Path analysis, run in Stata v. 11.1, for direct/indirect effects of upwelling on seabirds; data were collected at Dassen and Robben Islands, Malgas Island and in Lamberts Bay, South Africa

Website: https://www.bco-dmo.org/dataset/679946
Data Type: model results
Version: 1
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Project
» Climate Change and Upwelling -- Comparative Analysis of Current and Future Responses of the California and Benguela Ecosystems (CalBenJI)

Contributors	Affiliation	Role
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Abstract
Path analysis, run in Stata v. 11.1, for direct/indirect effects of upwelling on seabirds; data were collected at Dassen and Robben Islands, Malgas Island and in Lamberts Bay, South Africa.

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Coverage

Spatial Extent: **N**:-32.0896 **E**:18.371 **S**:-33.8067 **W**:17.9254

Dataset Description

These data include total anchovy and sardine biomass west and southeast of Cape Agulhas (sampled in November), and anchovy and sardine recruitment west of Cape Infanta (sampled in May). Seabird variables included % of the diet comprised of anchovy, % of the diet comprised of sardine, breeding success, and survival.

Benguela Current African Penguin - These data were collected at two seabird colonies: Dassen Island (-33.4205 lat, 18.0872 lon) and Robben Island (-33.8067, 18.371 long), South Africa.

Benguela Current Cape Gannett - These data were collected at two seabird colonies: Lamberts Bay (-32.0896

lat, 18.3026 lon) and Malgas Island (-33.0526, 17.9254 long), South Africa.

Methods & Sampling

These data include total anchovy and sardine biomass west and southeast of Cape Agulhas (sampled in November), and anchovy and sardine recruitment west of Cape Infanta (sampled in May). Seabird variables included % of the diet comprised of anchovy, % of the diet comprised of sardine, breeding success, and survival. African penguin data were collected at Dassen and Robben Islands, South Africa. Cape gannets data were collected at colonies on Malgas Island and in Lamberts Bay, South Africa.

These variables were entered into path analyses, run in Stata v. 11.1 (StataCorp). Path models were designed *a priori* with upwelling as the base predictor variable, fish biomass (both species) and anchovy recruitment as intermediate predictors, and a seabird metric as the response variable. Path analysis produces beta coefficients for each path segment of the model. To determine the dominant path of effect, the beta coefficients for each indirect path were multiplied together, then summed. This sum of the products of all of the indirect paths was compared to the beta coefficient of the direct path of effect. The greater value indicated if the dominant path was direct or indirect. If indirect, the path with the largest beta coefficient product was considered the dominant path of the model. Note that fish biomass, and anchovy recruitment data were ln-transformed prior to analysis. Anchovy and sardine biomass were lagged one year for analyses of penguin responses, to precede the penguin breeding season when those measurements were collected.

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Data Files

File
path_analysis.csv (Comma Separated Values (.csv), 4.06 KB) MD5:8b2e9b9fdd1d0474daa9b2ca59b2e2db Primary data file for dataset ID 679946

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Parameters

Parameter	Description	Units
year	4-digit year of sampling	unitless
anc_tot_biomass	Total anchovy biomass for the southwestern Benguela Current Ecosystem along the west coast of South Africa southeast through Cape Agulhas. Sampling season: November.	tons
sar_tot_biomass	Total sardine biomass for the southwestern Benguela Current Ecosystem along the west coast of South Africa southeast through Cape Agulhas. Sampling season: November.	millions of tons
anc_recruitment	Total anchovy recruitment for the southwestern Benguela Current Ecosystem along the west coast of South Africa southeast through Cape Infanta. Sampling season: May.	billions of fish

sardine_recruitment	Total sardine recruitment for the southwestern Benguela Current Ecosystem along the west coast of South Africa southeast through Cape Infanta. Sampling season: May.	billions of fish
ap_di_anc_pcnt_diet	Percent of the Dassen Island African penguin diet mass that was anchovy	percent (%)
ap_di_sar_pcnt_diet	Percent of the Dassen Island African penguin diet mass that was sardine	percent (%)
ap_di_bs	Dassen Island African penguin breeding success	number of chicks fledged/pair
ap_di_surv	Dassen Island African penguin adult survival (fraction surviving)	unitless (fraction)
ap_ri_anc_pcnt_diet	Percent of the Robben Island African penguin diet mass that was anchovy	percent (%)
ap_ri_sar_pcnt_diet	Percent of the Robben Island African penguin diet mass that was sardine	percent (%)
ap_ri_bs	Robben Island African penguin breeding success	number of chicks fledged/pair
ap_ri_surv	Robben Island African penguin adult survival (fraction surviving)	unitless (fraction)
cg_lb_anc_pcnt_diet	Percent of the Lamberts Bay Cape gannett diet mass that was anchovy	percent (%)
cg_lb_sar_pcnt_diet	Percent of the Lamberts Bay Cape gannett diet mass that was sardine	percent (%)
cg_lb_bs	Lamberts Bay Cape gannett breeding success	number of chicks fledged/pair
cg_lb_surv	Lamberts Bay Cape gannett adult survival (fraction surviving)	unitless (fraction)
cg_mi_anc_pcnt_diet	Percent of the Malgas Island Cape gannett diet mass that was anchovy	percent (%)
cg_mi_sar_pcnt_diet	Percent of the Malgas Island Cape gannett diet mass that was sardine	percent (%)
cg_mi_bs	Malgas Island Cape gannett breeding success	number of chicks fledged/pair
cg_mi_surv	Malgas Island Cape gannett adult survival (fraction surviving)	unitless (fraction)

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Project Information

Climate Change and Upwelling -- Comparative Analysis of Current and Future Responses of the California and Benguela Ecosystems (CalBenJI)

Coverage: California Current Ecosystem and Benguela Current Ecosystem

Desciption from NSF award abstract:
Along the west coasts of North and South America, Africa, and Iberia, alongshore equatorward winds bring nutrient-rich waters to the sunlit surface of the ocean, stimulating phytoplankton blooms that support robust, rich and diverse ecosystems. This process is known as "upwelling". Because upwelling is driven by winds, and winds are related to atmospheric conditions, upwelling is highly vulnerable to the effects of climate change. However, the potential impacts of climate change on upwelling and biology remain largely uncertain. In earlier work in the California Current upwelling system, off the west coast of the United States, researchers found that upwelling occurs in distinct winter and summer "modes" that have different impacts on biology. In this project, oceanographic and atmospheric data from the Benguela Current system, off South Africa and Namibia, will be analyzed for similar seasonal patterns and relationships with the ecosystem. Comparisons between these two upwelling systems will allow researchers to investigate if previous findings of regional climate impacts on biology are applicable at a global scale and consider how these systems may change in the future. The project will facilitate collaboration between researchers from South Africa, Namibia, and the United States, integrating a team of young and senior scientists from the three countries and providing them with opportunities for broad-scale scientific synthesis early in their careers.

This project will be a comparative analyses of climate forcing and biological responses in the California Current (CCS) and Benguela Current systems (BCS), the two upwelling systems with the most similar time series of atmospheric and oceanographic conditions, seabird demography, and lower (chlorophyll) and mid (forage fish) trophic data. The project will determine whether changes in the ecosystems can be attributed to regional or global climate processes. Growth-increment chronologies from fish in the BCS (deep-water hake) will be developed as indicators of upper-trophic fish growth, and compared to rockfish growth chronologies developed in the CCS. Mid-trophic level fish abundance will be modeled as indices of prey availability for integration between climate and upper-trophic-level parameters. Oceanographic and atmospheric data will be analyzed from global observational and reanalysis data sets, as well as from earth system model projections of climate change. The project will address the following questions:
1) are seasonal upwelling modes (winter and summer) discernible in the BCS as they are in the CCS?
2) are upwelling modes forced by similar or contrasting atmospheric forcing mechanisms?
3) is there evidence of coherence/covariance among mid-trophic fish, upper-trophic fish, and seabirds (and at which lags) within and between the CCS and BCS?
4) will the positioning and amplitude of the atmospheric pressure systems that result in upwelling-favorable winds change coherently between ecosystems under various climate-change scenarios? and
5) what are the fisheries and wildlife management implications for variability in the seasonality and spatial distribution of upwelling in a changing climate?

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1434732

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