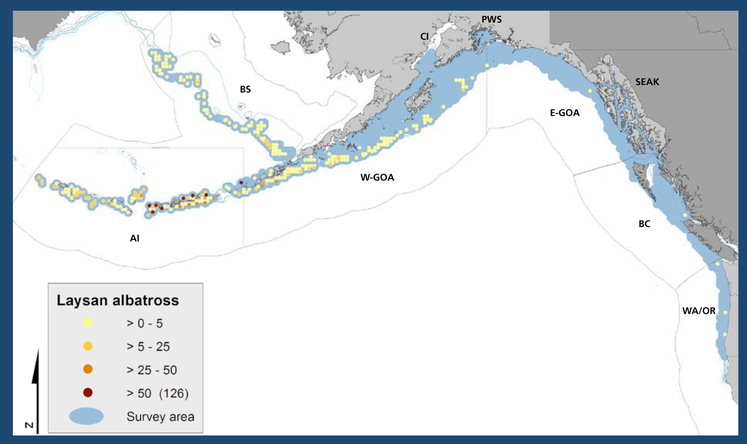


Foraging Concentrations in January (white circles)



Kappes et al. 2010

Alaska Foraging in Summer (yellow and red)



Melvin et al. 2006

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The recommendations and general content presented in this poster do not necessarily represent the views or official position of the Department of Commerce, the National Oceanic and Atmospheric Administration, or the National Marine Fisheries Service

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