

Bibliography of Literature on Seabirds as Indicators of the Marine Environment

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Background and purpose: We can observe seabirds at sea and study them at their colonies with relative ease, and so quantify many aspects of seabird behavior and biology. Seabirds forage over a wide range of marine habitats, and therefore serve as sensitive and cost-effective indicators of the health and status of marine ecosystems. Because of this, the North Pacific Research Board (NPRB, <http://www.nprb.org/>) called for a synthesis of the current state of knowledge of seabirds as indicators of marine ecosystems and change in the North Pacific. To meet that request, we are working with our colleagues to: 1) review literature on seabirds as indicators, 2) hold a symposium to consolidate current knowledge about seabirds as indicators and publish those findings, and, 3) to incorporate the results of the symposium into a cost-effective research and monitoring plan for the NPRB that identifies species and parameters best suited for long-term study and most likely to be useful indicators of ecosystem status and change in the North Pacific. This bibliography comprises our effort to review literature on seabirds as indicators, and make it available as a bibliography for use in preparing products from the symposium and to locate reference material for the NPRB research plan.

Organization: Citations in this bibliography are organized into four main sections. First are papers that deal specifically or largely with using seabirds as indicators of some aspect of the marine environment. Following that are citations organized loosely into three categories of

papers that deal with seabirds as indicators of the forage base, habitat or climate change. The bulk of these papers are not about seabirds as indicators *per se*, but represent good examples of studies in which aspects of seabird ecology provide insight into changes in the marine environment. In other words, examples where seabirds are *actually used* as indicators. This bibliography was created by searching several online databases for indicator-type papers, and by searching through our personal libraries. While the list of papers on using seabirds as indicators is fairly complete, the list of papers which illustrate how seabirds are used as indicators is by no means exhaustive and deals mostly with studies conducted during the past 20 years or so.

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A ProCite version of this bibliography is also available at the above web site.

1. Seabirds as Indicators

Literature specifically about using seabirds as indicators of the marine environment

Adams, N. J., P. J. Seddon, and Y. M. Vanheezik. 1992. Monitoring of seabirds in the Benguela upwelling system - can seabirds be used as indicators and predictors of change in the marine-environment. *South African Journal of Marine Science* 12: 959-974.

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2. Seabirds as Indicators of the Forage Base

(a) *indicator of forage base characteristics like community*

composition, diversity, size, energy value, etc.

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*(b) indicator of forage base relationships, prediction of stock size,
functional/numerical responses, ecosystem dynamics*

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3. Seabirds as Indicators of Habitat

(a) indicator of oceanographic features, habitat quality, spatial variability

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(b) indicator of habitat degradation, oil pollution, contaminants, plastics, etc.

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4. Seabirds as Indicators of Climate Change

(a) indicator of anomalous events, one time events, short term events like ENSO

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*(b) indicator of long-term change in marine climate, cyclic changes,
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