Effects of Expanding Viticulture on the Home Range and Habitat Use of Nesting Swainson's Hawks in the Central Valley

Project Information

1. **Proposal Title:**

   Effects of Expanding Viticulture on the Home Range and Habitat Use of Nesting Swainson's Hawks in the Central Valley

2. **Proposal applicants:**

   Douglas Bell, California State University, Sacramento Foundation
   Craig Swolgaard, CSUS Foundation

3. **Corresponding Contact Person:**

   Douglas Bell
   Calfornia State University Sacramento
   Department of Biological Sciences 6000 J St. Sacramento, CA 95819-6077
   916 278-6573
   dbell@csus.edu

4. **Project Keywords:**

   Endangered Species
   Upland Birds
   Wildlife-friendly Agriculture

5. **Type of project:**

   Research

6. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

7. **Topic Area**:

   Uplands and Wildlife Friendly Agriculture

8. **Type of applicant:**

   University

9. **Location - GIS coordinates:**

Latitude: 38.180

Longitude: -121.294

Datum:

Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

The location covers the area surrounding Lodi, north to the Consumnes River, south to Eight-mile Rd., east to Hwy 99 and west to I-5. The total acrage is approximately 38,000 acres.

10. **Location - Ecozone:**

    1.2 East Delta, 11.1 Cosumnes River, 11.2 Mokelumne River

11. **Location - County:**

    Sacramento, San Joaquin

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    No

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    District 11

15. **Location:**

    California State Senate District Number: 5

    California Assembly District Number: 10

16. **How many years of funding are you requesting?**

    2

17. **Requested Funds:**
    a) Are your overhead rates different depending on whether funds are state or federal?

       No

       If no, list single overhead rate and total requested funds:

Single Overhead Rate: 32% MTDC

Total Requested Funds: 201524

b) Do you have cost share partners already identified?

No

c) Do you have potential cost share partners?

No

d) Are you specifically seeking non-federal cost share funds through this solicitation?

No

If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

18. **Is this proposal for next-phase funding of an ongoing project funded by CALFED?**

No

Have you previously received funding from CALFED for other projects not listed above?

No

19. **Is this proposal for next-phase funding of an ongoing project funded by CVPIA?**

No

Have you previously received funding from CVPIA for other projects not listed above?

No

20. **Is this proposal for next-phase funding of an ongoing project funded by an entity other than CALFED or CVPIA?**

No

Please list suggested reviewers for your proposal. (optional)

21. **Comments:**

Environmental Compliance Checklist

Effects of Expanding Viticulture on the Home Range and Habitat Use of Nesting Swainson's Hawks in the Central Valley

1. **CEQA or NEPA Compliance**
   a) Will this project require compliance with CEQA?

      No
   b) Will this project require compliance with NEPA?

      No
   c) If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

      This is a telemetry study and does not involve take.

2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies).** *If not applicable, put "None".*

   CEQA Lead Agency:
   NEPA Lead Agency (or co-lead:)
   NEPA Co-Lead Agency (if applicable):

3. **Please check which type of CEQA/NEPA documentation is anticipated.**

   CEQA
   -Categorical Exemption
   -Negative Declaration or Mitigated Negative Declaration
   -EIR
   Xnone

   NEPA
   -Categorical Exclusion
   -Environmental Assessment/FONSI
   -EIS
   Xnone

   If you anticipate relying on either the Categorical Exemption or Categorical Exclusion for this project, please specifically identify the exemption and/or exclusion that you believe covers this project.

4. **CEQA/NEPA Process**
   a) Is the CEQA/NEPA process complete?

      None

   b) If the CEQA/NEPA document has been completed, please list document name(s):

5. **Environmental Permitting and Approvals** (*If a permit is not required, leave both Required? and Obtained? check boxes blank.*)

LOCAL PERMITS AND APPROVALS

Conditional use permit

Variance

Subdivision Map Act

Grading Permit

General Plan Amendment

Specific Plan Approval

Rezone

Williamson Act Contract Cancellation

Other

STATE PERMITS AND APPROVALS

Scientific Collecting Permit Required, Obtained

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land.
Agency Name:

Permission to access state land.
Agency Name:

Permission to access federal land.
Agency Name:

Permission to access private land.
Landowner Name:

6. **Comments.**

None

Land Use Checklist

Effects of Expanding Viticulture on the Home Range and Habitat Use of Nesting Swainson's Hawks in the Central Valley

1. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

2. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?**

   Yes

3. **Do the actions in the proposal involve physical changes in the land use?**

   No

   If you answered no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

   research only

4. **Comments.**

   None

Conflict of Interest Checklist

Effects of Expanding Viticulture on the Home Range and Habitat Use of Nesting Swainson's Hawks in the Central Valley

Please list below the full names and organizations of all individuals in the following categories:

- Applicants listed in the proposal who wrote the proposal, will be performing the tasks listed in the proposal or who will benefit financially if the proposal is funded.
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant(s):

Douglas Bell, California State University, Sacramento Foundation
Craig Swolgaard, CSUS Foundation

Subcontractor(s):

Are specific subcontractors identified in this proposal? No

Helped with proposal development:

Are there persons who helped with proposal development?

Yes

If yes, please list the name(s) and organization(s):

Wendy Johnson OSPR

Fred Jurick DFG

Comments:

Budget Summary

Effects of Expanding Viticulture on the Home Range and Habitat Use of Nesting Swainson's Hawks in the Central Valley

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

Federal Funds

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	Project Management	500	8260	991		2000				11251.0	3600	14851.00
2	Point Counts	1840	21160	2539	4304	2214				30217.0	9970	40187.00
3	Nest Searches	100	1500	180	538	935				3153.0	1008	4161.00
4	Telemetry	1880	22520	2702	2152	8000	2800			38174.0	12216	50390.00
		4320	53440.00	6412.00	6994.00	13149.00	2800.00	0.00	0.00	82795.00	26794.00	109589.00

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	Project Management	500	8260	991						9251.0	2962	12213.00
2	Point Counts Searches	1840	21160	2539	4304					28003.0	8961	36964.00
3	Nest Searches	100	1500	180	538					2218.0	710	2928.00
4	Telemetry	1880	22520	2702	2152		2800			30174.0	9656	39830.00
		4320	53440.00	6412.00	6994.00	0.00	2800.00	0.00	0.00	69646.00	22289.00	91935.00

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
0	0								0	0.0	0	0.00
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Grand Total=201524.00

Comments.

Budget Justification

Effects of Expanding Viticulture on the Home Range and Habitat Use of Nesting Swainson's Hawks in the Central Valley

Direct Labor Hours. Provide estimated hours proposed for each individual.

Principal Investigator Douglas A. Bell: 320 Graduate Student Craig Swolgaard: 2560 Graduate Student #2: 1920 Undergraduate Student #1: 1920 Undergraduate Student #2: 1920

Salary. Provide estimated rate of compensation proposed for each individual.

Principal Investigator Douglas A. Bell: $32/hr Graduate Student Craig Swolgaard: $15/hr Graduate Student #2: $12/hr Undergraduate Student #1: $9/hr Undergraduate Student #2: $9/hr

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

Benefit rate for all employees: 0.12

Travel. Provide purpose and estimate costs for all non-local travel.

Two field teams require 2 vehicles for travel to and within study areas for the purpose of censusing hawks via point counts, searching for hawk nests and tracking hawk with radio telemetry. 40545 miles x $0.345/mile= $13988

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

Computing Supplies and Programs: $2000 Field Supplies: $11,149

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

Swainson's Hawk Technical Advisory Committee will perform Trapping of hawks and radio transmitter attachment. Estimate trapping 12 hawks in 14 days. Committee compensated @ $400/day x 14 days = $5600

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

0

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentatons, reponse to project specific questions and necessary costs directly associated with specific project oversight.

Project Oversight: $2256 Training field personnel& testing field supplies:$1800 Hiring and coordinating personnel: $2400 Data management, data analysis, report preparation & presentations: $9900

Other Direct Costs. Provide any other direct costs not already covered.

0

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs.

California State University Sacramento Foundation has a Federally approved and negotiated Facilities and Administrative rate of 32% Modified Total Direct Costs which is applied to State and Federal proposal submissions

Executive Summary

Effects of Expanding Viticulture on the Home Range and Habitat Use of Nesting Swainson's Hawks in the Central Valley

This project is a research study. The goal of this study is to determine foraging site preferences of the Swainson's Hawk in the Central Valley in relation to agriculture. The Swainsons Hawk is a state-threatened species. It forages for small mammals using aerial hunting over grassland and open areas. We propose to investigate Swainson's Hawk response to increasing monocultures of vineyards in the mid-section of the Central Valley. By use of point counts and radio telemetry, habitat use by foraging hawks will be documented and compared to agricultural land uses. The home ranges of radio-tagged hawks nesting in both vineyard and non-vineyard areas will be measured and compared between groups. The home range area, distance traveled per day and distance from the nest to centers of foraging activity will be quantified. The results of this study will increase our understanding of the habitat requirements of the Swainson's Hawk in agricultural areas and allow us to measure the effect of large areas of vineyard production on the nesting success of local Swainson's Hawks. To date, no study has addressed the effect of viticulture on the long term population viability of the Swainson's Hawk. The null hypothesis states that vineyards do not affect foraging and nesting habitat choice in the Swainson's Hawk. The location of this study will be in southern Sacramento and San Joaquin counties, California. The area between north Stockton and Elk Grove will be used for point counts and telemetry efforts, as well as the area southwest of Stockton and northeast of Galt. Field personnel will track radio-tagged Swainson's Hawks over the course of two breeding seasons to identify preferred habitats and home ranges. Hawk foraging locations will be triangulated and recorded by GPS on electronic maps. Point counts will visually census foraging hawks in two 130 km2 study areas to determine which crop types constitute preferred foraging areas. At the beginning of each breeding season, nest searches will be conducted. The density and locations of nests noted will be compared with historic records to determine nesting trends in relation to the decades-long increase in vineyard growth within the study areas. This study is related to CALFED ERP strategic goals 1 & 4 (MR-2&6, DR-3&4), in that it will increase our understanding of habitat preference and use by a threatened species. It will also help guide future land use decisions and incentive programs to enhance wildlife friendly agriculture, including viticulture.

Proposal

California State University, Sacramento Foundation

Effects of Expanding Viticulture on the Home Range and Habitat Use of Nesting Swainson's Hawks in the Central Valley

Douglas Bell, California State University, Sacramento Foundation
Craig Swolgaard, CSUS Foundation

Effects of Expanding Viticulture on the Home Range and Habitat Use of Nesting Swainson's Hawks in the Central Valley

I.) Problem

A.) The Problem

In the interest of developing a Central Valley ecosystem where agriculture and wildlife can coexist, landowners must make informed land use decisions. The goal of the Ecosystem Restoration Program is to achieve recovery of at-risk species and expand their suitable habitat while sustaining agricultural practices.

The increase in vineyard acreage in the mid-section of the Central Valley may negatively impact the state-threatened Swainson's Hawk (*Buteo swainsoni*) (Estep 1989). Impacts on this hawk may be especially exacerbated in large, contiguous areas devoted to viticulture. Without alternative foraging area for the Swainson's Hawk, its population density may decrease. Vineyards appear to constitute poor foraging habitat for Swainson's Hawks for two reasons:

1.) They support only low prey densities of their preferred small mammal prey, e.g. microtine voles (Estep, personal comm.)
2.) They create a visual and physical barrier to the ground, making it difficult for the hawks to see or capture prey (see conceptual model).

Furthermore, because vineyards are long-term plantings, they may effectively remove potential foraging areas for nesting Swainson's Hawks for long-periods of time.

According to a State agricultural census, from 1987 to 1997 there was a 54% increase in vineyards in San Joaquin county and a 256% increase in vineyard acreage in Sacramento county (Agricultural Census For California 1997; see figs. 1 & 2). Vineyard acreage has also increased substantially in Colusa (163%), Yolo (344%), Solano (65%) and Merced (69%) counties. Concurrently, there has been a drop in the amount of alfalfa acreage in these counties. The impact of these agricultural trends on locally threatened species requires

attention. Understanding what forms of agriculture enhance the success of the Swainson's Hawk will assist in future agricultural planning.

B.) Goal Statement

The goals of this project are to:

1.) compare the number and locations of Swainson's Hawk nesting territories in areas recently converted to vineyard production with historical data for these areas from the mid-1980s and 1990s.
2.) investigate if vineyards constitute unpreferred foraging habitat for breeding Swainson's Hawks in the Central Valley.
3.) evaluate which crops or land uses constitute preferred foraging habitat for Swainson's Hawks in the Central Valley.
4.) chronicle the effects of vineyard landscapes on aspects of the home range of Swainson's Hawks nesting within vineyard areas.

By use of point count and radio telemetry methods, these goals will be met in a two-year study located in San Joaquin and Sacramento counties.

C.) Null Hypotheses

1.) There is no difference between the number or locations of Swainson's Hawk nests in areas of recent vineyard expansion versus those areas historically devoted to non-viticulture.
2.) There is no significant difference in the habitat use dynamics between Swainson's Hawks nesting in vineyard landscapes versus other agricultural landscapes.
3.) There is no significant difference in measurements of travel between home ranges of vineyard nesting and non-vineyard nesting Swainson's Hawks.

4.) The mean distance to centers of activity from nests will be the same for Swainson's Hawks nesting in vineyard and non-vineyard areas.

D.) Background/ Past Studies

1.) Swainson's Hawk's Threatened Status:

Earlier last century, the Swainson's Hawk (*Buteo swainsoni*) was a common inhabitant of the Central Valley grasslands. In 1980, Peter Bloom brought attention to the tenuous status of this species, pointing out that its population had declined in California by an estimated 91% between the middle of the 20th century and 1979. See figure 3. In 1983 the hawk was given a state threatened status. Presently, the population of the Swainson's Hawk has grown to an estimated 1000 pairs in California, with the greatest density of nesting pairs in Yolo, Sacramento and San Joaquin counties (Estep, pers. comm.).

2.) Past Studies:

Studies have shown that this hawk has adapted somewhat to agricultural habitats (Bloom 1979, Estep 1989) especially those that provide easy access to microtine prey. This switch from grasslands to croplands has been observed in many other parts of the Swainson's Hawks' geographic range (Bechard 1982, Gilmer & Stewart 1984, Schmutz 1989, Woodbridge et al. 1995). Crops such as alfalfa, irrigated pasture, grain and row crops are preferred as foraging habitat in the Central Valley (Estep 1989, Smallwood 1995). Tall, dense crops such as corn, safflower, orchards and vineyards appear to be avoided (England, et al. 1997). In addition to harboring low microtine abundance, they presumably reduce prey visibility, thus accessibility for this hawk. Jim Estep (1989) showed that Swainson's Hawks in the Central Valley will switch foraging strategies many times during the breeding season,

because of increases in prey availability caused by cropping practices such as irrigation, cultivation, and harvest. For instance, beets and tomatoes were shown to be a preferred crop, but only during the time of harvest (Estep 1989). Other land uses, such as irrigated pastures, were used for foraging more consistently throughout the season.

E.) Location of Study

The study plots will be located in San Joaquin and Sacramento counties. One area of expanding viticulture is located within historic nesting areas of Swainson's Hawks in northern San Joaquin County. Additional areas of vineyard and non-vineyard land uses are located in southern Sacramento and San Joaquin counties. Aggregations of nesting Swainson's Hawks are still found in these areas. These nesting territories are located along or near:

1.) Interstate 5, between North Stockton and Elk Grove (Ecozone 1.2).
2.) Dry Creek, between Clay Station Road and the Mokelumne River (Ecozone 11.2).
3.) Mokelumne River, between Lodi and Consumnes River Preserve (Ecozone 11.2).
4.) Consumnes River, between Sloughouse and Consumnes River Preserve (Ecozone 11.1).
5.) The agricultural area east of South Stockton, and north of Tracy (Ecozone 1.3).

See figures 4 & 5 for maps of these areas.

II.) Justification

A.) Conceptual Model

The conceptual model behind the proposed study is based upon previous research performed by others. It includes the following ideas:

1.) Food availability and nest sites are the most significant variables in determining hawk density (Newton 1979).
2.) Limited food supply correlates with reduced brood weight, survival, and reproductive decline of Swainson's Hawks (Bechard 1983, Houston & Schmutz 1995).
3.) For raptors, habitat patches that contribute the highest gain in energy per unit of hunting effort do not necessarily contain the highest prey density (Bechard 1982, Preston 1990).
4.) A positive correlation exists between raptor foraging effort and prey biomass when adjusted for amount of plant cover (Bechard 1982, Preston 1990). Prey abundance is of secondary importance to prey accessibility, but it is the combination of the two that determines foraging success.
5.) The preference of Swainson's Hawks for habitats with shorter vegetative height and lower plant density has been explained theoretically by Janes (1985). Morphologically, the Swainson's Hawk is an aerial forager, and as such, has better view of prey in areas of shorter, less dense vegetation. Janes developed a simple model, in which the area (A) that a raptor can detect prey is dependent upon variables such as plant height (h), plant density (ρ), plant diameter (d), vertical distance of the hawk (H), and height of the prey (m) (see fig. 6. The equation for determining total effective area of prey detection is

$$A = 0.785 (kH/ dh(1-m))^2 / \rho \qquad \text{(k is a proportionality constant)}$$

Thus, an increase in a variable such as plant density will decrease the effective foraging area, forcing obligate aerial-foraging Swainson's Hawk to fly higher to compensate. Also, increases in plant height or diameter should decrease the area of prey detection.

For crops such as grapes or orchards, one would expect to see an effect on hawk foraging success compared to shorter crops (e.g. alfalfa) or pastures.

According to the above equation, large areas that become dominated by crops possessing unfavorable vegetative structure will cause both abandonment of territories by Swainson's Hawks as well as preclude new territories from being established later. Raptors with differing foraging behaviors (such as perch hunters) may not experience the same effect.

B.) Testing the Hypotheses

1.) Nest searches will be conducted within a large area of vineyards north and west of Lodi, California. Numbers and locations of nests will be recorded on maps and compared with data from the mid-1980s and 1990s, when viticulture was not so extensive in this area.
2.) Presence/absence of foraging Swainson's Hawks in a variety of crop types and land uses, including vineyards, will be determined by point-count (see below). Data will also be gathered on foraging behavior, plant variables and cropping practices during the hawk's breeding season. Habitat preferences will be determined by statistical methods. This aspect of the study is entirely habitat-based.
3.) The locations and habits of individual Swainson's Hawks nesting in either vineyard or non-vineyard areas will be followed with radio telemetry. Habitat preferences will be determined for hawks nesting in either vineyard or non-vineyard areas. This aspect of the study is individual-based.
4.) Home ranges of both groups will be compared for total area, the distance traveled per day, and the distance from nest to core areas of foraging activity.

C.) Key Uncertainties

1.) Although it is assumed that the type of habitat offered in vineyards is not suitable for Swainson's Hawks, no study has ever examined the use of vineyards by Swainson's Hawks. This study will test for Swaison's Hawk foraging preferences among a variety of agricultural land uses, including viticulture.
2.) Statements about habitat preferences based solely on telemetry data are not entirely robust. Tracking individuals only sheds light on those individuals, since they are the experimental units (Samuel and Fuller 1996, Aebischer et al. 1993). This study will be also use the point count method to determine habitat preference, thereby increasing independence and sample size. The point count method provides more data (Ralph, et al. 1993).
3.) Exactly how a Swainson's Hawk responds to having its nesting territory encroached upon by vineyards is not known. The telemetry study will allow several aspects of home range to be analyzed and compared for those individuals tracked.

D.) Relation to Adaptive Management

Before any restoration action or education program can be proposed in relation to viticultural practices, the foraging habits of the Swainson's Hawk must first be established. The proposed study is a research project. It addresses the problem of increasing vineyard acreage in the Central Valley and its presumed effects on the foraging success of Swainson's Hawks. Our goals are two-fold:

- To determine whether Swainson's Hawks in the Central Valley include or exclude vineyards in their choice of foraging habitat.
- To investigate the effects of vineyard landscapes on the home range of Swainson's Hawks nesting in those areas.

If the conceptual model holds, then the density of Swainson's Hawks in a large area will be partially correlated with suitable habitat and available foraging areas. This will include crops and habitats that maximize the accessibility of microtine prey to the hawks. Thus, a balance between prey abundance and amount of plant cover may be demonstrated. If the study shows conclusively that vineyards constitute poor foraging habitat and that large areas of this crop are causing a decline in local Swainson's Hawk density, then action can be taken to mitigate this effect. Educating local farmers and offering incentives to mix suitable crops in areas where there are vineyards is one of several actions that may be taken. Also, we may be able to ascertain if certain viticultural practices might increase the suitability of some types of vineyard plantings to foraging Swainson's Hawks. For example, the practice of planting manure crops between rows of grapes may increase the prey base for these hawks.

III.) Approach

Nest Searches:

Historical numbers and locations of nesting territories in northern San Joaquin county from the years 1986-87 & 1994 (historical data in Estep 1989, SWTAC & DFG unpublished records) will be compared to those numbers ascertained from the 2002-04 breeding seasons. During March & April of the latter years, exhaustive nest searches will be conducted in a large area of vineyards bordered by Dry Creek to the north, Eight Mile Road to the south, Highway 99 to the east, and Interstate 5 to the west. The methodology developed by the Swainson's Hawk Technical Advisory Committee will be used (SWTAC 2000). These nesting territories will be compared with records of nesting territories from 1986-87 and 1994 to see if the increase in vineyard production in this study area has affected nesting density.

Point counts:

Two 130-square km study areas will be established for point count surveys; one between North Stockton and Dry Creek, the other east of South Stockton and north of Tracy. Thirty points will be chosen in each of these study areas by the stratified random method (Cochran 1977), so that land uses representing the greatest proportion of total area are included. Since the area surveyed from each point may include more than one land use, location of points will be stratified in such a way that all land uses are equally represented. After point locations are established they will be flagged, and GPS coordinates will be taken. Ten-minute point counts surveys will be conducted, recording all Swainson's Hawks within a circle of 300-m radius, the land use they occupy, time spent in each land use, and behavior (non-foraging or foraging). Foraging will be considered to be behaviors such as kiting or coursing over a field, stooping, prey capture or standing on the ground . Any crop practices, such as irrigation, cultivation or harvesting will be recorded for all areas within the survey area. Also, once a month, a randomly chosen representative sample of each crop type from the survey areas will be measured for plant height and estimated % plant cover. Permission to enter property will be acquired from landowners before executing this task.

Point counts will be conducted once per week, 25 weeks per season (mid-March to mid-September), for two seasons. The land uses will include vineyards, orchards, grain, corn, tomatoes, alfalfa, irrigated pasture, fallow cropland, non-crop fields, and other row crops. Survey schedules will be staggered so that bias is not introduced due to point locations being regularly surveyed the same time of day.

Radio Telemetry:

Beginning in early June, when the hawks have finished mating and have begun incubating eggs, 12 adult male Swainson's Hawks (total for two seasons) will be trapped using the dho-gaza technique that includes a mist net and live Great-Horned Owl as a lure (Estep 1989). Each hawk will be fitted with a tail-

mounted radio transmitter and released. Only adult males will be tracked to avoid problems associated with sex-biased, differential habitat use (Aebischer, et al. 1993). A total of 12 individuals will be tracked during the breeding seasons of 2002 and 2003, divided into two groups of three each. The two groups of six hawks each will be divided into the following groups based on landscape types:

1.) Experimental Group: Nesting territories within or adjacent to a large expanse of vineyard agriculture located in North San Joaquin county, between Eight Mile Rd. to the south, Dry Creek to the north, Highway 99 to the east, and Interstate 5 to the west.
2.) Control Group: Nesting territories in non-vineyards areas that reflect a variety of other land uses, including rangeland. These areas are located southwest of Stockton and northeast of Galt.

A total of twelve hawks will be fitted with transmitters over two study seasons, early June until mid-September. Radio receivers and 3 element Yagi antennae will be used to track the hawks. Two teams of two persons each will be responsible for tracking three hawks each season. A team will track each hawk for eight hours per day, once per week throughout the season. That sums to an approximate total of 105–120 hours of tracking per hawk. Hawk locations will be determined both visually and by triangulation (Samuel & Fuller 1996). Triangulation will be done, using compasses to get bearings on each hawk, and GPS units to record location points from which bearings are taken. Two-way radio contact will be provided for each team member.

Since both home range and habitat use will be determined, locations will be recorded at five-minute intervals (Estep, personal commun.). However, of all those locations, points at thirty-minute intervals will be used to calculate home range, to avoid autocorrelation (Swihart & Slade 1985, Babcock 1995). Data on hawk behavior and cropping practices will be recorded as well, using the same format as the point counts.

Quality Assurance:

Standardized data sheets will be used for all data acquisition. Personnel will spend preliminary time in the field to identify Swainson's Hawks and learn hawk foraging behavior. Identification of hawk behaviors is derived from Sibley (2000). Binoculars used will be of the same brand and power. For point counts, all distances determined by pacing will be calibrated with true distance for each team member. All compasses used to measure bearings will be of the same type and brand. Prior to the arrival of Swainson's Hawks from their wintering areas in central and south America, all team members will practice taking bearings in the field to standardize measurements. Teams will practice with the radio telemetry equipment to streamline triangulation methods. Teams will practice in all study areas to identify interference problems from radio towers, etc.

During the field season, the telemetry teams will regularly meet to fine-tune data gathering and trouble-shoot discrepancies or differences in data acquisition that might cause bias. Team tracking schedules will be staggered throughout the season to preclude observer bias (Martin & Bateson 1993).

Statistical testing:

For the habitat use data, the methods used by Estep (1989) in his study will be followed. Specifically, for habitat use data, habitat will be ranked by preference (Johnson 1980). Two null hypotheses will be tested:

1.) "All habitats are equally preferred." This will be tested using Hotelling's T statistic (Anderson 1958).

3.) "Selection of habitat type 'I ' equals that of habitat type 'j'." This will be tested using the Waller-Duncan multiple comparisons method (Waller and Duncan 1969).

These can be used for both the telemetry data and the point count data. Parameters such as distance traveled per day and home range area can be compared between groups by a simple ANOVA or Mann-Whitney test. Simple regression analysis will determine if there is a correlation exists between increasing vineyard acreage and changes in local Swainson's Hawk abundance.

Differences in means will be tested by student's t test.

IV.) Feasibility

The approach to the proposed study is feasible for several reasons. Having two teams of workers to complete the tasks involved will assure that a sufficient amount of data is gathered in the field. The amount of work will be spread out over four people, so mistakes caused by fatigue are less likely. The task of tracking 12 nesting Swainson's Hawks in the Central Valley can be completed in two six-month breeding seasons.

Requirements concerning handling of threatened species will be addressed by approved biologists from the Swainson's Hawk Technical Advisory Committee (SHTAC). Members of this committee are permitted to trap and handle Swainson's Hawks by a Memorandum of Understanding between state and federal agencies as well as federal banding permits. Members of the SHTAC have agreed to perform the actual trapping and handling of Swainson's Hawks.

V.) Performance Measures

Activities

1.) A timetable for purchasing equipment and hiring the workers will be followed each year, before the season begins. All equipment will be tested and practiced with before it is used in the field.
2.) Twice during each field season, the teams will come together to compare identification and method skills and assure that no deviations are occurring. Each team member will keep the project leader apprised of any problems encountered during the season.

Outputs

1.) All data for the first season will be evaluated statistically to verify that the chosen analysis methods are appropriate. Once the data are analyzed, hypotheses will be tested and compared with expected outcomes. If necessary, aspects of data acquisition and study design will be altered to increase the power of statistical tests.

2.) Twice during each season, the data gathered will be evaluated and compared to expectations to ensure that work schedules are sufficiently planned and maintained.

Outcomes

1.) All research and results will be complied into a thesis to fulfill the requirements for the Master's Degree at California State University Sacramento. The thesis will be reviewed by a committee of five university professors and researchers.

2.) In addition to the Master's thesis, results will be compiled and published in one or more peer-reviewed scientific journals.

3.) Information relating to viticulture practices and Swainson's Hawk habitat use will be disseminated to local and regional wildlife agencies, land management agencies, planning commissions, non-governmental agencies and farm bureaus. Special emphasis will be placed on incorporating results into the joint-venture planning process for the Central Valley.

4.) This study will provide individuals with information seeking to achieve an optimum balance between vineyard practices and wildlife habitat improvement. Land management agencies, planning commissions and other parties will benefit from his information.

VI.) Data Handling/Storage

Point count data will be stored in an Access database. Shapefiles created by GPS coordinates for nest search and telemetry data will be stored in appropriate software (e.g. Global Pathfinder). National Geographics Map of California CD-ROM will be used to create maps of study locations. DWR online land use maps (Internet) will be used for researching land uses in the past. Two copies of field data will be stored in two separate locations, and all computer-stored data will be backed up.

VII.) Expected Products

This project is part of a Master's thesis to be completed by Craig Swolgaard, and as such, will be evaluated by a committee of university professors and scientists. Products of the study will include a written thesis, oral presentations at educational and research institutions, publications in peer-reviewed journals, and presentations at professional conferences as well as local and regional government agencies and non-governmental organizations. The data will further assist the Swainson's Hawk technical Advisory Committee in predicting long-term population viability of this threatened species of hawk in the Central Valley.

VIII.) Work Schedule

Assuming that funding begins on June 1, 2002, the following tasks will be completed during the indicated dates.

Task	Dates		
	2002	2003	2004
1.) Project Management	6/1-12/31	1/1-12/31	1/1-5/31
2.) Point Counts	6/1-9/30	3/1-9/30	3/1-5/31
3.) Nest Searches	6/1-9/30	3/1-9/30	3/1-5/31
4.) Telemetry	6/1-9/30	3/1-9/30	3/1-5/31

The tasks deemed inseparable from the project would be point count, nest searches, travel, and project management. If the telemetry portion of the study was not funded, the point count & nest search designs would be altered and the effort would be increased.

IX.) Applicability to CALFED ERP

- Multi-regional Priorities: This study will satisfy many of the components of priorities MR-2 (Wildlife-Friendly Agriculture) and MR-6 (At-Risk Species). Specifically, adding o the knowledge of the Swainson's Hawk habitat use in agricultural areas will help develop plans to enhance wildlife-friendly agricultural practices in the Valley on a multi-regional basis. In addition, an understanding of the habitat requirements of this threatened species will aid in maintaining viable densities of the Swainson's Hawk throughout its range in the Central Valley.
- Delta and Eastside Tributaries Priorities**:** The proposed study will also satisfy some of the components of priorities DR-3 (Wildlife Friendly Agriculture) and DR-4 (At-Risk Species). In this case, the knowledge

gained from understanding Swainson's Hawk habitat interactions will help guide incentive programs for the farmers.

- ERP Strategic Goals: By documenting any changes in Swainson's Hawk abundance and establishing their habitat preferences, Strategic Goals 1 and 4 will be met for that species. This study focuses on the population health of Swainson's Hawks in relation to a stressor (increasing vineyard acreage). By determining suitable and unsuitable foraging habitat, efforts to protect habitat will be enhanced.
- CALFED Science Program: Results from this study will improve efforts for developing a habitat suitability model for the Swainson's Hawk.
- CVPIA Goals: The study will help fulfill the goal of the Habitat Restoration Program, that is, to improve populations of a state threatened species. It is important to identify any agricultural activities that might effect viability of Swainson's Hawk populations.

X.) Relationship to Other CALFED Projects

At the time of writing this proposal, the author is not privy to any other projects involving either assessment of the Swainson's Hawk or a program to encourage wildlife friendly agriculture. Being a research project, it is hoped that this study will enhance such programs or enable them to get under way.

XI.) Requests for Next-Phase Funding/ Previous Recipients of CALFED or CVPIA Funding

The proposal does not apply to either of these sections.

XII.) System-Wide Ecosystem Benefits

Being a research project, any system-wide benefits would be dependent on programs that could result from it. Potentially, it could have a favorable effect of Swainson's Hawk abundance by preventing the further spread of large monocultures of vineyards in the Central Valley, and developing plans that would enhance the distribution of favorable foraging habitat.

XIII.) Land Acquisition

The proposed study does not include a land acquisition component.

XIV.) Qualifications

Douglas A. Bell received a Bachelor's degree in Zoology from Humboldt State University, a Master's degree in Biology from the University of Muenster, Germany, and a Ph.D. in Zoology from the University of California at Berkeley. He performed seven years of field and laboratory based postdoctoral work in avian biology at the California Academy of Sciences, and thereafter worked as Senior Biologist for the San Francisco Bay Bird Observatory. He is a Research Associate of the Santa Cruz Predatory Bird Research Group. He has published numerous articles on the population dynamics and genetics of raptors and other species of birds. He is currently an Assistant Professor of Biology at California State University, Sacramento.

Craig Swolgaard received a B.S. degree in Plant Science from U.C. Davis. He worked for as an assistant fieldman for a fertilizer company in the Sacramento Valley from 1979-1983. Presently, he is finishing graduate classes in Biological Conservation at California State University, Sacramento.

XV.) Local Involvement

The counties of Sacramento and San Joaquin will both be contacted and apprised of the upcoming study. Consumnes River Preserve has been informed of the study and permission to work on the Preserve is being pursued. All relevant landowners in the study areas will be contacted and informed of the study. Permission will be asked for entering their property for the purpose of plant measurements of crop types. Members of the Swainson's Hawk Technical Advisory Committee will participate in the capture and handling hawks for the purpose of radio-transmitter attachment. Participation in the study by undergraduate and graduate students from California State University Sacramento as well as members of the local community will be encouraged.

XVI.) Compliance with Standard Terms

As grantee, the CSUS Foundation will comply with the standard terms and conditions as set forth in Attachments D & E of the 2002 Proposal Solicitation Package.

XVII.) Literature Cited

Aebischer, Nicholas J. and P.A. Robertson, R.E. Kenward. 1993. Compositional analysis of habitat use from animal radio-tracking data. Ecology 74: 1313-1325.

Agricultural Census of California, 1997. Internet. http://govinfo.library.orst.edu

Anderson,T.W. 1958. An introduction to multivariate statistical analysis. John Wiley & Sons, New York, N.Y.

Babcock, Keith W. 1995. Home range and habitat use of breeding Swainson's Hawks in the Sacramento Valley of California. J. Raptor Res. 29:193-197.

Bechard, Marc J. 1982. Effect of vegetative cover on foraging site selection by Swainson's Hawk. Condor 84:153-159.

Bechard, Marc J. 1983. Food supply and the occurrence of brood reduction in Swainson's Hawk. Wilson Bull. 95:233-242.

Bloom, Peter H. 1980. The status of the Swainson's Hawk in California, 1979. Wildlife Mgmt. Branch, Nongame Wildlife Invest, Job II-8.0. Calif. Dept. Fish & Game, Sacramento, CA.

Cochran, W.G. 1977. Sampling techniques, 3rd edition. John Wiley & Sons, New York, NY.

England, A. Sidney, Marc J. Bechard and C. Stuart Houston. 1997. Swainson's hawk (*Buteo swainsoni*) *in* Birds of North America, No. 265 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Estep, James A. 1989. Biology, movements and habitat relationships of the Swainson's Hawk in the Central Valley of California, 1986-87. Calif. Dept. Fish and Game, Nongame Bird and Mammal Sec. Rep.

Gilmer, David S. and Robert E. Stewart. 1984. Swainson's Hawk nesting ecology in North Dakota. Condor 86:12-18.

Houston, C. Stuart and Josef K. Schmutz. 1995. Declining reproduction among Swainson's Hawks in prairie Canada. J. Raptor Res. 29:198-201

Janes, Stewart W. 1985. Habitat selection in raptoral birds. *in* Habitat selection in birds (M.L. Cody, ed.) Academic Press, Inc. New York.

Johnson, D.H. 1980. The comparison of usage and availability measurements for evaluating resource preference. Ecology 61: 65-71.

Martin, Paul and Patrick Bateson. 1993. Measuring behaviour. Cambridge University Press. Cambridge, UK.

Newton, Ian. 1979. Population ecology of raptors. Buteo Books. Vermillion, S.D.
Preston, Charles R. 1990. Distribution of raptor foraging in relation to prey biomass and habitat structure. Condor 92:107-112.

Ralph, C. John, et al. 1993. Handbook of field methods for monitoring landbirds. Gen. Tech. Rep. PSW-GTR-144. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Dept. of Agriculture.

Samuel, Michael D. and Mark R. Fuller. 1996. Wildlife telemetry *in* Research and management techniques for wildlife and habitats (T.A. Bookout, ed.). The Wildlife Society. Bethesda, MD.

Schmutz, Josef K. 1989. Hawk occupancy of disturbed grasslands in relation to models of habitat selection. Condor 91:362-371.

Sibley, David A. 2000. National Audubon Society: the Sibley guide to birds. Alfred A. Knopf, Inc. New York.

Smallwood, K. Shawn. 1995. Scaling Swainson's Hawk population density for assessing habitat use across an agricultural landscape. J. Raptor Res. 29: 172-178.

Swainson's Hawk Technical Advisory Committee. 2000. Recommended timing and methodology for Swainson's Hawk nesting surveys in California's Central Valley. Unpublished, TAC. Sacramento, CA.

Swihart, Robert K. and Norman A. Slade. Influence of sampling interval on estimates of home-range size. J. Wildlife Mgmt. 49:1019-1025.

Waller, R.E. and D.B. Duncan. 1969. A Bayes rule for the symmetric multiple comparisons problem. J. American Statistical Association 64:1483-1503.

Woodbridge, Brian, Karen K. Finley and Peter H. Bloom. 1995a. Reproductive performance, age structure, and natal dispersal of Swainson's Hawks in the Butte Valley, California. J. Raptor Res. 29: 187- 192.

Figure 1 **Land Use Trends 1987-97 in San Joaquin and Sacramento Counties (Ag. Census of Calif. 1997)**

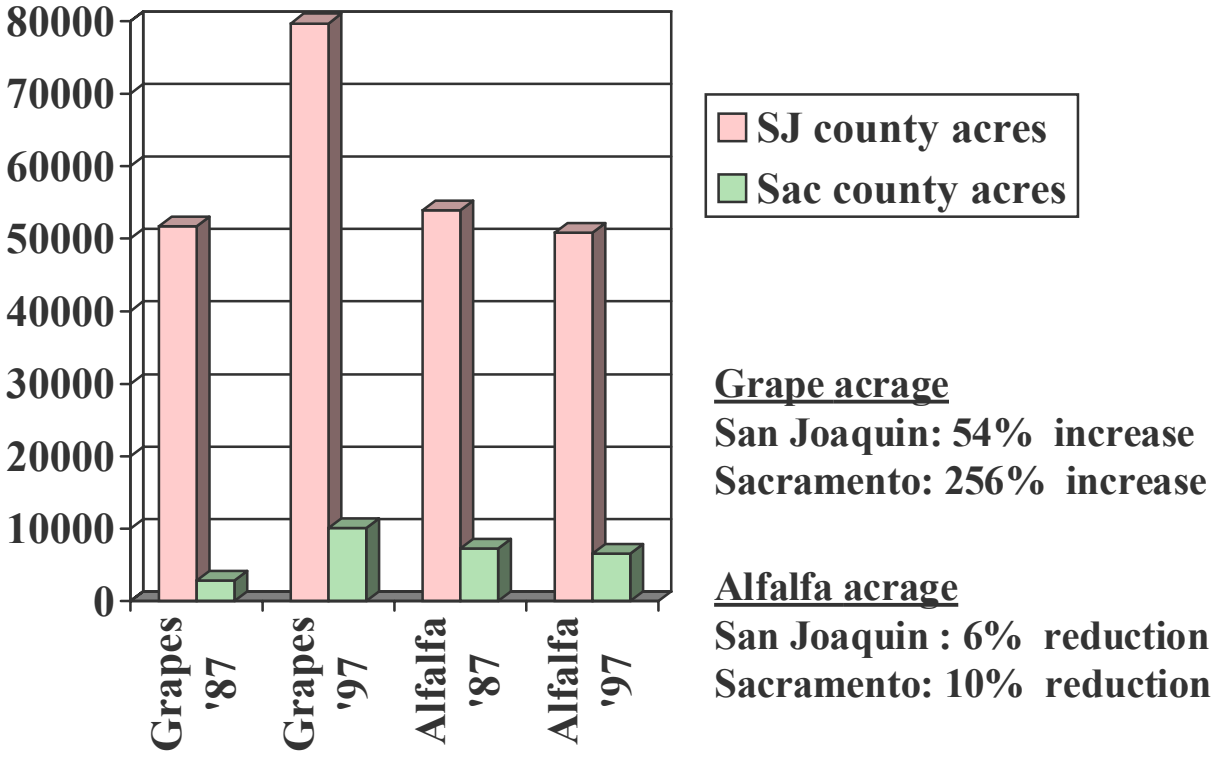
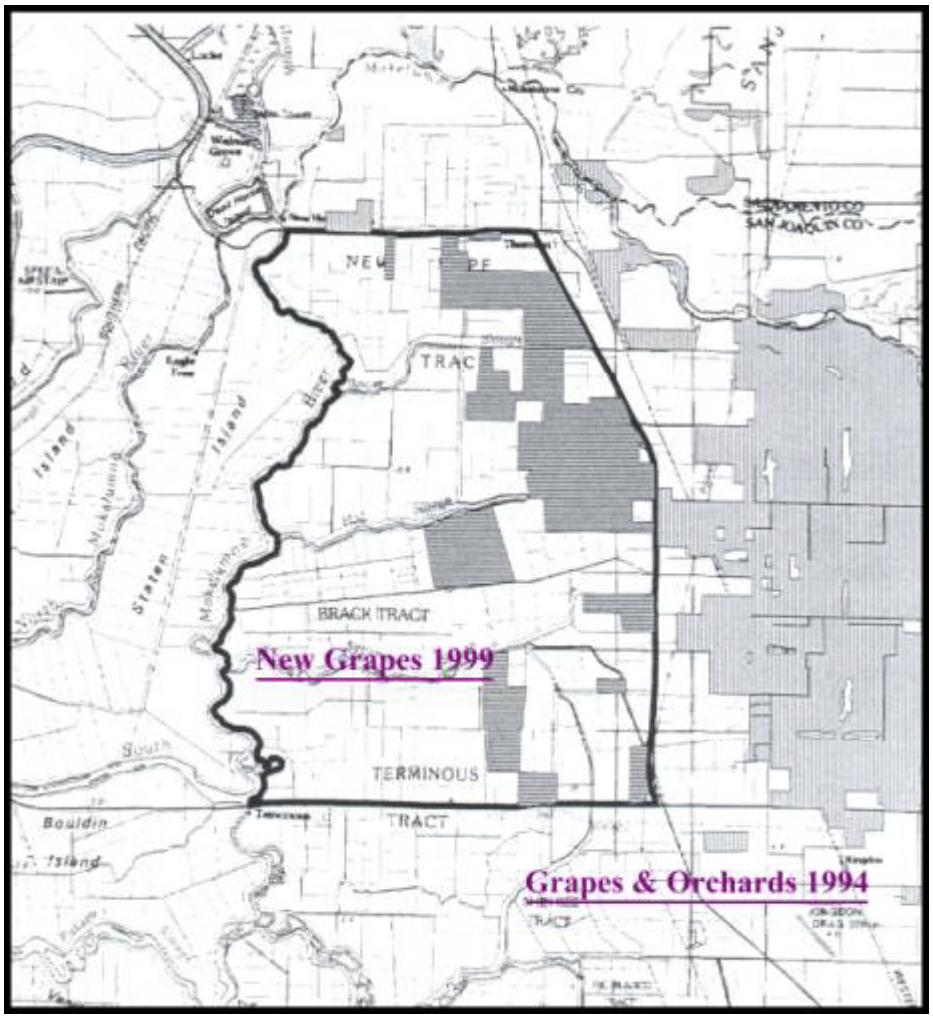


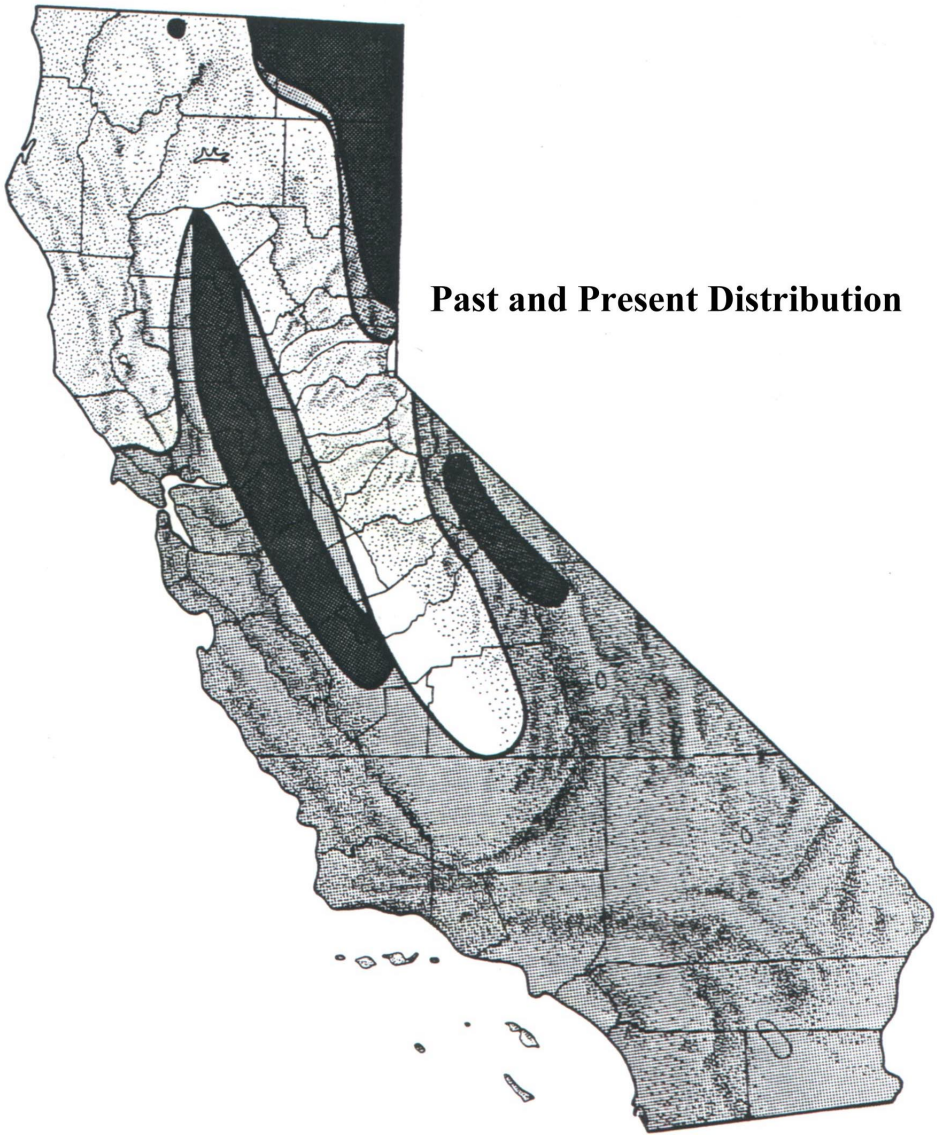
Figure 2 **Recent Growth in Vineyard Acreage; Northern San Joaquin County**



Courtesy DFG

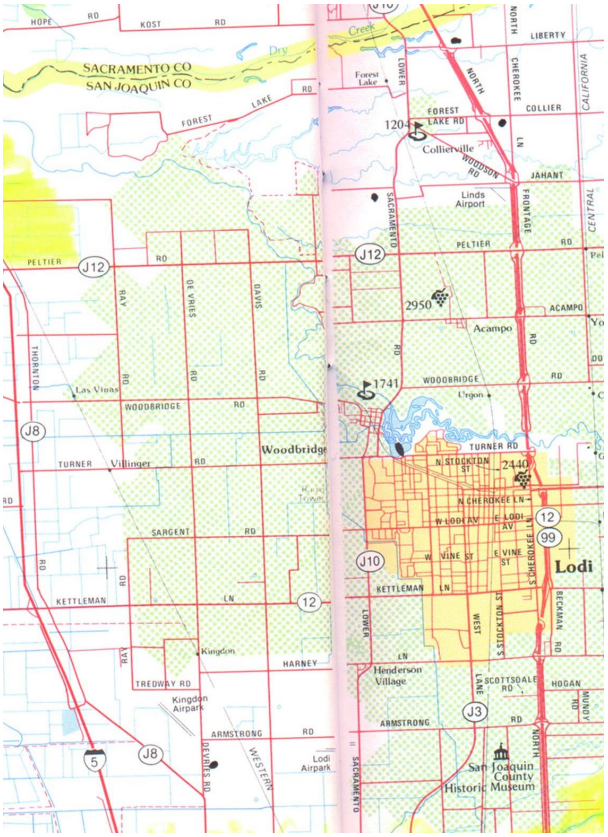
Figure 3 Swainson's Hawk Distribution in California (Bloom 1980)

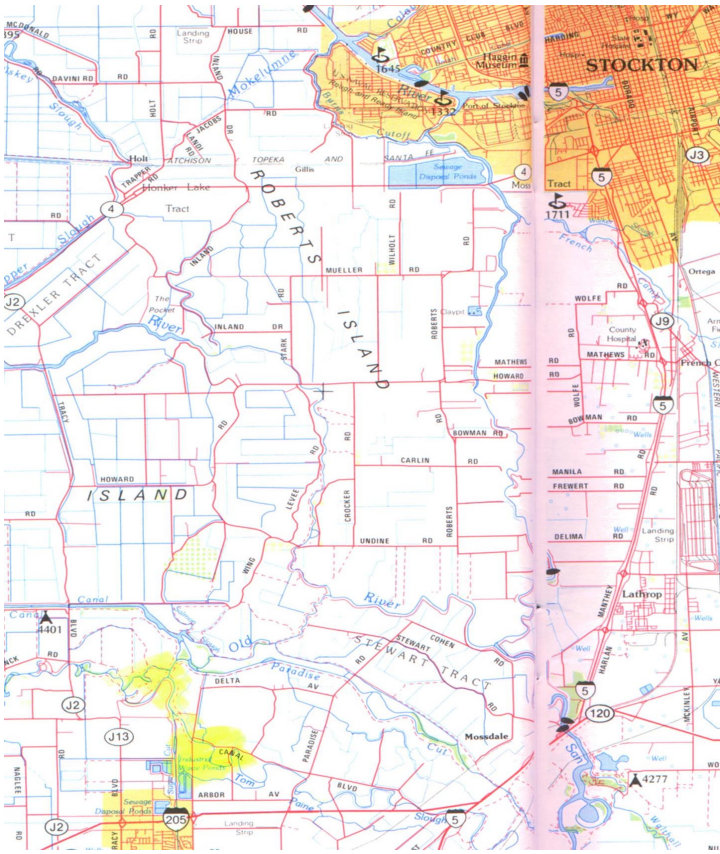
- **Shaded areas are past distribution**
- **Dark areas are present distribution (as of 1980)**



Map by Peter Bloom

Figure 4: Point Count Study Plots

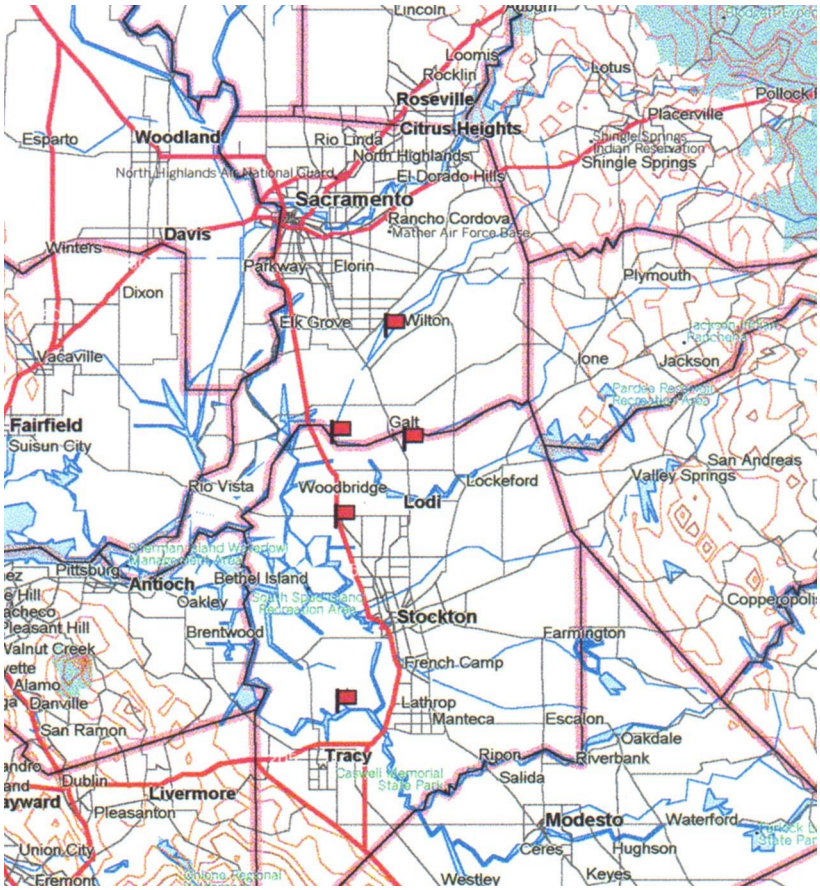




DeLorme

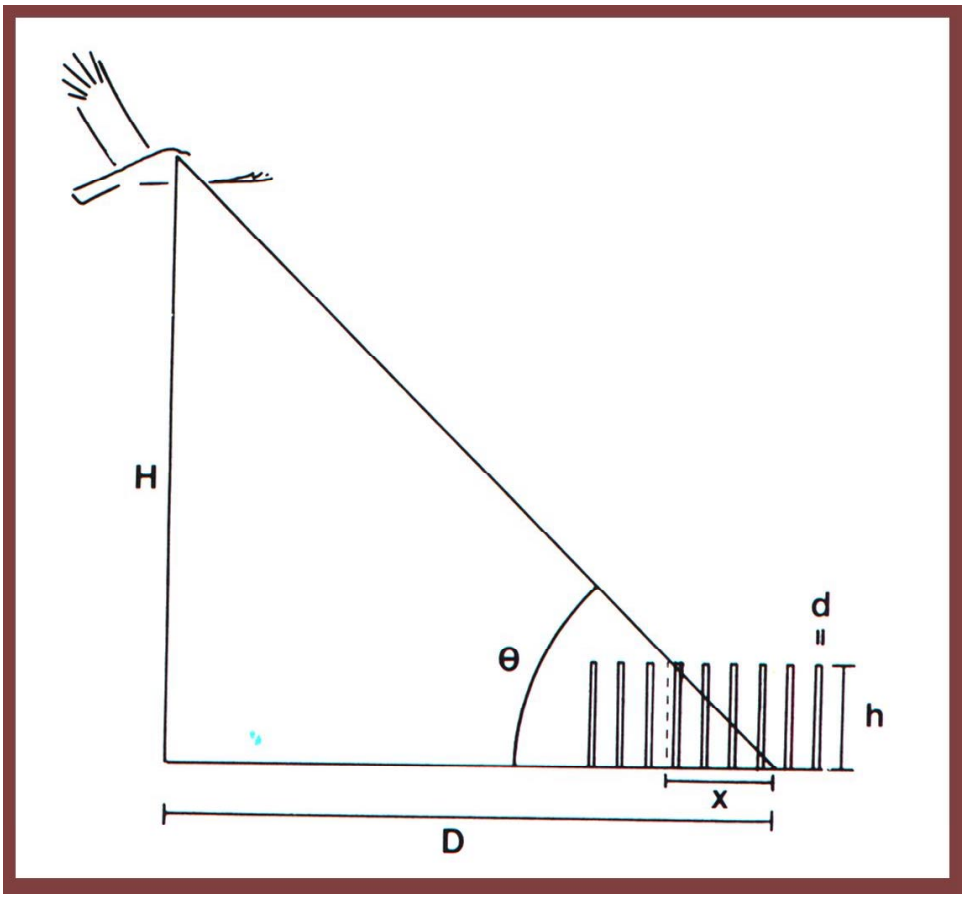
<u>Figure 5</u>: Telemetry Study Plots

- **Flags represent populations from which hawks will be tracked for the study**



DeLorme

Figure 6 Janes' Foraging Model (Janes 1985)



From *Habitat Selection in Birds, M.L.Cody, ed.*

$A = 0.785 (k*H/ d*h (1-m))^2 / \rho$

A is effective foraging area
k is a proportionality constant
H is vertical distance of hawk
d is plant diameter
h is plant height
m is height of prey
ρ is plant density