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Population Decline of the Island Loggerhead Shrike (*Lanius ludovicianus anthonyi*) in the California Channel Islands

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ABSTRACT.—The Island Loggerhead Shrike (*Lanius ludovicianus anthonyi*) is classified as a species of special concern by the California Department of Fish and Game. We conducted a breeding bird census of Loggerhead Shrikes on Santa Cruz Island in 2006 based on potential shrike habitats identified using remote sensing. Census results for 2006, along with additional findings, constitute the first quantitative and replicable assessment of the subspecies' status. Population size is <30 birds with 12 on Santa Cruz Island and 15 on Santa Rosa Island. These observations, coupled with comparable surveys on other northern Channel Islands, provide the basis for a species and habitat conservation management plan. *Received 15 November 2007. Accepted 1 July 2008.*

An isolated race of the Loggerhead Shrike (*Lanius ludovicianus anthonyi*) was described as phenotypically distinct by Mearns (1898). The taxonomic identity of this subspecies has been studied using morphological, nuclear, and mitochondrial DNA analyses to show the *anthonyi* subspecies occurred historically on California's northern Channel Islands of Santa Cruz, Santa Rosa, Anacapa, San Miguel, Santa Barbara, and Santa Catalina (Mundy et al. 1997, Patten and Campbell 2000, Eggert et al. 2004). This subspecies mixes with the *mearnsi* and *gambeli* subspecies on Santa Catalina and San Clemente islands (Eggert et al. 2004). *L. l. anthonyi* is listed by the California Department of Fish and Game (2003) as a species of special concern.

Historical accounts of *L. l. anthonyi* provide insight into its relative abundance on Santa Cruz Island, but descriptions are limited and lack quantitative population estimates. Blake (1887:330) described shrikes on Santa Cruz Island as ''extremely common.'' This race was considered a ''fairly common resident'' on some of the Channel Islands in the early 1900s (Willett 1912:92, Howell 1917). Grinnell and Miller (1944:382) described it as ''fairly common on Santa Cruz Island; less numerous on other islands,'' with the ''total population . . . small by reason of limited range and normal spacing of individuals.'' Miller (1951:119) later described the status of this race on Santa Cruz Island as, ''[shrikes occur] regularly on Santa Cruz, but one must search particular areas, chiefly about the ranches . . . on my recent trip I saw none, although I took one in 1922.'' Collecting of island shrikes was not uncommon in the mid 1900s, with 42 *anthonyi* specimens collected between 1900 and 1949 (HSW, unpubl. data). These historical reports clearly indicate that shrike numbers were decreasing. Between 1900 and 1950, *L. l. anthonyi* went from being an ''extremely common'' resident to one of the more difficult birds to observe.

Reports concerning the distribution of *L. l. anthonyi* on the northern California Channel Islands were mixed from the 1940s to the 1980s, and most accounts were inconsistent. Grinnell and Miller (1944) reported that *anthonyi* occurred on Santa Barbara, Santa Rosa, Anacapa, Santa Cruz, and Santa Catalina islands. *L. l. anthonyi* was observed on Santa Cruz, Santa Rosa, Anacapa, and Santa Catalina during the 1970s (Johnson 1972). *L. l. anthonyi* was listed as an inhabitant of Santa Rosa, San Miguel, Santa Cruz, Anacapa (sporadically), and Santa Catalina islands (Garrett and Dunn 1981). Breeding *anthonyi* populations on Anacapa, San Miguel, and Santa Barbara appear to have been extirpated, leaving

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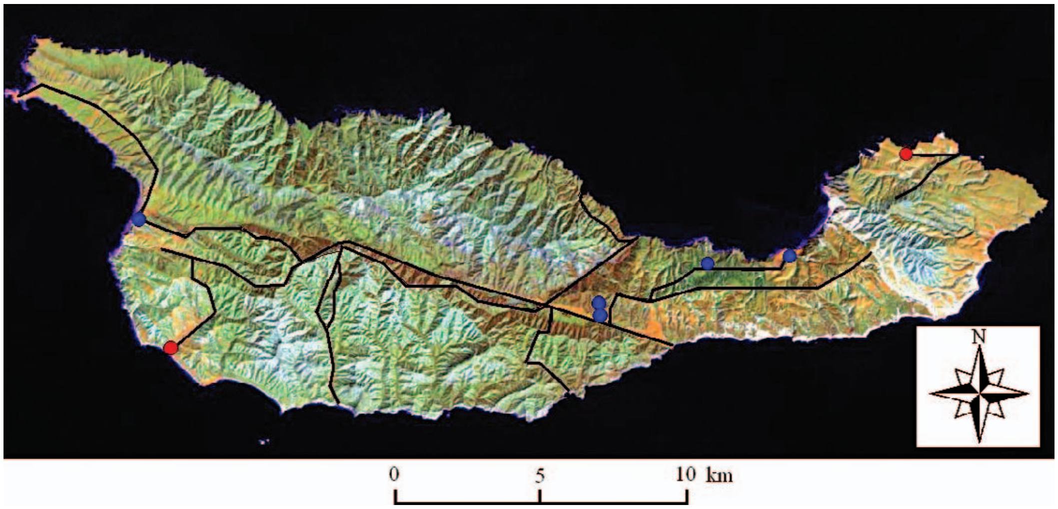

FIG. 1. Santa Cruz Island using a satellite image (LANDSAT 7 ETM$^+$, 27 July 2000). Overlaid lines are survey routes representing a total distance of 100 km^2. Blue dots are pair sightings. Red dots are individual sightings.

shrikes on only three of the Channel Islands: Santa Cruz, Santa Rosa, and as hybrids on Santa Catalina (Yosef 1996, Roemer and Wayne 2003, Walter 2005).

Historical accounts indicated that *L. l. anthonyi* was once common but became more difficult to find. Based on this evidence, a census was required to ascertain the total number of individuals remaining on Santa Cruz Island. Our objectives were to observe as many shrikes as possible on Santa Cruz Island during the 2006 breeding season.

METHODS

Study Area.—The study site consisted of Santa Cruz Island (34° N, 119° W), which is owned by the Nature Conservancy (western 76%) and the National Park Service (eastern 24%). It is the largest of the Channel Islands, consisting of 249 km^2. The island is 30 km west of Santa Barbara, California, and has two mountain ranges bisected by a central valley. The southern mountain range contains road accessible canyons, while the northern mountain range is mostly inaccessible with steep terrain and few roads. The island has four ecological zones (Junek et al. 1995). Three of the ecological zones were covered in this study as the north-facing slopes and canyons on the north side of the island were eliminated due to inaccessibility, and a lack of potential shrike habitat.

Remote Sensing.—We surveyed shrike habitats during spring (25 Mar–15 May) 2006. Potential Loggerhead Shrike habitats were identified using remotely sensed images of Santa Cruz Island. Grassland on gentle slopes close to a water source was the criterion used to select the spring 2006 survey sites (Scott and Morrison 1990, Yosef 1996, Cade and Woods 1997). Most potential shrike habitat was on the south mountain range and on the south-facing slope of the Central Valley. The entire north side of the Island was eliminated from the survey because of the steep hillsides and lack of potential shrike habitat. The image, taken in March 2000, was retrieved from the Global Land Cover Facility (2004). Different bands, produced by the LANDSAT 7 ETM$^+$ sensor, were combined to produce images that highlighted different vegetation. LANDSAT 7 ETM$^+$ band 4 (0.750–0.9 um) and band 5 (1.55–1.75 um) were used to create an image that showed densely vegetated areas in red or brown, and grassland habitat in green (Fig. 1). The image was compared to a vegetation map of the island created by Minnich (1980) to verify vegetation types identified on the image. A normalized difference vegetation index (NDVI) was created of the entire island and vegetation density was used as a guideline for identifying potential shrike habitat. A 3-D Surface Model was created using two-arc second National Elevation Data (USGS 1999) for Santa Cruz Island to identify areas with gentle grassland slopes. Geographic coordinates were recorded when a shrike was detected and Loggerhead Shrike habitats were recorded for each sighting as to vegetation type, water sources, slope, and distance to the coast.

RESULTS

The 2006 spring survey of Loggerhead Shrike habitat on Santa Cruz Island covered an area of ~100 km^2. The survey route was confined to the island's dirt roads and paths with about 1 km^2 of visibility from any given point of observation. Five shrike pairs and two individual shrikes were observed during the survey. Shrikes were observed at Potato Harbor (individual), Chinese Harbor (pair), Del Norte Ranch (pair), Orange Grove by Valley Anchorage (2 pairs), Pozo Canyon (individual), and Christy Beach (pair).

Every observation of shrikes occurred on a gentle grassland slope with mixed vegetation that included lemonade berry (*Rhus integrifolia*) and non-native fennel (*Foeniculum vulgare*). A source of fresh water was within the birds' active foraging area. Three pairs had a cattle trough as the water source, while two pairs were found near drainages near the coast. Five of the observation areas were within 1 km of the coast. Shrikes on Santa Cruz Island closely associated with barbed wire fences and dense bushes such as lemonade berry, fennel, and mule fat (*Baccharis salicifolia*).

The average size of each shrike territory was estimated at 2 km^2. The seven shrike territories comprised about 14 km^2 of island habitat. We extrapolate that between 24 and 36 km^2 of habitat may have been occupied on Santa Cruz Island in 2006. The total population of birds could range from 24 to 36, assuming pairs of Loggerhead Shrikes in habitat not covered by this survey also occupy 2.0 km^2 during the breeding season. We surveyed canyons that appeared to contain shrike habitat including Coches Prietos, Willows, and Laguna, but found no shrikes. Each of these canyons contained open grassland, shrubs for perches, and fresh water, suggesting shrikes are not sufficiently abundant to fill the potential habitat.

DISCUSSION

We identified locations of 12 individual shrikes in 100 km^2. This is low compared to 1887 when they were considered ''extremely common'' (Blake 1887:330). The breeding bird census conducted on Santa Rosa in spring 2006 season detected only about 15 adults after surveying every canyon on the island (Cedrick Villasenor, unpubl. data). Once abundant on the Channel Islands, the *anthonyi* subspecies of Loggerhead Shrike has become one of the top conservation priorities in California.

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Long-term Pair Bonds in the Laysan Duck

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ABSTRACT.—We describe long-term pair bonds in the endangered Laysan Duck (*Anas laysanensis*), a dabbling duck endemic to the Hawaiian Archipelago. Individually marked birds were identified on Laysan Island between 1998 and 2006 (n = 613 marked adults). We recorded pair bonds while observing marked birds, and documented within and between year mate switches and multi-year pair bonds. Twenty pairs banded before 2001 had stable pair bonds lasting $\geq$5 years with a maximum enduring pair bond of nine breeding seasons. Understanding reproductive strategy, including mate retention, would aid conservation planning and management efforts for the Laysan Duck. Further study is needed to characterize the social system of this endangered species. *Received 12 December 2007. Accepted 20 June 2008.*

Waterfowl (Anseriformes) typically form either new seasonal pair bonds, multi-year pair reunions, or continuous life-time monogamous pair bonds (Oring and Sayler 1992). The Laysan Duck, or Teal (*Anas laysanensis*), a critically endangered island species (IUCN 2006), illustrates the diversity of breeding strategies within Anatidae. This non-migratory species is endemic to the Hawaiian Islands and isolated anthropogenically for 150 years to Laysan Island (USFWS 2004). The Laysan Duck's breeding ecology is under-studied in part because of its isolated location on a remote atoll of the Hawaiian Archipelago. Its life history on Laysan Island is characterized by high adult survival (Reynolds and Citta 2007) and low recruitment (Reynolds and Work 2005). Laysan Ducks typically court and form pair bonds in fall and initiate nests in spring and summer. Males of this species

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do not engage in nest building, incubation, or brood rearing (Warner 1963, Moulton and Marshall 1996). Moulton and Weller (1984) described ''breaks'' in pair bonds during female incubation, brood rearing, and male molt. Mate reunion during a mark-recapture study over two breeding seasons was 42% (n = 19 pairs; Moulton and Weller 1984) and mate fidelity within a breeding year based on observing marked birds was 83% for 35 known pairs (Reynolds 2002). Over three breeding seasons (1998–2000), 69% of mated pairs (n = 26) reunited for ≥2 years after molt and brood rearing (Reynolds 2002).

We had the opportunity to identify long-term pair bonds from individually marked Laysan Ducks during multi-year studies to examine survival and population demographics (Reynolds and Citta 2007). Our objective in this paper is to describe the maximum known pair bond, and the first known long-term pair bonds >3 years for this species.

The following definitions are used: (1) a long-term pair bond is between a male and a female lasting for multiple breeding seasons, but may be interrupted during incubation and duckling rearing (Fowler 1995); (2) a reunion is pairing with the same mate for a second or subsequent year; and (3) a mate change (or divorce) refers to pair termination, or failure to reunite due to death, or disappearance of one mate (Black 1996), followed by survivors pairing with new partners (Rowley 1983).

METHODS

Laysan Island is part of the Hawaiian Islands National Wildlife Refuge and the newly created Papahānaumokuākea Marine National Monument (USFWS 2004, NOAA 2006). Laysan Island (25° 46′ N, 171° 44′ W) is 1,463 km northwest of Honolulu, and accessible only by boat, a 5-day journey. It is ~415 ha and the majority of the island is covered with vegetation. Scattered coastal vines (*Ipomoea* spp., *Sicyos* spp.) and shrubs (*Scaevola sericea*, *Tournefortia argentea*) characterize the coastal vegetation. The inland vegetation consists of vines, shrubs, bunch grass (*Eragrostis variabilis*), sedges, and matted vegetation. There is a hypersaline lake along with adjacent freshwater and brackish seeps in the center of the island.

We captured Laysan Ducks between March 1998 and October 2005 using a flexible hand-held net or a noose carpet (Bub 1991). Birds were individually marked with federal numbered aluminum bands on one leg, and unique color-bands, some with alpha or numeric codes, on the opposite leg (Reynolds 2004). We conducted surveys at least twice monthly on Laysan Island to monitor population status through July 2006. Observers recorded gender, age, mate status and affiliation, presence and age of ducklings, and the band combination of each bird identified. We monitored hens with broods daily with a spotting scope during March–July 1998–2000 and 2003, and April–September 2004–2006. We read bands twice each month at areas on the coast where ducks congregated from March 1998 to October 1999 and March to July 2000. Incidental observations of individually marked birds were also included.

We defined a ''pair'' as an adult male and female observed together (within 1 m) in at least 75% of observations of pairs. We observed pairs traveling, foraging, loafing, copulating, courting, defending (by males), and inciting (by females) with each other on multiple occasions. Pairs typically maintained close proximity to each other in comparison to distances of other flock members, and typically did not exhibit aggression towards their mate.

RESULTS

We marked 358 post-fledgling females and 255 post-fledgling males during 1998–2005, and recorded ~20,300 observations of these marked birds through July 2006. We observed changes in Laysan Duck pair bonds, including within a breeding season, between breeding seasons, and among prolonged pair bonds lasting ≥3 years. We observed one pair bond lasting 8 years (9 breeding seasons). The female (#103) and male (#100) were first marked on 18 May 1998 as After-Hatch-Year (AHY) and were observed together between June 1998 and June 2006. We recaptured the female three times and observed her 35 times. We did not detect her with ducklings during 6 years when we monitored brood production. This pair holds the record for mate retention longevity during our study; however, long-term pair bonds were common. Twenty pairs banded before 2001 had stable pair bonds lasting at least 5 years.

DISCUSSION

Many factors inherent to the life history and environment of a species influence whether a pair reunites for multiple years. The Laysan Duck and most Northern Hemisphere continental ducks share mating characteristics such as timing of pair bond breaks and female-only parental care (Moulton and Weller 1984). However, unlike many migratory *Anas*, the Laysan Duck is long-lived, has low reproductive rates on Laysan Island (Lack 1974, Weller 1980), and commonly forms long-term pair bonds. This contrasts greatly to migratory Mallards (*A*, *platyrhynchos*) where mate reunions are rare (<1% of marked pairs) (Losito and Baldassarre 1996). Rowley (1983) correlated avian mortality and longevity with rates of mate change and suggested the probability of mate change is higher in short-lived species. When pair members reunite, it may reduce the costs of courtship and pair bond maintenance (Robertson and Cooke 1998), or result in more successful breeding (Rowley 1983, Black 1996). However, with intensive brood monitoring observations during six of their nine breeding seasons, we have no observations of female #103 with ducklings; it is unknown if the pair successfully reproduced. Hepp and Hair (1984) found that pairing in waterfowl enhanced the dominance status of both partners and improved their foraging opportunities. Similarly, long-term pair bonds in Laysan Ducks may increase their status or fitness (survival or reproduction or both). Further analysis of long-term pairs will aid our understanding of mate retention for this species. Mating strategies influence population genetics and dynamics, and estimates of effective population sizes. The influence of long-term pair bonds in the Laysan Duck are of concern for conservation, and the species mating strategy warrants further study.

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Return Rates in Two Temperate Breeding Orioles (*Icterus*)

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ABSTRACT.—We monitored two migratory oriole species, Baltimore (*Icterus galbula*) and Orchard (*I. spurius*) orioles, for information on return rate and pair fate over 4 years. The return rate after migration for Baltimore and Orchard orioles was low (38 and 35%, respectively). Pairs were more likely to dissolve due to non-return of one or both members than they were to reunite or change mates. Pair members infrequently returned to the study site and previous pairs had little opportunity to reunite in the next year. Birds with non-returning mates appeared to take advantage of the first available mating opportunity instead of waiting for the return of their previous partners. *Received 4 February 2008. Accepted 11 July 2008.*

An individual bird that forms a seasonal pair bond has two choices if it survives to return to its breeding site; either reunite with its partner from the previous year or seek a new mate (Black 1996). Each strategy has specific advantages and disadvantages. Reunion or mate change are often not options in species where survival is low and pair members frequently do not return to the breeding site (Choudhury 1995).

We investigated rates of seasonal return after migration, and patterns of pair formation in Baltimore (*Icterus galbula*) and Orchard (*I. spurius*) orioles. Both species are temperate-breeding, migratory birds which are considered socially monogamous (Ollason and Dunnet 1978, Rising and Flood 1998, Jaramillo and Burke 1999). The maximum observed life spans for Baltimore and Orchard orioles are 11 and 9 years, respectively (Rising and Flood 1998, Jaramillo and Burke 1999). Previous studies have addressed the issue of monogamy and extra-pair mating in orioles (Edinger 1988, Richardson and Burke 1999), but few data have been published on post-migration return rates and pair fates of oriole species. Our objectives were to: (1) examine return rates after seasonal migration, and (2) identify which pair fate is most common (reunion, mate change or loss of mate due to non-return).

METHODS

We captured 53 Baltimore Orioles (26 pairs) and 78 Orchard Orioles (39 pairs) using mist nets and marked them with three band combinations (1 aluminum band and 2 color bands). Pairs were observed at three study sites in Maryland, USA during the breeding seasons of 2002–2005. These sites were designated Croom (89 ha), Monocacy (24 ha), and University of Maryland, Baltimore County (UMBC, 24 ha). Baltimore Orioles were absent from the Croom site and data for this

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TABLE 1. Baltimore and Orchard oriole return rates, Maryland 2002–2005.

Species/Parameter	2002	2003	2004	2005	Average
Baltimore Oriole					
Newly arrived	14	9	8	22	
Returned	NA	6	5	5	
Did not return	NA	8	10	8	
Total present	14	15	13	27[a]	
Return rate, %	NA	43 (6/14)	33 (5/15)	38 (5/13)	38 (16/42)
Orchard Oriole					
Newly arrived	16	27	15	20	
Returned	NA	4	9[b]	12[b]	
Did not return	NA	12	23[b]	15[b]	
Total present	16	31	24	32[a]	
Return rate, %	NA	25 (4/16)	29 (9/31)	50 (12/24)	35 (25/71)

[a] Increased sample size due to intensive work at the Monocacy field site.

[b] [# birds returned from a previous year + # not returned] does not equal total birds present from the previous year because some birds were absent for a year or more before returning.

species were only available at the Monocacy and UMBC sites.

We conducted thorough searches of each study site 6 days a week to identify individuals from previous years, and recorded the location and whether the individual was seen with another bird. Nests (n = 30) for Baltimore and Orchard (n = 43) orioles were located by conducting daily nest searches at the beginning of the breeding season. Most nests were found during the building stage by observing and following a female carrying building material. Pairs were confirmed when a male was seen interacting with a nest-building female (e.g., copulating with female, landing repeatedly on or close to nest, feeding female on nest). We monitored and confirmed pairing status throughout the nesting cycle, especially noting provisioning visits made by males. Data for each species were pooled from all three study sites.

We defined return rate as the percentage of banded birds observed the following year. Baltimore and Orchard oriole pairs were divided into three main categories to investigate pair fate: reunited pairs, lost pairs, and pairs that changed mates. These terms describe the fate of a pair in the next season after they have paired for one season. A lost pair occurred when at least one member of a previous pair failed to return to the study site. Lone returners were individuals that returned while their mate did not.

Two additional categories were defined to encompass the remainder of the pairs observed: first pairs and mixed pairs. Placement in these categories was based on each pair member's experience on the study site. A pair that formed between two newly banded birds was considered a first pair, whereas a pair that formed between a newly banded bird and a banded/experienced bird was considered a mixed pair. An experienced bird was a bird that had previous pairing experience on the study site. A newly banded bird was a bird with no previous experience on the study site. Pairs present in 2002 were not placed into categories because all birds in the first year of the study were newly banded. A proportion of the birds we designated newly banded may have obtained breeding experience at a different site and arrived at one of our sites via breeding dispersal.

RESULTS

Return Rates and Pair bonds.—The majority of pairs that formed during one breeding season had no opportunity to reunite in the next season because one or both pair members did not return. The return rate was 38% for Baltimore Orioles and 35% for Orchard Orioles (Table 1). Pair bond duration for both species averaged about one season. Only two pairs (Orchard = 1, Baltimore = 1) during our 4-year study remained paired for more than one season. Baltimore Orioles averaged 0.87 (SD = 0.98) mates per study period (4 years), while Orchard Orioles averaged 0.92 (SD =

TABLE 2. Frequency of mate change and reunion for all Baltimore and Orchard oriole pairs, and for pairs with both mates returning.

Year[a]	All pairs	Mate change due to partner's death or disappearance, %	Both mates returned (Pairs)	% Change	% Reunite
Baltimore Oriole					
2002	3	33 (1/3)	2	100 (2/2)	0 (0/2)
2003	3	67 (2/3)	1	100 (1/1)	0 (0/1)
2004	4	75 (3/4)	1	0 (0/1)	100 (1/1)
Overall	10	60 (6/10)	4	75 (3/4)	25 (1/4)
Orchard Oriole					
2002	5	100 (5/5)	0	0 (0/0)	0 (0/0)
2003	11	100 (11/11)	0	0 (0/0)	0 (0/0)
2004	7	71 (5/7)	2	50 (1/2)	50 (1/2)
Overall	23	91 (21/23)	2	50 (1/2)	50 (1/2)

[a] Pairs present in 2005 were excluded from this analysis because fates of these pairs in the next year (2006) were not known.

0.83) mates. The individual with the highest number of mates, a male Baltimore Oriole, had a different mate each breeding season for 4 years.

Mechanism of Pair Formation.—Baltimore Oriole pairs between 2002 and 2004 became lost pairs in the next year more often than they reunited or changed mates (pairs were lost 60% of the time, reunited 10% of the time, and changed mates 30% of the time, when all pairs are considered). The same was true for Orchard Orioles (pairs were lost 91% of the time, reunited 4% of the time, and changed mates 4% of the time, when all pairs are considered). More mixed pairs ($n = 16$) were present than first pairs ($n = 6$) for Baltimore Orioles between 2003 and 2005. The same was true for Orchard Orioles ($n = 16$ mixed pairs, $n = 13$ first pairs).

The pattern of pair formation that was most often observed involved pairing of a lone returner with another available bird. The lone returner either paired with a newly banded bird or with an experienced bird. We observed no situations in which a lone returner disrupted a pair that had formed that same season, and no situations in which a lone returner did not pair. Lone returners most frequently paired with newly banded birds (80% of the time). When lone returners paired with experienced birds (20% of the time), the experienced birds were most often available because they were lone returners as well, although one experienced bird was available to pair with a lone returner because he did not pair with his previous mate (which was present on the study site).

Mate Change in Orioles.—Both Baltimore and Orchard orioles most often changed mates due to the death or disappearance of their partner (Table 2). Six of 10 Baltimore Oriole pairs changed mates in the next year due to their partner's death or disappearance. Twenty-one of 23 Orchard Oriole pairs changed mates in the next year due to their partner's death or disappearance. Three of four Baltimore Oriole pairs in which both partners returned in the next year changed mates and one pair reunited. One of two Orchard Oriole pairs with both partners returning in the next year changed mates and one pair reunited.

DISCUSSION

Baltimore and Orchard orioles had low rates of return to the study site and had a low tendency to reunite. It was more likely for a pair bond to dissolve in the next season, after pairing for one season, due to non-return of one or both pair members than it was for a pair to reunite or change mates. The remaining (lone returner) mate was more prone to pair with a newly banded bird than to not pair at all or to pair with an experienced bird.

Reunion occurred infrequently, as should be expected given the low probability that both previous mates will return. There is a 14% chance that both members of a previous Baltimore Oriole pair will return and a 12% chance that both members of a previous Orchard Oriole pair will return. Both members of previous Baltimore Oriole pairs actually returned more often than expected from return rates (29% of the time) while both members of previous Orchard Oriole pairs returned less often than expected from return rates (8% of the time).

The patterns observed in these two oriole species closely parallel the mating systems of other temperate-breeding migratory birds that have low return rates. For example, the American Redstart (*Setophaga ruticilla*) is a long-distance migratory bird with a return rate of ~50% (Sherry and Holmes 1992, Sherry and Holmes 1997), and a similar pairing strategy in that pair bonds are maintained only during the breeding season (Sherry and Holmes 1997). A similar pattern has also been reported for Great Reed Warblers (*Acrocephalus arundinaceus*), which have an annual return rate of ~55% (Hansson et al. 2002) and a low tendency to reunite (Bensch and Hasselquist 1991). A conflicting pattern is shown in the Black-throated Blue Warbler (*Dendroica caerulescens*). This species has a low return rate (between 36 and 39%), yet ~80% of pairs reunite between seasons (Holmes et al. 2005). The mating system of the Eastern Kingbird (*Tyrannus tyrannus*) has a different pattern in that both return rate (69% for males, 54% for females) and reunion rate (85%) are relatively high (Murphy 1996). Little is known about other orioles, but tropical orioles, such as the Altamira Oriole (*Icterus gularis*), maintain pair bonds year-round and are thought to maintain pair bonds for life (Brush and Pleasants 2005). This pattern in a non-migratory, tropical oriole species suggests that migration affects how likely a pair is to maintain pair bonds between breeding seasons.

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