WINTERING RAPTORS OF THE GREAT BASIN

Oases in the High Desert: *Census and Banding Study 1985-2015*

Juvenile Female Gyrfalcon, Magna, Utah December 26, 1991

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Project Summary and

Winter Surveys: 2012-2015

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INTRODUCTION

Since 1985, Principal Investigator (PI) Al Hinde has conducted a roadside census and banding study of wintering raptors in the Great Basin. Initially, this project was limited to northeastern Nevada and was intended to augment knowledge of regional raptor ecology derived from HawkWatch International's (HWI) long-term migration study in the Goshute Mountains of northeastern Nevada (on-going annually since 1983; Hoffman and Smith 2003; Smith and Neal 2008a). By 1989, further exploration throughout Utah and Nevada had revealed eight major concentration areas for wintering raptors, with each roughly 50-square-mile area consistently containing 100–300+ individuals of 19 species (14 diurnal and 5 owl species). Drought conditions in the Southwest appear to create favorable conditions for rodent infestation, coinciding with record peaks of wintering raptor populations.

One such area, Lovelock, Nevada, on December 12, 1992, contained a previously undocumented communal roost of 200+ buteos (150 Rough-legged Hawks [*Buteo lagopus*], 50 Ferruginous Hawks [*B. regalis*]), some Red-tailed Hawks [*B. jamaicensis*], Great Horned Owls (*Bubo virginianus*), and Barn Owls (*Tyto alba*). Continuing each January, with field assistance from experienced HWI raptor biologists, other ornithologists, and local and state wildlife officials, Mr. Hinde focused on these eight areas, including the Lovelock roost. All sites have continued to sustain similar large numbers of wintering raptors each year. The Lovelock roost routinely contained dozens of mixed-species buteos in the past; it is still used, to a lesser extent, by Ferruginous and Rough-legged Hawks. Another roost, of 25+ Ferruginous Hawks, was discovered December 2009-January 2010 in Flowell-Pahvant Valley, Utah, and we monitored decreasing numbers there until the trees of the roost were cut down in 2013. The Ferruginous Hawks have not been found roosting elsewhere in the Valley.

This long-term study suggests that these areas are among the most significant winter ranges for raptors in western North America, and the censuses provide a means of monitoring population changes in relation to habitat, land-use, and climatic changes in the study regions. The capture and banding of 429 raptors (12 species) over the course of the study—including 128 Rough-legged Hawks, the focal species—also has yielded morphometric, genetic, and photographic data that have been used in several other studies and publications. Following the 2006/2007 season, the project contributed feather and saliva samples to two studies, one examining endocrine disruptors and the other comparing Harlan's Hawks (*B. jamaicensis harlani*) with other subspecies of Red-tailed Hawks. In addition, as following the past four winter field seasons, the project contributed feather samples to another study examining toxins, pollutants, and heavy metals in raptors. Each of the three buteos analyzed thus far show mercury concentrations below the level above which adverse effects are predicted; however, one Harlan's Hawk showed a much higher concentration than the others.

This report summarizes the results of the past four winter surveys (2012-2015), consisting of roadside census and banding activities conducted in four of the nine primary, known concentration areas in Utah and Nevada, with supplementary information derived from two other areas in the two states. GIS maps of three of the highest counts are included in the summary.

A twelve-year census (2003-2015) of major wintering areas—originally planned as a ten-year census with Dr. Jeff Smith, then of HawkWatch International—is now complete, and this report also represents a summary of the project's past 30 years.

And the project continues.

Since January 2011, "citizen scientists" and staff biologists from HawkWatch International have assumed the PI's censuses in Utah, especially in the Pahvant Valley and Snowville. Now HWI employ a full-time biologist to coordinate the winter surveys.

In January 2015, staff biologists of the Nevada Department of Wildlife (NDOW) accompanied the PI on his annual census in Eureka and Lovelock, and they will conduct future censuses in Nevada.

This will allow the PI to focus on banding and biological sampling in the study area in future.

Winter 2011/2012 Highlights

- *The highest count in project history (through 2012) was recorded: 355 raptors in Fillmore/Pahvant Valley, central Utah on January 11-13, 2012. But see below for the new record high—in the winter of 2014/2015.*
- *The highest number of raptors for Eureka, central Nevada was recorded: 209 raptors, which included a record 145 Rough-legged Hawks.*

Winter 2012/2013 Highlights

- *In contrast, the January 2013 survey revealed the lowest number ever in Eureka, Nevada: only 23 raptors and the lowest count ever for Smith Valley, W Nevada, also 23.*
- *A planned 10-year, standardized census was completed this past winter.*
- *The partial albino/leucistic Red-tailed Hawk, (photo page 29) banded December 27, 2008, in Smith Valley, W Nevada, is still present at its breeding location there, as of September 5, 2015, and is at least nine years old.*

Winter 2013/2014 Highlights

- *LeRoy Fink conducted the sole surveys of this season: in Fillmore/Pahvant Valley, and Snowville, Utah.*

Winter 2014/2015 Highlights

- *The previous record high count of 355 raptors in Fillmore, Utah (noted above 2011/2012), was surpassed January 2015 with 361 birds in Lovelock, NV, including a phenomenal 212+ Red-tailed Hawks.*
- *The PI, now a staff member of the BioDiversity Research Institute of Portland, ME, was joined by BRI colleagues to conduct counts and collect biological samples in Fillmore and San Pete Valley, Utah.*
- *Staff biologists from the Nevada Department of Wildlife (NDOW) assisted the PI with the counts in Eureka and Lovelock, NV; they plan to continue these counts in future.*
- *In the Eureka count, the NDOW biologists and PI conducted a comparison count that day, using two vehicles starting from opposite ends of Diamond Valley, and reached total*

counts of 170 and 169—supporting the merit of valley-wide surveys, as opposed to linear standardized counts. (See Recommendations and Conclusion.)

ROADSIDE CENSUS

(Table 1) In the past, the nine areas of major concentration typically have each supported in excess of 100 wintering raptors. These areas consist of agricultural (primarily alfalfa) and pasture lands at elevations between ~1,200–1,800 m (4,000–6,000 ft) above mean sea level (amsl). Most of the areas are well-defined valleys, roughly 125 sq km (50 sq mi) in extent and enclosed by mountains ranging in height from 1,500–3,000 m (5,000–10,000 ft) amsl. Exceptions include the Fallon, Nevada, and Fillmore, Utah, areas bordered by mountains to the east but desert scrub to the west. Nevertheless, similar combinations of agricultural, pasture, and natural grassland/woodland habitats are bounded by the mountains and low desert, and form similarly distinct survey areas (Figures 1 & 2).

With minimum funding in 2011/12 and 2012/13, the census was limited to at least the three areas consistently of most interest, both for the diversity and abundance of raptors: Lovelock and Eureka, Nevada, and Fillmore/Pahvant Valley, Utah.

In 2013/14, due to absence of funding, the PI conducted no surveys but Fillmore/Pahvant Valley and Snowville, Utah, was conducted by long-time collaborator LeRoy Fink.

This past winter, 2014/15, funding from BioDiversity Research Institute and assistance from BRI colleagues in the field allowed the PI to return and conduct counts in Fillmore and San Pete Valley, Utah. This funding also allowed the PI to continue to Beaver-Minersville, Utah, and Eureka and Lovelock, Nevada, with biologists from Nevada Department of Wildlife.

The areas surveyed two winters ago (2011/2012) are listed below. The primary survey areas are underlined.

Lovelock, NV	January 2-4	**177**
Eureka, NV	January 6-8	**209 (highest count for Eureka)**
Spring Valley, NV	January 9	10
Fillmore, UT	January 10-12	**355**
Smith Valley, NV	January 14	87
Snowville, UT	January 16	27

The areas surveyed this past winter (2012/2013) were:

Eureka, NV	**January 3**	***23 (*lowest count for Eureka)**
Lovelock, NV	**January 5-6**	***160***
Smith Valley, NV	January 8	27
Snowville, UT	January 14	47
Fillmore, UT	**January 15-17**	***193***

The areas surveyed this past winter (2013/2014) were:

Fillmore, UT	**December 17**	***131***
Snowville, UT	December 23	55
"	March 15	12

The areas surveyed this past winter (2014/2015) were:

San Pete Valley, UT	January 14	38
Fillmore, UT	**January 15-16**	***146***
Eureka, NV	**January 20**	***170***
Lovelock, NV	**January 22-24**	***361 (highest count in project history)***

METHODS

Surveyors tallied observed raptors while traveling in a slow-moving vehicle on established paved and dirt roads along designated routes defined in previous years. All efforts provided as complete a census as possible of wintering raptors in the proscribed survey areas. Similar to the past seven annual surveys, surveyors recorded UTM coordinates with a handheld GPS receiver (accuracy ±3–5 m) on roads at locations perpendicular to all raptor sightings, with the perpendicular distance of the raptor from the road also estimated in meters. Surveyors recorded all visually detected raptors, taking care to avoid double counting of mobile individuals.

In the past four years, the PI participated in all surveys except 2013-14, when LeRoy Fink of Burley, Idaho, conducted the two surveys of that winter. Participants from 2012 - 2015 include LeRoy Fink of Burley, Idaho; Soheil Zendeh of Lexington, Massachusetts; and Mike Shaw of Salt Lake City, Utah.

This past January 2015, BRI colleagues Chris Persico, Michelle Kneeland, and Carl Brown participated in Utah. The Eureka, Nevada, comparison counts (January 2015) were conducted by the PI, LeRoy Fink, and NDOW biologists Joe Barnes, Rory Lamb, and McKenzie Jeffers. In

Lovelock, Nevada, last January the PI and LeRoy Fink were joined by NDOW biologists Jane Van Gunst and Andy Hart.

STANDARDIZED COUNTS: COMPARISON OF LINEAR AND COMPREHENSIVE COUNTS

To avoid duplication of raptors, many population counts over the past few decades adopted linear standardized counts, not necessarily covering all areas where raptors are known to be, e.g., a count conducted by the Utah Division of Wildlife in recent years regularly follows the same route between the Fillmore/Pahvant Valley to Delta, Utah, in one day, but not including large areas of the Valley where raptors are usually present. The counts recorded in our study, including Fillmore/Pahvant Valley, covers each entire valley over sometimes two or three days. While risk of duplication is increased, generally we have found that, especially on windless and cloudy days, raptors are fairly sedentary and do not waste energy moving about.

This protocol was vindicated this past January 20, 2015, when a comparison count to assess survey accuracy was conducted by the PI and colleagues in one vehicle, and NDOW biologists in another, beginning at opposite ends of Diamond Valley/Eureka, Nevada. Our two teams counted almost identical totals—of 170 and 169 raptors.

Raptors indeed move more readily on windy and sunny days. So ideally counts should be conducted on windless and cloudier days, when they are comparatively sedentary.

Soheil Zendeh with large 1100 g SY Female Prairie Falcon, Lovelock, Nevada, January 12, 2010

CORRELATION BETWEEN DROUGHT AND RECORD WINTERING POPULATIONS

As droughts continue to worsen in the Southwest, we see increasingly high numbers of raptors in some areas, e.g., Eureka, Nevada, in January 2012 (209); Fillmore/Pahvant Valley, Utah, in January 2012 (355); and Lovelock, Nevada, in January 2015 (361). While we have not yet analyzed weather data, evidence from interviewing local ranchers in all areas suggests this correlation. The ranchers confirm that high precipitation allows them to irrigate and flood their alfalfa fields, which reduces their "gopher" or ground squirrel population. In contrast, low precipitation and drought conditions allow rodent and wintering raptor populations to explode.

Joe Barnes, now NDOW biologist, and Jeff Smith, former Science Director of HawkWatch International with SY Female Rough-legged Hawk, Diamond Valley, Eureka, NV, January 4, 2009

Major wintering concentrations identified in the past 25 years. NEVADA

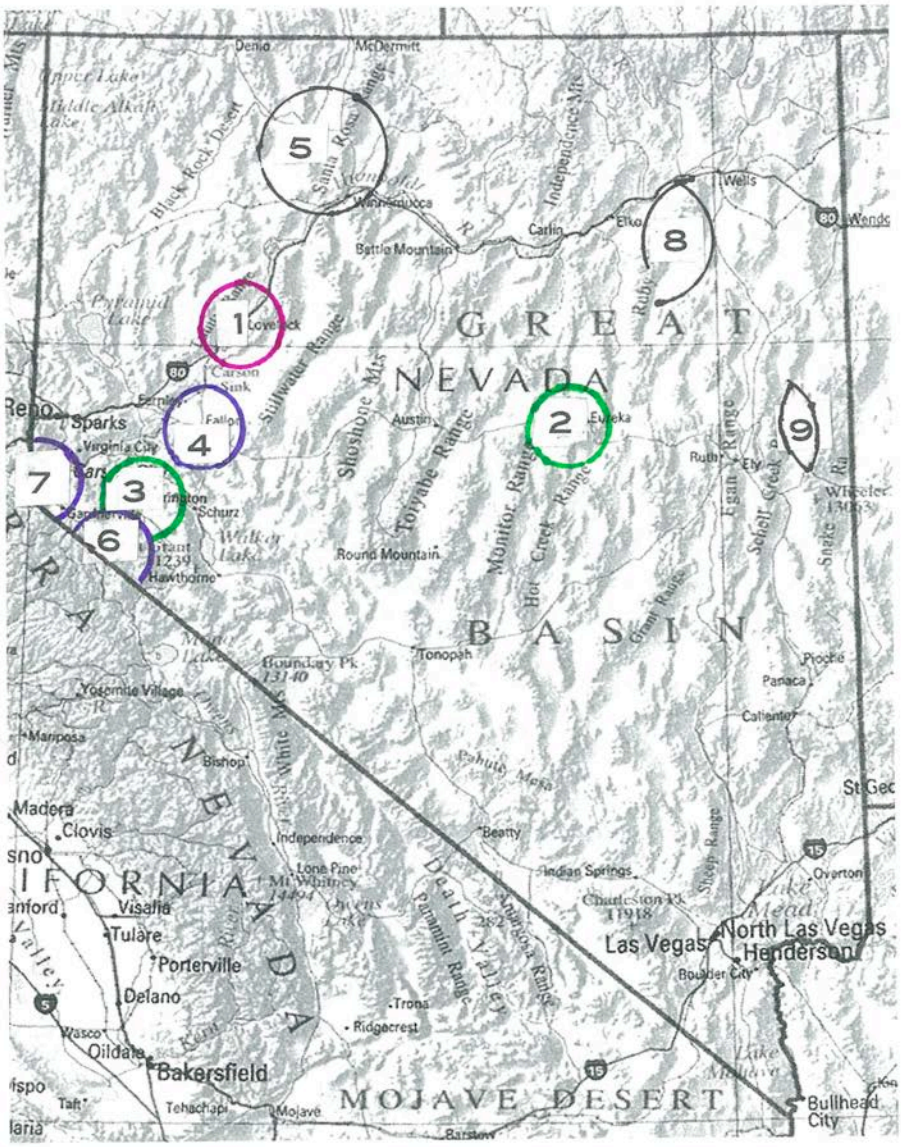


Figure 1.
Area that has contained 300+ raptors in a single survey, in red:
1) Lovelock.
Areas that have contained 200+, in green:
2) Eureka, 3) Mason Valley/Yerington.
Areas that have contained 100+, in blue:
4) Fallon, 5) Carson Valley, 6) Smith Valley.
Areas that have contained 25+, in black:
7) Paradise Valley/Orovada, 8) Ruby Mountain Valley, 9) Spring Valley.

Major wintering concentrations identified in the past 25 years. UTAH

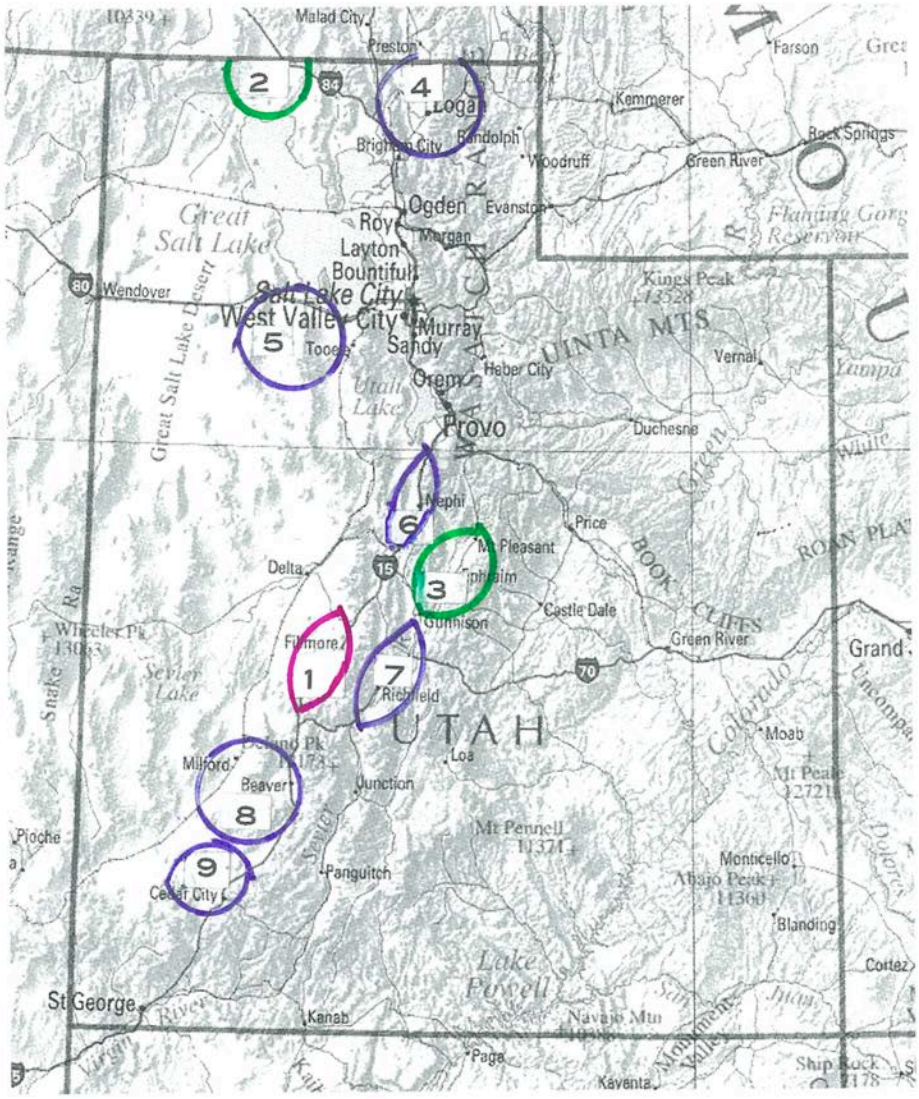


Figure 2.
Area that has contained 300+ raptors in a single survey, in red:
1) Fillmore/Pahvant Valley
Areas that have contained 100+, in green:
2) Snowville, 3) San Pete Valley
Areas that contained dozens of raptors, in blue:
4) Cache Valley, 5) West Valley/Tooele/Rush and Skull Valleys, 6) Nephi, 7) Sevier Valley, 8) Beaver/Milford, 9) Cedar City

NEVADA HIGHLIGHTS

Eureka, central Nevada

January 2012: (209) As previously shown, Eureka, central Nevada, continued the highest number of raptors ever seen there, including 145 Rough-legged Hawks—the highest count of Rough-legged Hawks in the history of the ten-year census. (We saw 150+ Rough-legged Hawks in the communal roost at Lovelock, NV in 1992.)

January 2013: (23) In contrast however, this past January Eureka contained only 23 raptors, the lowest number ever recorded here and which included just 10 Rough-legged Hawks.

January 2015: (170) A comparison count, conducted the same day by the NDOW biologists, recorded 169. (See comments on standardized counts above.)

Diamond Valley, Eureka, central Nevada

Lovelock, western Nevada

After its highest count in January 2011 (312), the counts of 2012 (177) and 2013 (160) were average for Lovelock, but in January 2015 the highest count in project history was recorded—361.

Smith Valley, western Nevada

Decreasing numbers of raptors were recorded over the two winters of 2012 (87) and 2013 (27), after a high of 149 in January 2011.

As of September 2015, the partial albino/leucistic Red-tailed Hawk banded here in 2008 still resides on the same ranch in Wellington, Smith Valley, and is at least nine years old. (See photo, page 29.)

Dark-morph Adult Ferruginous Hawk, Smith Valley, western Nevada, January 9, 1998

UTAH HIGHLIGHTS

Fillmore-Pahvant Valley, central Utah

January 2012 (355): the highest count anywhere in Nevada or Utah in the study's history (until last January in Lovelock, Nevada, see above) was recorded, with record numbers for Fillmore of Rough-legged Hawks (72), Red-tailed Hawks (121), America Kestrels (31), and good numbers of Ferruginous Hawks (36).

January 2013 (193): In contrast to the above count, numbers returned to an average and only 2 American Kestrels and no Northern Harriers were seen here. Average numbers of raptors were present in December 2014 (131) and January 2015 (146).

Although our January 14, 2013 count in Snowville consisted of a total of 47 raptors, including 20 Rough-legged Hawks, an earlier count completed by HawkWatch International volunteers on December 12, 2012, consisted of 249 raptors, including 143 Rough-legged Hawks.

Professor Ian Newton with Adult Male Rough-legged Hawk, Fillmore, Utah, January 3, 2011

Table 1. Raptor counts by species in selected Nevada concentration areas during the past ten winters.

	SPECIES[1]																						
	NH	SS	CH	RT	HH	FH	RL	RS	UB	GE	BE	UE	AK	ML	PR	UF	GO	LO	SO	BO	UO	UR	TOTAL
Lovelock																							
2014/2015	28			212		22	18		49	5			14		6		5			1		1	361
2013/2014	no count																						
2012/2013	14	1	1	75		14	19			3			13	1	11		5		3				160
2011/2012	11			93		10	13		7				26	1	9		6					1	177
2010/2011	65	3	1	145		24	14		6	7			28	1	14		2			1			311
2009/2010	22			82		5	11		13				23		9	1	3					1	170
2008/2009	20			69	1	5	21		10				17		10		2						155
2007/2008	19	0	0	58	0	5	14	0	9	0	0	0	12	0	7	0	6	1	0	0	0	0	131
2006/2007	20	0	0	80	0	10	17	0	15	0	0	0	21	0	6	0	3	0	0	1	0	1	174
2005/2006	20	0	0	84	0	9	9	0	7	0	0	0	10	0	10	0	5	0	0	0	0	3	154
2004/2005	4	0	0	149	0	30	11	0	19	0	1	0	7	0	13	0	9	0	0	0	0	0	247
2003/2004	34	0	0	130	1	22	22	0	20	3	0	0	31	0	13	0	9	0	0	0	0	3	288
Mason Valley																							
2010/2011	24	3	1	136					3	2			39		13								221
2009/2010	no count																						
2008/2009	18	1	2	97		12	16		18				31	1	5		1					2	204
2007/2008	9	1	0	88	0	5	9	0	10	0	0	0	14	3	6	0	4	0	0	0	0	5	154
2006/2007	22	1	1	92	0	5	3	0	12	3	1	0	34	1	12	0	0	0	1	1	0	1	191
2005/2006	15	0	1	105	0	9	0	0	14	3	0	0	42	0	4	0	1	0	0	0	0	3	197
2004/2005	11	0	0	86	0	3	0	0	4	3	0	0	23	0	3	0	1	0	0	0	0	0	131
2003/2004	11	1	0	55	0	2	1	0	9	0	0	0	25	0	4	0	0	0	0	0	0	2	110
Smith Valley																							
2012/2013		2		13		1	2		2		1		1	2	3								27
2011/2012	7			44		9	3		4	3	4		9	4									87
2010/2011	28		1	81		3			1		2		24	2	4	**(1)***						2	149*
2009/2010	no count																						
2008/2009	10			56		4	15		15	6			4	1	1								112
2007/2008	0	0	0	34	0	0	7	0	5	3	0	0	1	0	4	0	0	0	0	0	0	1	55
2006/2007	18	0	1	81	0	11	3		16	2	4	1	16	1	7	0	2		0	0	0	1	164
2005/2006	no count																						
2004/2005	7	0	0	35	0	1	0	0	16	5	3	0	15	0	2	2	2	0	0	0	0	1	89
2003/2004	7	0	0	27	0	4	5	0	0	2	4	0	5	0	4	0	0	0	0	0	0	0	58
Diamond Valley /Eureka																							
2014/2015	17			24	1	1	83		22	18			1		2		1						170
2013/2014	no count																						
2012/2013				3		2	10		1	2					1		4						23

2011/2012	14			11		10	145		9	5			7		6		2						209
2010/2011	21			18		7	58		10	3			5	1	7		4						134
2009/2010	3		1	11		1	73		5				5	1	1		2						103
2008/2009				8		2	94		8	4	1		1		3		4						125
2007/2008	0	0	0	2	0	0	18	0	4	2	0	0	0	0	1	0	2	0	0	0	0	0	29
2006/2007	1	0	1	17	0	9	94	0	3	4	0	0	0	0	5	0	3	0	3	0	0	0	140
2005/2006	22	0	1	27	0	14	72	0	47	5	0	0	2	0	10	0	0	0	0	0	0	3	200
2004/2005	5	0	0	7	0	2	50	0	14	5	0	0	0	0	1	0	0	0	0	0	0	1	86
2003/2004	0	0	0	0	0	1	26	0	1	1	0	0	0	0	1	0	1	0	0	0	0	1	32

Fallon

2008/2009	6			39			2		5				20	3	1							3	79
2007/2008	9	1	2	68	1	1	7	1	4	1	1	0	18	0	6	0	0	0	0	0	1	0	121
2006/2007	17	0	1	56	0	1	1	0	4	1	0	0	31	0	1	0	0	0	0	0	0	0	113
2005/2006	6	0	0	35	0	2	1	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	49
2004/2005	7	1	0	20	0	1	0	0	0	1	0	0	13	0	2	0	0	0	0	0	0	0	45
2003/2004	5	0	0	33	0	2	2	0	1	0	1	0	10	0	2	0	3	0	0	0	0	0	59

(*Total includes 1 Peregrine Falcon seen in Smith Valley, the only Peregrine ever sighted in these winter studies.)

[1] NH = Northern Harrier; SS = Sharp-shinned Hawk; CH = Cooper's Hawk; RT = Red-tailed Hawk; HH = Harlan's Red-tailed Hawk; FH = Ferruginous Hawk, RL = Rough-legged Hawk; RS = Red-shouldered Hawk; UB = unknown buteo; GE = Golden Eagle; BE = Bald Eagle; UE = unknown eagle; AK = American Kestrel; ML = Merlin; PR = Prairie Falcon; UF = unknown falcon **(also includes 1 PG, Peregrine Falcon);** GO = Great Horned Owl; LO = Long-eared Owl; SO = Short-eared Owl; BO = Barn Owl; UO = unknown owl; UR = unknown raptor.

Table 2. Raptor counts by species in selected Utah concentration areas during the past twelve winters.

	Species[1]																			
	NH	SS	CH	RT	HH	FH	RL	UB	GE	BE	UE	AK	ML	PR	UF	GO	SO	BO	UR	Total
Pahvant Valley																				
2014/2015	8			56	1	11	31	13	1	4		17		2		2				146
2013/2014	2		1	36		7	48	13	4	8		8		4						131
2012/2013				73		27	58	17	3	4		2	3	2		3	1			193
2011/2012	36			121	1	36	72	30	9	8		31		10					1	355
2010/2011	1		2	46	1	37	16	8	7	3		10	1	3			1	1		137
2009/2010	7	2		57	3	45	24	14	8	29		17	1	4						211
2008/2009				54	1	8	21	6	5	29		9	2	5						140
2007/2008	12	0	0	42	1	13	45	14	2	7	2	10	0	7	0	10	0	0	0	165
2006/2007	0	0	0	40	2	5	13	0	6	8	1	5	1	2	0	0	1	0	3	87
2005/2006	29	0	0	40	0	57	16	18	8	6	0	15	0	7	0	0	0	0	0	199
2004/2005	4	1	0	67	0	16	13	9	5	6	0	5	0	0	1	3	1	0	0	131
2003/2004	8	0	0	48	0	13	17	16	2	5	0	8	0	3	0	2	0	0	0	105
San Pete Valley																				
2010/2011				17			3	2	7	29		7		5		1				71
2009/2010			no count																	
2008/2009	2			9	1	1	7	2	2	35	2	7		3						71
2007/2008	0	0	0	7	0	0	3	1	3	17	1	1	1	0	0	0	0	0	0	34
2006/2007	0	0	1	28	0	0	1	1	7	23	1	3	1	5	0	0	0	0	0	71
2005/2006	9	1	0	44	0	6	2	1	8	47	0	14	0	2	0	0	0	0	0	134
2004/2005	species-specific records unavailable																			25
2003/2004	2	0	0	15	0	0	9	10	6	38	0	5	0	0	0	0	0	0	0	85
Nephi																				
2010/2011*	1			11		3	7	1				2								25
2009/2010			no count																	
2008/2009	3			11			1			4		5	1	1					1	27
2007/2008	1	0	0	9	1	2	17	2	1	11	0	4	0	2	0	0	0	0	0	50
2006/2007	1	0	0	11	0	3	8	5	1	6	0	5	0	0	0	0	0	1	0	41
2005/2006	20	0	0	24	0	4	8	6	1	2	0	9	0	3	1	0	0	0	2	81
2004/2005	6	1	0	28	0	3	7	2	4	4	0	8	0	2	0	0	0	0	0	65
2003/2004	14	0	0	19	0	4	8	4	0	1	0	4	0	0	0	0	0	0	1	52

[1] NH = Northern Harrier; SS = Sharp-shinned Hawk; CH = Cooper's Hawk; UA = unknown accipiter; RT = Red-tailed Hawk; HH = Harlan's Red-tailed Hawk; FH = Ferruginous Hawk, RL = Rough-legged Hawk; UB = unknown buteo; GE = Golden Eagle, BE = Bald Eagle; UE = unknown eagle; AK = American Kestrel; ML = Merlin; PR = Prairie Falcon; UF = unknown falcon; GO = Great Horned Owl; SO = Short-eared Owl; BO = Barn Owl.

*Half count completed; survey vehicle stuck in snow. Only southern half of survey completed.

TOTAL RAPTOR COUNTS AND SPECIES TRENDS

Total raptor counts. During the first eight years of the census, Lovelock, Nevada, contained the three highest counts. In January 2012, Fillmore/Pahvant Valley, Utah, surpassed these (355).

But on January 22-24, 2015, Lovelock regained its position with the highest count in project history **(361)**.

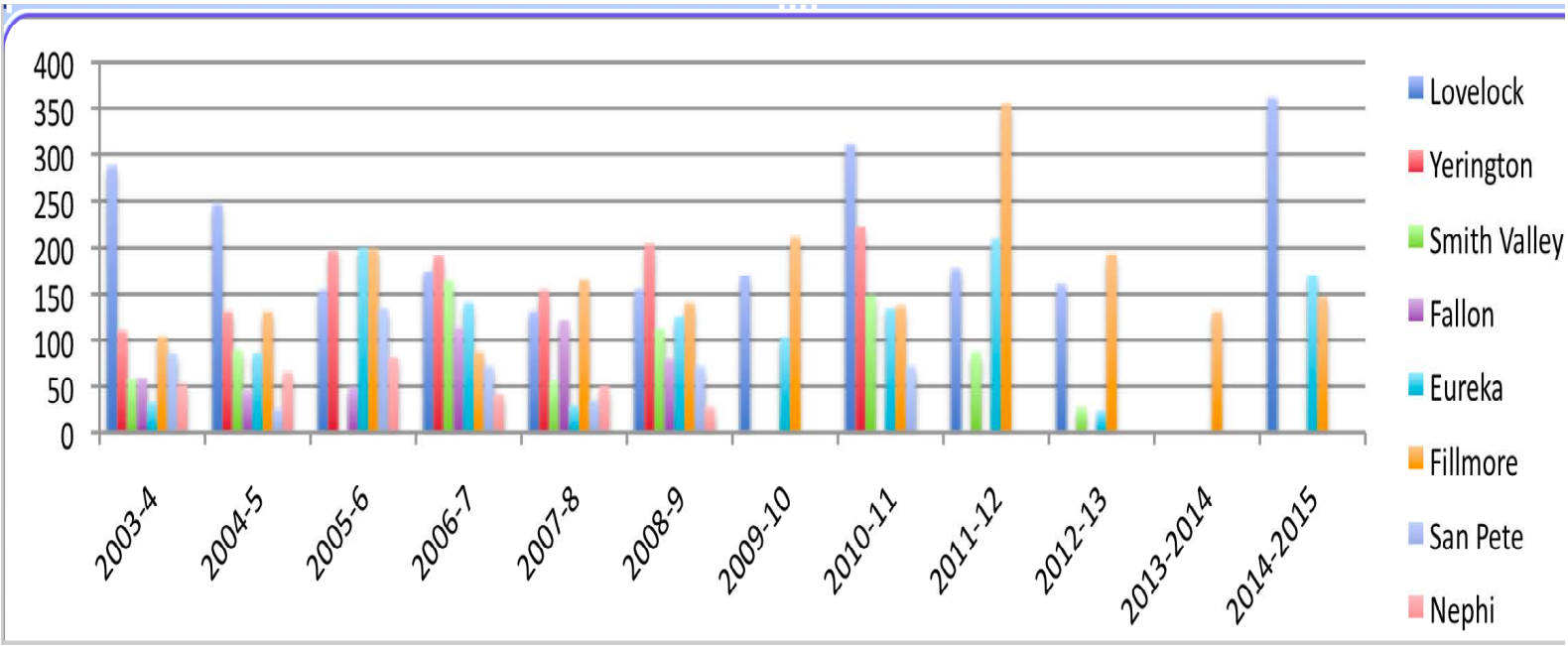


Figure 3. **Total raptor counts in eight major Nevada and Utah concentration areas in the past twelve winters.**

Species Trends (Figures 4-8)

Red-tailed Hawks. Lovelock, western Nevada, regularly contains the highest winter population of this raptor with a previous record high count here or elsewhere (149) in the winter of 2004/2005. This count was easily surpassed in January 2015 in Lovelock (212).

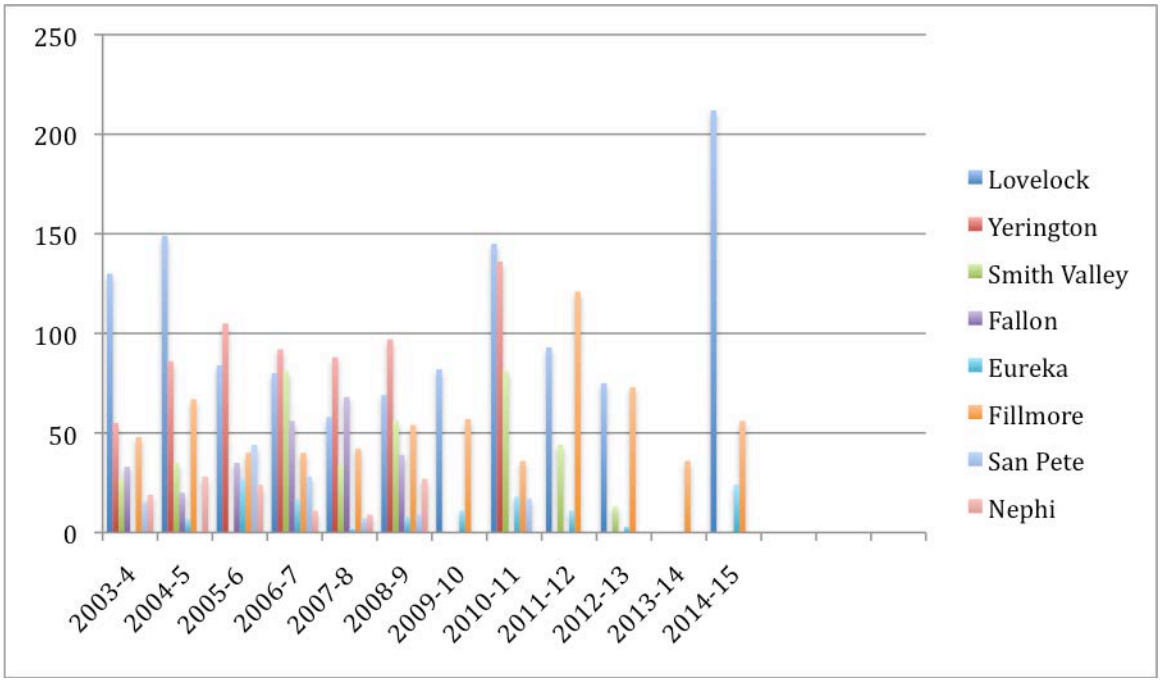


Figure 4. Twelve-year count trends for Red-tailed Hawks in eight major winter concentration areas in Utah and Nevada.

Rough-legged Hawks. Except for the winters of 2007/2008 and 2012/2013, when Fillmore/Pahvant Valley, Utah, contained more Rough-legged Hawks, Eureka, Nevada, consistently contains the highest wintering population (record high 145, January 2012) of this raptor.

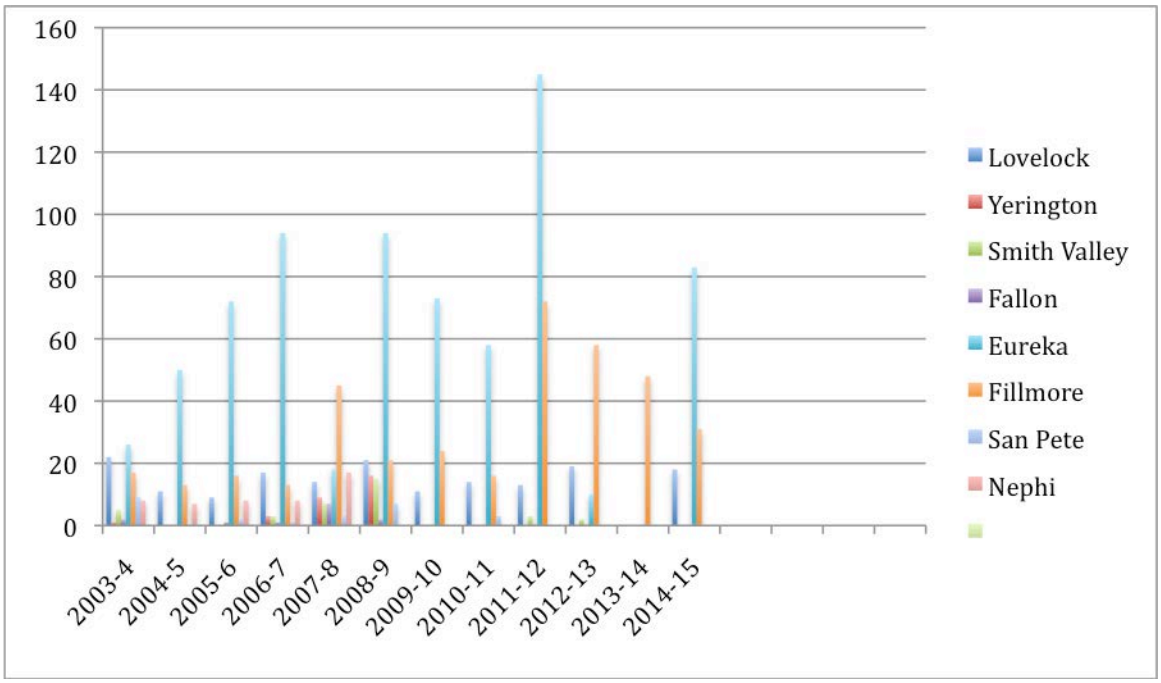


Figure 5. Twelve-year count trends for Rough-legged Hawks in eight major winter concentration areas in Utah and Nevada.

Ferruginous Hawks. Fillmore/Pahvant Valley usually contains the highest number of this raptor with a record 57, at least, in January 2006.

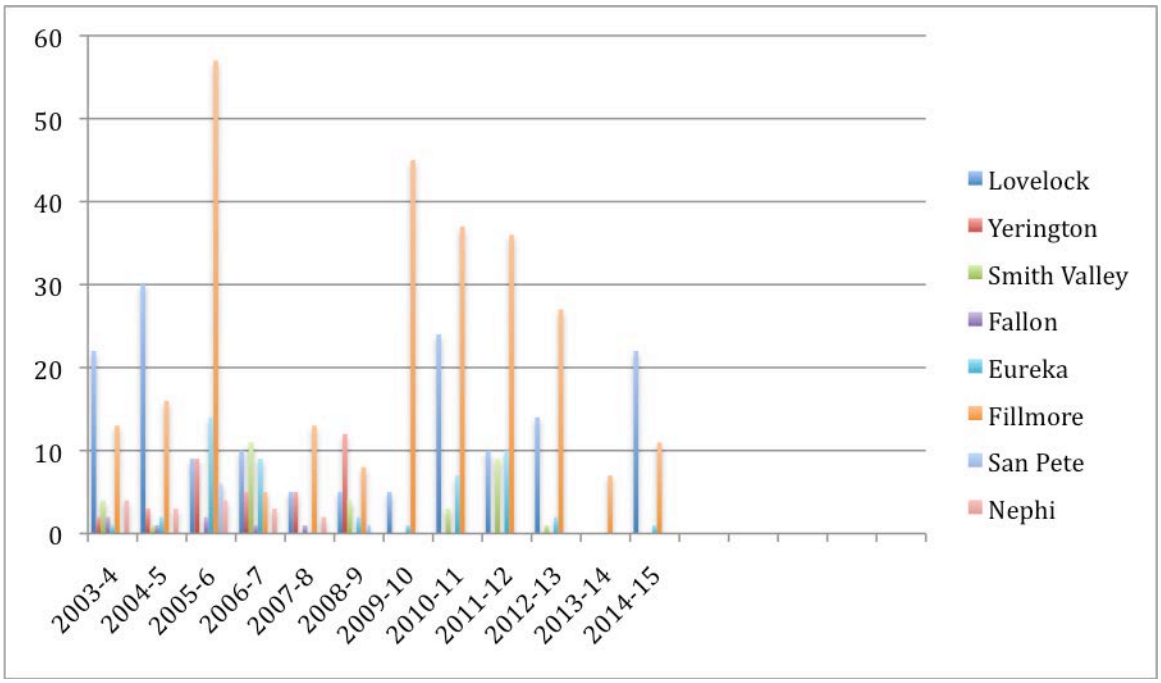


Figure 6. Twelve-year count trends for Ferruginous Hawks in eight major winter concentration areas in Utah and Nevada.

Northern Harriers. Numbers of this species fluctuate more than another other in the survey area. Lovelock, western Nevada, achieve the highest count of these (65) in January 2011. In January 2012, Fillmore contained 36 (the second highest count of these). The following year, January 2013, none were found there or in Eureka and Smith Valley, Nevada.

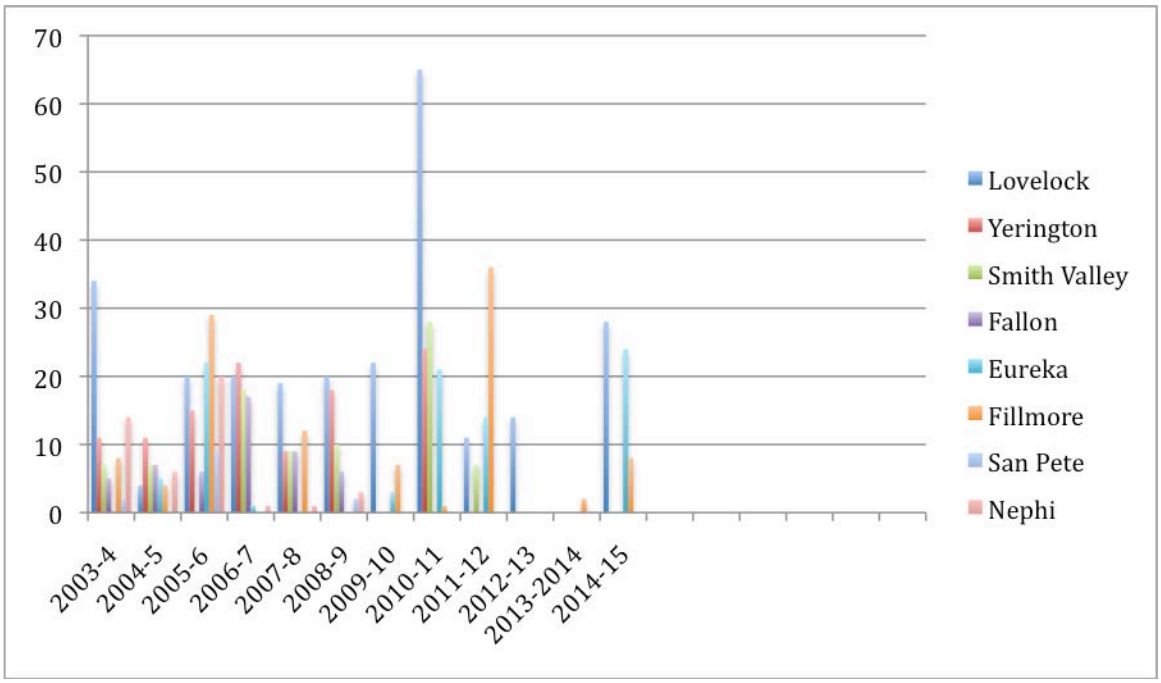


Figure 7. Twelve-year count trends for Northern Harriers in eight major winter concentration areas in Utah and Nevada.

American Kestrels. Yerington, Mason Valley western Nevada, has usually contained more American Kestrels (record high 42, 2005/2006) than elsewhere, but in 2011/2012 Fillmore/Pahvant Valley contained the highest number and record for Fillmore (31). However in winter 2012/2013, only 2 were present there and none were seen in Eureka, central Nevada.

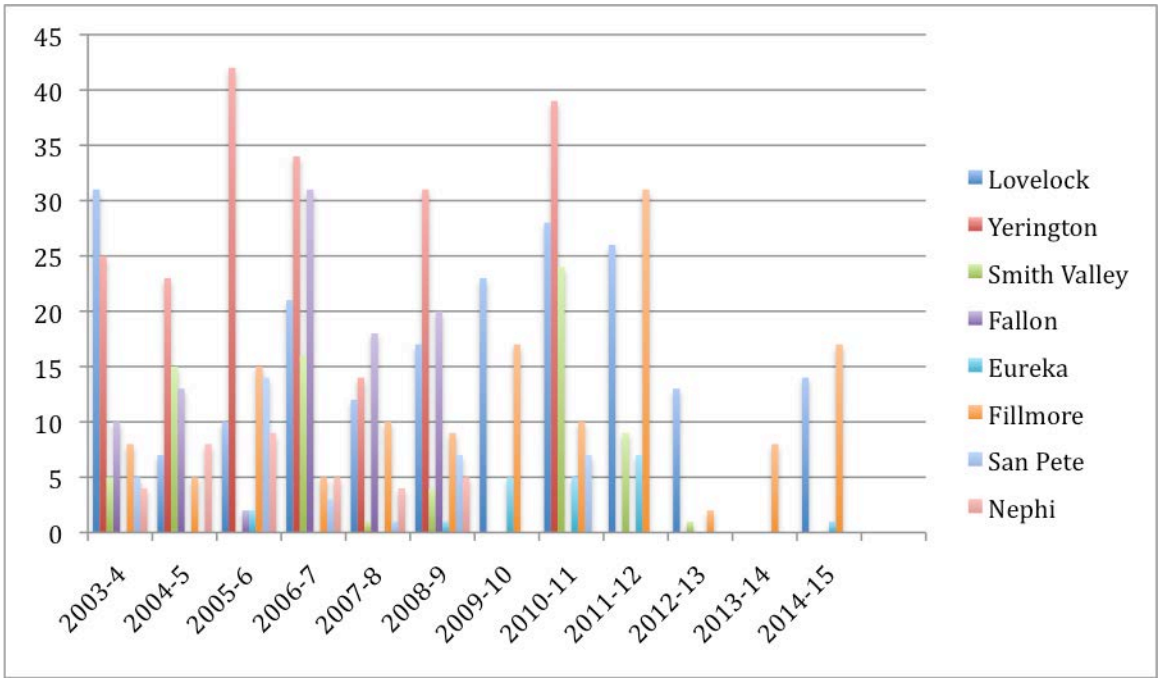


Figure 8. Twelve-year count trends for American Kestrels in eight major winter concentration areas in Utah and Nevada.

ADDITIONAL SPECIES TRENDS OVER THE PAST 30 YEARS

Gyrfalcon. Only one was seen (and banded), on December 26, 1991, in Magna. (See cover photo.)

Peregrine Falcons. Only one has been seen, in January 2011 in Smith Valley, Nevada.

Prairie Falcons. In January 2012, ten were encountered in Fillmore (central Utah), a high for this site, but Lovelock usually sees more of these than other areas, including the record count of 14 in January 2011.

Golden Eagles. A record number (9) were present 2011/2012 in Fillmore (central Utah), where these raptors are observed more than elsewhere but this was greatly surpassed January 2015 by the discovery of 18 in Eureka, Nevada.

Bald Eagles. The highest numbers of these were found in San Pete Valley, Utah, in 2008/2009 (35), but Fillmore/Pahvant Valley contained 29 in January 2009 and 29 in January 2010. Since, these high numbers in Fillmore have decreased, and counts in San Pete Valley have not been conducted since January 2011.

Red-shouldered Hawks. Two were observed in the 1990s, both in Fallon, western Nevada. One was captured and banded.

January 13, 2007, Al Hinde with Short-eared Owl, Eureka, Nevada

Great Horned Owls. Ten were present in Fillmore/Pahvant Valley in January 2012 and a roost of 7 were found here in 1990. They are more common usually in Lovelock, Nevada.

Short-eared Owls. Three were observed in Eureka, Nevada, 2006/2007, and three in Lovelock, Nevada, January 2013. Otherwise, only individuals are occasionally present if at all.

Barn Owls. These are not seen every winter and only individuals when present.

Long-eared Owls. Only one individual has been observed in 25 years in Lovelock, Nevada, in January 2008.

ROOST DYNAMICS IN LOVELOCK, NEVADA, AND FLOWELL-FILLMORE/PAHVANT VALLEY, UTAH

Following identification in 1989 of the Lovelock, Nevada, area as the most substantial wintering area for raptors in the Great Basin, we have monitored since 1991 a unique multi-species communal roost located in a 2-ha (5-acre) grove of cottonwood trees ~4.8 km (3 mi) south of

town on Reservation Road. This grove of trees apparently has not been altered nor has there been any apparent change in agricultural practices near the grove in the past 23 years. Rough-legged Hawks and Ferruginous Hawks most commonly use the roost, with Red-tailed Hawks and Great Horned Owls less common. The number of birds documented at the roost in a given winter has ranged as high as 200+ individuals in 1992/1993, also the winter with the highest census total for the area to date (300+), to none in 2007/2008 – for the first time since its discovery in 1989 – when the census total for this area was at its lowest (Table 2).

As the total number of birds in the valley increased over two consecutive years (from 131 in 2007/2008 to 155 in 2008/2009 and then 170 in 2009/2010), the winter roost increased as well. No birds occupied the roost in 2007/2008; nine raptors were observed in 2008/2009; 11 in 2009/2010; 12 in January 2012; and just 3 in January 2013.

In the year with the record-high total of 311 in the area, on January 12, 2011, the roost increased to 44+ birds, mostly Ferruginous Hawks and then Rough-legged Hawks. As usual, the birds occupying the roost increase and decrease proportionately to the valley population. Also as usual Ferruginous Hawks use the same two or three trees with Rough-legged Hawks flanking them in adjacent trees. When surveyed again January 23, 2015, the roost contained just 28 birds, mostly Ferruginous Hawks, but three miles south of here, 80 buteos were roosting between Westergard Road, Carpenter Road, and South Meridian Road, a roost not used since 1989.

In Utah, the roost of 25+ Ferruginous Hawks—discovered January 2010 in Flowell, part of the Fillmore-Pahvant Valley study area—contained 21+ Ferruginous Hawks December 15, 2010 and 12 Ferruginous Hawks twenty-one days later on January 5, 2011, then 17 on January 10, 2012, and finally just 3 on January 15, 2013. Since then the grove of trees containing the roost has been cut down. In January 2015, the Ferruginous Hawks were not found roosting elsewhere.

January 8, 1990, Kelly Gray with Adult Male Dark-morph Rough-legged Hawk and Adult Red-tailed Hawk at the roost on Reservation Road, Lovelock, Nevada

TRAPPING, BANDING, AND COLLECTION OF BIOLOGICAL SAMPLES AND MORPHOMETRIC DATA

During all surveys, crews also simultaneously sought to trap and band selected raptors using bal-chatri traps with hamsters as lures. Trapping efforts focused on Rough-legged Hawks, the

project's target species, and secondarily on Ferruginous Hawks and Harlan's Hawks. Opportunistic trapping of other subspecies of Red-tailed Hawks and species such as the Prairie Falcon (*Falco mexicanus*) also occurred.

We banded all captured raptors with uniquely numbered U.S. Geological Survey – National Bird Banding Laboratory aluminum leg bands, recorded the wing chord and mass of each bird, and collected feather samples from all birds. In addition, we took photographs of all Rough-legged, Hawks, Ferruginous Hawks, and raptors with unusual plumage.

To minimize census disturbance, we typically limited all trapping attempts to five minutes, beyond which time capture success decreases sharply anyway. We sometimes made exceptions for unusual birds, such as dark-morph buteos, Prairie Falcons, and owls.

December 27, 2007, Adult Harlan's Hawk, Fallon, western Nevada

Table 3. Raptors banded in Utah and Nevada 1985 - 2015.

RAPTORS BANDED 1985 - 2015

SPECIES	BANDED
Rough-legged Hawk	128
Red-tailed Hawk	216
Ferruginous Hawk	22
Harlan's Hawk	5
Red-shouldered Hawk	1
Gyrfalcon	1
Prairie Falcon	35
American Kestrel	5
Northern Harrier	3
Cooper's Hawk	3
Great Horned Owl	7
Short-eared Owl	3
TOTAL	**= 429**

RAPTORS BANDED 2012 - 2015

Rough-legged Hawk	12
Red-tailed Hawk	11
Ferruginous Hawk	1
Prairie Falcon	1
Great Horned Owl	1
TOTAL	26

BAND RECOVERIES

Three Rough-legged Hawks have been recovered. One was found a year later, twenty miles away from the banding site in eastern Nevada. One was discovered in Death Valley, three hundred miles south of its banding site a year later. The most interesting recovery was of an adult female discovered four years later, 4,000 miles north of the Brooks Range in northern Alaska.

Ten Red-tailed Hawks have been recovered, five were found within a twenty-mile radius of the banding site. One exception was banded in northern Utah and discovered 400 miles northwest in Idaho; another banded in western Nevada was found several hundred miles away in Fresno, California. A Red-tailed Hawk banded January 14, 2015, in San Pete Valley, Utah, was found June 13, 2015, 40 miles north of Las Vegas, Nevada.

COLLECTION OF BIOLOGICAL SAMPLES AND MORPHOMETRIC DATA

Morphometric data from this study was included in the *Birds of North America* account for Rough-legged Hawks, and morphometric data for this and other species was presented in Hinde et al. (2000, op cit) and Bechard et al. (2002, op cit). In 1999, blood samples provided to Dr. Andreas Helbig of Greifswald University, Germany, revealed a close ancestral genetic relationship between Rough-legged and Ferruginous Hawks. Photographs of plumage variation and biological samples of Harlan's Hawks were used by Clark et al. (2004, op cit).

Ferruginous Hawks are usually the third most abundant buteo in the study area. The PI has banded 22 Ferruginous Hawks during the project. Our morphometric data are showing that, contrary to popular belief, while greater on average in dimension and body mass, the Ferruginous Hawks captured in this study have not exceeded the masses or dimensions of the largest Red-tailed and Rough-legged Hawks captured in the same areas. However, we measured the 30 Ferruginous Hawks in the Harvard Museum of Comparative Zoology and six birds did have wing chords measuring between 455 to 489 mm, whereas, the wing chord of the largest Ferruginous Hawk captured by us was 448 mm.

We continue to collect feather samples from all birds captured. We provide these samples to Chris DeSorbo of the BioDiversity Research Institute in Portland, Maine, to facilitate their study of contaminants (toxins and heavy metals, especially mercury and lead) in raptors. Feather samples provided in the past to Mike Schindlinger of Lesley University in Cambridge, Massachusetts, to facilitate his ongoing study of endocrine disruptors in birds, are now archived by BRI for future examination. Pending available funding, BRI are holding these samples for broader analyses (i.e., a full metal scan). Blood swabs were sent by BRI to Buffalo State for analysis in ongoing genetic research.

Among three birds analyzed thus far for contaminants, the mercury levels in a Rough-legged Hawk (0.608 ppm), a Ferruginous Hawk (0.175 ppm), and a Harlan’s Hawk (4.514 ppm) were below the level above which adverse effects are predicted. But note the much higher concentration in the Harlan’s Hawk. Regurgitated raptor pellets were collected from Lovelock, Nevada, January 2011, were provided to Professor Gwilyn S. Jones, mammalogist in the Department of Biology, Northeastern University, for analysis to determine prey species. His initial analysis of these determined some contained Montane Voles (Microtus montanus). We await further analysis and expect to collect more pellets in coming winters.

SUMMARY WITH GIS AND SATELLITE MAPS

Since 1985, 30 years ago, the PI conducted banding and census operations each winter throughout Nevada and Utah, excepting 1986, 1996, and 1997. This past January a twelve-year standardized census of most of the major concentrations was concluded. The main purpose of this was to document the existence of these remarkable and sometimes dense concentrations of wintering raptors.

The areas in ***Nevada*** that have at some time over the past ten years contained 100+ wintering raptors are:

Lovelock, Pershing County, western Nevada	[every winter 100+]
Yerington, Lyon County, western Nevada	[every winter 100+]
Smith Valley, Lyon County, western Nevada	
Carson Valley, Carson County, western Nevada	[most winters 100+]
Fallon, Churchill County, western Nevada	
Eureka, Eureka County, central Nevada	[most winters 100+]

Areas that have contained at least dozens of wintering raptors are: Paradise Valley and Orovada in Humboldt County (northern Nevada); the Ruby Mountain Valley in Elko County (northeastern Nevada); Spring Valley and Ely, White Pine County (northeastern Nevada).

The areas in ***Utah*** which have at some time contained 100+ wintering raptors are:

Fillmore/Pahvant Valley, Millard County, central Utah	[every winter 100+]
San Pete Valley, San Pete County, central Utah	

And recently, Snowville, Box Elder County, northern Utah

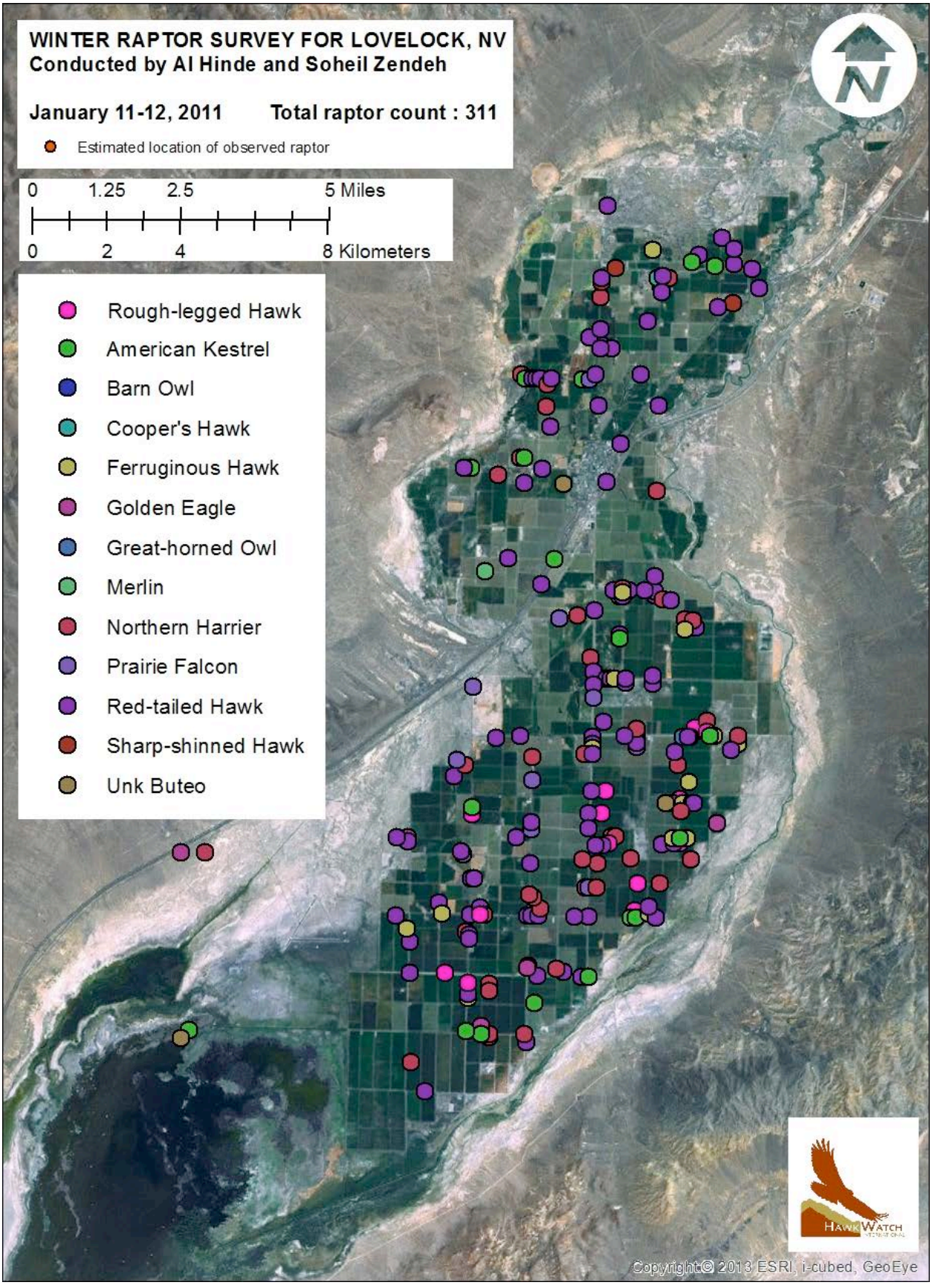
Areas that have contained at least dozens of wintering raptors are: Sevier Valley in Sevier County (southern Utah); Beaver/Milford in Beaver County (southern Utah); Cedar City in Iron County (southern Utah); Nephi, Juab County (central Utah); Rush Valley in Tooele County (northwestern Utah).

Areas usually containing the highest number of particular species:

Rough-legged Hawks	Eureka, central NV
Red-tailed Hawks	Lovelock, western NV
Ferruginous Hawks	Fillmore/Pahvant Valley, central Utah
Northern Harriers	Lovelock, NV
Prairie Falcons	Lovelock, NV
American Kestrels	Yerington, western NV
Golden Eagles	Fillmore/Pahvant Valley, UT
Bald Eagles	San Pete Valley, central UT

GIS MAPS

The following three GIS maps, prepared by HawkWatch International, show locations of raptors for three of the highest counts during the past twelve years.


WINTER RAPTOR SURVEY FOR LOVELOCK, NV
Conducted by Al Hinde and Soheil Zendeh
January 11-12, 2011
Total raptor count : 311
Estimated location of observed raptor
0 1.25 2.5 5 Miles
0 2 4 8 Kilometers
Rough-legged Hawk
American Kestrel
Barn Owl
Cooper's Hawk
Ferruginous Hawk
Golden Eagle
Great-horned Owl
Merlin
Northern Harrier
Prairie Falcon
Red-tailed Hawk
Sharp-shinned Hawk
Unk Buteo
HawkWatch
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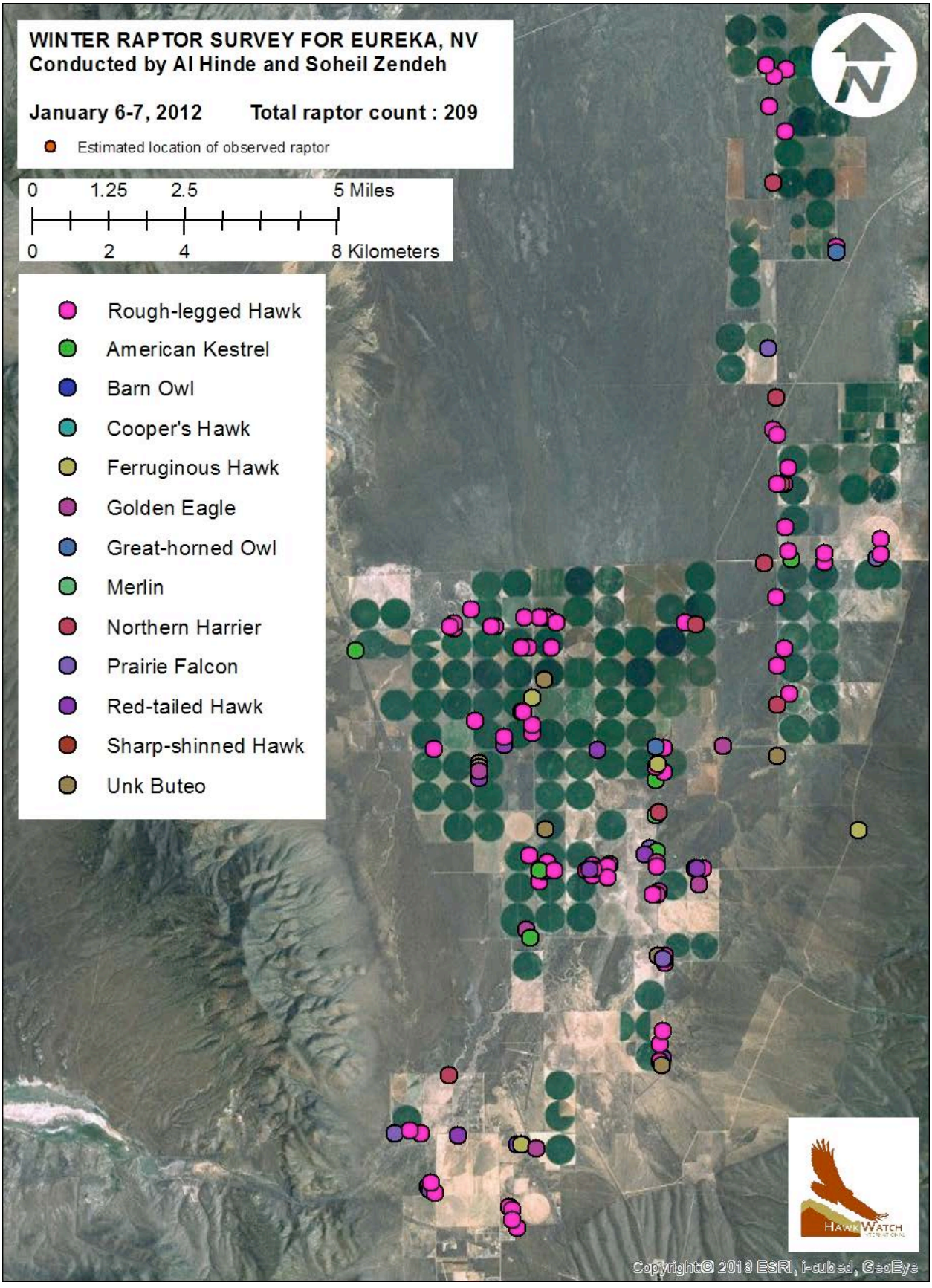
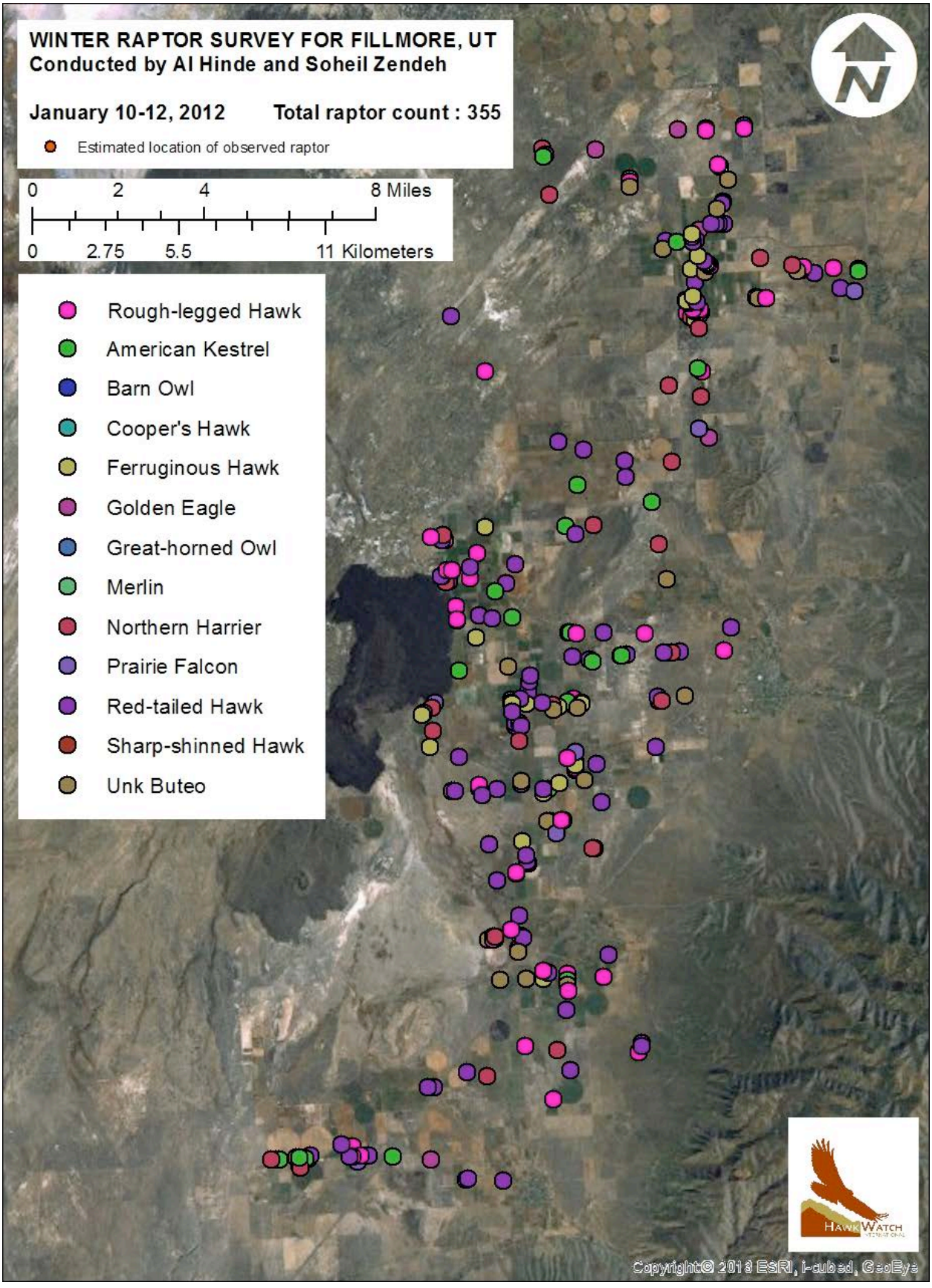

WINTER RAPTOR SURVEY FOR EUREKA, NV
Conducted by Al Hinde and Soheil Zendeh
January 6-7, 2012
Total raptor count : 209
Estimated location of observed raptor
0 1.25 2.5 5 Miles
0 2 4 8 Kilometers
Rough-legged Hawk
American Kestrel
Barn Owl
Cooper's Hawk
Ferruginous Hawk
Golden Eagle
Great-horned Owl
Merlin
Northern Harrier
Prairie Falcon
Red-tailed Hawk
Sharp-shinned Hawk
Unk Buteo
N
HawkWatch
Copyright© 2013 EsRI, i-cubed, GeoEye


WINTER RAPTOR SURVEY FOR FILLMORE, UT
Conducted by Al Hinde and Soheil Zendeh
January 10-12, 2012
Total raptor count : 355
Estimated location of observed raptor
0 2 4 8 Miles
0 2.75 5.5 11 Kilometers
Rough-legged Hawk
American Kestrel
Barn Owl
Cooper's Hawk
Ferruginous Hawk
Golden Eagle
Great-horned Owl
Merlin
Northern Harrier
Prairie Falcon
Red-tailed Hawk
Sharp-shinned Hawk
Unk Buteo
HawkWatch
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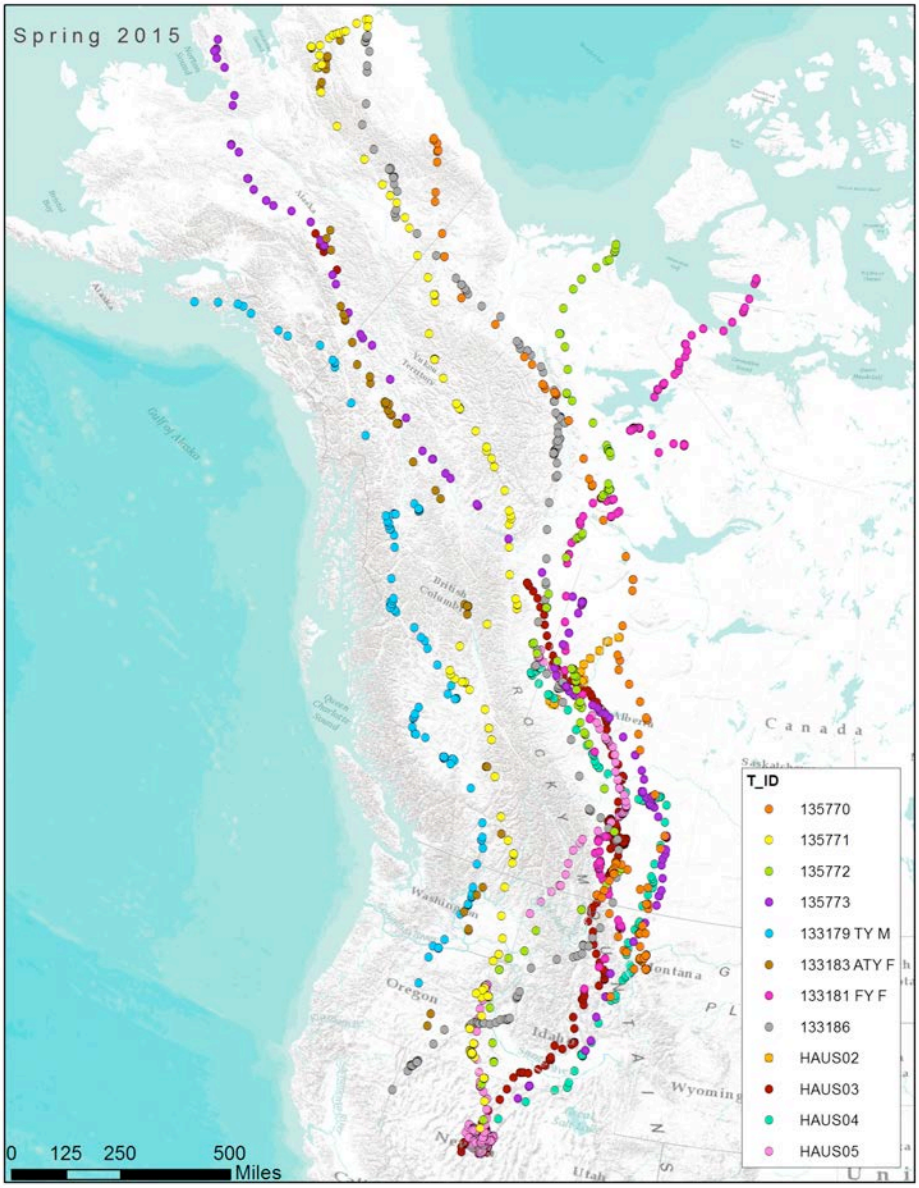
SATELLITE TRACKING OF ROUGH-LEGGED HAWKS FROM EUREKA, NV, AND CA

The PI and others, including Professor Ian Newton, have long advocated the use of satellite telemetry to monitor the movements of Rough-legged Hawks.

Jeff Kidd of Kidd Biological, Inc., and Dr. Jeff Smith of H.T. Harvey Associates, have now tracked Rough-legged Hawks for two seasons on their spring migration from California and Eureka, Nevada, to Alaska. We were pleased to collaborate with their biologist Scott Thomas in the field in Eureka, Nevada January 20, 2015. (See the map of their study below.)



Map: ***Jeff Kidd of Kidd Biological, Inc., and Dr. Jeff Smith of H.T. Harvey Associates***

DISCUSSION AND CONCLUSION

These oases in the high desert are refuges for upwards of 1000+ wintering raptors and are worthy of more attention than our annual visits. To monitor these winter populations more accurately, a monthly if not weekly winter census would undoubtedly be more effective than our one-time visits each winter.

For the past twelve winters these standardized counts have been conducted from late December through January. Before then, greater trapping and banding success in the colder months of January, than in November or December, determined this operational period. However, the comparison counts earlier in the season, in Eureka, Nevada, 6 December 2008; and Fillmore, Utah, 6 November 2009 and 15 December 2010, revealed much greater and record numbers of Rough-legged Hawks in Eureka and Fillmore, and of Ferruginous Hawks in Fillmore. Also higher counts were recorded in December 2012 and 2013 in Snowville, northern Utah, by HWI staff and "citizen scientist" volunteers, which included higher numbers of Rough-legged Hawks there than the PIs surveys in January. The value of being in the field earlier is evident. Since 2012 when HawkWatch International recorded 249 raptors there—which elevated Snowville into an area of major interest—HWI again recorded 200+ raptors there this winter.

Additional surveys in Nevada, with its greater wintering raptor populations, would be of great interest and value. To this end, the NDOW biologists joined the PI in Eureka and Lovelock in January 2015, and the PI is pleased to report that they plan to assume future counts in Nevada.

The increased interest in the collection of biological samples, and early evidence of elevated mercury levels in one of the three biological samples analyzed so far, demonstrates the potential and increasing value of the capture and banding of these birds.

Now that the twelve-year census is complete, the PI hopes to focus once again on earlier primary objectives—trapping, possible color banding, satellite telemetry, as well as the collection of biological samples for heavy metal contaminant and isotope analysis. As mentioned above, the BioDiversity Research Institute will continue their association with the PI, who is now on staff, in the collection and analysis of samples.

This has been a long-term study. Although the PI has entirely funded this project in past years, more recently, as costs became prohibitive, critical financial support was obtained from the Harvard Nuttall Ornithological Club, HawkWatch International, and, as of January 2015, BRI. Continued support will determine whether comprehensive or limited surveys are possible.

A Brief History…

This project began 30 years ago as a banding study targeting wintering Rough-legged Hawks in the vicinity of HawkWatch International's main migration study area on the Goshute Mountains. However, with the early identification of unusually high concentrations of wintering raptors throughout the Great Basin of Nevada and Utah, the study evolved to include an annual winter population census as well. Over time this became a main focus of the project, and the planned ten-year standardized census survey is now complete. In addition, as banding continued, over the

past 17 years biological samples of all species were collected for genetic, contaminant, and heavy metal studies.

A correlation between increasing drought and increasing record peaks of wintering raptors populations is apparent.

Above all, the prime concern of the study has been to record the existence of these remarkable populations and refuges of wintering raptors in the high deserts of Utah and Nevada. I know of no history chronicling when raptors began utilizing these artificially created oases of ranch and farmland. It is hoped these surveys will represent an historical record for the archive, for future generations to reference.

February 18, 2005, LeRoy Fink and Jeff Johnson with SY Male Rough-legged Hawk

Ruby Mountains, northeast Nevada

ACKNOWLEDGMENTS

During the past four winters the PI enjoyed again the company and support of project veterans LeRoy Fink of Burley, Idaho, and Soheil Zendeh of Lexington, Massachusetts, who also generously shared expenses. Thanks to Mike Shaw and Eric Peterson of Salt Lake City, who also joined us in the field.

Over the years several ranchers have allowed us access to their large ranches, especially (and since 1989) Pete Peterson, manager of the 4,000-acre D&S Land and Livestock Ranch in Lovelock, Nevada.

In the 1990s, Phil Magasich of Corpus Christi, Texas, and Jeff Johnson of Las Vegas, Nevada, were among the earliest supporters in the field as was Bob Walters, Utah Division of Wildlife, and Dr. Rob Williams of the Frankfurt Zoological Society, Cuzco, Peru.

In recent years, Ken Wright of British Columbia; Rich and Liz Hunkin of Cornwall, England; Keith Day, Utah Division of Wildlife; and Joanne Stoddard of Salt Lake City, Utah, assisted in the field, and in rehabilitating injured raptors discovered in the field in Utah. Nancy Laird of Carson Valley, Nevada, rehabilitated injured raptors discovered in the field in Nevada. Professor Reuven Yosef of Eilat, Israel, presented a paper on behalf of the PI at the 2000 Raptor Research Foundation conference in Salt Lake City.

The distinguished English ornithologist, Professor Ian Newton, joined the PI for a memorable ten days in the field in January 2011.

In January 2015 the PI's colleagues from BioDiversity Research Institute in Portland, Maine (Chris Persico, Michele Kneeland, and Carl Brown) joined him in Utah. Chris DeSorbo, director of the BRI Raptor Program, and biologist Rick Gray prepared and then guided the PI through the mysteries of Excel data entry.

NDOW biologist Joe Barnes, another veteran of this study, inspired NDOW biologists Rory Lamb, McKenzie Jeffers, Jan Van Gunst, and Andy Hart to collaborate with us in Nevada in January 2015, and to conduct comparison counts to assess survey accuracy.

Since 1985 the PI has received the support of too many people to name, but recognition must first be given to Steve Hoffman, founder of HawkWatch International, who, in 1984, supported the PI’s proposal to begin this study. The staff of HWI continued its support, especially former Science Directors Dr. Jeff Smith and more recently Dr. Markus Mika. Both joined us in the field and provided invaluable assistance preparing annual reports and grant proposals. Many thanks to Dr. Steve Slater, current Conservation Science Director, and research associate Eric Chabot who prepared the three GIS maps.

Financial assistance was much appreciated from the Nuttall Ornithological Club’s Blake Fund at Harvard for three winters, as was HWI’s financial assistance in 2010 and 2011; and, in January 2015, collaboration with and financial assistance from the BioDiversity Research Institute of Portland, Maine. Since the project’s inception, Art and Deneb Sandack of Salt Lake City, Utah, supported the PI with their friendship and hospitality.

The PI has enjoyed the company of Kelly Gray of Cambridge, Massachusetts, from the early years of camping in the frozen, unheated Volkswagen van and, in the past twelve years, for her patience as we prepared the PI’s grant proposals and annual reports. These would not have been written without her.

December 27, 2008, Partial Albino/Leucistic Adult Red-tailed Hawk, Smith Valley, western Nevada

As of September 2015, this bird is at least nine-years-old, residing and breeding successfully on the same ranch in Wellington, Smith Valley, Nevada. Monitored by ranch owner Luetta Mann.

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