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Consumption of Largemouth Bass Eggs by Redhead Ducks at Ruby Lake, Nevada

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Dietary preferences and nutrient cycles of breeding ducks are well documented (Krapu 1974, 1981; Serie and Swanson 1976; Drobney and Fredrickson 1979; Reinecke and Owen 1980). Before egg-laying, many species of ducks typically feed on plant foods high in carbohydrates to accumulate lipid reserves for ovarian development and incubation. During the laying period, females feed on animal food to obtain the protein necessary for egg production. Because protein cannot be stored in appreciable amounts, protein for egg formation is obtained principally from the diet (Krapu 1981). Lipid reserves during the laying period provide energy that allows females to feed on invertebrates, the consumption of which may be energetically inefficient (Drobney 1980, Krapu 1981). Because lipid reserves are also needed during incubation, it should be important for female ducks to minimize energy expenditure during egg-laying. Thus, both the protein content of foods and the energetic costs of acquiring them are important factors governing choice of diet.

To my knowledge, breeding waterfowl in freshwater marshes have not been previously reported to eat fish eggs. Utilization of herring (*Clupea harengus*) eggs along the Pacific Coast was reported by Munro (1941) for Greater Scaup (*Aythya marila*) and by Bayer (1980) for several species of diving ducks (*Aythya* spp.), including Redheads (*A. americana*). Peterson and Ellarson (1977) reported that Oldsquaws (*Clangula hyemalis*) wintering on Lake Michigan consumed fish eggs when available.

I report here observations on Redheads during the

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breeding season, in which fish eggs were consumed presumably to obtain dietary requisites for reproduction.

The study area was a 3,180-ha marsh referred to as the South Sump on Ruby Lake National Wildlife Refuge in northeast Nevada, 80 km southeast of Elko. The South Sump was an interspersion of hardstem bulrush (*Scirpus acutus*), islands, and open water. Average water depth for most of the South Sump was about 1.5 m, with depths of 3-4 m in several of the large, open water areas. Most breeding Redheads at Ruby Lake NWR nested in the South Sump (Bouffard 1983).

Foraging birds were collected and contents of their esophagi examined (Noyes 1983, Noyes and Jarvis 1985). Reproductive status of females was based primarily on ovarian condition (Krapu 1974). Reproductive status of paired males was based on the status of their mates. Samples of available foods were taken with 3 net sweeps (1 mm mesh) covering an area of 1.5 m^2 at the time and site where birds were collected. Foods, both consumed and available, were expressed as percent occurrence and aggregate percent (Swanson et al. 1974) by dry weight.

While studying the diet and nutrition of breeding Redheads and Canvasbacks (*Aythya valisineria*) during spring and summer 1980 and 1981 (Noyes and Jarvis 1985), I observed several instances in which female Redheads foraged on eggs of largemouth bass (*Micropterus salmoides*). Female Redheads appeared to forage opportunistically throughout the breeding season and, except during the laying period, their diet generally was composed of the more abundant food items. Muskgrass (*Chara* spp.), bulrush seeds, and snails were among the most abundant foods, both consumed and available (Noyes 1983). During the laying stage, however, the protein requirements of egg production possibly necessitated that Redheads seek less-abundant animal foods capable of satisfying those requirements. At Ruby Lake, nearly one-half (45% by dry weight) of all animal food consumed by 11 female Redheads collected during the laying period was bass eggs (Noyes and Jarvis 1985). All but 1 of the 5 females that consumed bass eggs had begun egg-laying, as evidenced by ovarian condition. Bass eggs were a rich source of protein; by proximate analysis, I found these eggs to contain 63.9% protein by dry weight.

Of the four females that foraged on bass eggs during the laying period, bass eggs comprised 94% of all foods consumed. My field observations also indicated a high degree of selectivity for bass eggs. Pairs of Redheads appeared to search for bass nests along the edge of bulrush. Between 80 and 90% of all bass nests ($n = 22$) in the study area were within approximately 0.6 m of bulrush edge (M. Green pers. comm.). Twice I observed what I believe was an interaction between a male Redhead and a male bass guarding the nest. The male Redhead repeatedly made brief dives, each time surfacing in an aggressive posture; each dive was followed by the female diving at the same location. After collecting the birds, I examined their esophagi and found the female's to contain bass eggs. One male consumed a small amount of bass eggs. The absence of fungus on the eggs indicated that the ducks were eating eggs from active bass nests, rather than from deserted nests (M. Green pers. comm.).

Bass eggs were available at Ruby Lake throughout most of the nesting period of Redheads. The density of bass nests in the study area during 1980 was about 8-10 nests/ha; owing to inclement weather conditions, bass made 4 nesting attempts between 1 May and 3 June 1980 (M. Green pers. comm.). This period coincided with the peak of Redhead egg-laying (Bouffard 1980). Apparent interactions between male Redheads and male bass guarding the nest may allow female Redheads to acquire protein, while conserving energy. The seasonal abundance of a readily available source of protein appears to be well exploited by this population of Redheads.

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Relationships of Pelagic Seabirds with the Southern Ocean Environment Assessed by Correspondence Analysis

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Spatiotemporal changes in pelagic seabird assemblages probably reflect changes in the dispersion of prey stocks (Croxall 1984). Direct observations of seabird-prey interactions are too rare to allow modeling on that basis alone (Griffiths 1982). Construction of a deterministic model of seabird-habitat relationships, which is linked to a similar prey-habitat interaction model, seems a practical approach to determining whether or not monitoring pelagic seabirds can be useful in the management of pelagic prey stocks. Such a model requires an understanding of the multiple cues used by seabirds for purposes of long-range navigation (Baker 1978) between areas of high prey density and seabird breeding colonies.

Seabird distribution in deep-sea areas has been related qualitatively to patterns of sea temperature, salinity, and weather (Murphy 1936, Salomonsen 1965, Brown et al. 1975, Pocklington 1979). Areas of peak seabird density coincide with oceanic areas reported to contain concentrations of food (Griffiths et al. 1982, Abrams 1985a). If these areas can be recognized by simple environmental parameters, then a descriptive model of seabird-habitat-prey relationships can be developed.

Linear regression techniques applied to seabird-habitat interactions have been insufficient, suggesting that models must include nonlinear relationships between seabird abundance and, for example, sea-surface temperature (Abrams 1982, 1983, 1985b). We report on a preliminary effort to use correspondence analysis to qualify the relationships of seabird abundance with temperature, wind strength, and weather parameters. The nature of nonlinear regression equations that may fit a deterministic model can be explored in this manner.

Data on seabird distribution and environmental variables were collected aboard the M.V. 'S. A. Agulhas' during 16 February to 10 March 1981, as part of the First International BIOMASS Experiment (FIBEX). The cruise track ran between Cape Town and a grid study area bounded by 59° and 69°S and 15° and 30°E (Fig. 1). All birds flying past and passed by the moving ship (mean speed = 23.4 km/h) in a 1-km-wide transect were recorded as described by Griffiths (1981), during 1,445 10-min seabird observations (hereafter referred to as stations).

The predictability of the abundance of seabirds in four diet classes (plankton, squid, fish, mixed; see Appendix) in relation to environmental features was assessed at oceanic and regional scales by identifying the relative strengths of seabird associations with air temperature (AIR), water temperature (WAT), barometric pressure (BAR), wind strength on Beaufort scale (WIND), and weather (WEATH) coded from 1 (clear sky) to 6 (storm with rain or snow).

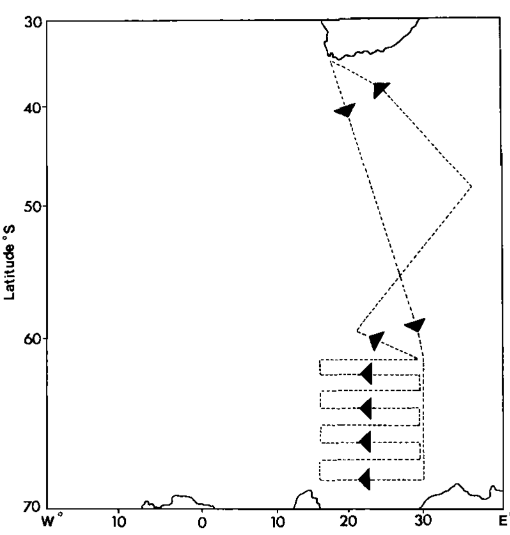

Fig. 1. African sector of the Southern Ocean showing FIBEX cruise track.

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