

# Monitoring Occupancy of Nesting Areas and Reproductive Success of Golden Eagles in Denali National Park, Alaska



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# Overall Goals of Denali Golden Eagle Population Monitoring

Detect trends (magnitude and direction) in occupancy rate and productivity on a population level.

Determine factors that influence occupancy of nesting areas and productivity (ongoing Ph.D. research).

Determine expected range of occupancy and productivity.

Provide management with solutions to prevent damage or negative impacts to population.

Examine spatial and temporal variation in occupancy and reproductive output among nesting areas over time.

# Goal of The Denali Long-Term Ecological Monitoring Program

*Help park managers protect the resources of Denali by providing the ecological context for resource preservation decisions.*

## **Management Focus**

*To provide timely information to decision makers to determine if the ecological status and trends require a change in management.*

## **Ecological Focus**

*To improve understanding of the ecosystem within and surrounding Denali National Park and Preserve*

# The First Steps: Baseline Research in 1987 and 1988



- \* Reviewed historical records, maps, reports
  - \* Conducted field work to locate previously unreported nesting areas
  - \* Conducted field work to estimate breeding phenology to schedule surveys to determine occupancy and fledgling production
  
- \* Defined study area as boundaries of old Mt. McKinley National Park, north of the Alaska Range, east of the Muldrow Glacier and Kantishna Hills. (Murie's old study area)
  
- \* Modeled data collection (surveys and type of data) after golden eagle monitoring program in Snake River Birds of Prey National Conservation Area in Idaho and modified as necessary.

# Golden Eagles in Denali and Alaska: 1900 to 1986

*“The Golden Eagle is one the conspicuous members of the Mount McKinley National Park fauna. There are probably 25 or more pairs breeding in the mountain sheep hills”*. Murie (1944)

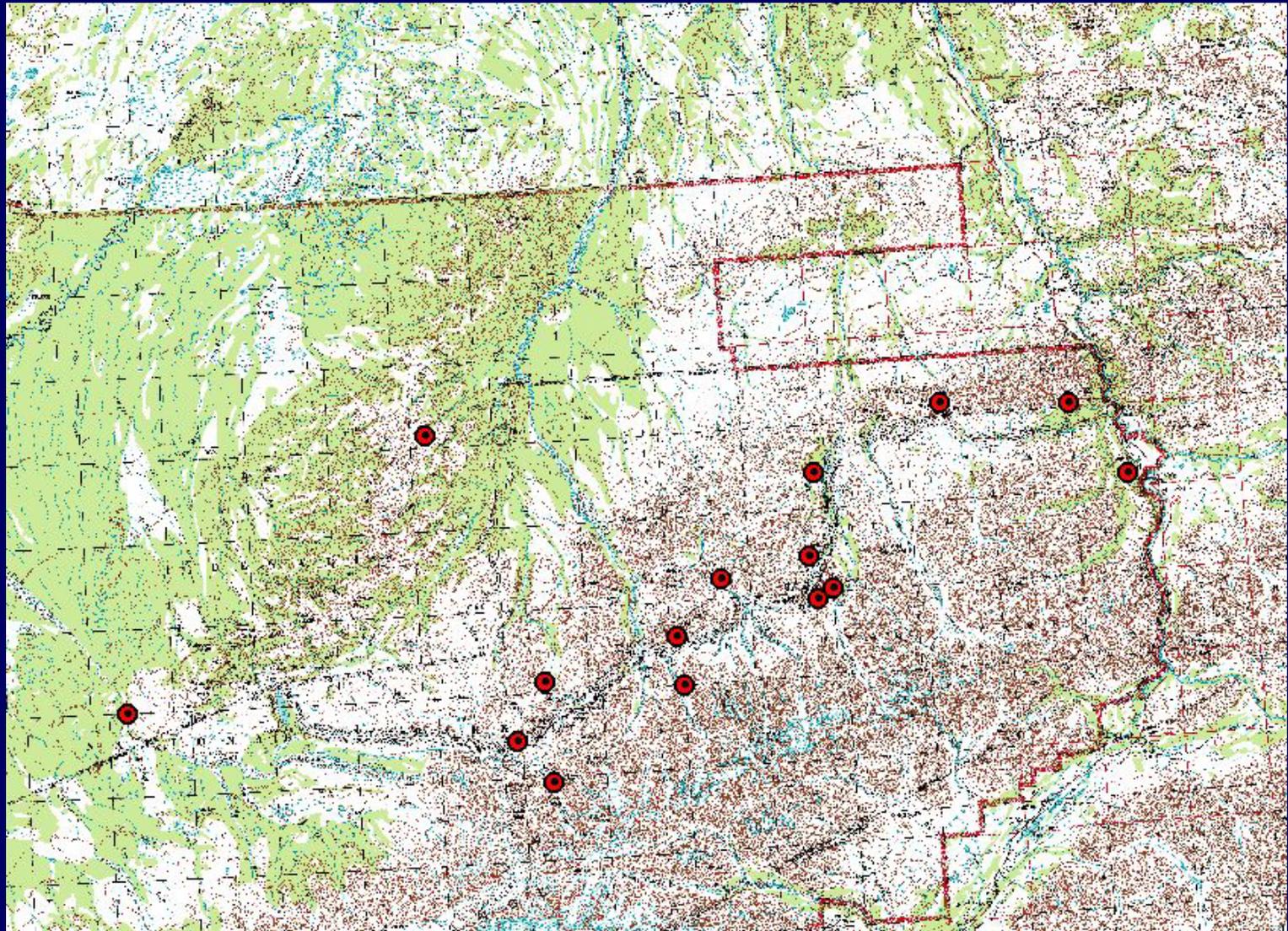
*“According to present information, this most magnificent of all American birds of prey is not common anywhere in Alaska.”* Gabrielson and Lincoln (1955)

*“The Golden Eagle is plentiful in Mount McKinley National Park . . .”*  
Murie (1963)

Other inventories and population monitoring in Alaska:

- short-term surveys to document mean brood size on Porcupine River (Ritchie and Curatolo 1982)
- baseline inventories on several rivers in western Alaska (Mindell, Petersen et al., White, Hobbie and Cade, Campbell, Kessel, Roseneau, Haugh): all short-term and lacking information on population level (focused on successful nests and mean brood size).

# Known Golden Eagle Nesting Areas: pre-1987



# Data Collection for Inventory and Monitoring

## **Inventory:**

Survey all areas within study area boundaries to locate nesting structures and identify nesting areas:

- foot surveys
- airplane surveys
- helicopter surveys

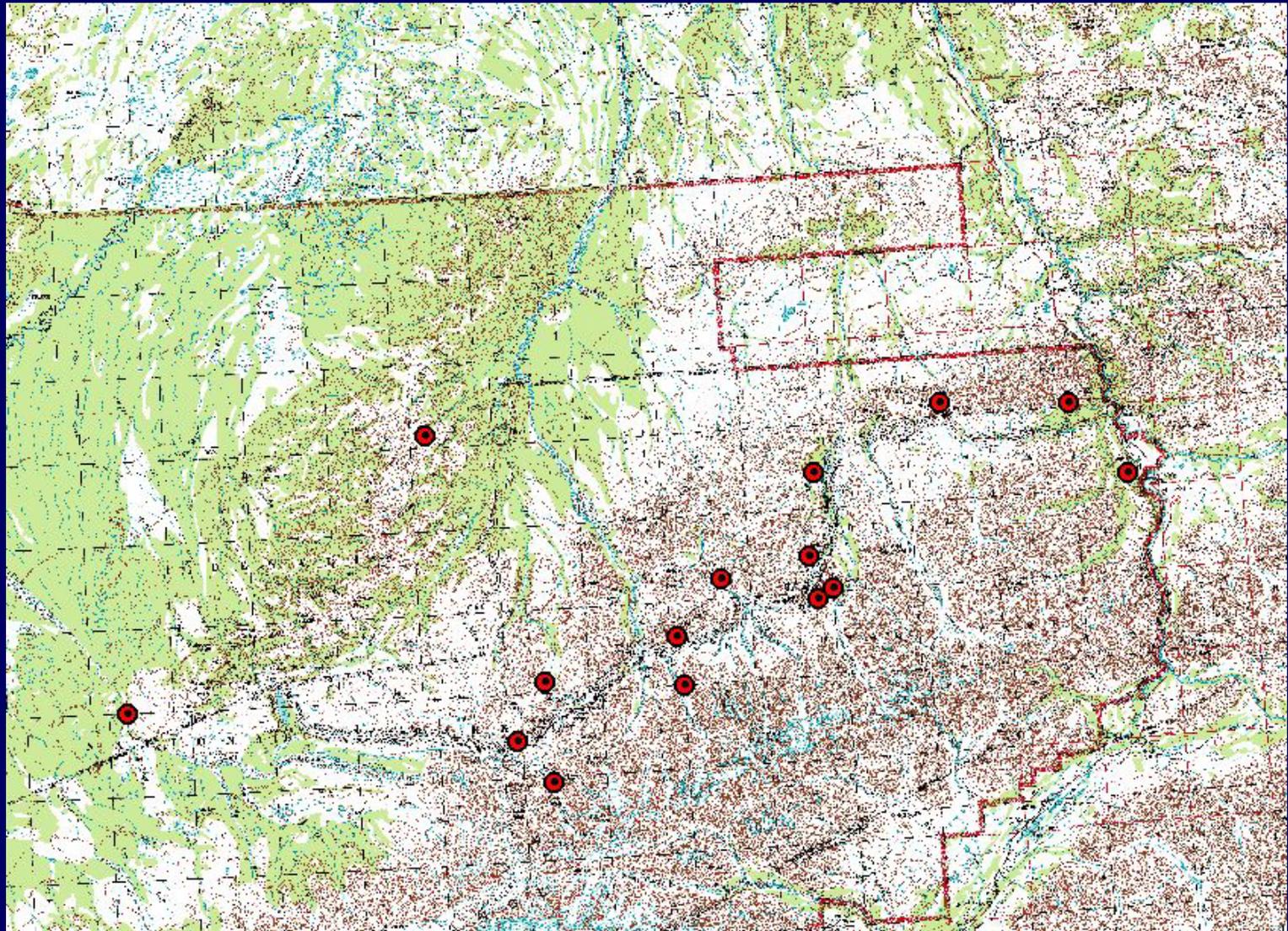
## **Monitoring:**

Observe all known nesting areas within survey boundaries and document:

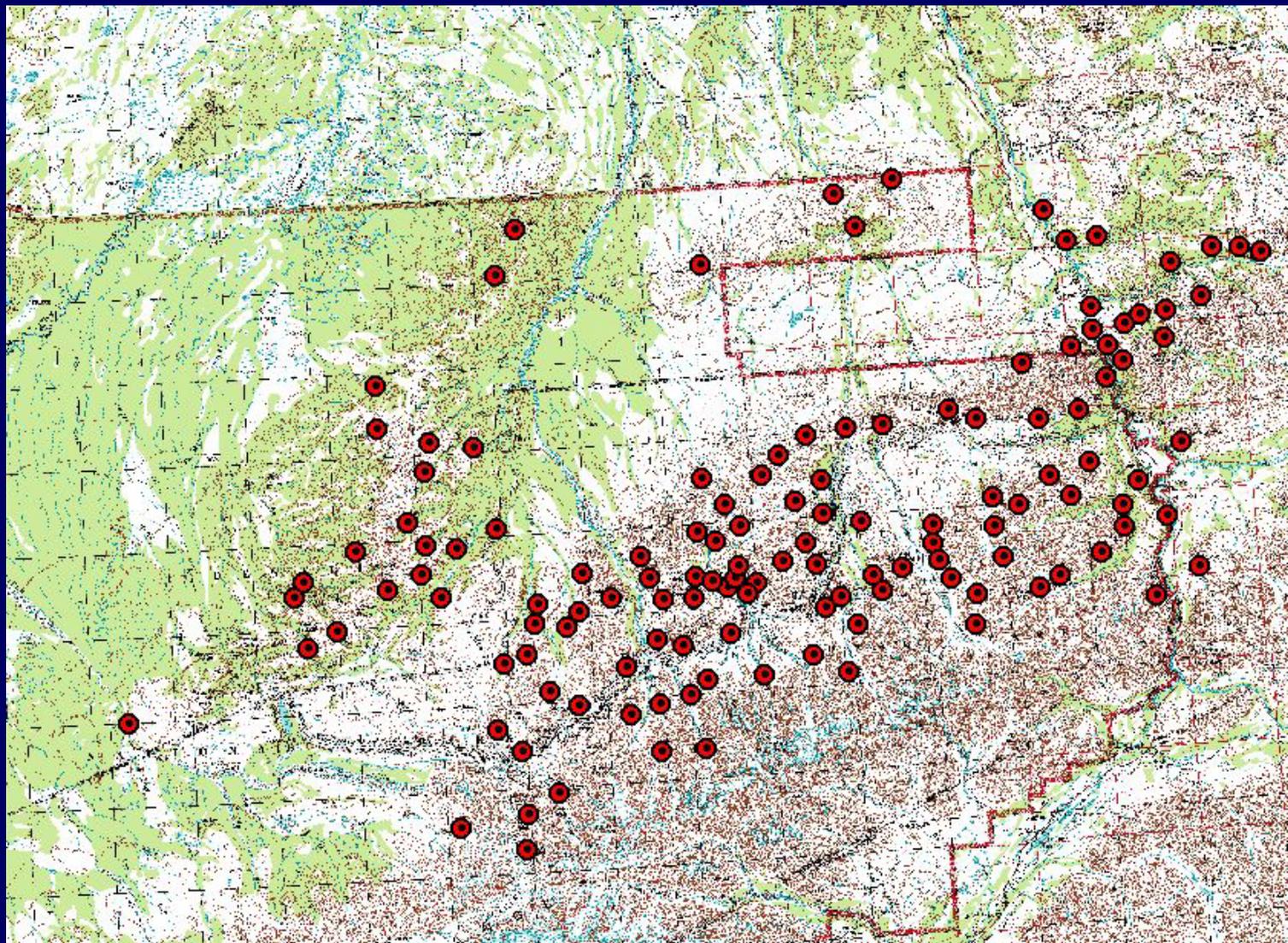
- Occupancy of nesting areas
- Egg-laying
- Number of fledglings produced
- Number of successful nesting pairs

All data recorded on raptor nest site observation cards and entered into computerized database and GIS.

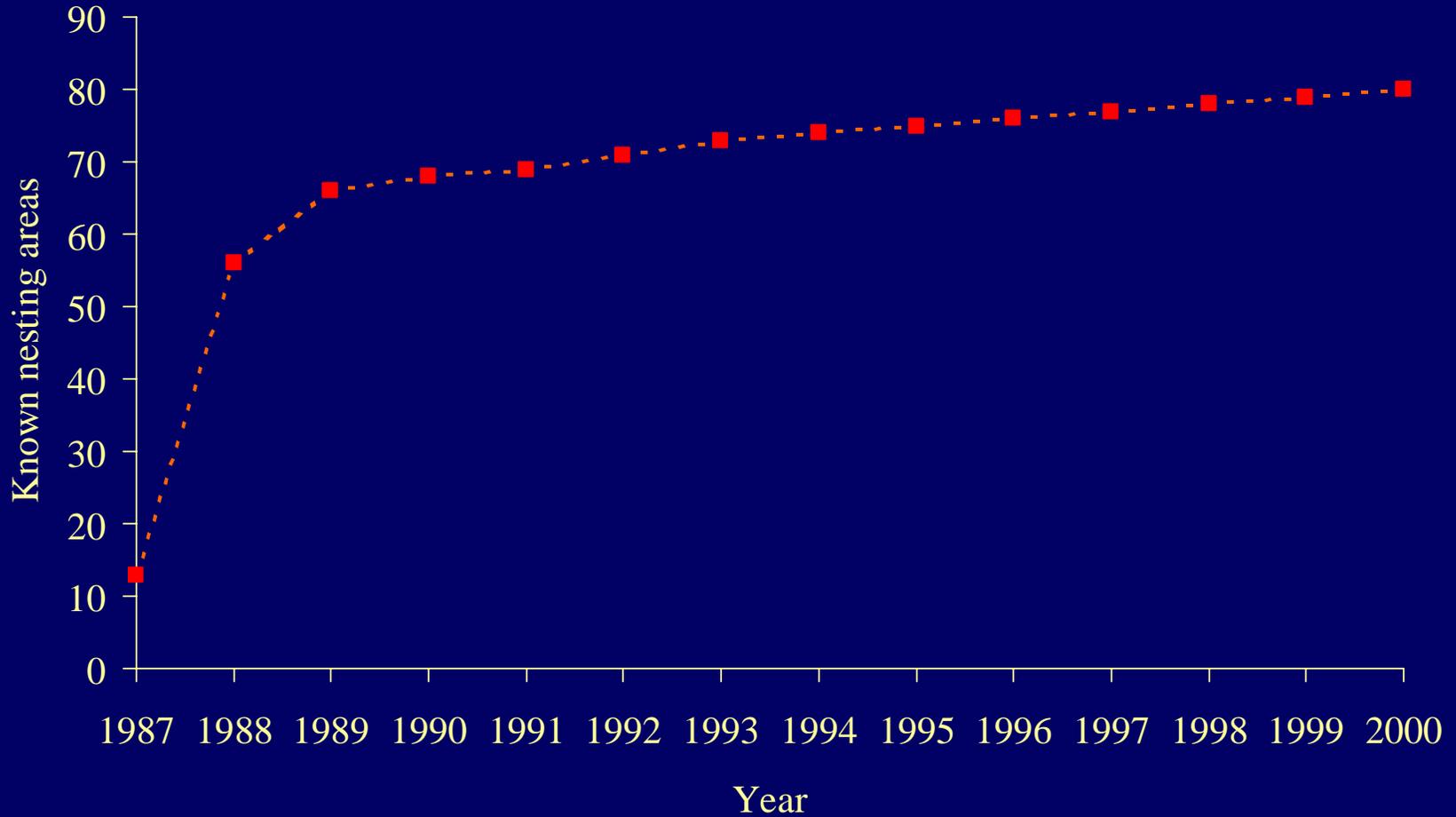
# Known Golden Eagle Nesting Areas: pre-1987



# Known Golden Eagle Nesting Areas: 2000



# Known nesting areas in study area: 1987 - 2000



# Methodology: Occupancy and Laying Rates

**Late April - early May:** aerial surveys by small helicopter with one or two experienced observers (McIntyre +1). Observe all known nesting areas to determine occupancy and document egg laying. Takes 3 to 6 days.



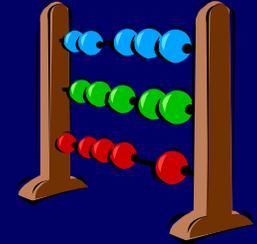
# Methodology: Productivity

Mid to late July: aerial surveys by small helicopter with one or two experienced observers (McIntyre +1). By this time most nestlings have reached 80% of their fledging age but few have actually left the nest. **Takes 6 to 8 hours.**

- observe all nesting areas where egg laying was documented
- count number of nestlings in each nest



# Calculating Reproductive Statistics



**Occupancy rate:** proportion of nesting areas that contained territorial pairs

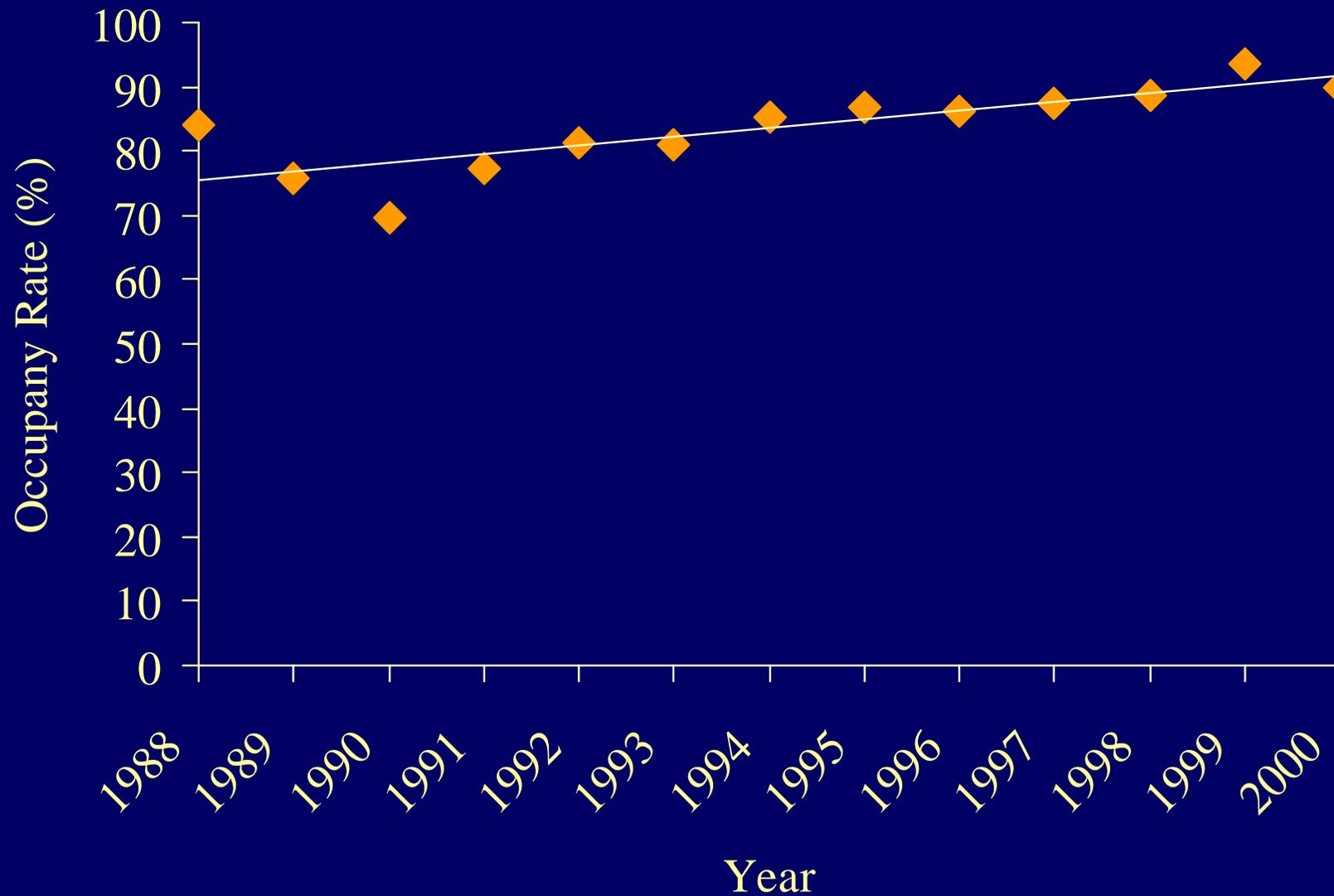
**Laying rate:** proportion of occupied nesting areas that contained laying pairs  
number of nests with eggs / number of occupied nesting areas

**Success rate:** proportion of nesting areas that contained eggs where fledglings were raised

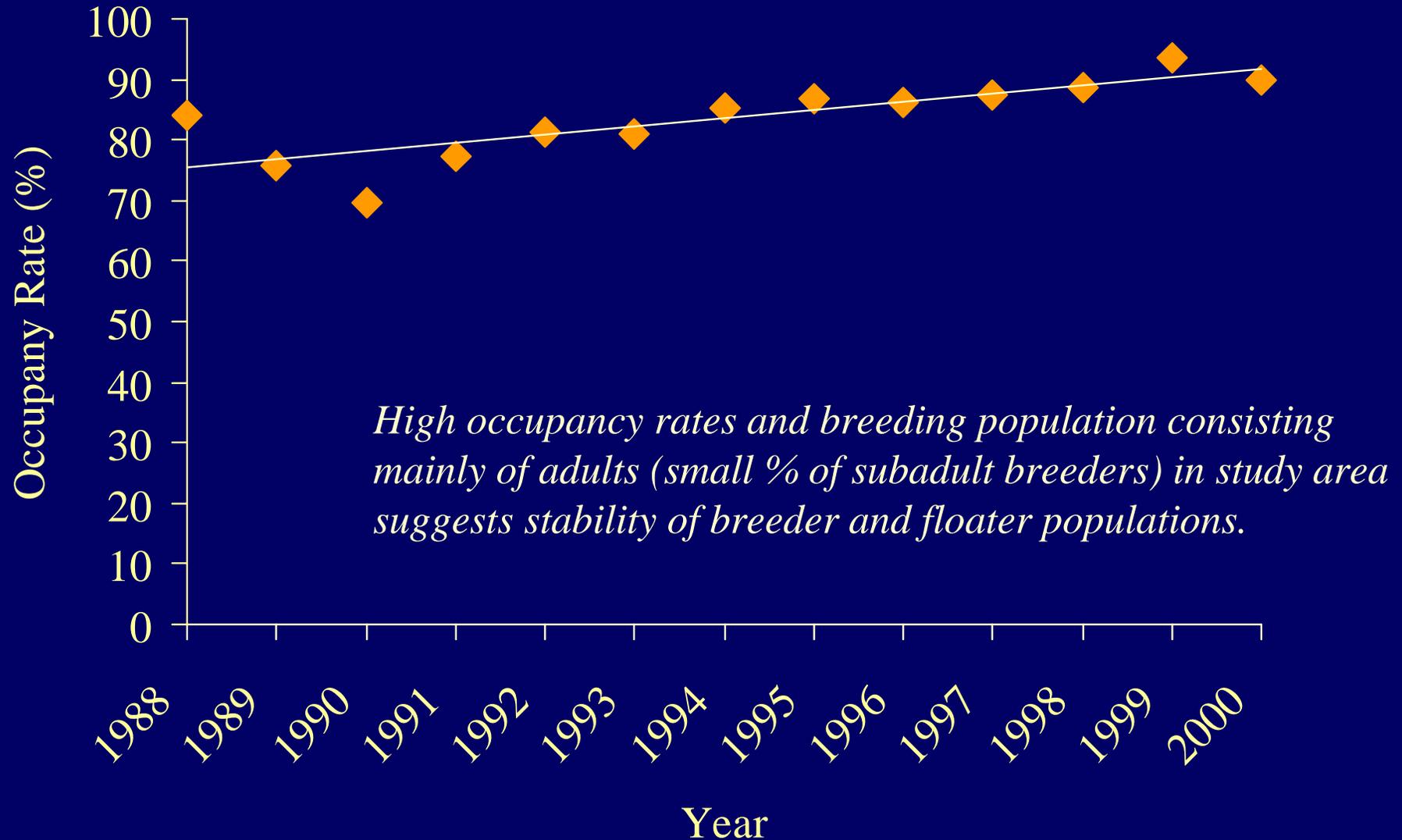
**Mean brood size:** average number of fledglings produced per successful pair

**Overall population productivity:** average number of fledglings produced per territorial pair (or occupied nesting area)

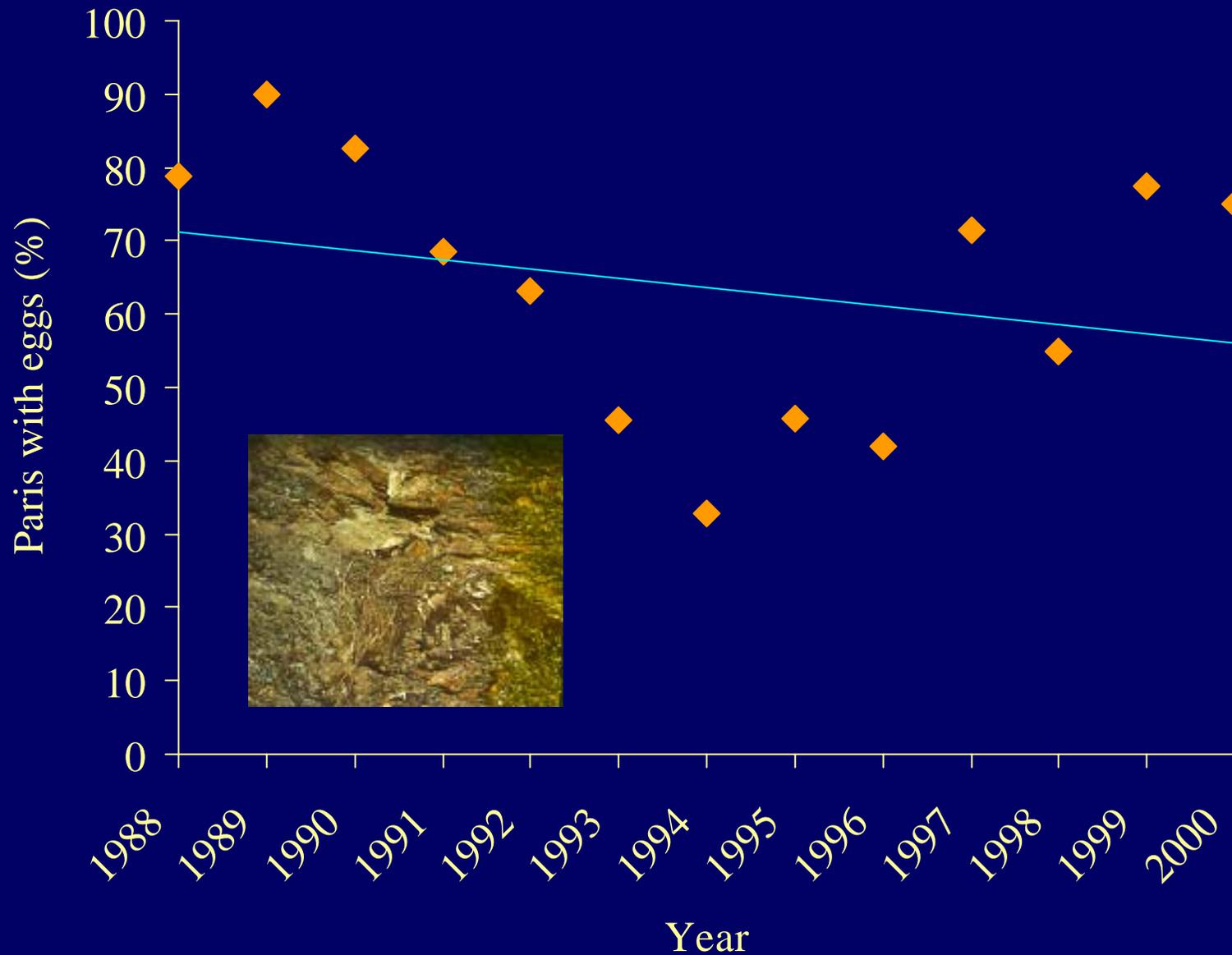
# Occupancy Rate: % of known nesting areas occupied by territorial pairs



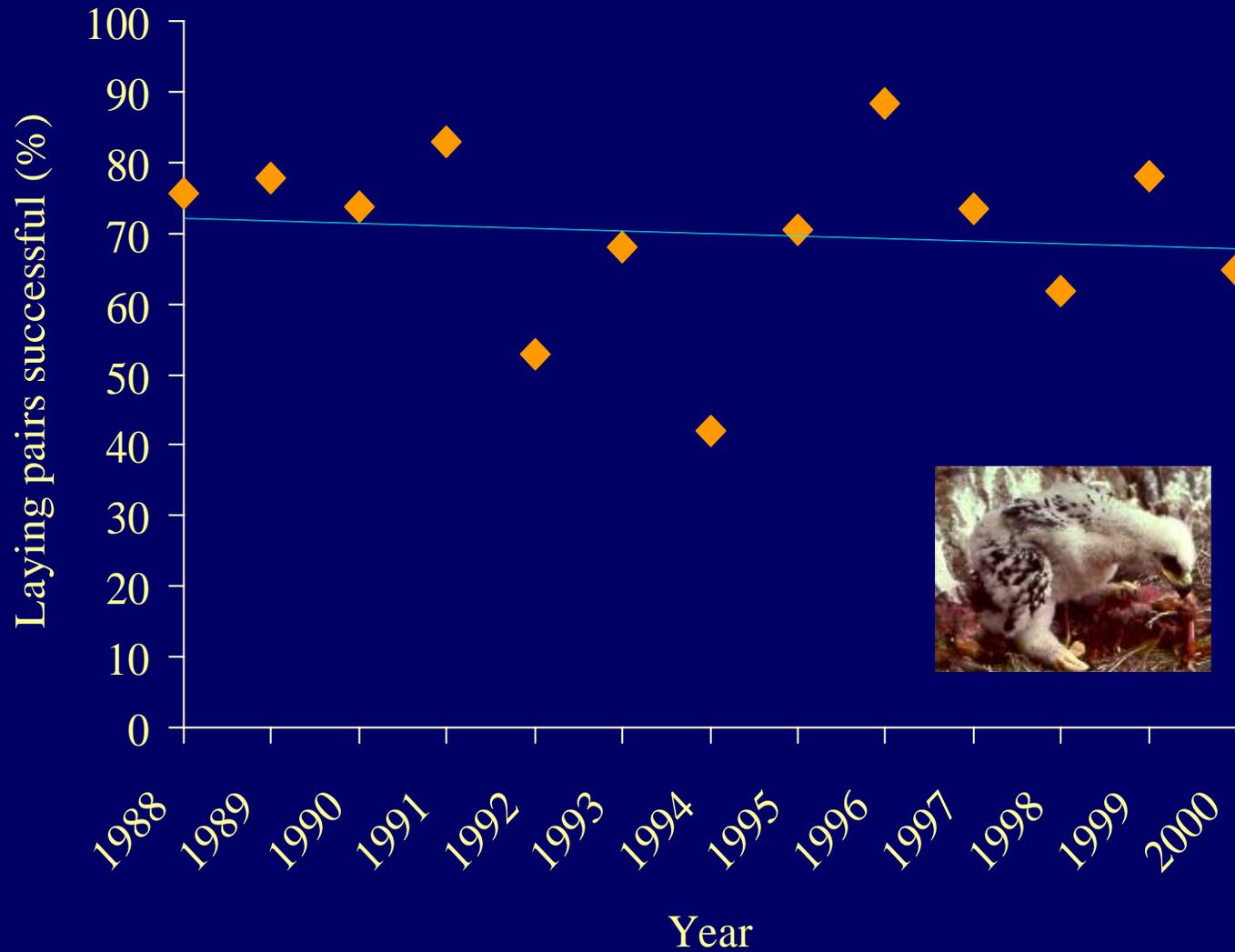
# Occupancy Rate: % of known nesting areas occupied by territorial pairs



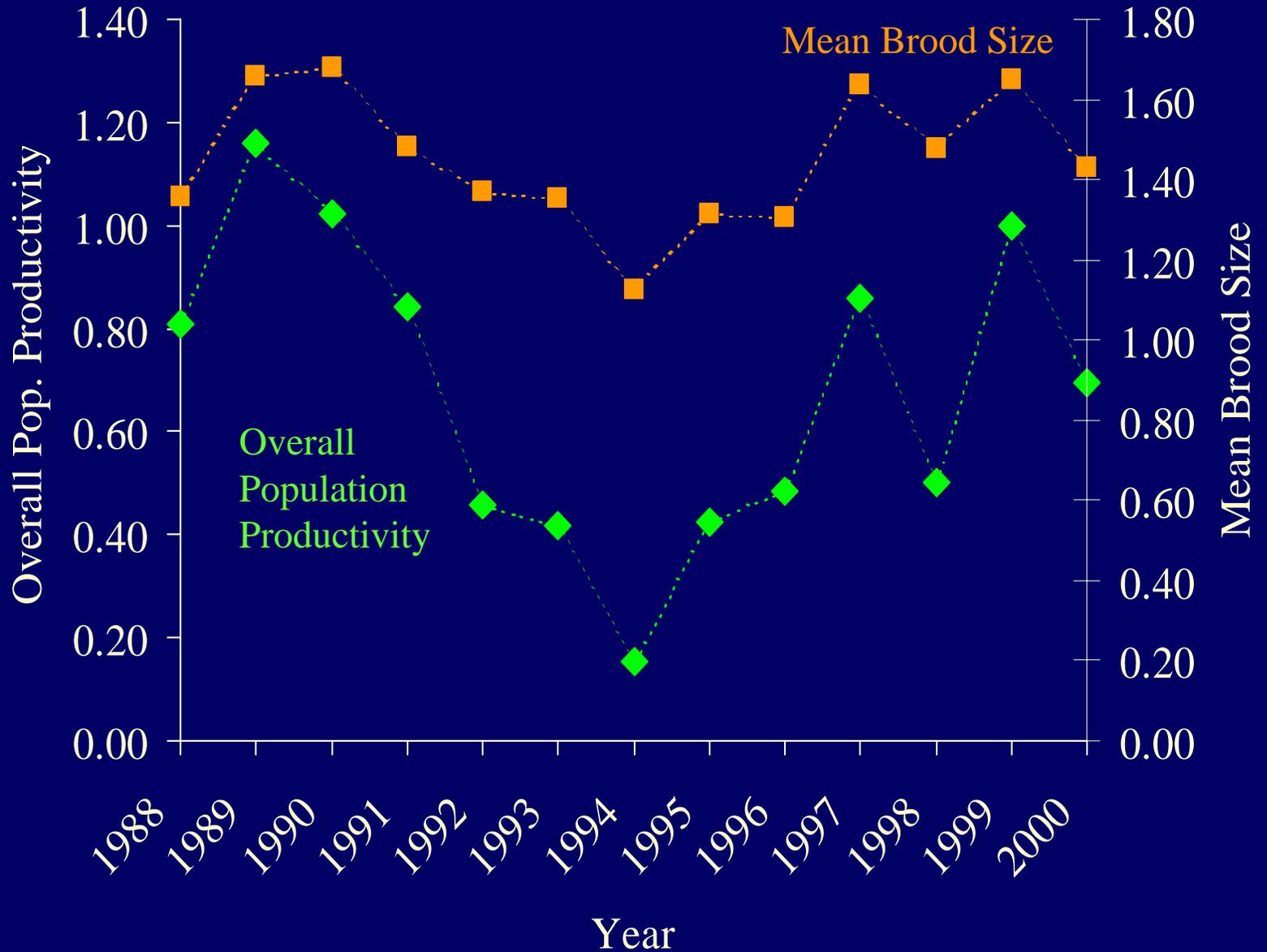
# Laying Rate: % of territorial pairs known to lay eggs



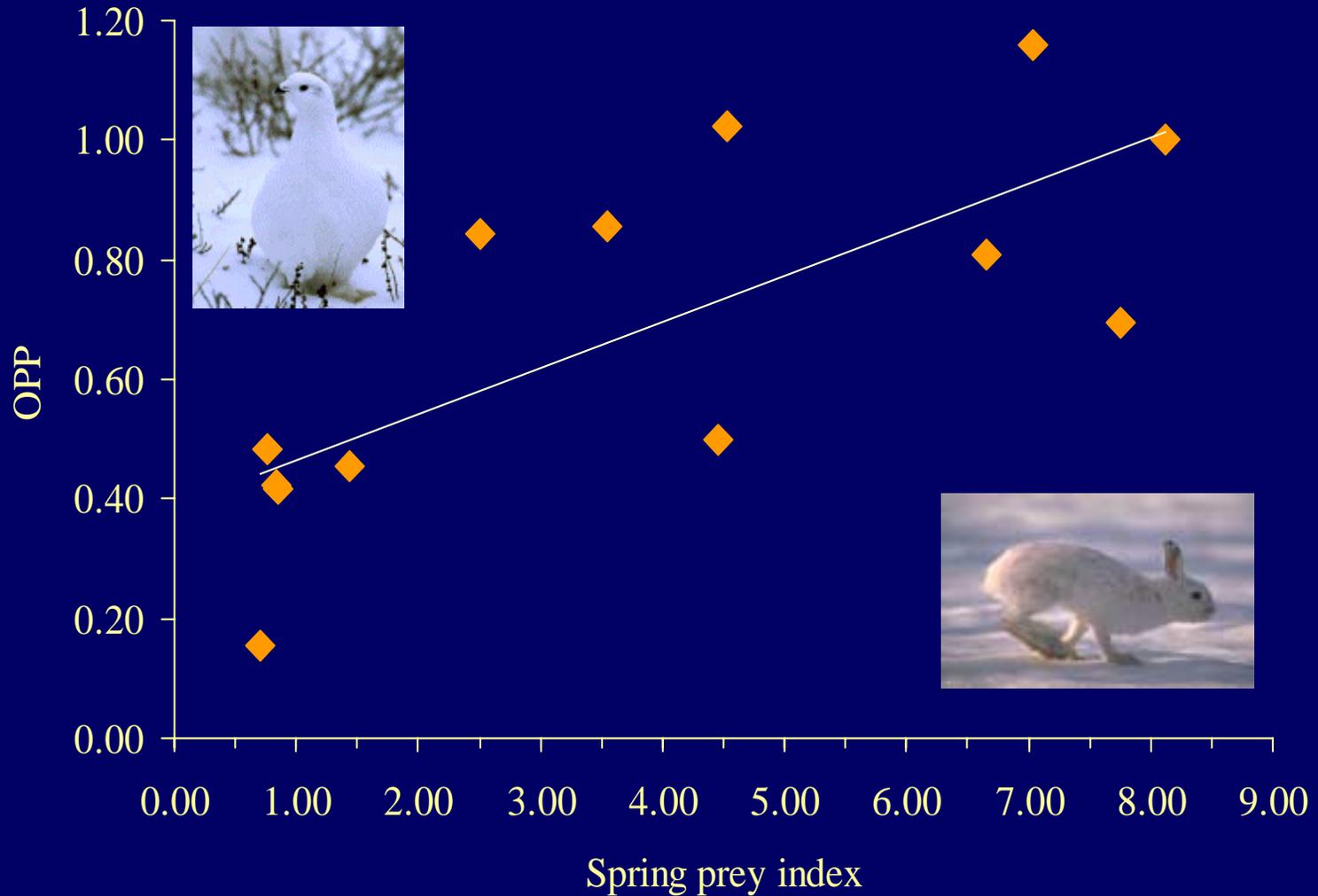
# Success Rate: % of laying pairs raising fledgling(s)



# Production



# Productivity in relation to changes in spring prey abundance



# Importance of individual nesting areas to overall production





## Annual Cost to Collect Data: Aerial Surveys

(n = 70 nesting areas per year)

**Occupancy surveys:** \$ 8,000 to \$12,000 per year

**Productivity surveys:** \$ 3,500 to \$ 5,000 per year

**Total cost:** \$11,500 to \$17,000 per year

**Average cost  
per nest per year:** \$ 167.00 to \$ 246.00



## Value of Long-Term Data Set

1. Full set of occupancy rates and reproductive output for 56 individual nesting areas from 1988 to 2000. Only long-term data set ( $> 15$  pairs,  $> 10$  years) on Golden Eagles breeding at high latitudes in western North America.

Allows us to examine environmental factors that influence occupancy and productivity over time (ongoing Ph.D. research).

Allows us to examine response of eagle population to changes in habitat over time.

2. Occupancy and reproductive data for 56 to 80 nesting areas through a complete snowshoe hare cycle: natural experiment to examine reproductive output in response to changes in prey abundance.



**EAGLE  
VIEW  
ESTATES**





## What's Missing?

Demographic parameters to model population dynamics:  
adult survivorship  
sub-adult survivorship  
recruitment

## Cost Effective Solutions

*Adult survivorship:* estimate adult survivorship by “marking” adults using molecular genetic techniques.

*Sub-adult survivorship:* ?? Radio-telemetry studies?

*Recruitment:* see above



## Questions about the Current Survey Design?

Nonrandom; covers entire study area.

Because eagle nests are fairly conspicuous, detection in study area is assumed to be equal across study area and near 100%.

Area of inference limited to study area boundaries.

Does survey design and lack of random sampling need to be addressed?



## Where Do We Go from Here?

1. Continue to monitor occupancy and reproductive output at 70 to 80 nesting areas per year.

**Benefits:**

consistency in long-term data set  
more power to detect change over time  
examine trends within individual nesting areas



## Where Do We Go from Here?

2. Work cooperatively with USGS Alaska Biological Science Center, Molecular Genetics Lab, to “mark” a sample of breeders in Denali to estimate adult survivorship.

**Benefit:** non-invasive methods

provide data to model population dynamics

examine tenacity of nesting area ownership

examine turnover rates in breeding population



## Where Do We Go from Here?

3. Continue to provide Park management with information on distribution of nesting sites to avoid disturbance due to increases in human visitation.



## Where Do We Go from Here?

4. Continue to provide population data for continent-wide monitoring efforts.



## Where Do We Go from Here?

5. Review current monitoring design and develop sampling design to allow inferences on landscape (park-wide) scale.