Western Riverside County
Multiple Species Habitat Conservation Plan (MSHCP)
Biological Monitoring Program

Overwintering Raptor Survey Report 2009

23 April 2010

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NOTE TO READER:

This report is an account of survey activities conducted by the Biological Monitoring Program for the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). The MSHCP was permitted in June 2004. The Monitoring Program monitors the distribution and status of the 146 Covered Species within the Conservation Area to provide information to Permittees, land managers, the public, and the Wildlife Agencies (i.e., the California Department of Fish and Game and the U.S. Fish and Wildlife Service). Monitoring Program activities are guided by the MSHCP species objectives for each Covered Species, the information needs identified in MSHCP Section 5.3 or elsewhere in the document, and the information needs of the Permittees.

MSHCP reserve assembly is ongoing and it is expected to take 20 or more years to assemble the final Conservation Area. The Conservation Area includes lands acquired for conservation under the terms of the MSHCP and other lands that have conservation value in the Plan Area (called public or quasi-public lands in the MSHCP). In this report, the term “Conservation Area” refers to the Conservation Area as understood by the Monitoring Program at the time the surveys were planned and conducted.

We thank and acknowledge the land managers in the MSHCP Plan Area, who in the interest of conservation and stewardship facilitate Monitoring Program activities on the lands for which they are responsible. A list of the lands where data collection activities were conducted in 2009 is included in Section 7.0 of the Western Riverside County Regional Conservation Authority (RCA) Annual Report to the Wildlife Agencies. Partnering organizations and individuals contributing data to our projects are acknowledged in the text of appropriate reports.

While we have made every effort to accurately represent our data and results, it should be recognized that data management and analysis are ongoing activities. Any reader wishing to make further use of the information or data provided in this report should contact the Monitoring Program to ensure that they have access to the best available or most current data.

The primary preparer of this report was the 2009, Avian Program Lead, Nick Peterson. If there are any questions about the information provided in this report, please contact the Monitoring Program Administrator. If you have questions about the MSHCP, please contact the Executive Director of the RCA. Further information on the MSHCP and the RCA can be found at www.wrc-rca.org.

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INTRODUCTION

The Western Riverside County MSHCP covers 13 diurnal raptor species (Order Falconiformes). Of these, 8 rarely or never breed within the Plan Area and generally occur only during overwintering or migration periods. These include: bald eagle (*Haliaeetus leucocephalus*), ferruginous hawk (*Buteo regalis*), merlin (*Falco columbarius*), osprey (*Pandion haliaetus*), peregrine falcon (*Falco peregrinus*), prairie falcon (*Falco mexicanus*), sharp-shinned hawk (*Accipiter striatus*), and Swainson's hawk (*Buteo swainsoni*). The MSHCP provides no species-specific monitoring objectives for any of the overwintering raptor species. The default objective for species without specific monitoring objectives is to monitor their status and distribution at least every 8 years (Dudek and Associates 2003). This survey addressed that general objective by gathering baseline data on the distribution of 3 overwintering raptor species in the Plan Area: ferruginous hawk, merlin, and prairie falcon.

We began surveying for overwintering raptors in winter of 2007–2008 by conducting driving and walking surveys within open landscapes (i.e., grassland, farmland, and low-density shrubland and woodland). Our goals were to document presence of target species and to quantify efficiency of each method with respect to raptor observations per observer-hour of survey time. Results of these surveys suggested that off-road walking surveys were more efficient than driving surveys, despite some investigators suggesting that vehicle-based surveys increase the efficiency of sampling and cover a wider survey area (Fuller and Mosher 1981, Andersen et al. 1985). Additionally, driving surveys can reduce the area of inference to places accessible to vehicles, which can lead to either high (Meunier et al. 2000, Dean and Milton 2003) or low (Sergio et al. 2005) bias in estimates of occupancy, depending on the raptor species.

The 2008–2009 overwintering raptor survey consisted entirely of walking surveys. We also only targeted ferruginous hawk, merlin, and prairie falcon because these species are known to use open landscapes (Bechard and Schmutz 1995, Steenhof 1998, Dudek & Associates 2003, Warkentin et al. 2005). We did not focus surveys on bald eagle, osprey, and peregrine falcon because they occur primarily in association with major water bodies that were surveyed separately as part of a 2009–2010 Lake Birds Project. Sharp-shinned hawks were excluded because they tend to occur in woodland, forest, and urban habitats (Bildstein and Meyer 2000). Swainson's hawks, though they occur in our surveyed habitats and occasionally overwinter in the Plan Area, more often overwinter in South America (England et al. 1997), and were thus excluded as a focal species.

Ferruginous hawk is a federal and California state species of special concern, and is a non-breeding winter resident of western Riverside County (Dudek & Associates 2003). The species typically arrives in wintering areas by early December, and remains until mid-February (Bechard and Schmutz 1995). Merlin is a California state species of special concern that also overwinters in the Plan Area, but breeds in the northern Rockies and throughout much of Canada (Warkentin et al. 2005). Merlin generally arrive in wintering areas by mid-November, and remain until mid-February (Warkentin et al. 2005). Prairie falcon is a California state species of special concern and year-round resident within the Plan Area, though most commonly observed during winter and throughout migration. Prairie falcon rarely breeds within the Plan Area (Dudek & Associates 2003) despite known accounts of the species reproducing throughout most of California (Boyce et al. 1986). The species generally occupies wintering grounds from November–February (Schmutz et al. 1991).

We present here results from overwintering raptor surveys conducted during the winter of 2008–2009. Species accounts do not specify Core Areas for the 3 focal species, but rather direct that suitable habitat (e.g., open landscapes) be conserved across the Plan Area, generally in large habitat blocks. We delineated the following 8 habitat blocks based on their geographic separation from one another, and quantified the area of open landscape on each: Estelle, Lake Perris/San Jacinto Wildlife Area/Mystic Lake, Potrero, Santa Ana River/Sycamore Canyon/Box Springs/San Timoteo Canyon ('Northern Tier'), San Bernardino National Forest, Santa Rosa Plateau, Lake Skinner/Johnson Ranch, and the Wilson Valley/Silverado. We conducted repeat-visit walking surveys at each habitat block with the aim of quantifying our ability to detect individual species.

Goals and Objectives

Goals and objectives for the 2008–2009 overwintering raptor survey were as follows:

1. Document winter distribution of overwintering raptor species occurring on open landscapes.
    a. Record species presence at randomly distributed transects with repeat-visit walking surveys.
    b. Quantify ability of our methods to detect species by modeling detection probabilities.

METHODS

Protocol Development

Survey methods for the winter raptor survey were based on repeat visits to line transects. Survey methods were developed using techniques described in Fuller and Mosher (1981), Andersen et al. (1985), Rosenstock et al. (2002), and MacKenzie et al. (2006). The design allowed for the calculation of transect-level detection probability (*p*) and can also be used to evaluate correlations between covariates that may affect *p* (MacKenzie et al. 2006).

Personnel and Training

All field personnel demonstrated proficiency at visual identification of all covered and co-occurring diurnal raptors. All observers practiced raptor identification for several weeks prior to the beginning of field surveys, and less experienced personnel trained with observers that had extensive experience identifying raptors. Trainings included review of photographs and drawings from general avian field guides and specialized raptor identification guides (e.g., Dunne et al. 1988, Sibley 2003), and at least 20 hours of raptor observation in the field. All personnel demonstrated proficiency with survey techniques, by conducting mock surveys with the Program Lead, before field surveys commenced. Less experienced personnel continued to train after surveys had started by accompanying more experienced personnel on transects. Staff that conducted raptor surveys in 2008–2009 are listed below. Biological Monitoring Program personnel were funded by the California Department of Fish and Game or the Regional Conservation Authority.

- Nicholas Peterson (Program Lead, Biological Monitoring Program)
- Masanori Abe (Biological Monitoring Program)
- Nydia Celis (Biological Monitoring Program)
- Jeff Galvin (Biological Monitoring Program)
- Conan Guard (Biological Monitoring Program)
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- Ashley Ragsdale (Biological Monitoring Program)
- Jonathan Reinig (Biological Monitoring Program)
- Lee Ripma (Biological Monitoring Program)
- Matt Talluto (Biological Monitoring Program)
- Nate Zalik (Biological Monitoring Program)

Study Site Selection

We used ArcGIS v.9.2 (ESRI 2006) and a GIS-based vegetation map (CDFG 2005) to delineate open landscapes (e.g., agricultural land, coastal sage scrub, grassland, meadows and marshes, playas and vernal pools, Riversidean alluvial fan scrub, and woodland of less than 60% density) across the 8 habitat blocks (Table 1).

Table 1. Amount of open habitat (ha) and the number of transects within each habitat block.

Habitat block	Amount of open habitat (km^2)	Number of transects
San Bernardino National Forest	109.9	19
Lake Perris/SJWA/Mystic Lake	67.3	18
Potrero	45.9	17
Southeast Area	40.8	17
Estelle	26.9	16
Northern Tier	21.3	16
Santa Rosa Plateau	21	16
Lake Skinner	16.4	15

We then applied a negative 270-m buffer to all habitat blocks to eliminate the possibility of transects extending beyond targeted landscapes, and used Hawth's Tools

(Beyer 2004) and ArcGIS v.9.2 to randomly distribute transect midpoints across buffered habitat blocks with a minimum spacing of 1 km (Figure 1). Staff availability limited our sample size to about 15 transects per habitat block, but we increased the number of transects by 10% for every doubling of area to maintain a standard proportion of transect number relative to size of habitat blocks. We then centered a 500-m transect on each random point, aligning transect endpoints on a north-south axis. We also generated an alternative set of transect midpoints to replace transects that could not be surveyed due to landscape conditions (e.g., impenetrable vegetation, excessively steep slope).

Survey Methods

We conducted surveys from November 2008 through February 2009 to coincide with raptor wintering periods. Transects were sampled 3 times during the survey season, with each survey period lasting approximately 3–5 weeks (Round 1 was 24 November 2008–8 January 2009, Round 2 was 8–23 January 2009, and Round 3 was 23 January–26 February 2009). We grouped transects into sets depending on accessibility and drive time, and randomized the order in which we visited them during each of the 3 survey rounds, though the period between subsequent visits to transect sets did not occur less than 2 weeks apart. Moreover, transects within sets may have been surveyed in different order across rounds, depending on how observers accessed them. Lastly, to the extent possible, we assigned different observers to different sets of transects each round, thereby reducing the effects of observer bias.

We commenced surveys no earlier than 30 min after sunrise, and did not begin new surveys after 1300 h. Observers navigated to either the northern or southern endpoint of a transect using a GPS unit, and recorded the following on their datasheet: start time, temperature (C), wind speed [measured with an anemometer (km/h) or estimated on the Beaufort Scale (Table 2)], and sky condition (0 = clear/few clouds, 1 = 50% clouded, 2 = overcast, 3 = fog, 4 = light drizzle) (Appendix A). Observers then walked along the transect toward the opposite terminus, attempting to maintain a constant speed. Observers turned around and walked the transect in the opposite direction if < 25 min were spent surveying, until a total of 25–30 min elapsed. Observers then recorded end time, temperature, wind speed, and sky condition at the conclusion of the survey period. Surveys were terminated if temperature exceeded 35° C, if wind speed exceeded 4 on the Beaufort Scale (i.e., > 28 km/h), or during heavy precipitation or fog. Additionally, we did not conduct surveys within 48 h of a significant precipitation event, any time vehicles could potentially leave ruts in the roadways, or when snow or ice accumulation on roads used to access transects made travel unsafe.

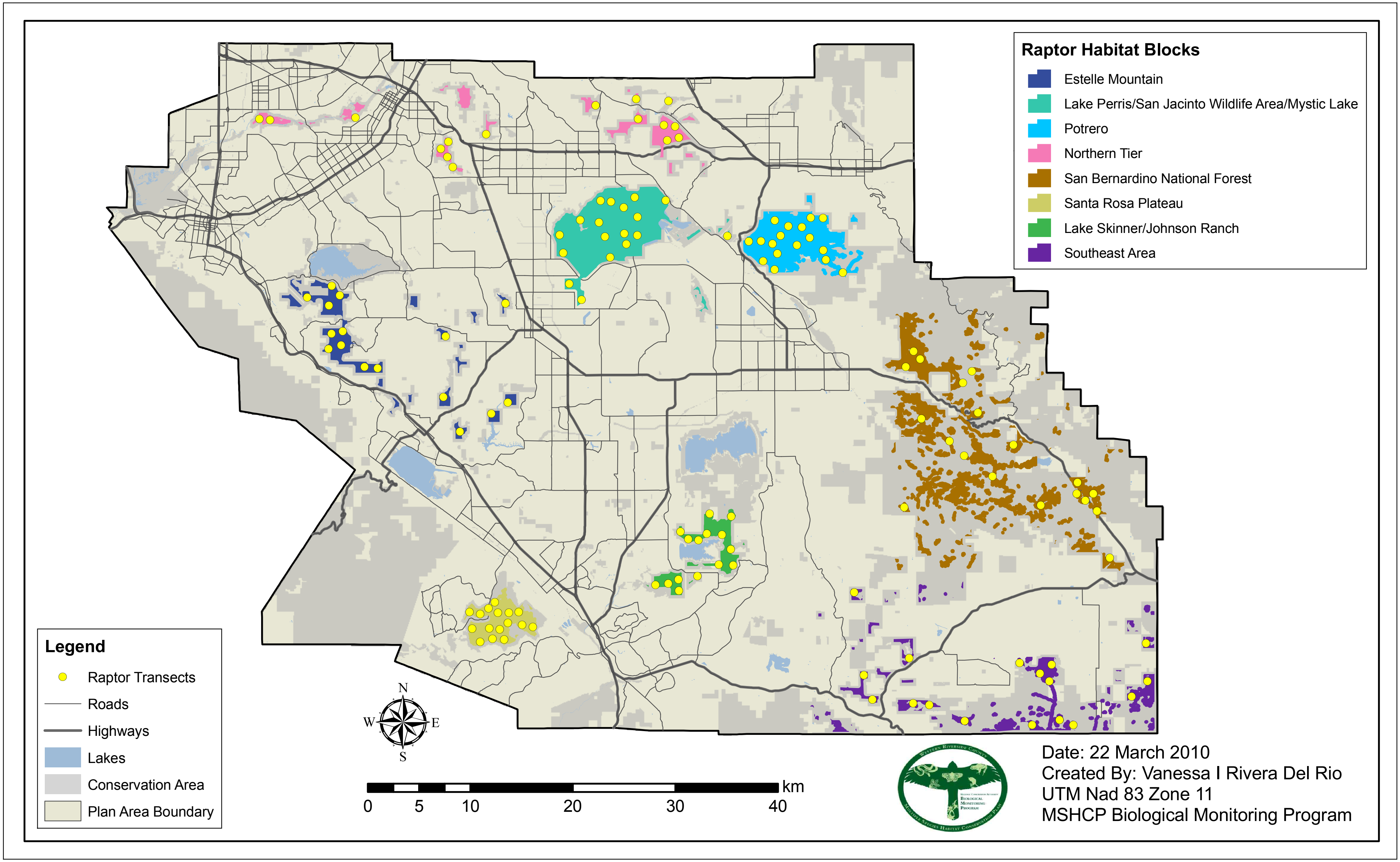

Figure 1. Raptor habitat blocks and transect midpoints in 2009.

Table 2. Description of Beaufort wind scale.

Beaufort Wind Scale	**Wind speed (km/h)**	**Description of land conditions**
0	< 1	Calm; smoke rises vertically
1	1.1–5.5	Wind motion visible in smoke
2	5.6–11	Wind felt on exposed skin, leaves rustle
3	12–19	Leaves and smaller twigs in constant motion
4	20–28	Dust and loose paper raised, small branches begin to move

Observers recorded all raptor (i.e., Accipitridae, Cathartidae, Falconidae, Laniidae, Pandionidae, Strigidae, and Tytonidae) or raptor-like Covered Species [e.g., turkey vulture (*Cathartes aura*)] encountered during the survey period. Loggerhead shrikes (*Lanius ludovicianus*) were also recorded when detected. Observers were careful to avoid recording the same individual bird more than once. This was accomplished by instructing observers to record subsequent birds of a species already encountered during a particular survey only if they were confident that it was a different individual (based on plumage, where the bird was last seen, etc.). Observers recorded all cues (i.e., call, visual, or other) used in detecting and identifying birds encountered during surveys, and noted the age (adult, juvenile) and sex when known. Covered raptors that were observed within the survey area, but between survey periods (i.e., in-transit), were recorded as incidental observations. Lastly, our biologists were also instructed to record any observations of covered raptor species while conducting focal surveys for other Covered Species. These observations can be used to meet species objectives and provide target locations for future surveys. We provide the complete protocol for raptor surveys in 2009 in *Western Riverside County MSHCP Biological Monitoring Program Protocol for Wintering Raptor Surveys, December 2008 – February 2009* (Appendix B).

Data Analysis

We estimated per round detection probabilities (p) for each target species using a closed-capture occupancy model (MacKenzie et al. 2006). We used Program MARK (White and Burnham 1999) to construct and compare candidate models that examined the full combination of site and visit effects on p. We did not estimate use (ψ), and only considered constant models for that parameter. We then ranked candidate models according to Akaike's Information Criterion for small samples (AIC*c*), calculated Akaike weights (w_i), and derived weighted-average estimates for p across the entire candidate set unless a single model showed clear support (i.e., $w_i > 0.9$) (Burnham and Anderson 2002). Cumulative detection probability ($P*$) was calculated across all rounds using model-averaged estimates of p and the following formula where p_i is the detection probability on a given survey night: $P* = 1 - \prod_{i=1}^{3} 1 - p_i$. Variances for $P*$ were calculated using the delta method (MacKenzie et al. 2006, Powell 2007).

RESULTS

We conducted raptor surveys across 3 rounds from 24 November 2008–8 January 2009, 8–23 January 2009, and 23 January–26 February 2009. We surveyed 129 transects/round, which was 5 fewer than we had originally planned. We eliminated 1 transect in the San Bernardino National Forest (SBNF) because the terrain made surveying impossible, and the habitat block would not support an additional transect due to its size and configuration. A second transect was eliminated at SBNF because it was located on a mountain that was inaccessible due to snow throughout the survey period. We removed 3 transects within at the Santa Rosa Plateau because they were within dense chaparral that could not be surveyed efficiently, and the size and configuration of the habitat block precluded us from moving those transects to new locations.

We recorded all 3 focal species during this project in 2009, with ferruginous hawk accounting for the greatest number of transect detections (*n* = 7) followed by merlin (*n* = 6) and prairie falcon (*n* = 2) (Table 3). Ferruginous hawk were most common at Lake Skinner/Johnson Ranch, but were only observed at 3 habitat blocks. Merlin and prairie falcon were also recorded across limited distribution, with detections at 3 and 2 habitat blocks, respectively.

We detected an additional 11 covered raptor species and 3 non-covered species during 2009 surveys (Appendix C). Covered Species detections included bald eagle (*n* = 2), burrowing owl (*Athene cunicularia hypugaea*, *n* = 1), cooper's hawk (*n* = 6), golden eagle (*n* = 6), loggerhead shrike (*n* = 8), northern harrier (*Circus cyaneus*, *n* = 49), osprey (*n* = 8), peregrine falcon (*n* = 1), sharp-shinned hawk (*n* = 5), turkey vulture (*n* = 13), and white-tailed kite (*Elanus leucurus*, *n* = 4). Non-covered species detections included American kestrel (*Falco sparverius*, *n* = 76), red-shouldered hawk (*Buteo lineatus*, *n* = 8), and red-tailed hawk (*Buteo jamaicensis*, *n* = 249). Our observers detected, but were unable to identify, falcons on 2 occasions and hawks on 3 occasions. We did not detect any raptor species on 36% (*n* = 47) of transects in Round 1, 48% (*n* = 62) of transects in Round 2, and 43.4% (*n* = 56) of transects in Round 3.

Table 3. Total number of transects in each habitat block (*n*) where ferruginous hawk (FEHA), merlin (MERL), and prairie falcon (PRFA) were detected over 3 survey rounds.

Habitat block	*n*	FEHA	MERL	PRFA
San Bernardino National Forest	19	0	0	0
Lake Perris/SJWA/Mystic Lake	18	2	0	1
Potrero	17	1	0	1
Southeast Area	17	0	0	0
Estelle	16	0	0	0
Northern Tier	16	0	2	0
Santa Rosa Plateau	16	0	1	0
Lake Skinner	15	4	3	0

We did not detect merlin and prairie falcon frequently enough to estimate detection probabilities for the species. We considered the constant and time-varying models to estimate *p* for ferruginous hawk, because these models accounted for nearly all of the weight in the candidate set (w_i = 0.99) (Table 4). In general, *p* was constant across sites, but estimated variances were too high to determine the trend of *p* across rounds (Round 1: *p* = 0.34, SE = 0.23; Round 2: *p* = 0.17, SE = 0.14; Round 3: *p* = 0.26, SE = 0.16). The cumulative detection probability across all 3 rounds fell below 1 (P^* = 0.60, SE = 0.30).

Table 4. Akaike Information Criterion for small samples (AICc), difference in AICc (ΔAICc), Akaike weights (wi), estimated parameters (K), and log likelihood of candidate-occupancy models used for estimating transect-level detection.

Model	AICc	ΔAICc	w_i	K	-2Log(L)
p(constant)Ψ(constant)	82.7	0.00	0.54	2	78.6
p(round)Ψ(constant)	83.1	0.37	0.45	4	74.7
p(habitat block)Ψ(constant)	92.9	10.3	0.00	9	73.4
p(round * habitat block)Ψ(constant)	120.7	38.00	0.00	25	58.1

Our biologists incidentally detected merlin and prairie falcon at additional locations in 2009 while surveying for other species: merlin was detected within the Lake Perris/SJWA/Mystic Lake habitat block on 4 occasions in the fall of 2009, during our Lake Bird Survey; prairie falcon was detected within the Estelle habitat block in September 2009, during our Lake Bird Survey, and in the Lake Skinner/Johnson Ranch habitat block in May 2009, during our Northern Harrier Survey. Finally, our biologists detected merlin at the Estelle habitat block during raptor surveys in the winter of 2007–2008.

DISCUSSION

We recorded focal species across a limited number of habitat blocks during transect surveys in 2009, and rarely detected merlin or prairie falcon. Both of these species are open-country hunters that are conspicuous when in flight or perched atop fence posts and utility wires. Timing of surveys should have resulted in winter residents being present, rather than occasional migrant individuals, though merlin are known to rarely winter in southern California (Zeiner et al. 1990) and prairie falcon more commonly winter in the Great Basin and Great Plains (Steenhof 1998). One explanation for our failure to detect merlin and prairie falcon in all habitat blocks is that these species may not have been present on transects during surveys. Conversely, these species may have been present on transects during surveys, but surveyors failed to detect them. Because we had too few observations to quantify detectability, we can not use collected data to discriminate between these possibilities; however, observations of prairie falcon and merlin during previous survey efforts, along with incidental observations of these species in habitat blocks in which we failed to detect them during transect surveys, suggest that these species were present but undetected on some habitat blocks surveyed in 2009.

We detected ferruginous hawk more frequently than any other target species. Most observations (67%) were recorded at Johnson Ranch, where we detected the species on every transect surveyed. We also observed ferruginous hawk on multiple occasions in the northern portion of the SJWA. Both Johnson Ranch and SJWA likely represent important wintering grounds in the Plan Area, as we have often recorded ferruginous hawk there in each of the past 2 winters.

In addition to our detections of merlin and prairie falcon during the winter 2009 survey, our biologists detected the species within additional habitat blocks both during subsequent avian surveys, and incidentally. We detected merlin on 4 occasions within the Lake Perris/SJWA/Mystic Lake habitat block during the fall and winter of 2009, indicating that they use the area during that time of year. Additionally, we regularly detected merlin within that habitat block during the winter of 2007–2008. While it is possible that merlin did not use that habitat block during the winter of 2008–2009, we have data demonstrating that the species was using the area prior to and following our focal surveys.

We also detected prairie falcon within additional habitat blocks while conducting other non-wintering raptor surveys. We detected 1 individual in the fall of 2009 while conducting lake bird surveys at Lake Mathews, which abuts the Estelle habitat block to the north. The individual was flying over the Estelle habitat block, but was seen from Lake Mathews. Additionally, we detected a prairie falcon in May 2009 within the Lake Skinner habitat block while surveying there for northern harriers. We can reasonably conclude, then, that prairie falcons use these 2 habitat blocks, even though we did not detect them during our focal wintering raptor survey.

Overall, we surveyed habitat blocks whose cumulative total size comprised approximately 86,363 ac of open habitat. Because we did not collect data on the relative quality of the habitat at observation locations or within surveyed areas, we cannot conclude whether observed raptors were selecting particular habitat blocks or particular areas within given habitat blocks based on available habitat quality.

Recommendations for Future Surveys

Future surveys should account for accessibility of landscapes before distributing transects. We wasted significant time in 2009 driving to areas that were ultimately inaccessible due to excessively steep slope, dense vegetation, or deep snow. Such transects had to be moved and re-assessed, thus restricting our inference to surveyed transects rather than suitable landscapes across entire habitat blocks. Time should be taken to model accessibility with GIS by removing slopes > 25 degrees and chaparral with cover density > 60%. The area of inference should also be restricted to elevations below 1500 m where deep snow rarely occurs, and to habitat patches large enough to fit entire transects. Time should also be taken before surveys begin to verify accessibility, and adjust the transect placement model and redistribute transects if necessary.

Logistics and personnel availability dictate that every habitat block can not be surveyed over a period that would allow 1-week intervals between rounds. Habitat blocks should then be surveyed in manageable groups that would allow transects to be surveyed multiple times over a relatively short time period (e.g., 3 visits within 1 month). Flexibility should also be incorporated into future designs to allow for habitat blocks lacking detections to be resurveyed within a season, specifically if estimated detection probabilities are less than 1, or if it is suspected that surveys missed the arrival of wintering individuals.

Lastly, we may benefit in the future from collecting habitat quality data near transects. Doing this might allow us to determine whether there is a difference in the quality of habitat being used by wintering raptors, and whether there is a shortage of ideal habitat that may be influencing use by the raptors. As it stands now, we cannot determine whether species were not using certain habitat blocks because they lacked ideal habitat, or there was abundant ideal habitat, but a low number of raptors.

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Appendix A. Raptor survey datasheet, 2008–2009.

2008 MSHCP Biological Monitoring Program
Wintering Raptor Datasheet (Walking)

Transcect Number RW____ Starting Ending Wind Units (circle)

Visit Number ________ Time ________ Time ________ km/h

Survey Date ________ Temperature ____ Temperature ____ Beaufort

Observer________ Wind speed ____ Wind speed ____

Weather ____ Weather ____

Species Code	Sex M, F, U	Age Ad, Ju, U	Abundance	ID Cues P, C, S, F, O	Species Code	Sex M, F, U	Age Ad, Ju, U	Abundance	ID Cues P, C, S, F, O	Species Code	Sex M, F, U	Age Ad, Ju, U	Abundance	ID Cues P, C, S, F, O

Notes

Transcect Number RW____ Starting Ending Wind Units (circle)

Visit Number ________ Time ________ Time ________ km/h

Survey Date ________ Temperature ____ Temperature ____ Beaufort

Observer________ Wind speed ____ Wind speed ____

Weather ____ Weather ____

Species Code	Sex M, F, U	Age Ad, Ju, U	Abundance	ID Cues P, C, S, F, O	Species Code	Sex M, F, U	Age Ad, Ju, U	Abundance	ID Cues P, C, S, F, O	Species Code	Sex M, F, U	Age Ad, Ju, U	Abundance	ID Cues P, C, S, F, O

Notes

ID Cues:
(P)lumage
(C)all
(S)hape
(F)light Pattern
(O)ther (describe in notes)

Data Entered Initial: Date:

Checked Initial: Date:

Appendix B. Western Riverside County MSHCP Biological Monitoring Program Protocol for Wintering Raptor Surveys, December 2008 – February 2009.

Goals

Document the distribution and species composition of open country wintering raptors in Western Riverside County, focusing on the following covered species: Ferruginous Hawk (FEHA), Merlin (MERL), and Prairie Falcon (PRFA). Examine potential habitat covariates for the occurrence of these covered species. Determine detection probabilities and available habitat use for wintering raptors in the Conservation Area.

Timing

Wintering Raptor surveys will be conducted from December 2008 to February 2009 to coincide with most raptor species wintering periods. Surveys will commence 30 minutes after sunrise and will terminate on or before 1300 hours.

Survey Locations

Surveys will be conducted on accessible lands in appropriate habitat within the conservation area. Appropriate habitat will consist of habitat types identified in the MSHCP species accounts for the target species, including all open country (grasslands, agriculture, bare ground) as well as shrubland and woodland habitats of less than 60% density (Dudek & Associates 2003). Habitat types will be identified using CDFG et al. (2005).

Methods

Protocol Development

Survey methods are based on techniques described in Andersen et al. (1985) and Fuller and Mosher (1981). We selected an analytical model based on repeat sampling of the same transects, following the techniques described in MacKenzie et al (2006), a design which provides for the computation of proportion of area occupied (PAO).

Sampling Design

Fifty (50) randomly-located 500-m long transects were placed throughout accessible lands within the Conservation Area. These transects are ≥ 1 km from one another and ≥ 100 m from the boundary of accessible lands. This will enable us to survey a greater amount of land within the Plan Area and will also minimize the likelihood that observers encounter raptors outside of the accessible lands. All transects are oriented in a north-south direction and include GPS coordinates for the southernmost, central, and northernmost points.

Survey Techniques

All observers must demonstrate the ability to visually and acoustically identify all the probable raptor species that can be seen in the area. Observers will receive at least 20 hours of field and office training in raptor identification, and at least 10 hours field protocol training, prior to beginning surveys.

All sites will be surveyed beginning 0.5 h after sunrise and will terminate at 1300 h. Surveys will be terminated early if the temperature exceeds 35 degrees C, if wind speed exceeds a 4 on the Beaufort Wind Scale (> 21 km/hr), or during precipitation or fog. Additionally, no surveys will be conducted for 48 h following a significant precipitation event, any time vehicles leave significant ruts in the roads, and any time there is significant snow or ice accumulation on the roads being used to access transects.

Waypoints and routes for each transect will be downloaded into a GPS unit prior to the beginning of the survey. At the beginning of each transect, observers will record the transect start time, temperature, wind speed (estimated on the Beaufort Scale if no wind gauge is available), and weather conditions. Observers will also record the total time spent in each individual cell.

Observers will survey the transect beginning at either the southernmost or northernmost point, and navigating to the opposite end of the transect. While surveying for raptors, observers should attempt to walk at a constant speed, spending approximately 30 minutes walking from one end of the transect to the other. If significantly less than 30 minutes have been spent walking a transect, the observer will turn around and begin walking the transect again until approximately 30 minutes have elapsed.

During the transect, observers will record all raptors, including all Falconidae, Accipitridae, Cathartidae, Tytonidae, Strigidae, and Laniidae. Care must be taken to avoid recording the same bird twice. Observers will also record all cues used in detection and identification (call, visual, other) and, if known, the sex and age of the bird. Covered raptors that are observed within the survey area between transect counts will be recorded as incidental observations.

All transects will be sampled 3 times during the survey season. Each survey period will last approximately 3 – 4 weeks.

Equipment

Handheld GPS Unit
Thermometer
Binoculars
Spotting Scope
Data Sheets
Anemometer
Rangefinder
Compass
Field Guide

Data analysis:

Occupancy and detection probability for all species will be determined using occupancy models in Program PRESENCE (Hines 2006). These models will incorporate the effect of habitat type at a broad scale (determined using GIS) on occupancy of selected species. The sampling unit of this analysis will be the 1 km square cell, and the occupancy analysis will report the proportion of cells used by the species of interest. Although cells are sampled as a group within a transect, the individual cells were selected independently, and thus can be analyzed as independent units. If sufficient sample sizes are obtained, analyses will be stratified by habitat block.

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Appendix C. Number of raptor species detections on transects per survey round during winter 2008–2009. Covered Species are in bold text.

Species	Round 1	Round 2	Round 3	Total
American kestrel (*Falco sparverius*)	38	26	12	76
Bald eagle (*Haliaeetus leucocephalus*)	0	1	1	2
Burrowing owl (*Athene cunicularia*)	0	1	0	1
Cooper's hawk (*Accipiter cooperii*)	2	1	3	6
Ferruginous hawk (*Buteo regalis*)	7	1	4	12
Golden eagle (*Aquila chrysaetos*)	3	1	2	6
Loggerhead shrike (*Lanius ludovicianus*)	5	3	0	8
Merlin (*Falco columbarius*)	4	3	0	7
Northern harrier (*Circus cyaneus*)	20	12	17	49
Osprey (*Pandion haliaetus*)	3	1	4	8
Peregrine falcon (*Falco peregrinus*)	0	0	1	1
Prairie falcon (*Falco mexicanus*)	1	0	1	2
Red-shouldered hawk (*Buteo lineatus*)	6	0	2	8
Red-tailed hawk (*Buteo jamaicensis*)	86	77	86	249
Sharp-shinned hawk (*Accipiter striatus*)	2	2	1	5
Turkey vulture (*Cathartes aura*)	3	5	5	13
Unidentified falcon	2	0	0	2
Unidentified hawk	2	0	1	3
White-tailed kite (*Elanus leucurus*)	1	0	3	4
Total	**185**	**134**	**143**	**462**