



The Western Section of The Wildlife Society and Wildlife Research Institute



Western Raptor Symposium February 8-9, 2011 Riverside, California

Symposium
Sponsors



February 8 – 04:55-05:10 pm Session: Raptor Biology

Spatial and Temporal Dynamics of Raptor Migration in Western North America.

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Concentrated studies and sustained long-term monitoring of the migrations of diurnal raptors in western North America began in the late 1970s and early 1980s. Since then, a broad network of sites run by several organizations has emerged, with representation in most western states and Alberta, Canada. Heretofore, most long-term studies in the West have focused on autumn migration, but a few noteworthy spring projects have contributed additional insight. Unlike in eastern North America, only a few projects have proceeded continuously for multiple decades, but most now extend beyond 10 years. The core operation at most sites is standardized, annual counts used to track population trends, species composition, and flight dynamics. Many of these and other independent projects also have involved extensive banding and tracking studies designed to investigate migration geography. Together these efforts have yielded considerable insight about the spatial and temporal dynamics of raptor migration in the West. In this paper, I will summarize and discuss primary patterns and insights concerning: 1) species representation and flight volume; 2) migration timing and associated weather relationships; and 3) current understanding of source population dynamics and migration routes and corridors for selected species.

The authors and institutions that have provided the following presentations are happy to share their information, data, and opinions. However, these are not, necessarily, peer-reviewed presentations and the potential to take something out of context also exists. In order to avoid that, you are requested to contact the respective lead author(s) before using specific information contained in any of the following papers. Once you have done that, the proper citation is: '[Author(s). Date. Title.] Presented at the Western Raptor Symposium. Jeffrey L. Lincer and David Bittner (Co-Chairs). Hosted by Wildlife Research Institute and The Wildlife Society, Western Section. Riverside Convention center, Riverside, California, USA. February 8-9, 2011

Spatial and Temporal Dynamics of Raptor Migration in Western North America

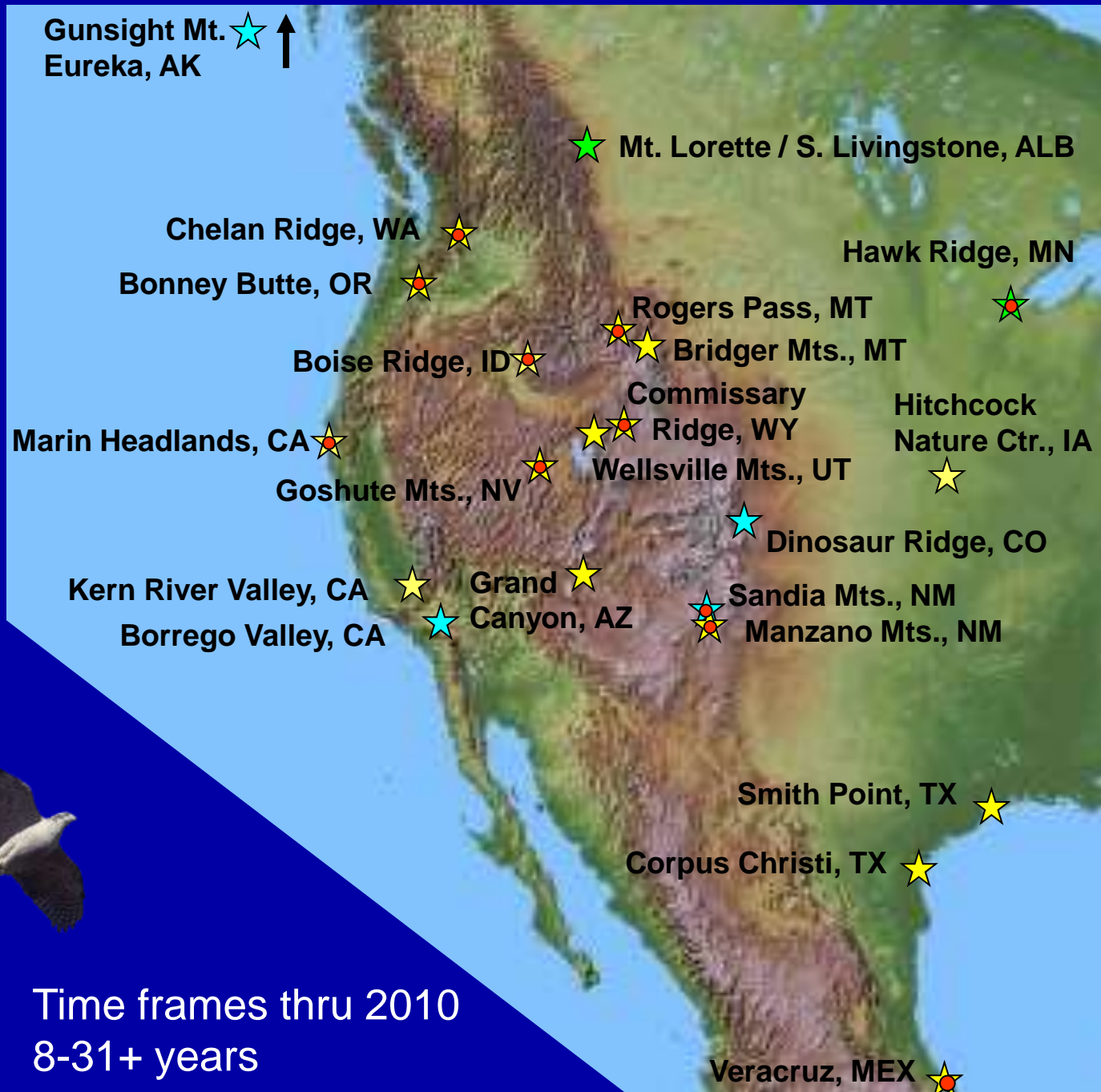
Jeff P. Smith, PhD

H. T. Harvey & Associates

Los Gatos, California



Primary Raptor Migration Monitoring Sites In Western N.A.

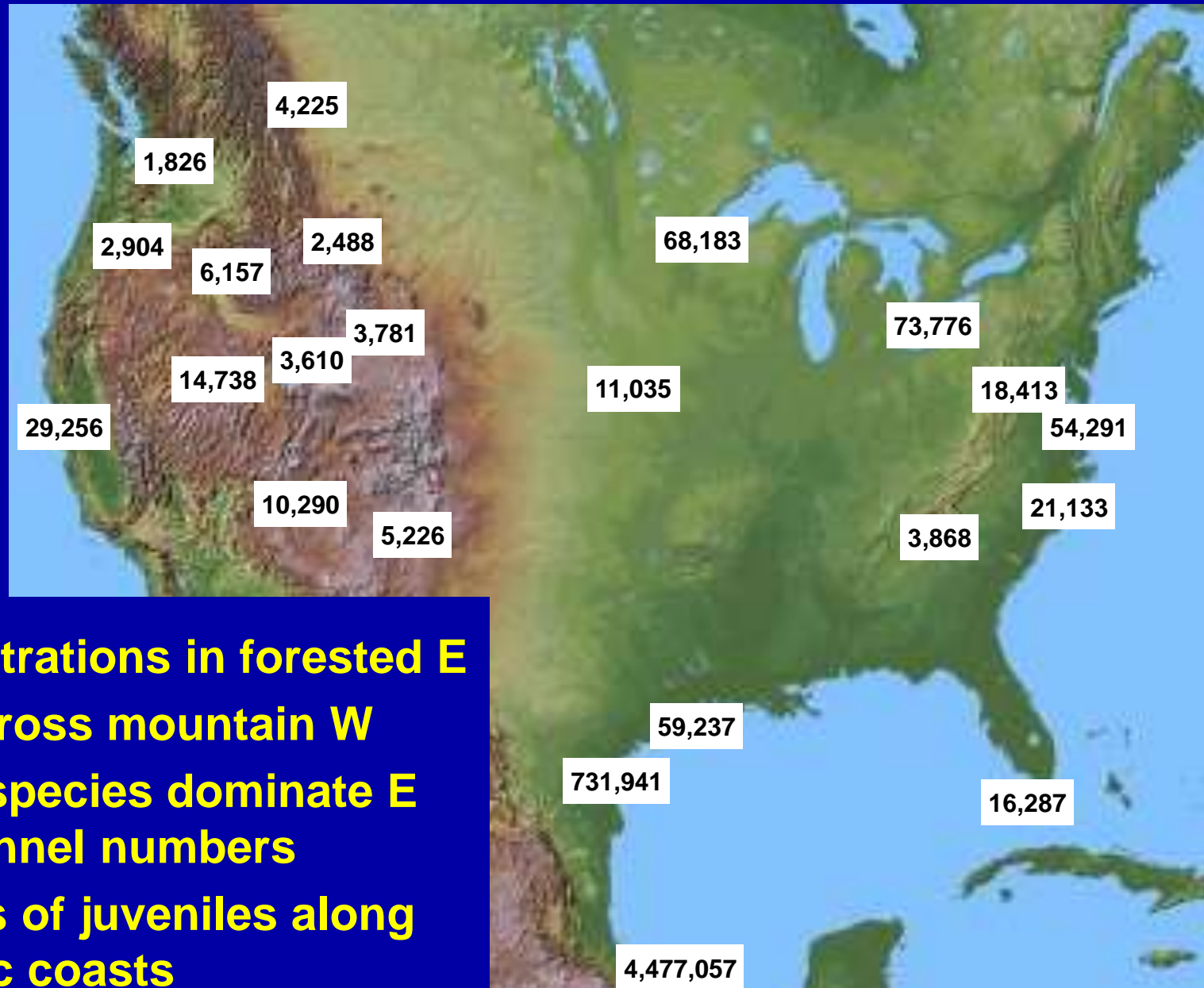


- ★ Fall
- ★ Both
- ★ Spring
- Banding Sites

Time frames thru 2010
8-31+ years

Migration Volume – Selected Full-Season Watchsites

All Raptors
long-term
average autumn
counts

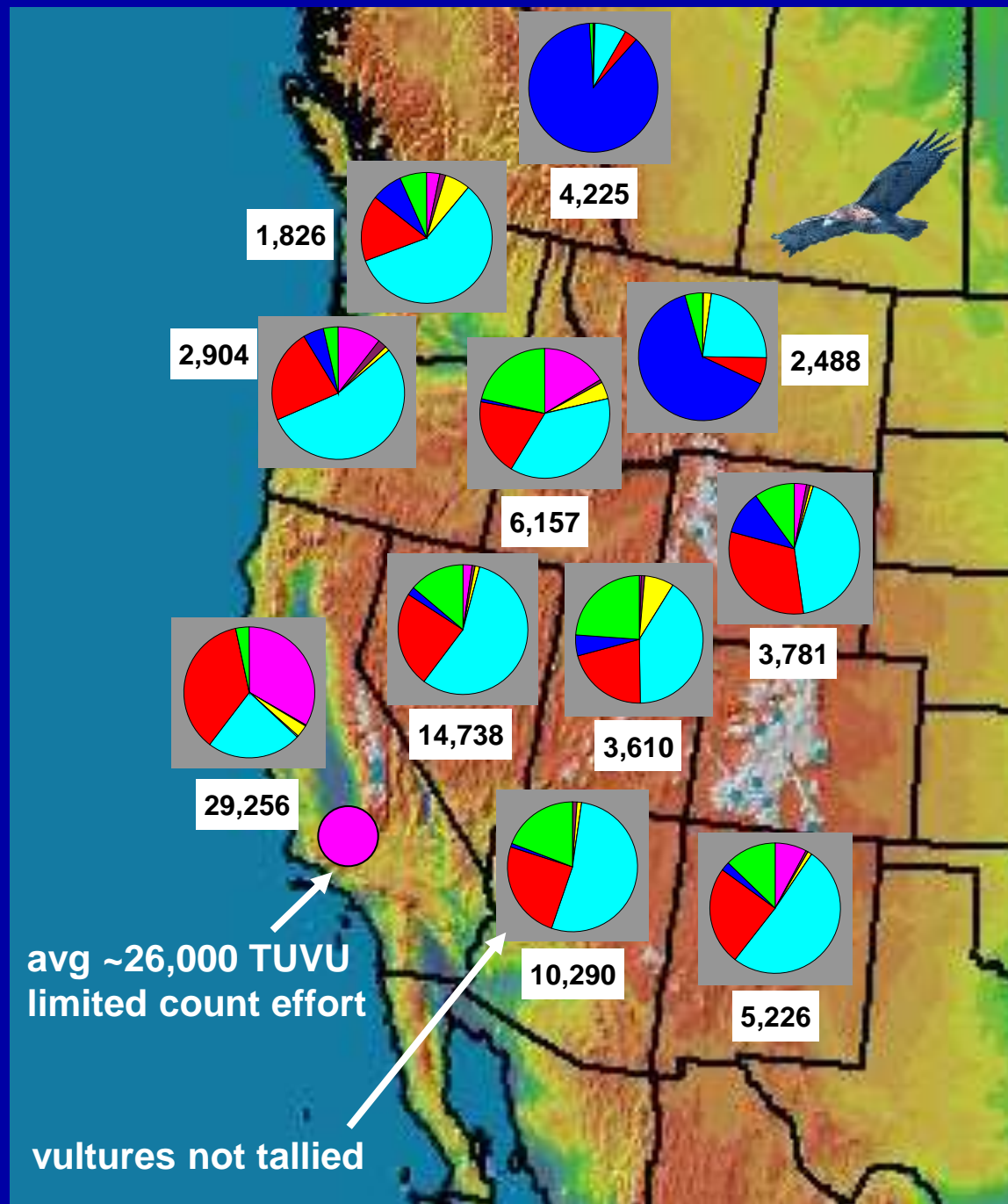


- ✓ High # and concentrations in forested E
- ✓ More dispersed across mountain W
- ✓ Few *superflocker* species dominate E and continental-funnel numbers
- ✓ Higher proportions of juveniles along Pacific and Atlantic coasts

Autumn Migration Composition

- Accipiters
- Buteos
- Falcons
- Eagles
- Harriers
- Ospreys
- Vultures

= average total flight



Seasonal Migration Timing – Species Differences

Sandia Mountains, NM

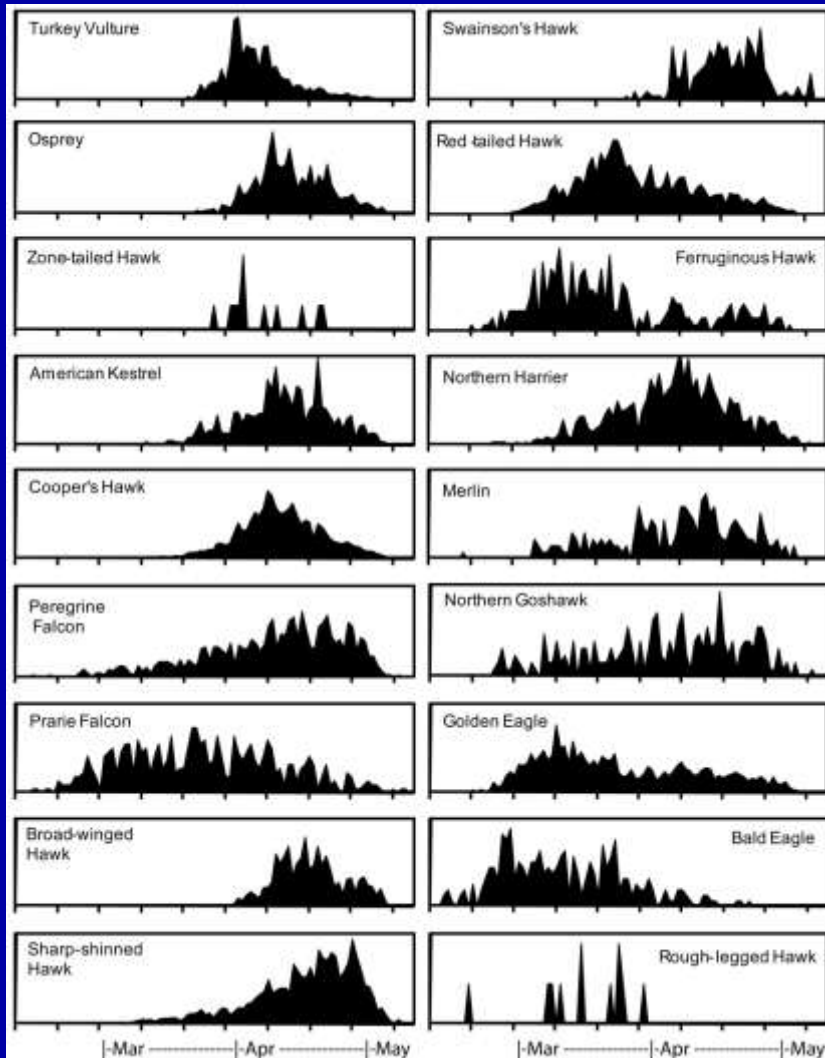


Photo by George Jameson

Spring



Autumn



Smith 2010
Raptors of NM

Manzano Mountains, NM

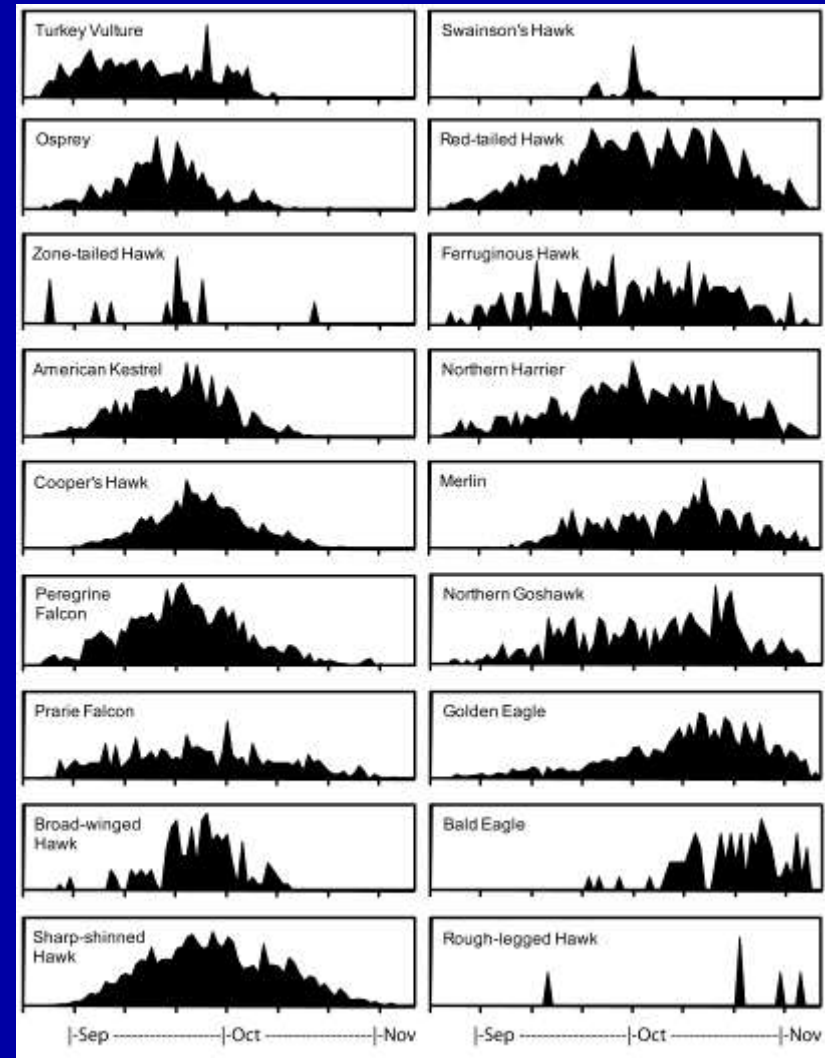


chart values are proportions of multi-year aggregate (1985-2007) flight totals by Julian date

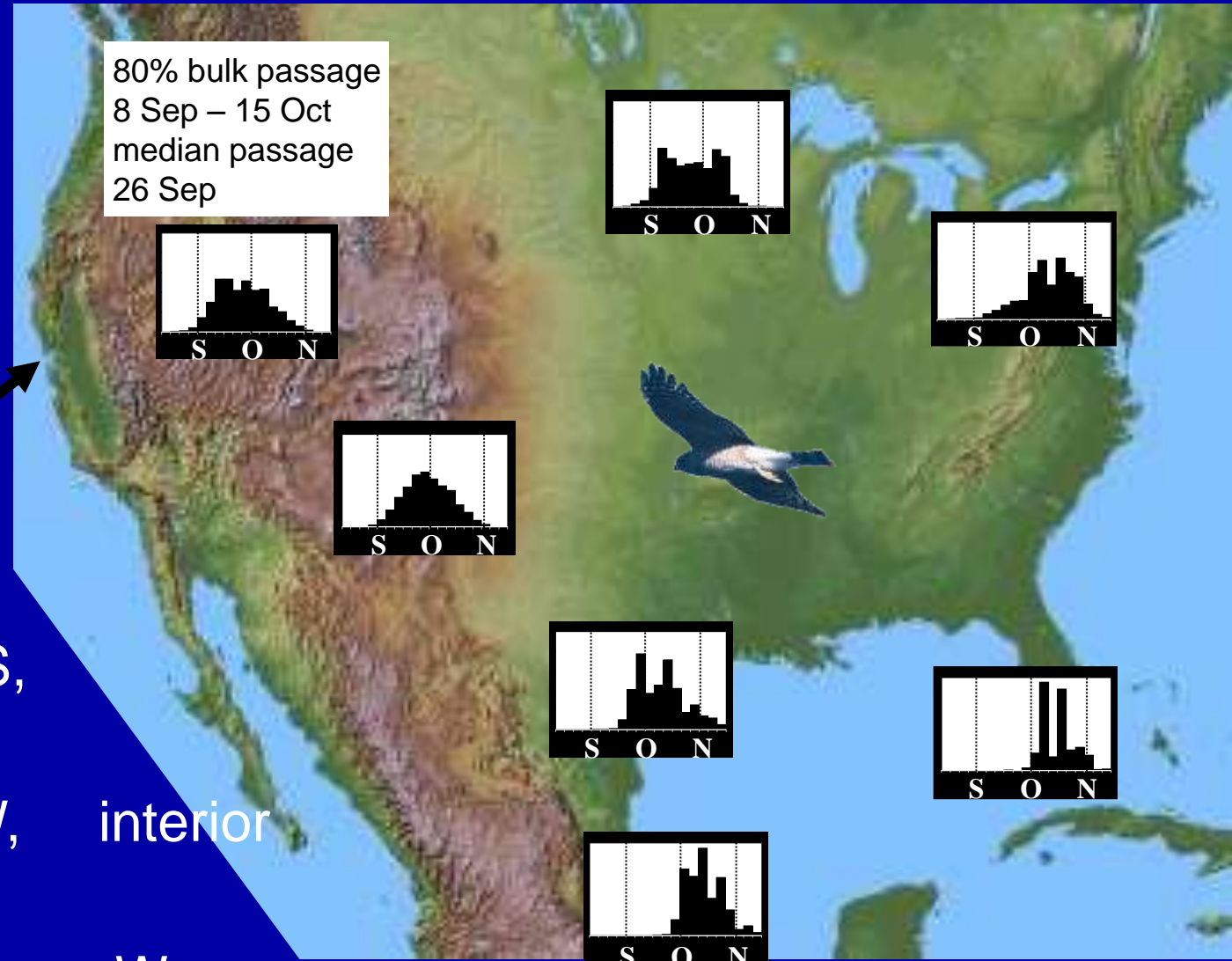
Seasonal Migration Timing – Regional Variation

Sharp-shinned Hawk

% aggregate total count
by 5-day periods

80% bulk passage
9 Sep – 5 Nov
median passage
30 Sep

80% bulk passage
8 Sep – 15 Oct
median passage
26 Sep



✓ Autumn passage

- 2-3 weeks later N to S, same longitude
- 1-2 wks earlier E to W, interior same latitude
- Protracted late season on W coast vs. interior, some species

Seasonal Migration Timing – Age-Sex Differences

Goshute Mts., NV - autumn

% aggregate total count by Julian date

- ✓ **Autumn: immatures earlier than adults, females earlier than males**
- ✓ **Spring: reverse**
- ✓ **Varies by species**

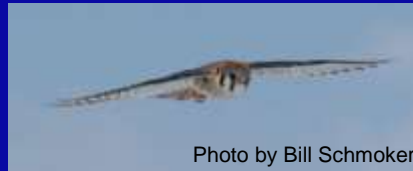
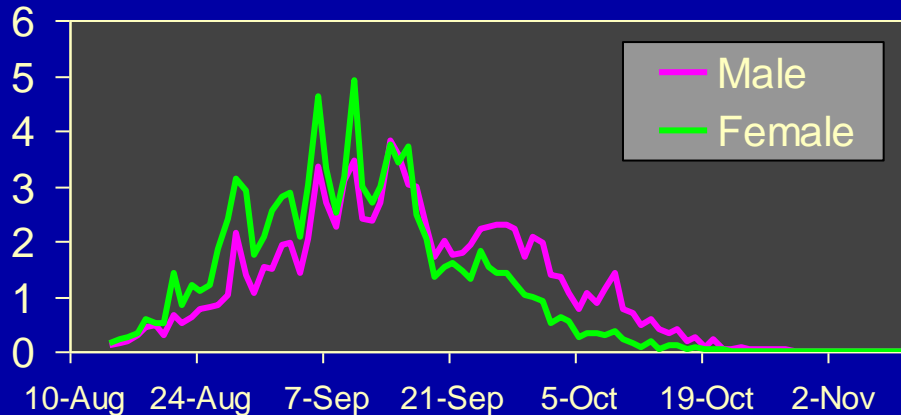
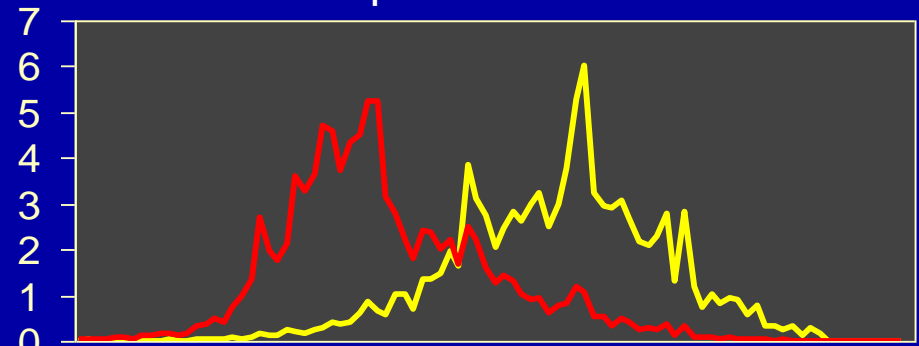


Photo by Bill Schmoker

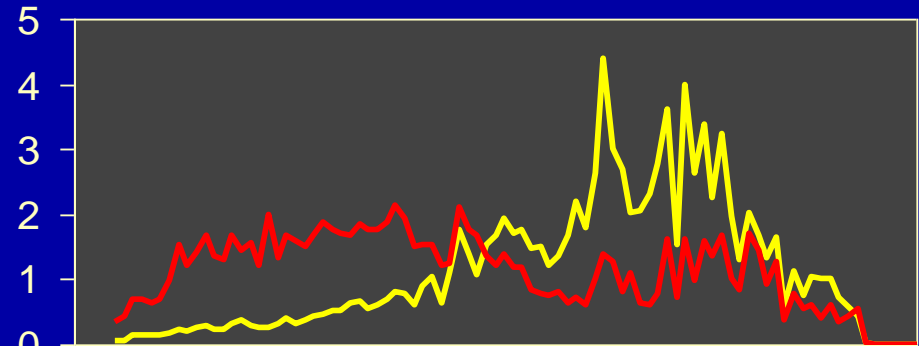
American Kestrel



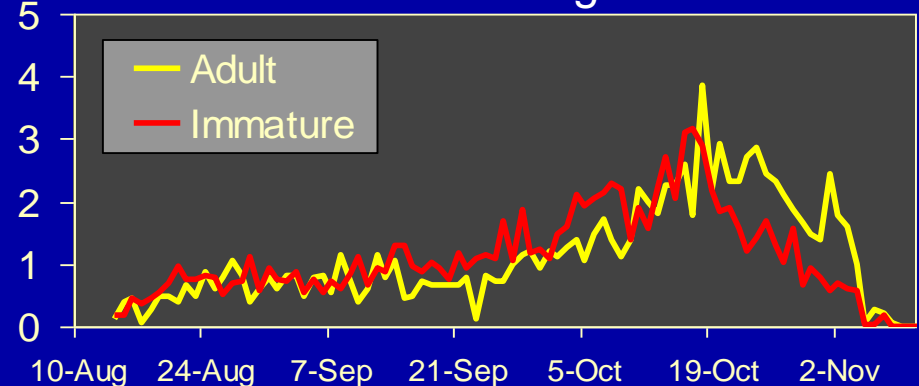
Sharp-shinned Hawk



Red-tailed Hawk



Golden Eagle



Species-Specific Dispersion and Timing Patterns

Sharp-shinned Hawk

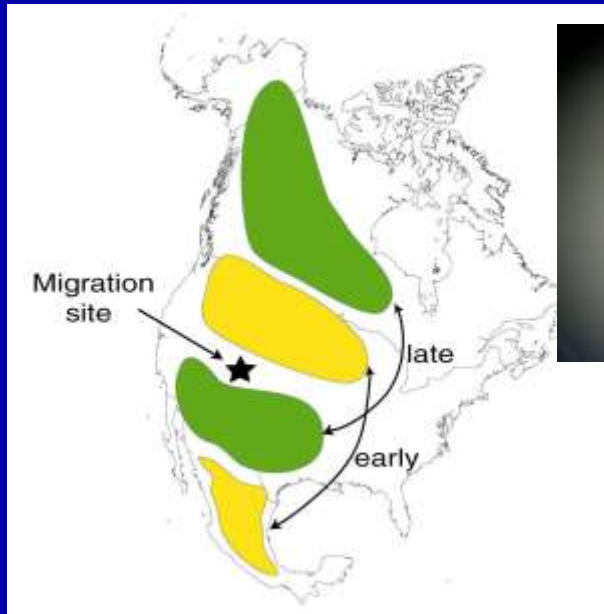


Photo by Bill Schmoker

Peregrine Falcons



Photo by Garrett Lau

N tundra birds migrate over S breeders to winter farthest S in S America

Leap-Frog Migration

Schmutz et al. 1991 *Wilson Bulletin*

Type I Chain Migration

R. Smith et al. 2003

Journal of Avian Biology



Photo by Bill Clark

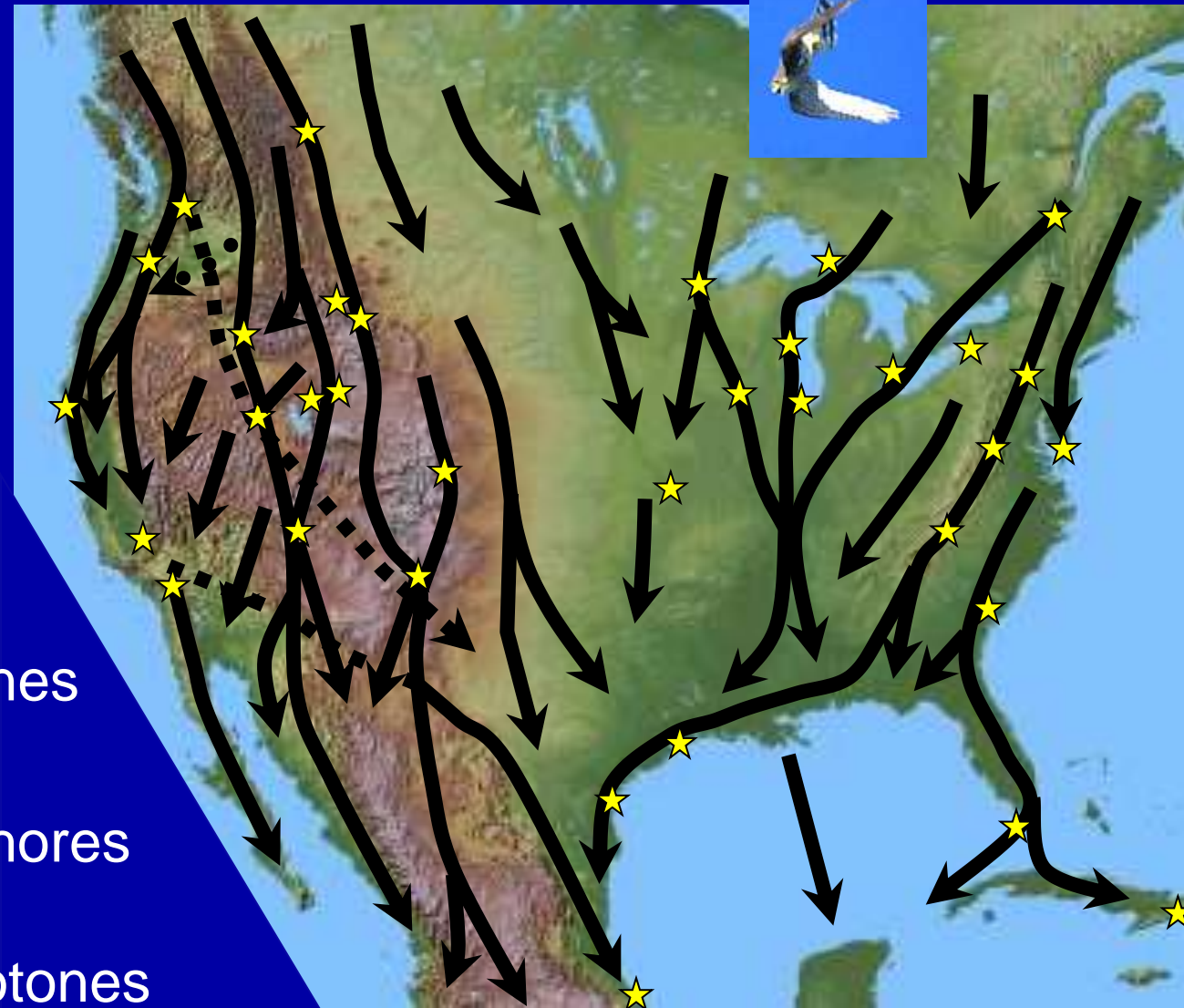
Red-tailed Hawks

bimodal pattern in coastal CA

genetics reveal early pulse is coastal CA birds, late pulse is n Great Basin birds

Hull et al. 2009 *The Auk*

Continental Migration Geography



1^o Concentration Points

✓ *Leading Lines*

- long N-S ranges
- major river corridors
- favorable habitat ecotones

✓ *Diversion Lines*

- coastlines, major lakeshores
- major peninsulas
- inhospitable habitat ecotones
- shortest water / canyon crossings
- high mountain passes

★ primary migration monitoring sites

General Migration Strategies

Powered Flight versus Soaring Dependent

✓ High reliance on powered flight

- flight paths not strongly dependent on availability of energy-saving lift
- broad-front migrations
- falcons often along coastlines
- readily cross large water bodies



Merlin
Osprey
Peregrine Falcon
Northern Harrier

✓ High reliance on energy-saving soaring flight

- flight paths correspond to availability of wind-driven updrafts and thermal streets
- reluctant to cross large water bodies
- concentrate along *leading* and *diversion lines* and where flight conditions are favorable

Most species



Photo by Garrett Lau



Goshute Mountains, NV

Remote Ridgetop Sites in the West



Wellsville Mountains, UT



Bridger Mountains, MT



Chelan Ridge, WA

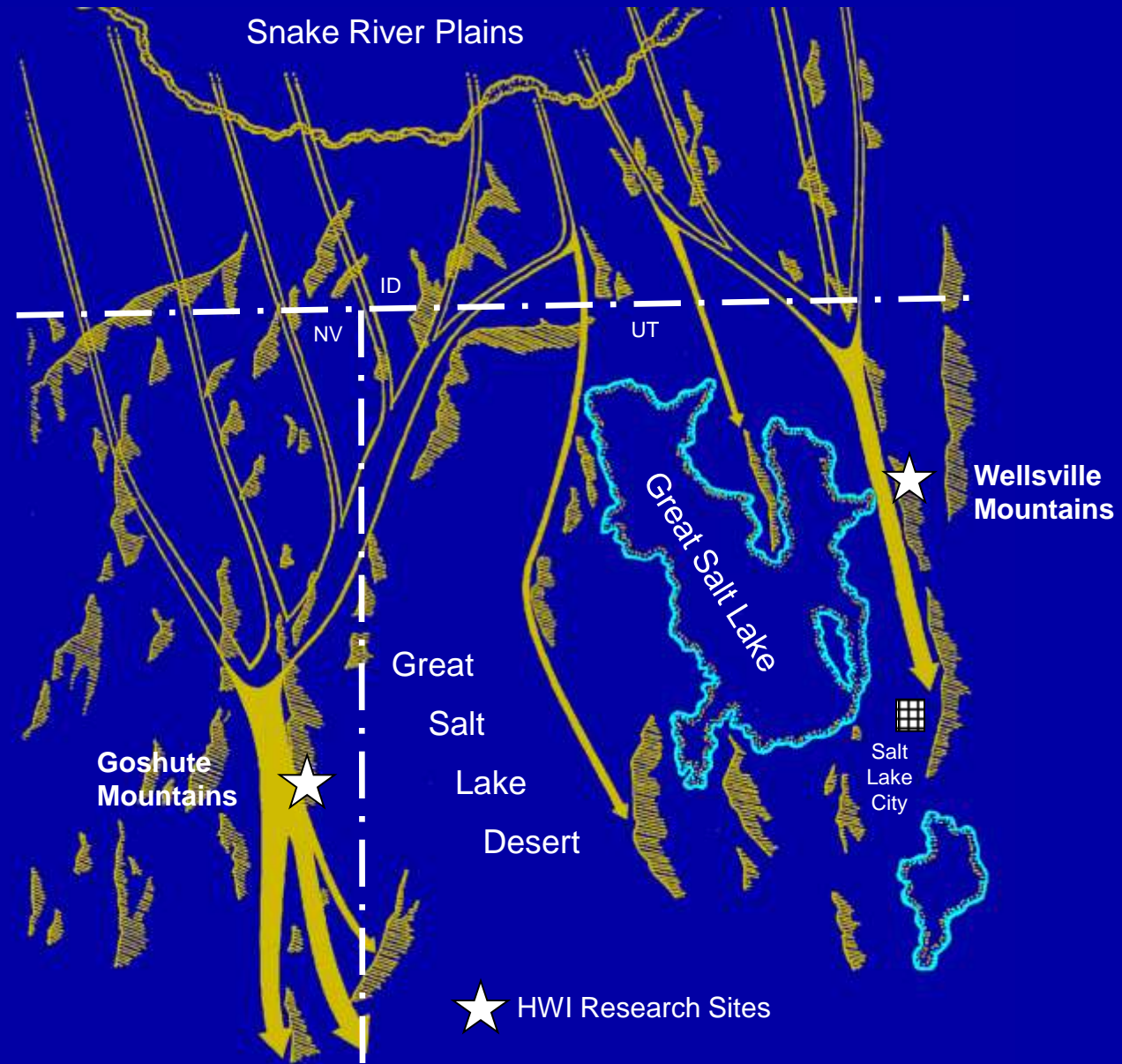
- ✓ **Leading line navigation aids**
- ✓ **Favorable habitat corridors**
- ✓ **Energy-saving mountain updrafts**



Commissary Ridge, WY

Great Salt Lake Barrier Effect

- ✓ Several montane *leading lines* funnel migrants toward and along Goshute Mountains
- ✓ GSL lake/desert complex acts as *diversion line* further concentrating migrants along W desert margin and Goshute Mts



Among largest western concentrations

San Francisco Bay Migratory Funnel Golden Gate Raptor Observatory Site

Photo by Garrett Lau

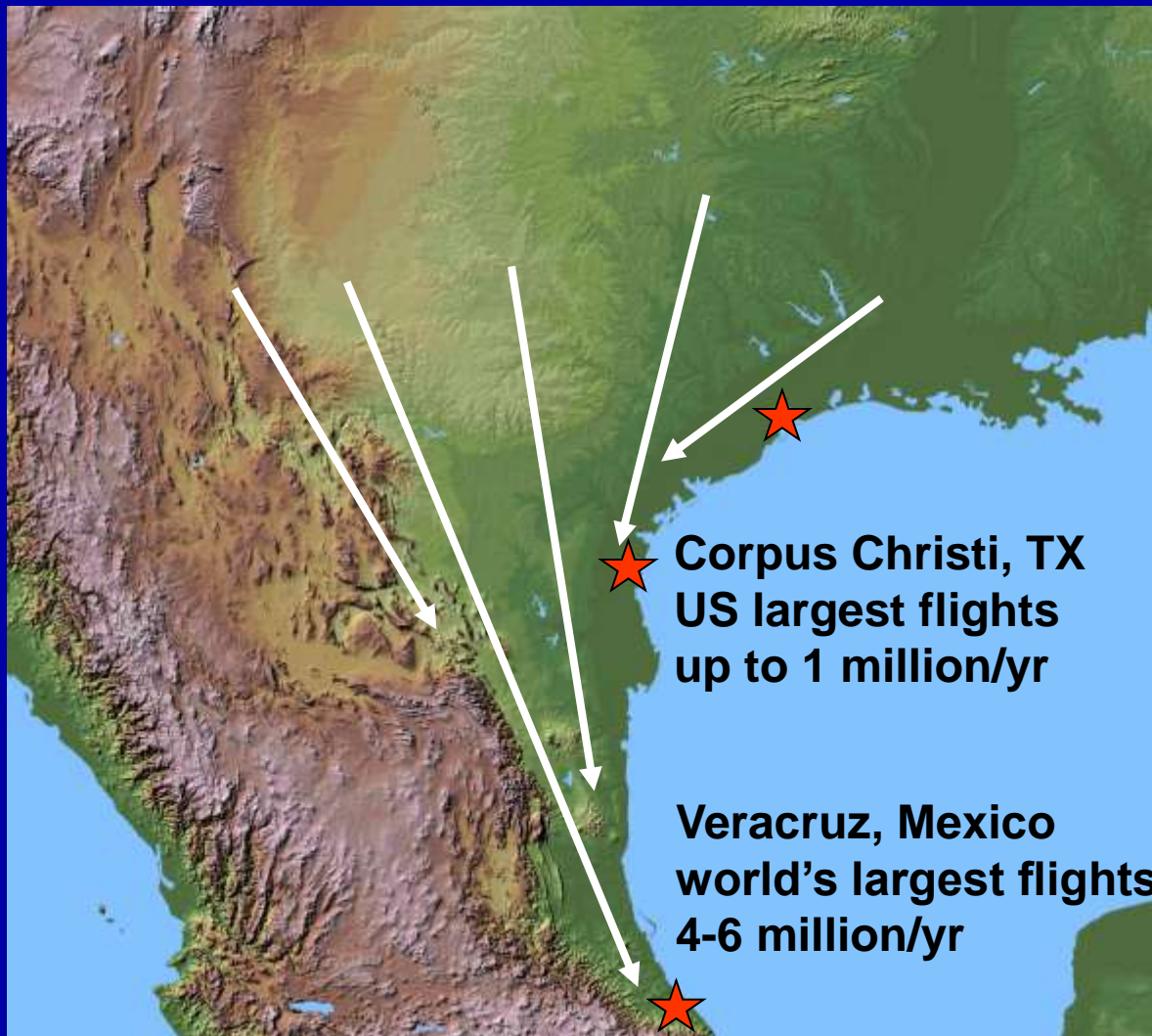


- ✓ Montane *leading lines* funnel migrants southward from N and ocean barrier and peninsula *diversion lines* further concentrate them along coastline and to narrowest crossing of SF Bay
- ✓ High proportion of juveniles compared to inland sites for most broadly distributed species

Among largest western concentrations



Gulf Coast Continental Migratory Funnel



- ✓ Migrants constrained to coastal plain where thermals are strong
- ✓ Cloud-shrouded mountains and coastline act as *diversion lines*
- ✓ Migrants squeezed through ~75-km-wide passage between coastal barrier and mountains in Veracruz
- ✓ Continental-scale population monitoring for some complete migrants

“Superflockers”



Turkey Vulture

Photos by Peter LaTourette



Swainson's Hawk



Photo by Peter LaTourette

Broad-winged Hawk



Photo by
Brian Wheeler

Mississippi Kite

- ✓ **Highly concentrated flights at continental funneling points**
 - coastal Texas Veracruz, Mexico Central America
- ✓ **Primary reliance on “thermal streets” on coastal plains**
- ✓ **Requires large areas of suitable stopover habitat**
 - major evening “set-downs” and morning “lift-offs”



Photo by Garrett Lau

Peregrine
Falcon



Fuller et al. 1998 *J Avian Biology*

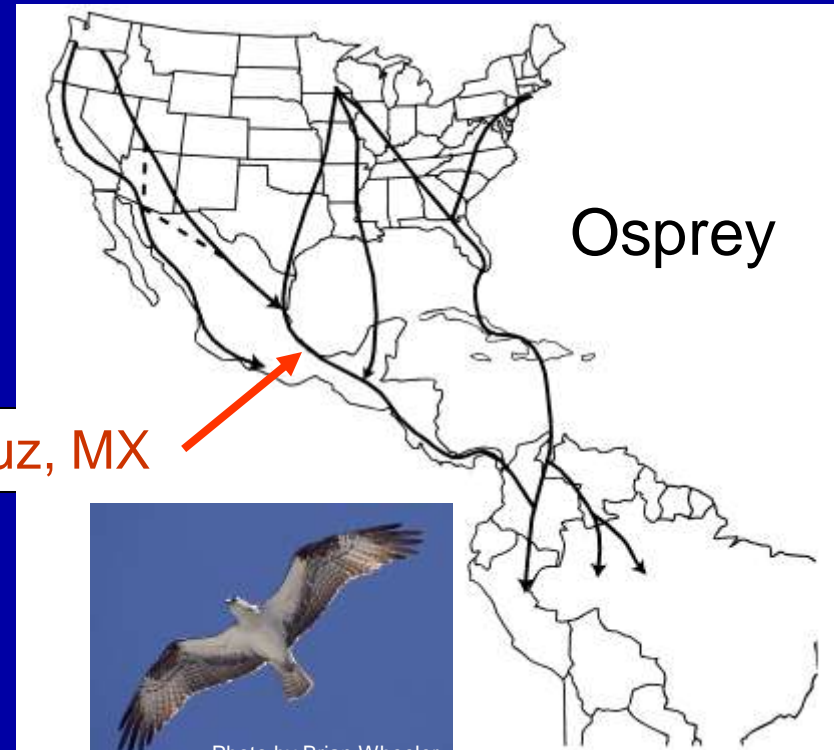
Swainson's
Hawk



Photo by Bill Schmoker

Satellite Tracking of Migration Routes

**Veracruz continental convergence
for species wintering in C/S America**



Osprey

Veracruz, MX

Photo by Brian Wheeler

Martell et al. 2001 *The Condor*

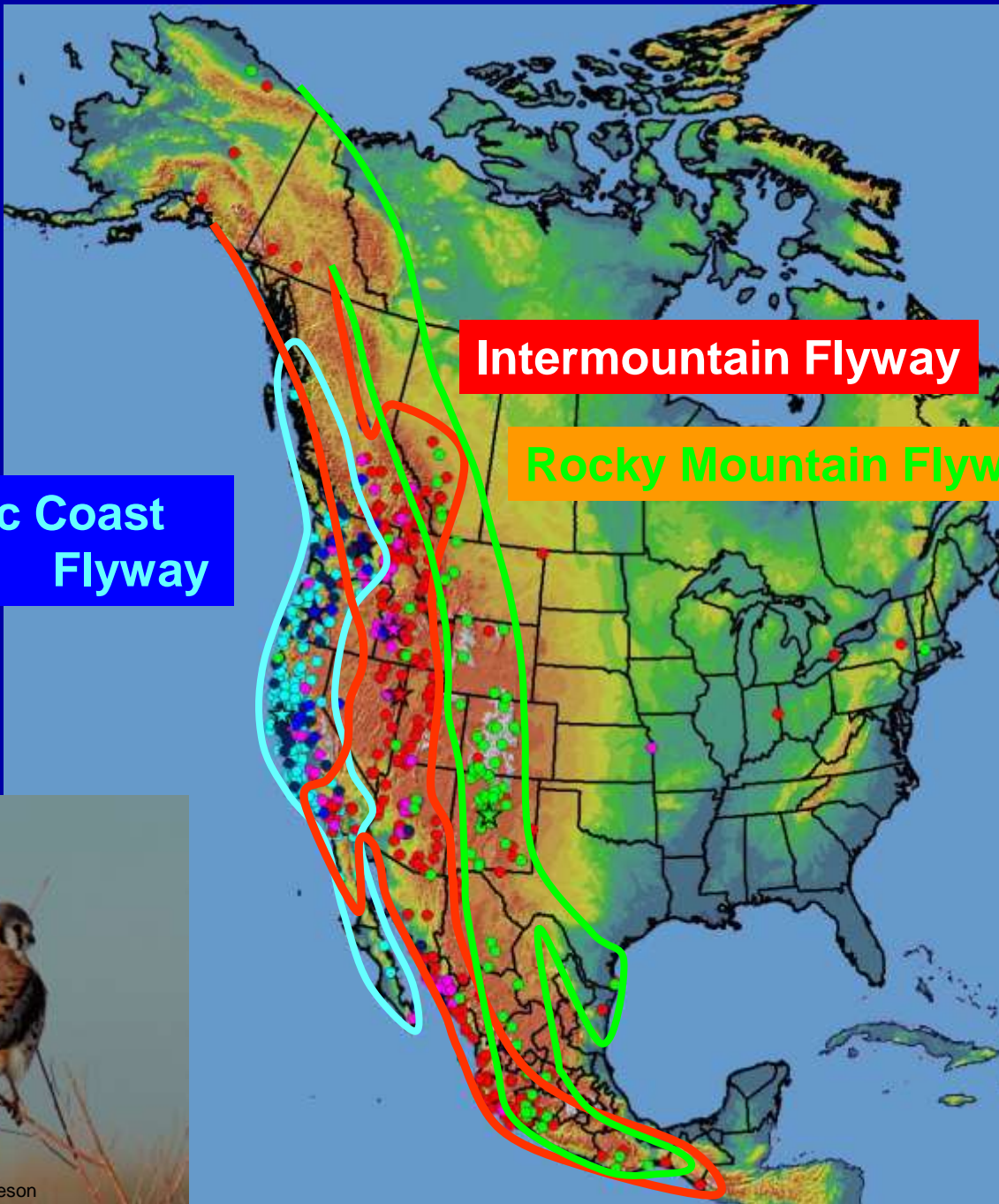
Migration-Site Band Returns & Associated Western Flyways

All birds banded
at migration
research sites
1980-2006

1° species
SSHA, COHA
RTHA, AMKE

Hoffman, Smith & Meehan 2002
J. Raptor Research

Goodrich and Smith 2008
State of NA Birds of Prey



**Pacific Coast
Flyway**

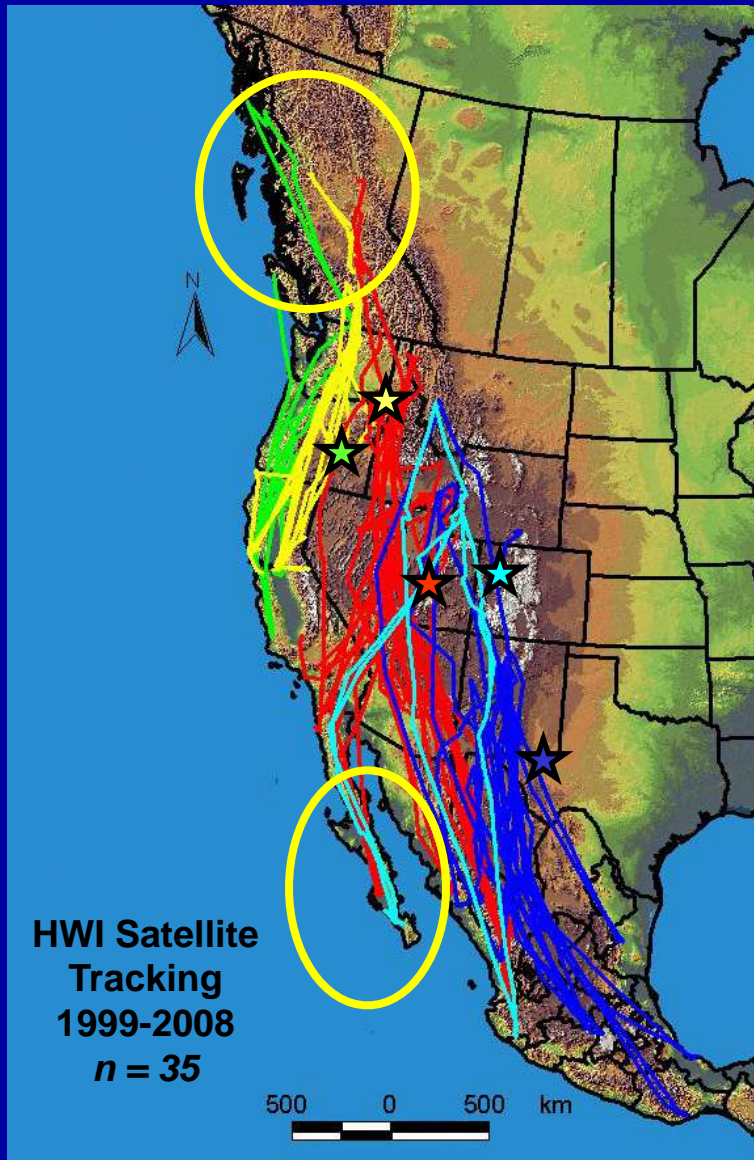
Intermountain Flyway

Rocky Mountain Flyway



Photo by George Jameson

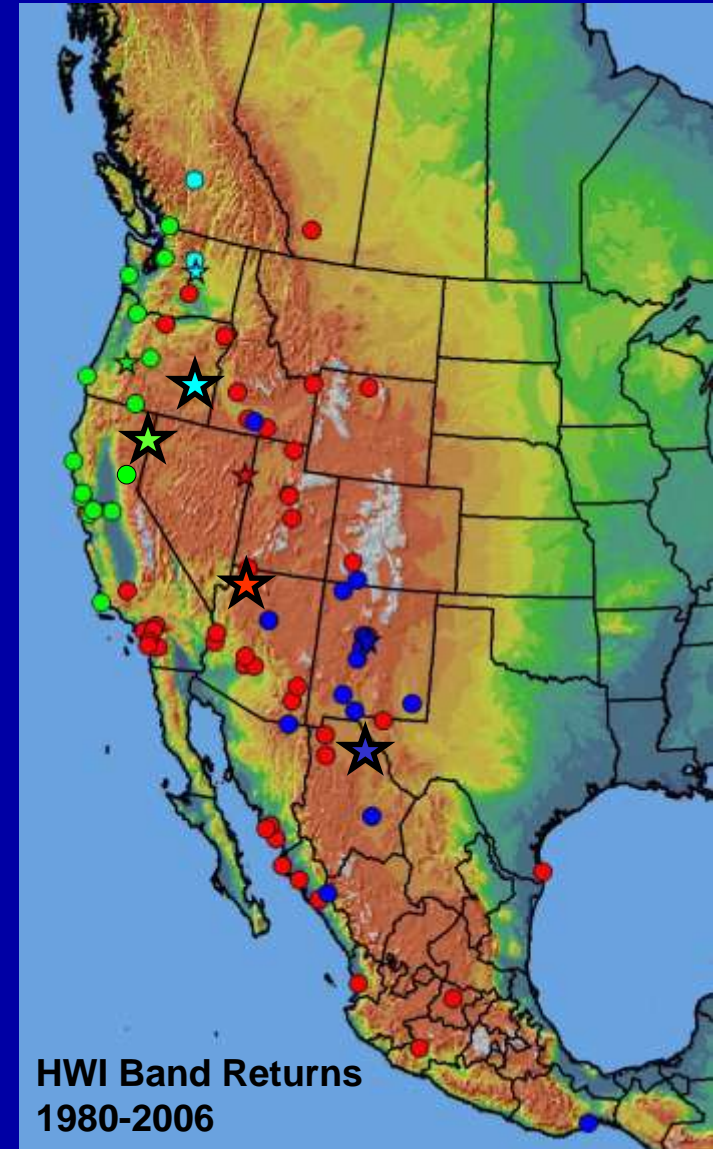
Red-tailed Hawk Movements



Chelan Ridge, WA
Bonney Butte, OR
Pacific Coast Corridor

Goshute Mts., NV
Intermountain
Corridor

Commissary Ridge, WY
Manzano Mts., NM
Rocky Mountain
Corridor



HWI / Smith unpublished data

Hoffman, Smith & Meehan 2002
J Raptor Research

Red-tailed Hawk Satellite Tracking Route Fidelity



Goshute
Mountains

high route fidelity =
consistent monitoring



- Fall 1999
- Spring 2000
- Fall 2000
- Spring 2001
- Fall 2001

HWI / Smith unpublished data

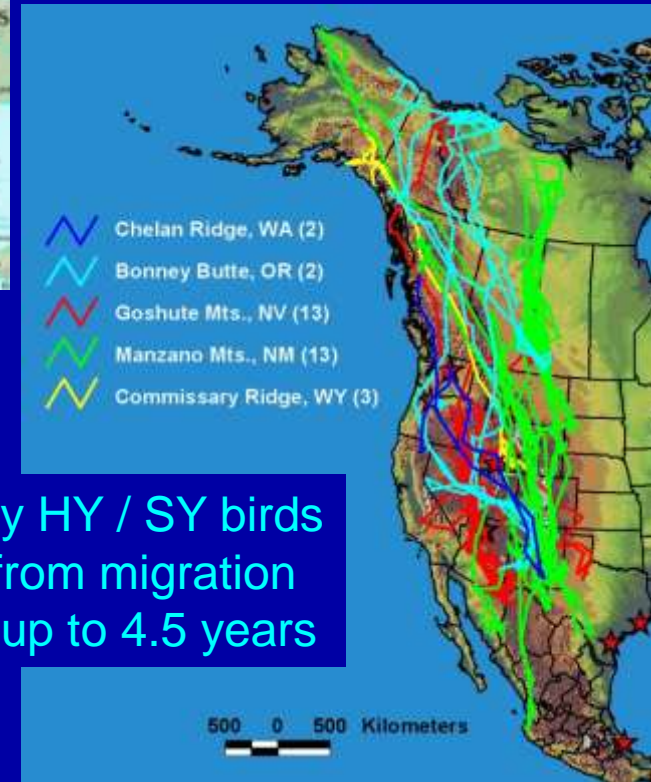
Golden Eagle Satellite Tracking

- ✓ **Mostly regional residents in Great Basin**
- ✓ **More long-distance migrants from northern summer ranges along Rockies and in PNW**
 - winter hotspot e NM / w TX / nc MX - multiple access routes
 - uncommon use of north-coast / trans-Great Basin route shifts with age to main Rockies corridor?
 - winter ranges shift north with age?
- ✓ **Immature eagles relatively sedentary in winter but wander extensively in summer**



McIntyre et al. 2008
The Auk

28 fledglings tracked from
Denali National Park, AK



33 mostly HY / SY birds
tracked from migration
sites for up to 4.5 years

Goodrich and Smith 2008 *State of NA Birds of Prey*
Smith *in preparation*

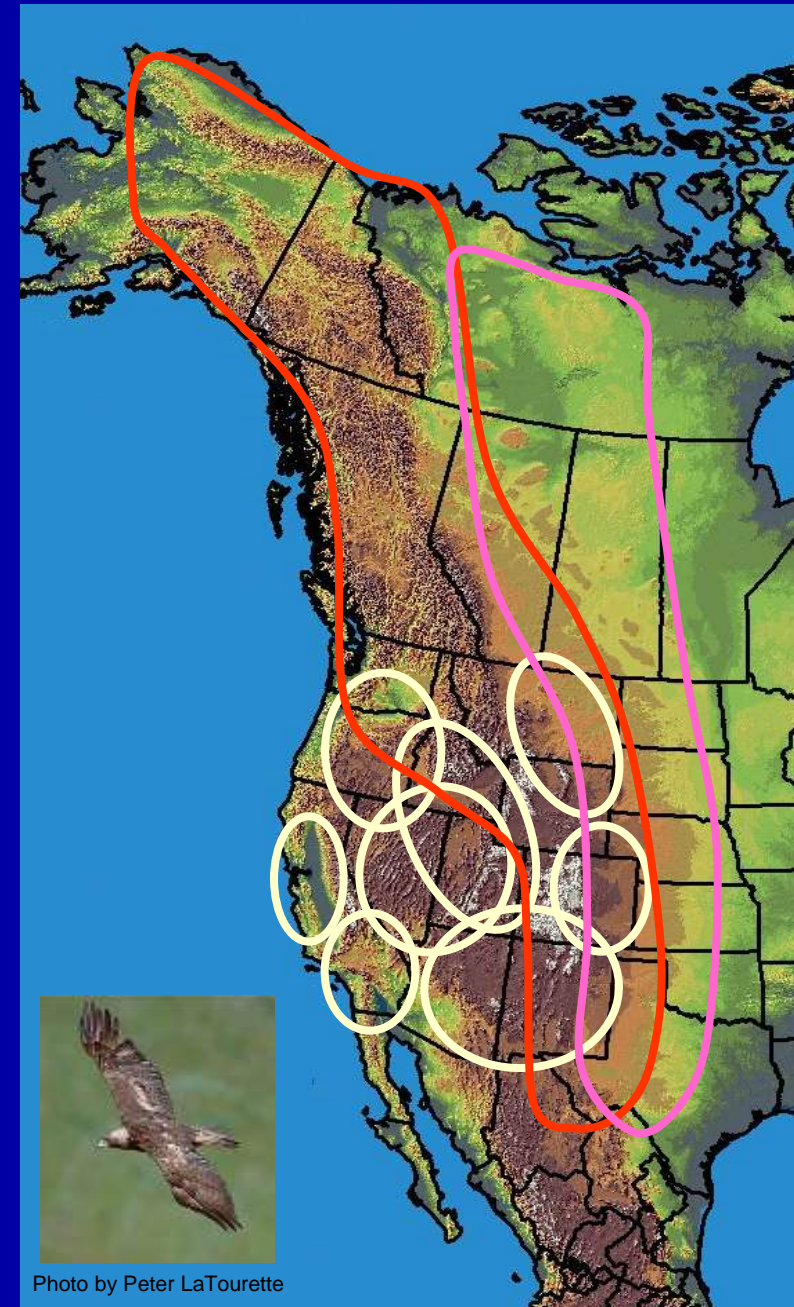
Golden Eagle Movement Patterns

✓ **Regional residents S half of range**

- residents, wanderers, altitudinal and short-distance migrants
- CA, Intermountain/Great Basin, CO Plateau, and w Plains “subpopulations”

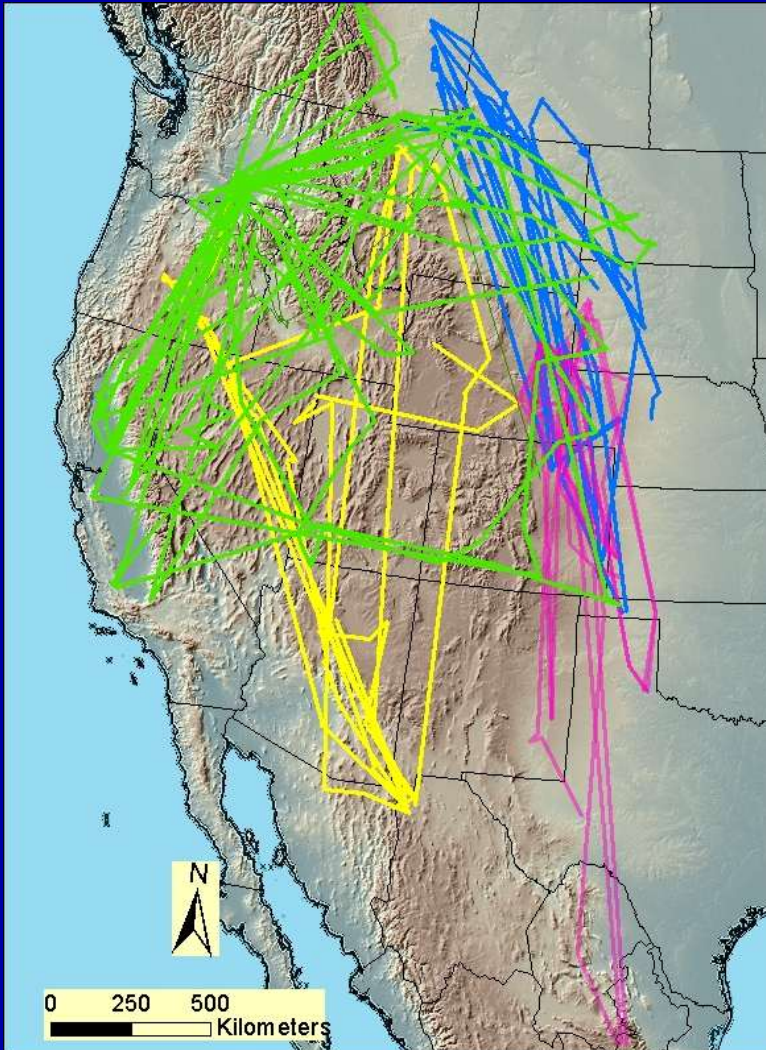
✓ **Long-distance migrants AK and Canada**

- numbers and distances depend on prey abundance and winter severity
- broad autumn funnel converges in c Rockies and along s Rockies / w Plains ecotone
- some W birds cross continental divide to w Plains; E birds remain E of divide
- winter in arid/semi-arid foothills, shrubsteppe, prairies, and deserts from s AB/SK to nc MX, broadly overlapping with resident populations



Ferruginous Hawk Migration Patterns

Breeding Adults Associated with Four Summer Ranges



- ✓ “Typical” N-S movements in w Plains; plains birds stay on plains
- ✓ Variable migration patterns W of Rockies, sometimes looping out onto W Plains in winter

31 adults
tracked
by satellite



Photo by Brian Wheeler

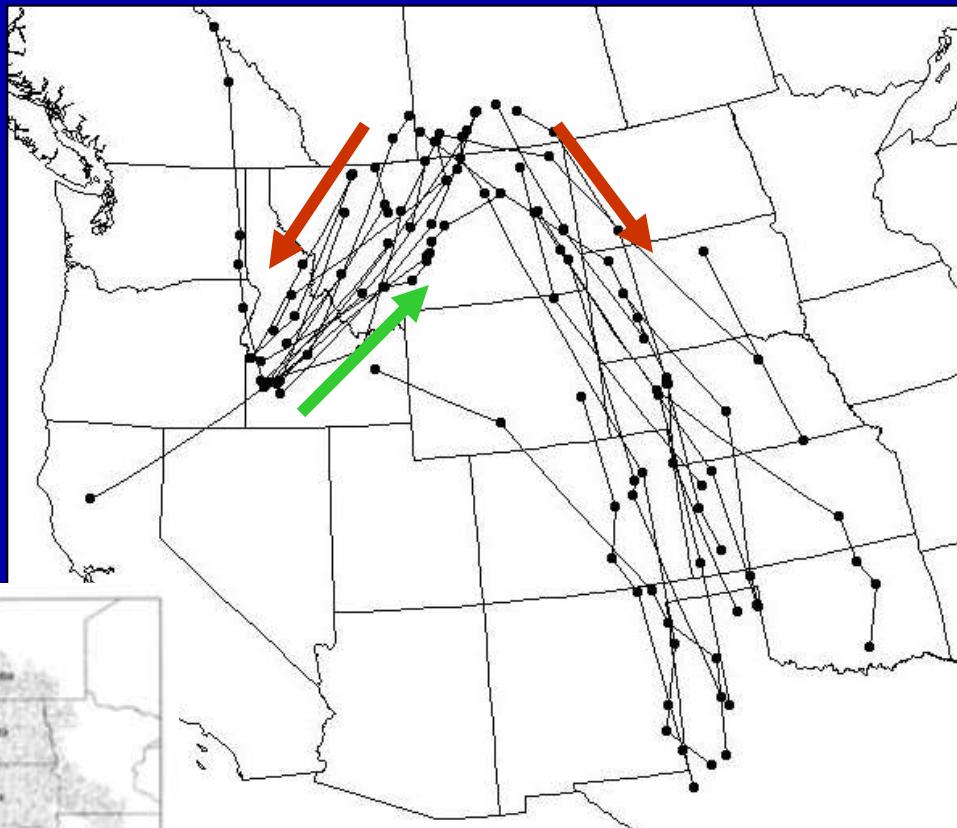
Watson and Banasch 2005
WDFW and CWS Technical Report

Prairie Falcon Migration Pattern

Breeding Adults - Snake River BPNCA, Idaho



Photo by Bill Schmoker



Fall migration tracks



General direction of post-nesting movements

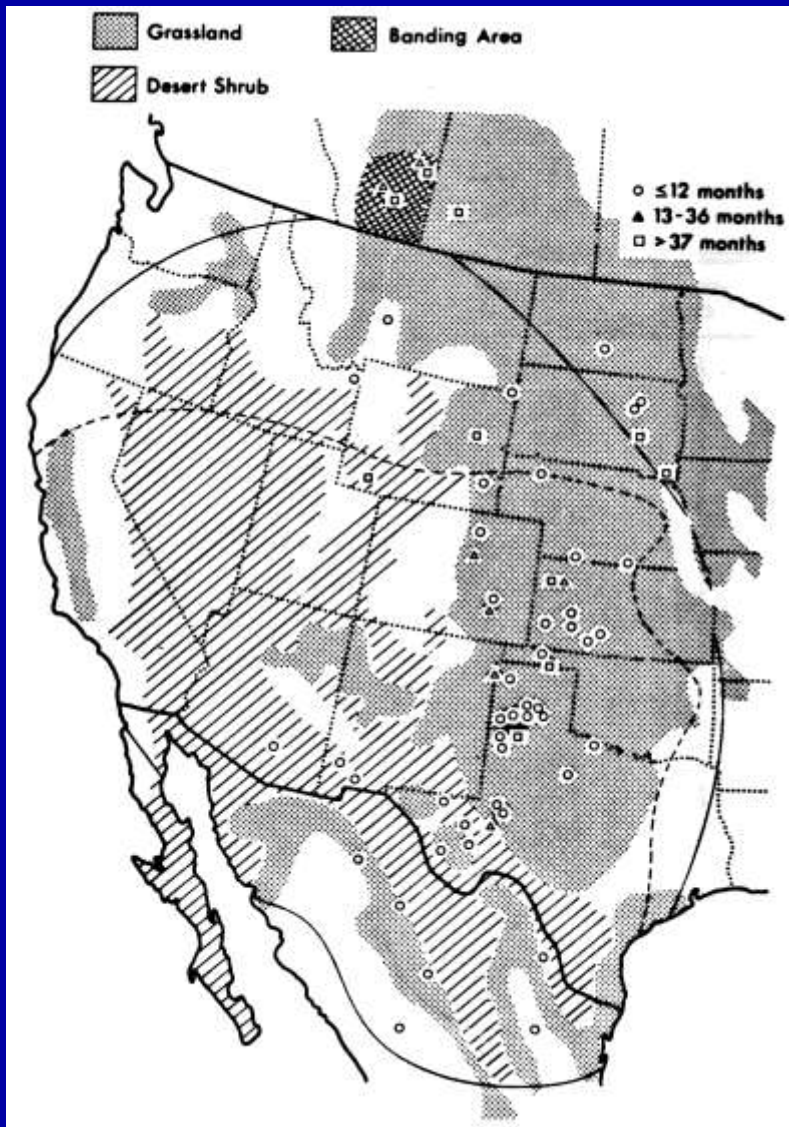


Spring return routes from east of Rockies

Steenhof et al. 2005
The Condor

Band Recovery Patterns Alberta / Saskatchewan Raptors

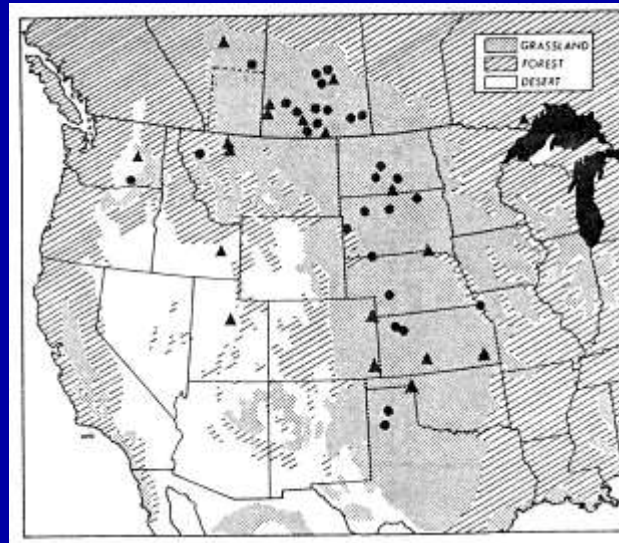
Ferruginous Hawks



Schmutz and Fyfe 1987 *Condor*

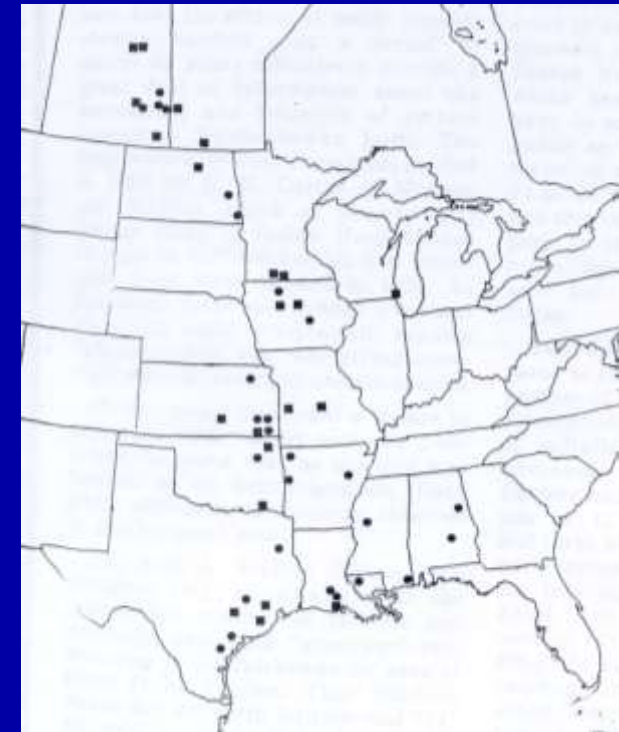


Prairie Falcons



Schmutz et al. 1991
Wilson Bulletin

Red-tailed Hawks



Houston 1967 *Blue Jay*

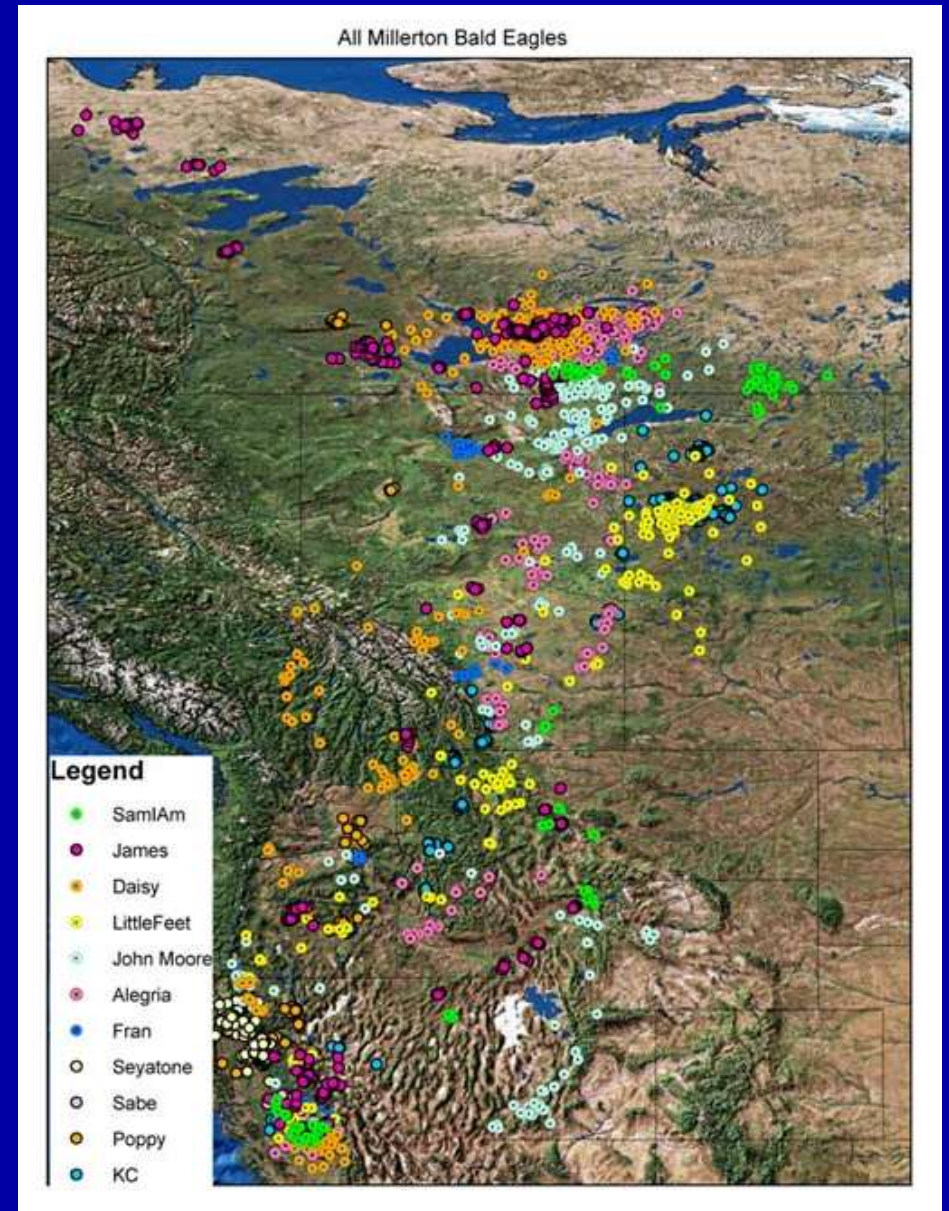
Bald Eagle Tracking

Follow the Fish!



Photo by Bill Schmoker

Arizona Game and Fish Department
Northward late summer movements to PNW



Santa Cruz Predatory Bird Research Group
Central CA (winter) to wc Canada (summer)

Northern Goshawk Satellite Tracking

Washington



mostly
HY birds

Nevada



Wyoming



Oregon



- ✓ Most stay within 150 km of project sites
- ✓ Mostly multi-directional dispersive movements
- ✓ Two exceptions during expected "invasion" year

New Mexico



Songsthaugen et al. 2006 *Studies in Avian Biology*

- ✓ UT adults – mix of sedentary, altitudinal migrants, and short-distance migrants to s UT / n AZ up to ~400 km

HWI / Smith
unpublished data

Continental Migration Geography – Summary

✓ **Most species partial migrants**

- migratory tendency increases with latitude
- some species: resident S, migratory N
- broad overlap of summer and winter ranges

✓ **Broad front movements across much of continent, with general convergence and concentration along:**

- **leading lines** - mountain ranges, major river corridors, habitat ecotones
- **diversion lines** - coastlines, lakeshores, peninsulas, habitat ecotones

✓ **For many species, movements more constrained along coasts**

- milder environments
- higher concentrations of juveniles for many species
- complex mixes of residents and migrants

✓ **Some atypical loop migrations (PRFA, FEHA), northward late-summer movements (s RTHA, BAEA), altitudinal migrations (some NOGO), and other unique patterns (BAEAs and aquatic prey)**



Research Needs

Migration Geography and Long-term Monitoring

- ✓ **Fill gaps in monitoring network to better cover major travel corridors**
- ✓ **Enhance understanding of movement dynamics in c Great Basin, through w Canada, and along n Pacific Coast**
- ✓ **Landscape-level studies to quantify relative migration volume across complex mountainous regions and broad valleys and plains**
- ✓ **Refine knowledge of source-population dynamics for specific monitoring sites and ranges**



Primary Long-Term Raptor Migration Monitoring and Research Organizations in Western North America

Hawk Migration Association of NA
Plymouth, NH USA

<http://www.hmana.org>

(continental umbrella organization
for citizen-science monitoring)

HawkWatch International
Salt Lake City, UT USA

<http://www.hawkwatch.org>

(OR WA NV MT WY UT NM AZ TX)

Golden Gate Raptor Observatory
San Francisco, CA USA

<http://www.ggro.org>

Idaho Bird Observatory, Boise, ID USA

<http://www.boisestate.edu/biology/ibo>

Rocky Mountain Bird Observatory
Brighton, CO USA

<http://www.rmbo.org>

Rocky Mountain Eagle Research
Foundation, Calgary, Alberta, Canada

<http://www.eaglewatch.ca>

Pronatura Veracruz
Xalapa, Veracruz, Mexico

<http://www.pronaturaveracruz.org>

Thank you for listening! Questions?

