Impact of the 1997/98 El Niño on Seabirds of the North East Pacific

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To a large extent, seabirds are constrained to specific parts of the ocean on the basis of the characteristics of the marine climate. Large water masses or groups of similar, adjacent water masses often have characteristic assemblages of seabirds. Large-scale events that alter marine climates should produce changes in the seabird community characteristics that are consistent with the water mass alterations. However, because the factors that constrain seabirds to particular water masses are poorly understood, it is difficult to predict their response to large-scale perturbations.

Wahl et al. (1993) noted that during the 1982/83 El Niño, Fork-tailed Storm-Petrels *Oceanodroma furcata* were observed to feed atypically on the larvae of Dungeness crab *Cancer magister* in coastal Washington. During that same summer, widespread abandonment and failure of Brandt's *Phalacrocorax pencillatus* and Pelagic *P. pelagicus* cormorants occurred in Oregon (Graybill and Hodder, 1985). It was assumed that the elevated surface water temperatures had affected the distribution and recruitment of prey fish, which in turn had impacted the feeding (and reproductive) ability of these species. Off California, Briggs et al. (1987) observed (during 1982/83) lower overall at-sea seabird densities; higher relative percentages of warm-water species; and reduced numbers and southward dispersal of northern nesting species. Common Murres *Uria aalge* were 60% less numerous at sea during the 1982/83 winter and they foraged unusually far from land. In marked contrast, off Washington passage migrants and resident species fed nearer to the coast during that same event. Wahl et al. (1993) suggested that detritus-based estuarine systems (such as off Washington), were less affected by El Niño events than upwelling systems (off California).

In an effort to better understand the impacts of large-scale variations in oceanographic conditions on seabirds off the British Columbia coast, I began monitoring seabirds along a repeated 1500-km cruise track (Line P) to Ocean Station Papa (50°N by 145°W) in May 1996. To date, six surveys have been completed (May and August '96, February and June '97, and February and June '98). Surveys were conducted only while the ship was steaming at more than 5 knots (9.25 km h^{-1}) during daylight hours. During the surveys, the sea and sky were continuously scanned in a 180° field centred on the ship's bow. Transects were a running series of 5-min counts; the start and end position and time of each transect series were noted. Within each 5-min count period, all birds seen within 250 m of the ship were identified and tallied. Numbers of birds observed in each transect were transformed into densities (no./km^2) by species and by total birds. Mean densities were calculated for five segments of the route (Table 1), as well as for the entire survey line.

It was predicted that the warming of the coastal surface waters, the depression of the thermocline, and the northward displacement of the Subarctic Boundary would significantly influence the composition, abundance and distribution of the pelagic seabird community. Preliminary examination of the data only partially supported this hypothesis. The following observations suggested that 97/98 El Niño impacted the seabird community.

- Comparing only the early summer cruises (May '96, June '97 and June '98), the overall total density of birds and the diversity of species, were lowest in June '97 (see Table 2). Of the three early summer cruises, June '97 had the highest near-surface temperatures (Figure 1).

- Species of birds that are usually associated with the continental shelf, such as Common Murre, Cassin's Auklet *Ptychoramphus aleuticus*, and

Rhinoceros Auklet *Cerorhinca monocerata* (Morgan et al. 1991) were entirely absent from the June ’97 survey.

- Fork-tailed Storm-Petrels, a species that typically is most abundant along the outer edge of the shelf and over the slope, ranged considerably farther offshore in June ’97 (see Figure 2); indicating that they were travelling greater distances in search of food, and were most likely working harder to find sufficient energy for themselves and/or for their young.

Table 1. *Line P segments, station numbers, locations and water depths (on station). Segments refer to all bird survey transects conducted between the station pairs noted.*

Line P Segment	Line P Station No.	Latitude (° ´ N)	Longitude (° ´ W)	Water Depth Range (m)
	P1	48 34.5	125 30.0	120
A	↓↑			
	P4	48 39.0	126 40.0	1300
	P4	48 39.0	126 40.0	1300
B	↓↑			
	P12	48 58.2	130 40.0	3300
	P12	48 58.2	130 40.0	3300
C	↓↑			
	P16	49 17.0	134 40.0	3550
	P16	49 17.0	134 40.0	3550
D	↓↑			
	P20	49 34.0	138 40.0	3890
	P20	49 34.0	138 40.0	3890
E	↓↑			
	P26	50 00.0	145 00.0	4200

Table 2. *Average densities (no./km^2) of the 8 most common species of birds along the entire survey route. Elevated sea surface temperatures were most pronounced during the June 1997 survey.*

	May ’96	Aug ’96	Feb ’97	June ’97	Feb ’98	June ’98
Black-footed Albatross	0.13	0.09	0.03	0.12	0.05	0.04
Northern Fulmar	0.04	0.01	0.44	0.02	0.41	0.15
Dark shearwaters *	1.03	0.02	0.01	0.31	0.002	11.05
Fork-tailed Storm-Petrel	0.34	0.02	0.06	0.16	0.10	0.14
Leach’s Storm-petrel	1.47	0.42	–	0.40	–	0.84
Common Murre	0.09	0.002	0.31	–	0.14	0.01
Cassin’s Auklet	0.05	0.27	0.18	–	–	0.03
Rhinoceros Auklet	0.07	0.01	0.01	–	0.02	0.02
Total Birds	3.60	1.09	2.48	1.19	1.47	12.77
Number of Species	22	23	20	16	20	21
Area Surveyed (km^2)	474.6	460.2	204.9	286.6	489.9	294.9

* Dark shearwaters = Sooty and Short-tailed Shearwaters, plus unidentified dark shearwaters.

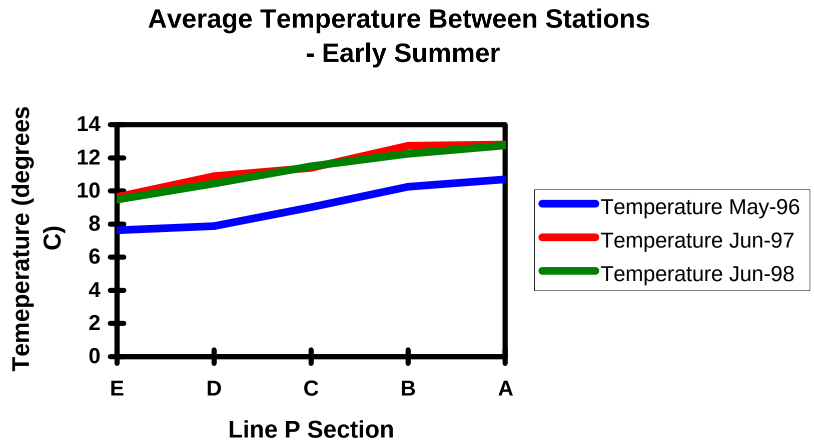

Figure 1. *Near surface (5m depth) temperatures averaged between stations during the three early summer cruises (May '96, June '97, June '98).*

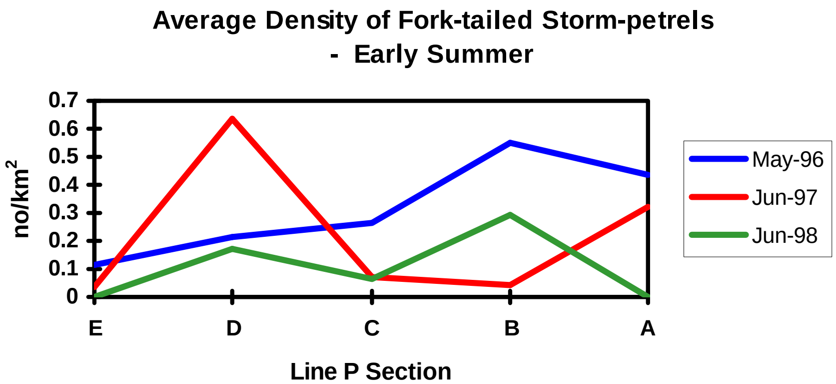

Figure 2. *Average density of Fork-tailed Storm-petrels within each line segment during the May '96, June '97 and June 98 surveys. Refer to Table 1 for location of each segment.*

Results that tended to contradict the hypothesis are as follows.

- Despite the continued persistence of warm near-surface waters (to at least June '98) the densities of dark shearwaters (Sooty *Puffinus griseus* and Short-tailed shearwaters *P. tenuirostris,* Figure 3) and Leach's Storm-petrel *Oceanodroma leucorhoa* surpassed the long-term average summer densities (derived for pelagic waters off the BC coast, see Table 3). The apparent "re-bounding" of dark shearwaters suggests that the decline was due to distributional shifts rather than due to population declines as suggested by Veit et al. (1996).

- In contrast to the previous year, the diversity of species in June '98 returned to pre-El Niño levels.

- Preliminary statistical analyses failed to demonstrate any significant relationships between species densities and the water characteristics tested (surface temperature, salinity, chlorophyll-*a* and nitrate levels).

Speculations on the results observed:

- Over the duration of the study, changes in the climatic/oceanographic conditions outside of the route covered by these surveys may have altered the normal migration routes, resulting in a depressed abundance of seabirds and an altered species mix.

- A time lag of unknown length (12 months or more?) may have existed between the changing oceanographic conditions and the response of the local seabird assemblage. Such a time lag would likely negate simple correlation tests between seabirds and water characteristics (that had been measured concurrently).

- The seabird community of the North East Pacific may have been dramatically altered long before this study commenced, from either a "regime shift" step-change or because of inter-decadal fluctuations (e.g., Francis and Hare, 1993; Mackas, 1995).

Figure 3. *Short-tailed Shearwater (Puffinus tenuirostris). Photograph by T. Palliser*

Table 3. *Long-term average seasonal densities (no./km^2, plus Standard Deviation) of common seabird species in pelagic waters off the coast of British Columbia[1], 1981–1998.*

	Spring		Summer		Winter	
	Density	SD	Density	SD	Density	SD
Black-footed Albatross	0.29	1.35	0.39	3.79	0.02	0.27
Northern Fulmar	0.16	2.08	1.14	18.36	0.29	2.56
Dark shearwaters	24.40	397.22	8.72	52.36	0.05	0.21
Fork-tailed Storm-petrel	0.86	4.15	1.01	9.29	0.11	0.57
Leach's Storm-petrel	0.55	2.18	0.50	2.13	0.003	0.04
Common Murre	0.65	9.17	0.84	5.48	1.21	3.34
Cassin's Auklet	1.68	19.16	2.26	27.73	0.67	2.76
Rhinoceros Auklet	0.47	1.45	0.58	3.45	0.05	0.31
Total Birds	32.36	398.93	23.67	172.90	6.85	21.72
Total Area Surveyed (km^2)	4369		7614		940	

[1] Data are from seabird surveys conducted anywhere within pelagic waters off the west coast of Canada, not just along Line P.

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