Diet of the Endemic Island Fox Reveals Variation in Sandy Beach Resource Use on the California Channel Islands

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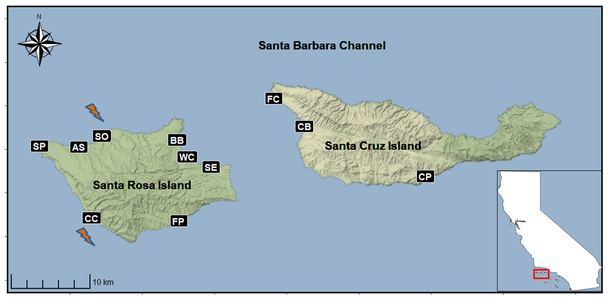
Background

The Channel Island Fox (*Urocyon littoralis*) is endemic to six of the eight Channel Islands, where it is the top terrestrial predator. While the seasonal diet of the island fox has been investigated in previous studies, the use of the coastal zone has not been explored. The coastal zone may provide important foraging opportunities which could increase dietary resource breadth and provide a valuable resource buffer during declines in terrestrial resources associated with climate variability and long-term climate change. We explored island fox use of sandy beach resources.

We predicted that beach and offshore attributes directly or indirectly influence the abundance of prey available to island foxes on the beach, and that fox use of beach prey would vary with prey abundance.



Data was collected from 11 sites on Santa Rosa and Santa Cruz Islands.
indicates a site where fox whiskers were collected.

Methods

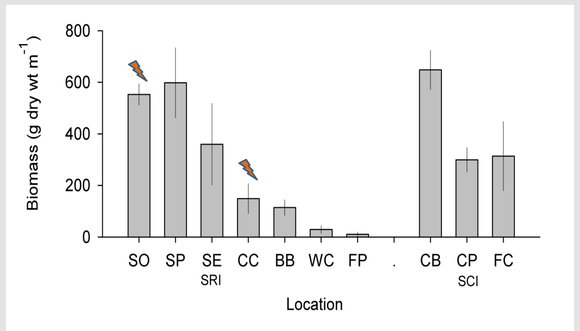
We examined island fox use of sandy beach resources on Santa Rosa and Santa Cruz Islands, using:

- Analysis of fox scat collected from all beach sites
  - Contents were separated by dry weight into terrestrial and beach components
- Stable isotope analysis of whisker segments from foxes live-trapped on two of the beaches
  - Subset into 8-15 segments to provide longitudinal dataset for each individual fox
  - Isotope values were compared to published and sampled prey values (corrected for TDF)
- Surveys of potential beach prey (invertebrates, pinnipeds, carcasses (pinnipeds and seabirds))
- Measurements of beach physical and biological attributes (macroalgal wrack cover, offshore kelp canopy, beach length, beach orientation, upper beach width, slope, presence/absence of dunes).

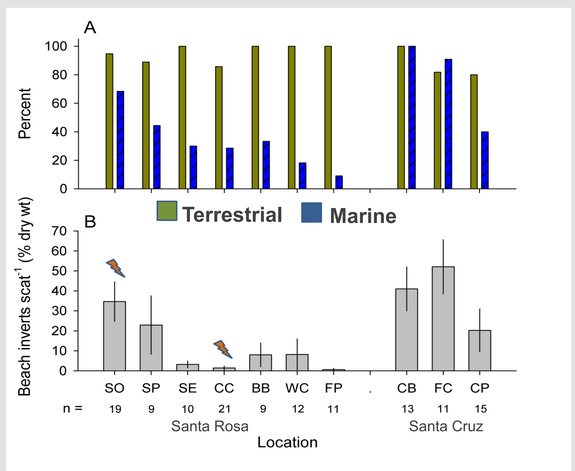
See publication for more details.

Results

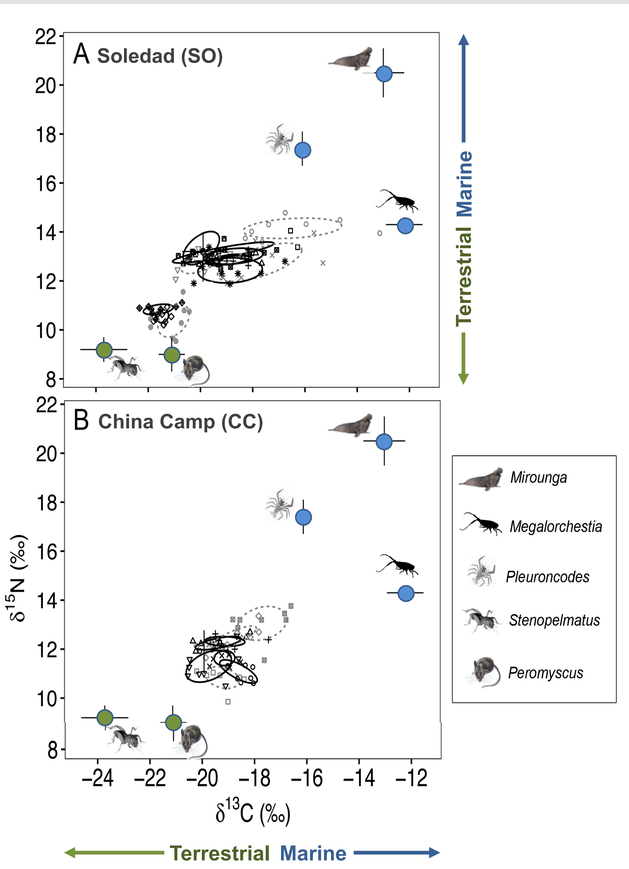
- Both beach and terrestrial resources were present, in varying proportion, in fox scat from all ten beach sites.
- The main beach resources used by island fox were the intertidal invertebrate talitrid amphipods (*Megalorchestia* spp.), beetle (*Thinopinus pictus*), and isopods (*Tylos punctatus* and *Allonoscus periconvexus*), all of which are associated with giant kelp (*Macrocystis pyrifera*) wrack.
- The abundance of beach invertebrates varied over 1000-fold, and biomass over 100-fold, across beach sites.
- The abundance of beach wrack explained 60% of the variation in amphipod and *Thinopinus* abundance (p = 0.019, DistLM analysis).
- The percentage of fox scats with upper beach prey varied significantly among sites (p < 0.001, test statistic = 43.471, Fisher's Exact Test) and increased with upper beach invertebrate abundance (p = 0.001, r^2=0.741) and biomass (p = 0.009, r^2 = 0.597).
- There was a positive association between beach wrack abundance, amphipod biomass, and proportion of beach prey in island fox diet.
- There was little evidence of use of pinnipeds or carcasses.



Biomass of upper beach invertebrates varied among beaches.
indicates a site where fox whiskers were collected.



A) Percent of scat containing terrestrial and beach diet items
B) Mean percent (+/-SE) of individual scat made up of beach items



Bivariate plots of individual island fox whisker segment δ13C and δ15N values for (A) Soledad and (B) China Camp beaches. Ellipses enclose standard ellipse areas (SEAc) of individual foxes. Solid lines are female; dotted lines are male. Stable isotope values revealed individual diet specialization. The fox population from the site with significantly higher amphipod abundance (Soledad) had a broader overall niche breadth and greater individual specialization than the site with low amphipod abundance (China Camp), and included beach and terrestrial specialists as well as individuals with a mixed diet.

Discussion

Island fox forage on sandy beaches for food resources, primarily wrack-associated talitrid amphipods. Use of beach items was proportional to their availability, which varied widely across beach sites and was dependent upon kelp wrack abundance. Wrack abundance may be influenced by prevailing wind, currents and beach orientation. In regions where this food source is available, it may increase local fox population resilience through diversification of food options that are not tied to terrestrial conditions, a topic of future investigation.

Future Directions

Explore the extent to which this mobile terrestrial mammal serves as a conduit for transporting marine-derived nutrients into the terrestrial ecosystem.

Further investigate how individual specialization influences the role of island fox in ecosystem processes, including the relationship between diet and diel activity patterns and implications for interactions with other species.

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