

SHORT COMMUNICATIONS

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IRRUPTIVE DISPERSAL OF BLACK-SHOULDERED KITES TO A COASTAL ISLAND¹

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Most accounts of species turn-over rates have focused on the attributes of islands and bird populations, treating ocean waters as a constant barrier to dispersal (see Cox and Moore:147-149). An invasion of San Clemente Island (Los Angeles County, California) by Black-shouldered Kites (*Elanus caeruleus*) shows how behaviors, such as the tendency to wander or undertake irruptive migrations (Kerlinger 1989), may combine with weather conditions to intermittently allow birds to cross these barriers. In late summer 1984, 26 kites crossed at least 80 km of ocean from the California mainland to San Clemente Island. Their arrivals on the island were staggered over two months, apparently occurring in pulses. They formed a communal roost from August to December, and then departed the island without nesting in the spring.

San Clemente Island (145 km²) lies 80 km south-southwest of the Palos Verdes Peninsula and 100 km west of San Diego (Fig. 1). The island is narrow (2-7 km) and its long axis is roughly parallel to the coast. Vegetation on the island is a combination of low scrub and grassland (Ferguson 1979). Kites have not bred on San Clemente or any of the other Channel Islands (Garrett and Dunn 1981). The closest source of migrant kites is the U.S. Marine Corps' Camp Pendleton (Wright 1978), the last large and undeveloped area of coastline in southern California. The island is seldom seen from shore because haze and smog lower visibility to less than 20 km. Visibility averaged 18.9 ± 7.1 km ($n = 728$, 8 observations per day) during the summer of 1984 (Anon. 1984). Summer winds typically blow onto the southern California coast from northwest to southeast, except during periods of the Catalina eddy when winds along the coast flow from the south and east (Wakimoto 1987).

I observed the first kite on 28 June 1984 during bird surveys on the island. These surveys, started in February 1984, were designed to map the occurrence of

potential predators and competitors of the island subspecies of Loggerhead Shrike (*Lanius ludovicianus mearnsi*) (see Scott and Morrison 1990), but provided an opportunity to record the occurrence of all large birds. It is unlikely that kites escaped detection prior to 28 June because we surveyed approximately 85% of the island each week (by vehicle; 5 15-km routes, 1 route/8-hr day), and the remaining 15% each month (on foot; 5-km/10-hr day). In addition, Black-shouldered Kites are conspicuous white and black raptors, which hunt by highly visible fluttering flights 10 to 20 m above the ground.

Eight days after the first kite observation, the number of kites on the island increased to three, with each bird occurring in different parts of the island. A communal roost, located on power lines in a grass-covered mesa near (2 km) the field station, was first used on 17 July (19 days after the first observation). Six kites occupied the roost from 17 July until 4 August, when they were joined by three additional kites (36 days after first observation). Our bird surveys of the island ended on 15 August; I made three additional counts at the roost: on September 15 (16 kites present), on October 23 (26 kites observed for three consecutive nights), and on 27 November (26 kites observed). In all, Black-shouldered Kite invasions of the island were staggered over at least three months and occurred in at least six waves.

No kites were present on the island when bird surveys resumed on 4 January 1985. This date, although early, corresponds with the dissolution of mainland roosts (Wright 1978). The fact that no kites nested on the island is difficult to interpret. Unlike latitudinal migrants, which regularly visit or overwinter on the island (Jorgensen and Ferguson 1985), Black-shouldered Kites are thought to move to winter roosts near their breeding territories (Mendelsohn 1983). Although speculative, the most reasonable explanation for kite departure is that they returned to mainland territories to breed. They abandoned ample, unoccupied nesting locations and the prey populations that supported the roost during the summer, fall, and early winter.

An analysis of 30 regurgitated pellets collected at the island roost in August 1984 indicates that kites were eating house mice (*Mus musculus*) (present in all pellets) and deer mice (*Peromyscus maniculatus*) (present in 30% of pellets). Nevertheless, the occurrence of kites

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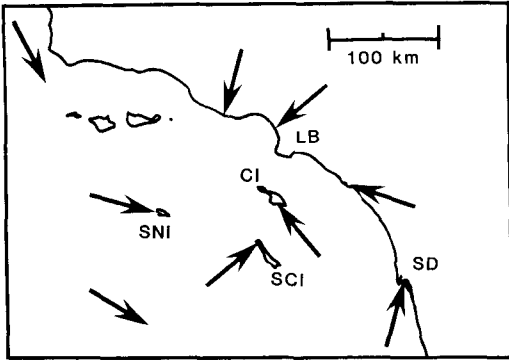


FIGURE 1. Typical wind directions during a Catalina Eddy. Black arrows indicate the wind direction taken at weather stations during a Catalina Eddy episode in August of 1984. Locations are: CI = Santa Catalina Island; LB = Long Beach; SCI = San Clemente Island; SD = San Diego; SNI = San Nicolas Island (Wakimoto 1987).

on the island did not appear to be coupled to densities of *Mus*. No kites were observed in the fall of 1983, when an outbreak of *Mus* was observed across the island by military personnel (J. Larson, Natural Re-

sources Office, NAF North Island, San Diego, CA, pers. comm.). In June 1984, when the kites first appeared, the density of *Mus* in the grasslands near the roost was 25 ± 6 (SE) mice/ha, estimated through marked recapture (White et al. 1980). This would not be considered an outbreak of *Mus* by mainland standards (Pearson 1963). The density of *Mus* in June 1986 were 40% higher (35 ha^{-1}) than in 1984, but only two kites wintered on the island.

There have been only two other observations of winter roosting kites on the island from 1984 to 1992: two kites observed in fall 1986 and one kite in July 1989. Despite numerous fall surveys of the island by ornithologists from 1974 to 1983 (Jorgensen and Ferguson 1984), the only other kites (two) found overwintering on the island occurred in 1981. In all, kites have been observed in four of the 19 fall/winters (1974–1992) of bird observations on the island.

I could not find any explanation on why the kites were in an irruptive phase during 1984. Gauthreaux (1982) suggests that most irruptive movements of birds have been associated with crowding and lack of food resources, often after a period of abundance or high fecundity. The population biology of southern California kites is complex, because they are subject to extensive habitat fragmentation and other kinds of human disturbance. Peter Bloom (unpubl. data), while studying the raptors of Camp Pendleton, did not record unusual patterns of breeding failure, or excessive in-

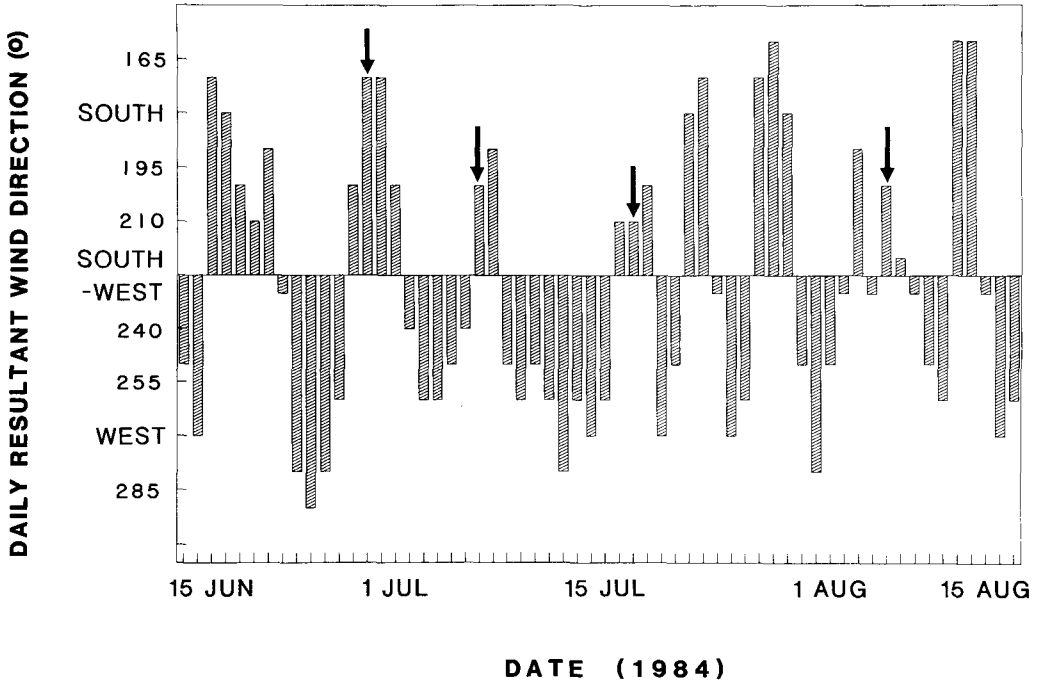


FIGURE 2. Resultant wind direction at Long Beach Airport, summer 1984. Columns represent the vector sum of wind speeds and directions divided by the number of observations/day (Anon. 1984). Predominant wind direction was approximately 255° off north, ranging from 230° and 290° (below the line); Catalina eddy winds typically blow from 165° to 210° off north (above the line). Dark arrows represent the days when kite numbers increased on the island.

creases or declines in the kite population size during the 1984 breeding season. The only abnormality setting 1984 apart from other 19 years of observation was the influence of *El Niño* on nearshore weather. Since 1984, there has been one *El Niño* event in 1991 and 1992, but no re-occupation of the roost.

The incremental increases in the number of kites observed (from one individual to three, then six, nine, 16, and 26) suggest that at least the first nine kites arrived on the island as individuals or in groups of two or three, rather than a single flock (*sensu* Kerlinger 1989). Kites are known to wander great distances (Eisenmann 1971, Pruett-Jones et al. 1980, Mendelsohn 1983), but typically do not wander over large bodies of water (Kerlinger 1989). Apparently any aversion these kites may have had to crossing water was overridden by their nomadic tendencies and the conditions in 1984. A similar episode of kite invasion was reported by Davies (1988) for Ashmole reef, where 16 Letter-winged Kites (*Elanus scriptus*) were found 200 km off the Australian coast during an irruption of that species in 1977. Unfortunately, no other data were reported.

Wind conditions may have contributed to the kite invasion of San Clemente Island. The arrival of kites on the island was coincidental with the seasonal start (mid-June) of cyclonic winds called Catalina eddies. These eddies can create offshore winds from Ventura to northern San Diego County, reversing typical onshore flows. The prevailing northwest winds in San Diego change to south or southwest winds. The circle is completed in the ocean south of San Nicolas Island, where winds shift from northwest to west. The result is a spiral of wind into a low pressure area between Santa Catalina and San Clemente Islands (Wakimoto 1987) (Fig. 2). Eddy winds are typically 5–10 m sec⁻¹ at sea level (Anon. 1984), often not showing significant changes in speed or direction at higher elevations (up to approximately 2,000 m) (Wakimoto 1987). Eddies last from two to seven days (Coffin 1959); in 1984, there were nine eddies from 15 June to 15 August. Each pulse of kites to the island coincided with the first or second day of a Catalina eddy (Fig. 2) ($P = 0.013$, Fisher Exact Test).

The correspondence of kite arrivals on the island with the first days of Catalina eddies presents an intriguing possibility: episodic winds may have pushed kites or allowed them to travel out over the ocean; the cyclonic motion may have oriented kites towards the island. Prevailing onshore winds, which would hamper bird movement out onto the ocean, are reversed during the eddies. It seems reasonable to speculate that the Catalina eddy is like a door to Santa Catalina and San Clemente Islands that irregularly opens and closes in the summer.

Kiff (1980) described difficulties in using raptors to model species turn-over rates on the Channel Islands, citing the effect of DDE on island reproductive rates. Nevertheless, some species, such as the Red-tailed Hawk (*Buteo jamaicensis*), have been extirpated and re-colonized the island in a manner that fits traditional models of species turn-over (Diamond and Jones 1980). Kites are more problematic; their arrival and departure from the island suggest condition-specific behaviors that govern crossing water barriers. Numerous factors

other than island size and proximity contribute to turn-over rates in island bird populations (Pimm 1991). Many southern California birds undergo a post-breeding dispersal in the summer (Garrett and Dunn 1981); understanding the timing and spatial patterns of these dispersals relative to the Catalina eddy may provide new insight on colonization of near-shore islands.

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DIURNAL BEHAVIOR OF THE SPOTTED OWL IN WASHINGTON¹

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Key words: foraging; predation; Spotted Owl; *Strix occidentalis*; Washington.

Although the Spotted Owl (*Strix occidentalis*) is primarily nocturnal, it does forage occasionally during the day (Miller 1974, Forsman 1975, Forsman et al. 1984, Laymon 1988). The extent of diurnal foraging is not known, but Miller (1974) and Laymon (1988) suggested that spotted owls with fledged young frequently foraged during the day. Forsman (1975) suggested a more limited role for diurnal foraging, arguing that it was a largely opportunistic response to prey observed near daytime roosts. We investigated the amount and types of diurnal activity engaged in by Spotted Owls, including differences in diurnal activity based on reproductive status.

STUDY AREA AND METHODS

The study was conducted on the Cle Elum Ranger District of the Wenatchee National Forest, on the east slope of the Cascades Mountains in Washington. To quantify diurnal activity we conducted 96.6 hours of continuous diurnal observation on 15 Spotted Owls (seven males, eight females) that were marked with radio-transmitters. All owls were paired, and five of the eight pairs had young. Time spent observing nesting and non-nesting individuals was 57.6 and 39 hours, respectively. Owls were located during the day by homing in on their radio-transmitters with a radio receiver and hand-held directional antenna.

Once an owl was located, we sat quietly and observed the owl from a distance of 25-50 m. The owls were extremely tame and paid little attention to us once we stopped moving. After waiting 10-15 min for the owl to become accustomed to being watched, the observer

began a 2-hr observation period, recording the time whenever the owl switched from one behavior type to another. Each interval between the time when an activity type began and ended was categorized as a single behavioral episode. The duration of behavioral episodes was rounded up to the nearest minute for analysis. The 2-hour observation period was strictly followed except in two cases when it became too dark to see.

Where possible, data were subdivided by sex, reproductive status, and time of day, to evaluate the relationship of these variables to the type and amount of diurnal activity. Time of day intervals examined were: 08:47-12:00, 12:01-15:00, 15:01-18:00, 18:01-20:10 PST. Observation schedules were arranged so that each owl was observed for an approximately equal number of 2-hour periods, and so that proportion of observations in each time interval were similar for nesting and non-nesting birds. All observations were conducted between 23 May and 5 September 1989.

We recorded four different behavior types (roosting, foraging, movement, and social interaction). The "roosting" category included a variety of resting and maintenance behaviors, including roosting with the eyes closed or open, preening, hopping from branch to branch within a roost tree, defecating, and consuming stored prey. The "foraging" category included two subcategories: (1) actual attempts at prey capture, and (2) visual searching behavior in which owls appeared to be looking for or observing prey. The "movement" category included any flight in which an owl actually left the roost tree and moved to a new location. The "social interaction" category included periods of vocalization or allopreening.

Methods used to assess diurnal activity included: (1) a Markov chain analysis of behavioral transition frequencies (Raphael 1990), (2) an empirical comparison of the proportion of time spent in different behavior types, and (3) a comparison of distances moved per hour.

The Markov chain analysis was used to compensate

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