Seguimiento a largo plazo del topillo nival (*Chionomys nivalis*) en el Parque Nacional de Ordesa y Monte Perdido: ocupación vs. abundancia

Ramón Antor – Sodemasa - Gobierno de Aragón

Inventariado y monitorización de los recursos naturales en el Parque Nacional de Ordesa y Monte Perdido

Elena Villagrasa - Parque Nacional de Ordesa y Monte Perdido

PARQUES NACIONALES

ORDESA Y MONTE PERDIDO

PARQUE NACIONAL

National Park Service
U.S. Department of the Interior

Resource Brief

Pikas in Peril

Multi-regional vulnerability assessment of a climate-sensitive sentinel species

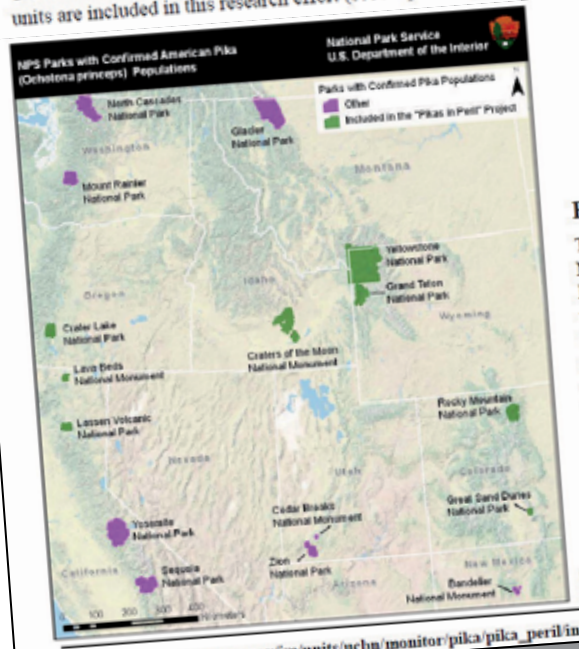
Importance: Species vulnerable to climate change

The American pika is considered an indicator species for detecting ecological effects of climate change. Results from recent studies suggest that in some areas pikas are being lost from lower elevations in response to increased warming, and thus, their suitable habitat is being reduced. In models designed to predict these patterns of loss, the importance of climatic factors has risen dramatically over the past decade. Recent habitat and extinction models predict that pikas may disappear from up to 80% of their current range by the turn of the century. Understanding the pika's vulnerability to climate change can provide important insights to park managers about potential impacts of climate change on park ecosystems. The National Park Service has a unique opportunity to assess the vulnerability of pikas to climate change by studying pika populations within the western U.S. parks. Sixteen western U.S. national park units have pika populations and eight of those units are included in this research effort (see map below).

American pika (*Ochotona princeps*)
Photo: John Apel, NPS

Parks involved in the project

- Crater Lake National Park, OR
- Craters of the Moon National Monument and Preserve, ID
- Grand Teton National Park, WY
- Great Sand Dunes National Park and Preserve, CO
- Lassen Volcanic National Park, CA
- Lava Beds National Monument, CA
- Rocky Mountain National Park, CO
- Yellowstone National Park, WY, MT, ID



Map of park units with confirmed pika populations and those involved in this project

Project background

This 3-year research project, funded through the National Park Service Climate Change Response Program, will address critical shortfalls in our understanding of pika ecology and vulnerability to climate change. A large team of academic researchers and National Park Service staff will work together to address questions regarding the vulnerability of the American pika to future climate change scenarios projected for the western United States. This team will also work with staff from the participating parks to develop information materials for the public and increase awareness.

a distribution across the eight park units.
populations within five park units representing major

tion, connectivity and vulnerability of pika

Above: A technician conducting a pika survey at Great Sand Dunes. *Photo: Jon Harris*
Below: A pika haypile and fresh scat. *Photo: Michael Munts, NPS*

T.J., E.A. Beever, L.K. Garrett, K.M. Irvine, M.R. Jeffress, s, and C. Ray. 2010. Distribution of American pikas in a low- lava landscape: conservation implications from the range periphery. Journal of Mammalogy 91:1287-1299.

Ray, C., E. Beever, and S. Loarie. *In press*. Retreat of the American pika: up the mountain or into the void? In Brodie, J.F., E. Post, and D. Doak, editors. Conserving wildlife populations in a changing climate.

Upper Columbia Basin Network
Resource Brief

Inventory & Monitoring
National Park Service
U.S. Department of the Interior

Pika Research and Monitoring at Craters of the Moon

An American pika at CRMO
Photo: Doug Owen, NPS

Importance: Species Vulnerable to Climate Change

The American pika (*Ochotona princeps*) is considered an indicator species for detecting ecological effects of climate change. Results from recent studies suggest that in some areas pikas are being lost from lower elevations in response to increased warming, and thus, their suitable habitat is being reduced. The National Park Service has a unique opportunity to assess the vulnerability of pikas to climate change and monitor pika population trends over time. Craters of the Moon National Monument & Preserve (CRMO) provides unique, low-elevation pika habitat and is one of eight National Park Service units included in a 3-year research project titled "Pikas in Peril." Additionally, the Upper Columbia Basin Network (UCBN) has developed a long-term pika monitoring protocol, which is being implemented in CRMO and 3 other Pacific West Region parks.

Objectives

"Pikas in Peril" research

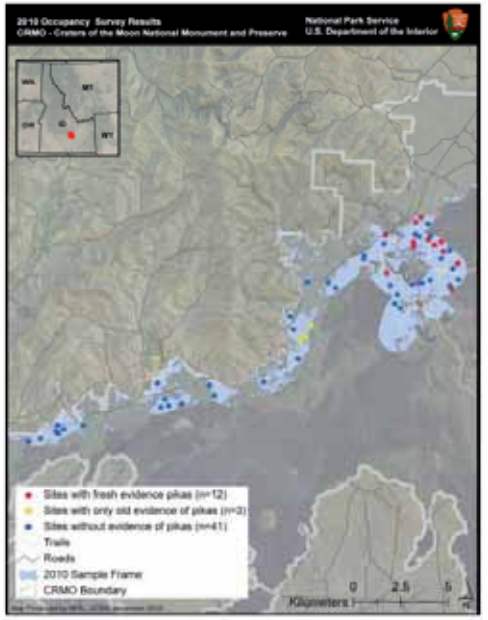
1. Document pika occurrence patterns and predict pika distribution across the eight park units.
2. Measure gene flow and model connectivity of pika populations within five park units (CRMO included).
3. Project climate change effects on the future distribution, connectivity and vulnerability of pika populations in each park unit.

Pika monitoring

1. Determine current patterns of pika site occupancy in the four parks.
2. Determine trends in pika site occupancy patterns in the four parks.

Methods and Preliminary Results

In 2010, research and monitoring methods were merged into a single survey effort. In July and September, 56 randomly-selected sites (12-m radius circular plots) were searched for evidence of pika occupancy in the form of visual encounters, calls, fresh fecal pellets, and fresh food caches found within the site. Pikas occupied 12 (21%) sites surveyed and occupied sites continue to most often be found in the higher elevation, pahoehoe areas. Eleven fresh fecal pellet samples were collected for genetic analysis.



Map of 2010 occupancy survey results for Craters of the Moon NM&P

Timeline and Future Plans

Data analysis will continue fall and winter 2010. Surveys of new sites and resurveys of current sites are scheduled for 2011 with a final research project report due in 2012. Furthermore, these sites will be monitored over time to detect trends in pika site occupancy using the revised UCBN pika monitoring protocol, which was submitted for approval in November 2010. Further details and results from these efforts will be available on the websites listed below.

Contact Information

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"Pikas in Peril" research: http://science.nature.nps.gov/im/units/ucbn/monitor/pika/pika_peril/index.cfm
Pika monitoring: http://science.nature.nps.gov/im/units/ucbn/monitor/pika/pika.cfm

November 2010

Global Change Biology

Global Change Biology (2011) 17, 2054–2070, doi: 10.1111/j.1365-2486.2010.02389.x

Contemporary climate change alters the pace and drivers of extinction

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Abstract

Contemporary climate change is expected to affect the distributions of most species, but the mechanics of contemporary range shifts are still largely speculative. Here, we use fine-scale data developed over the past Century, combined with spatially comprehensive microclimate models, to infer the dramatic shift in the range of a climate-sensitive mammal and to infer the increasingly severe local extinctions of this species across a 38.2 million-ha area. Changes in the distribution of pikas (*Ochotona princeps*) throughout the Great Basin ecoregion were characterized using records spanning a nearly five-fold increase in the rate of local extinction and an 11-fold increase in the rate of local extinction during the last ten years, compared with during the 20th Century. Four of ten local extinctions since 1999, and across this ecoregion the low-elevation range boundary for this species shifted at an average rate of about 145 m per decade. The rapid, ecoregional range shift of this small mammal in remarkable contrast with the dynamics and determinants of endangerment previously documented species, and to earlier extinction determinants for *O. princeps* in this region. Further investigation change are evolving in different portions of the earth.

Keywords: American pika, environmental change, Great Basin ecoregion, information-theoretic determinants, model updating, montane biotas, *Ochotona princeps*, upslope range retraction

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Introduction

Many taxa respond to interannual fluctuations in precipitation, temperature, and extreme climatic events over ecological and evolutionary timescales (Post & Forchhammer, 2002; Stenseth *et al.*, 2002; Walther *et al.*, 2002; Lyons, 2003; Thomas *et al.*, 2004; Cardillo *et al.*, 2005; Morrison & Hik, 2007; Schipper *et al.*, 2008). Climate-driven changes in phenology, morphology, density, and genetics have been suggested by many recent studies, and geographic ranges of some species are expanding towards higher latitudes and elevations (Parmesan *et al.*, 1999; Thomas & Lennon, 1999; Walther *et al.*, 2002; Root *et al.*, 2003; Wilson *et al.*, 2005; Kelly & Goulden, 2008; Moritz *et al.*, 2008). Still, the link between climate change and species response remains largely correlative.

To date, some species distrib change have b areas, using period or ju temperature meters or h 2002; Parm short spati temporall response tionally, only tw possibl compa deter Altho nour 197 Cha ran

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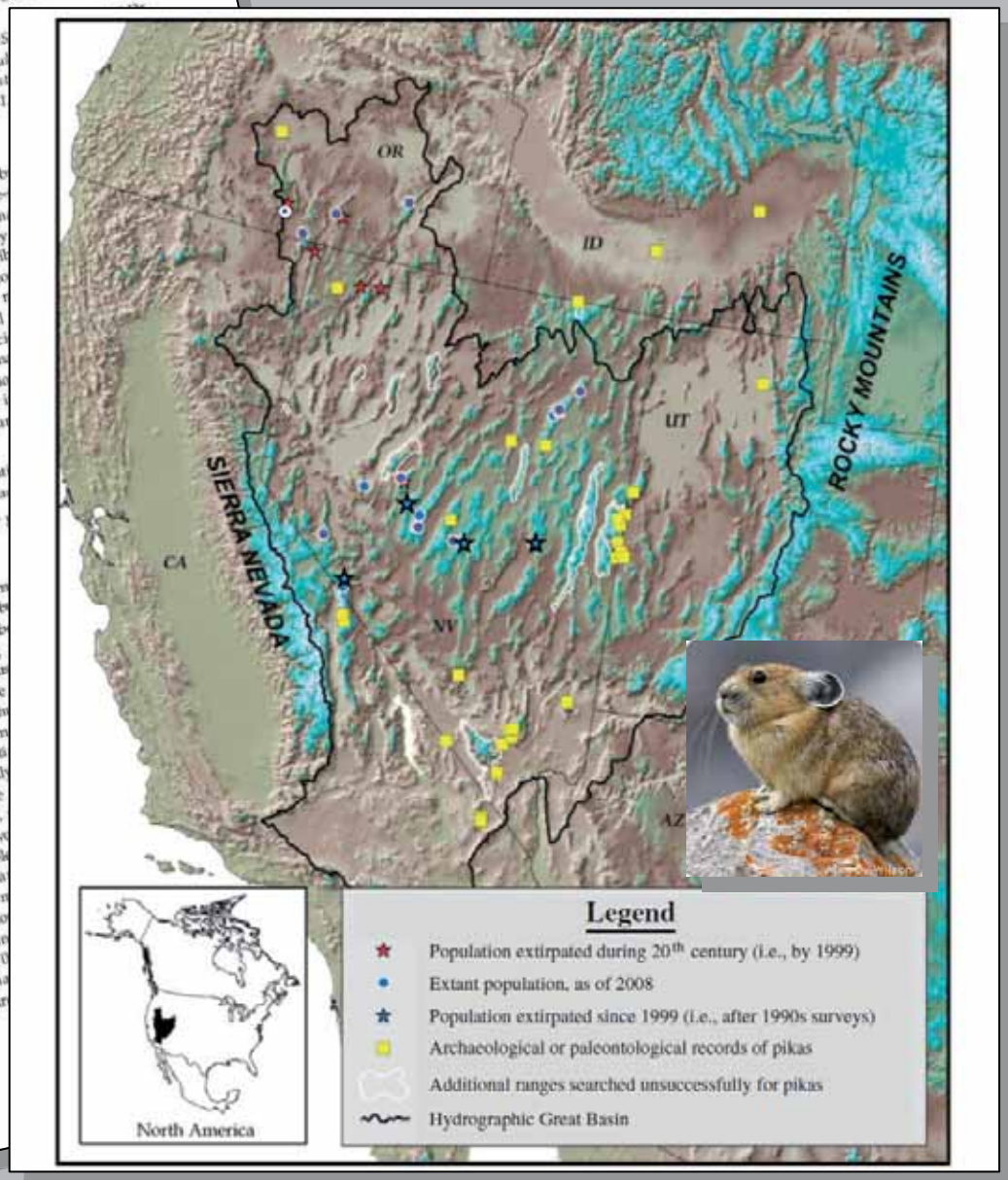
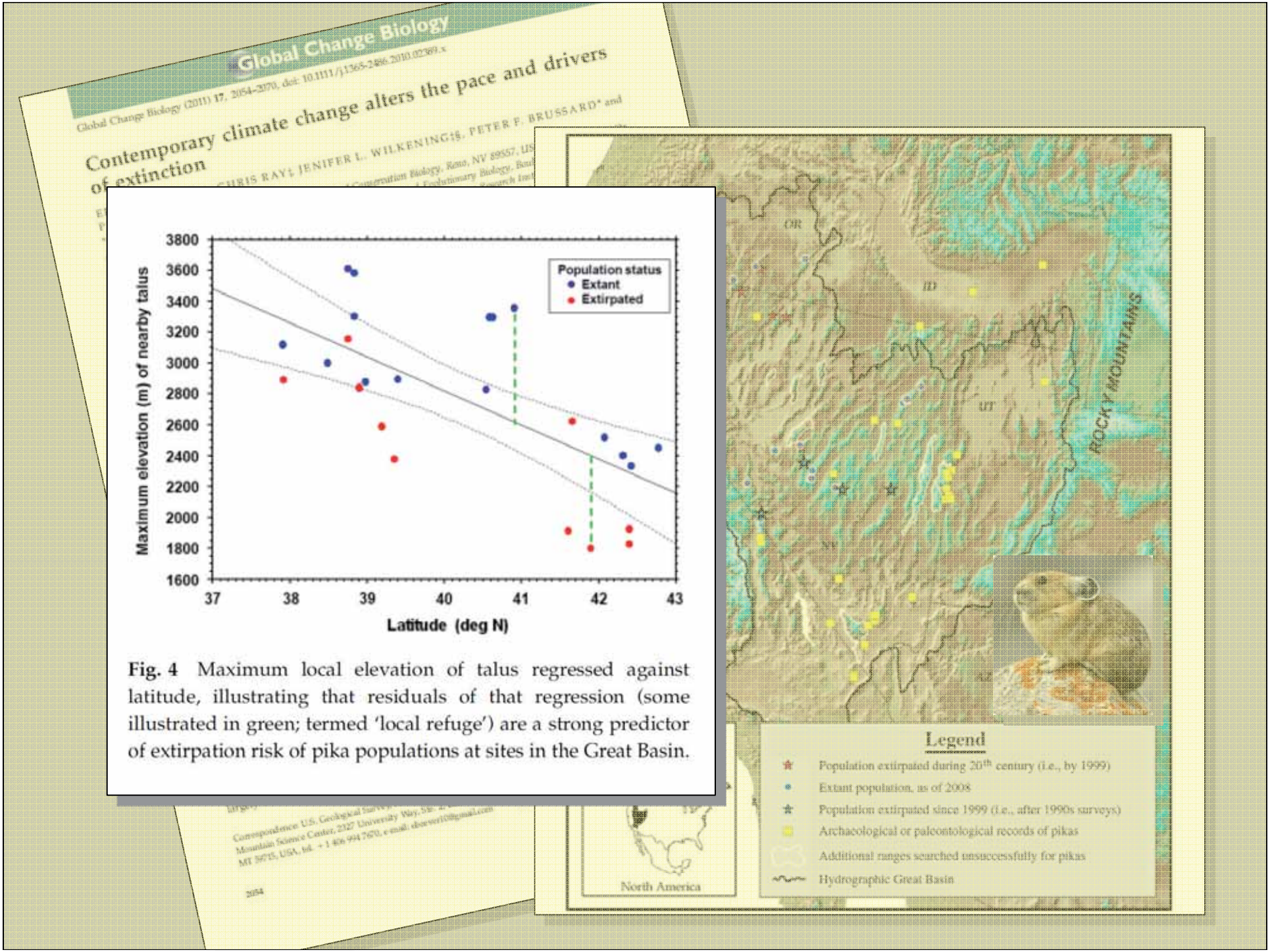
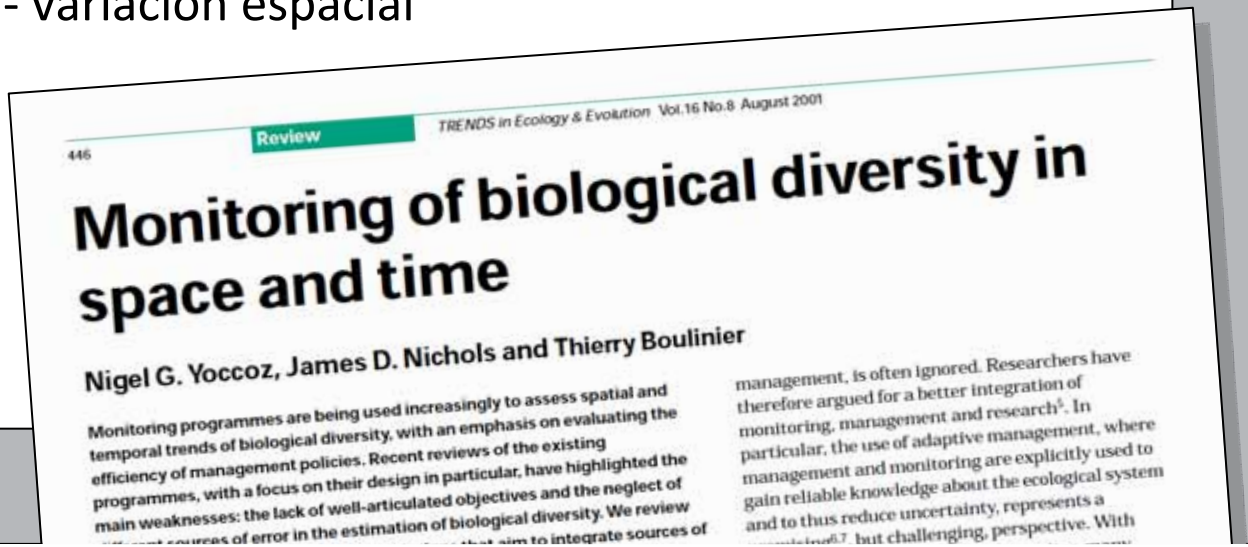



Global Change Biology
Contemporary climate change alters the pace and drivers of extinction
Population status
Extant
Extirpated
Maximum elevation (m) of nearby talus
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
37
38
39
40
41
42
43
Latitude (deg N)
Fig. 4 Maximum local elevation of talus regressed against latitude, illustrating that residuals of that regression (some illustrated in green; termed 'local refuge') are a strong predictor of extirpation risk of pika populations at sites in the Great Basin.
OR
ID
UT
ROCKY MOUNTAINS
Legend
Population extirpated during 20th century (i.e., by 1999)
Extant population, as of 2008
Population extirpated since 1999 (i.e., after 1990s surveys)
Archaeological or paleontological records of pikas
Additional ranges searched unsuccessfully for pikas
Hydrographic Great Basin
North America

Monitorización de sistemas biológicos

- *Why*: Objetivos de la recolección de datos
- *What*: Elegir una variable de estado
  - abundancía o tamaño poblacional
  - proporción de área ocupada
  - riqueza especies
- *How*: Dos fuentes de error
  - probabilidad de detección
  - variación espacial



446 Review TRENDS in Ecology & Evolution Vol.16 No.8 August 2001

Monitoring of biological diversity in space and time

Nigel G. Yoccoz, James D. Nichols and Thierry Boulinier

Monitoring programmes are being used increasingly to assess spatial and temporal trends of biological diversity, with an emphasis on evaluating the efficiency of management policies. Recent reviews of the existing programmes, with a focus on their design in particular, have highlighted the main weaknesses: the lack of well-articulated objectives and the neglect of sources of error in the estimation of biological diversity. We review

management, is often ignored. Researchers have therefore argued for a better integration of monitoring, management and research[5]. In particular, the use of adaptive management, where management and monitoring are explicitly used to gain reliable knowledge about the ecological system and to thus reduce uncertainty, represents a

Contributed Paper

Current Trends in Plant and Animal Population Monitoring

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Abstract: *Animal and plant population monitoring programs are criti
uating the effects of management or harvest, and tracking invasive and
activities are highly decentralized, which makes it difficult for researc
good general picture of what real-world monitoring programs actuall
to collect information on population monitoring programs. The surv
each program, including motivations for monitoring, types of data
of the program, and reasons for choosing that design. We received r
monitoring of various species and used these responses to summariz
used responses to determine whether monitoring strategies have chang
among monitoring agencies. Most commonly, monitoring entailed co
with the primary goal of detecting trends. But we also found that goals
to be diversifying, that area-occupied and presence–absence approache
and that several other promising approaches (monitoring to reduce p
toring, and directly linking monitoring data to management decisions
We suggest that improved communication between researchers study
are charged with putting these designs into practice could further im
match sampling designs to the objectives of monitoring programs.*

Keywords: biodiversity, government agencies, monitoring programs,
tion decline, population monitoring, sampling designs

Tendencias Actuales en el Monitoreo de Poblaciones de Plantas y Anim

Resumen: *Los programas de monitoreo de poblaciones de animal
cación de especies en riesgo, la evaluación de efectos del manejo o c
e invasoras. Sin embargo, las actividades de monitoreo están muy
investigadores o los planificadores de conservación tengan un buen
programas de monitoreo en el mundo real. Utilizamos un muestr
mación sobre programas de monitoreo de poblaciones. El muestre
cada programa, y las razones para seleccionar ese diseño. Recibimo
en el monitoreo de varias especies, y utilizamos estas respuestas
actuales. También utilizamos las respuestas para determinar si la
en el tiempo y si difieren entre agencias de monitoreo. En general,
conteo en múltiples sitios con el objetivo primario de detectar tend
metas y estrategias de monitoreo eran diversas, y que los enfoques*

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Paper submitted May 4, 2007; revised manuscript accepted November 12, 200

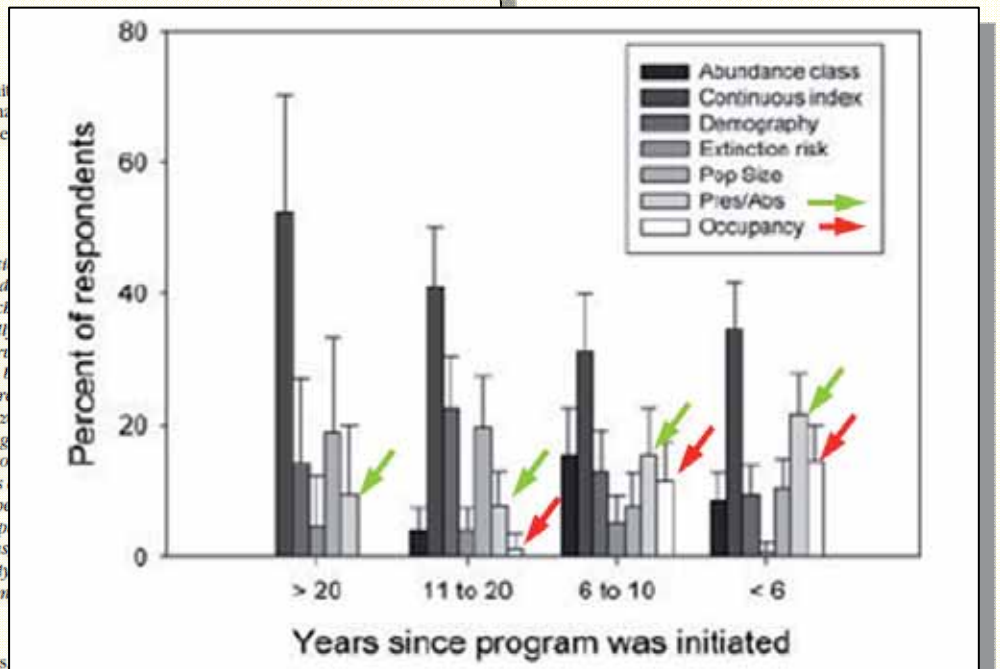

Figure 2. Changes over time in state variables used for monitoring populations of plants and animals. Grouped bars show the most common state variables for programs begun more than 20 years ago, programs begun between 11 and 20 years ago, programs begun 6–10 years ago, and programs begun within the past 5 years (<6). Error bars show margins of sampling error (pop, population; pres/abs, presence/absence).

Conservation Biology, Volume 22, No. 3, 647–655

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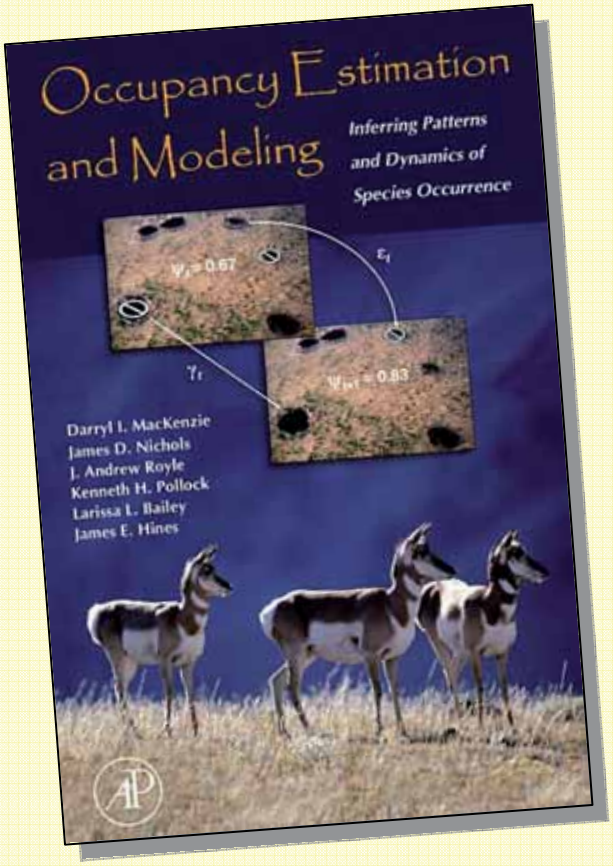
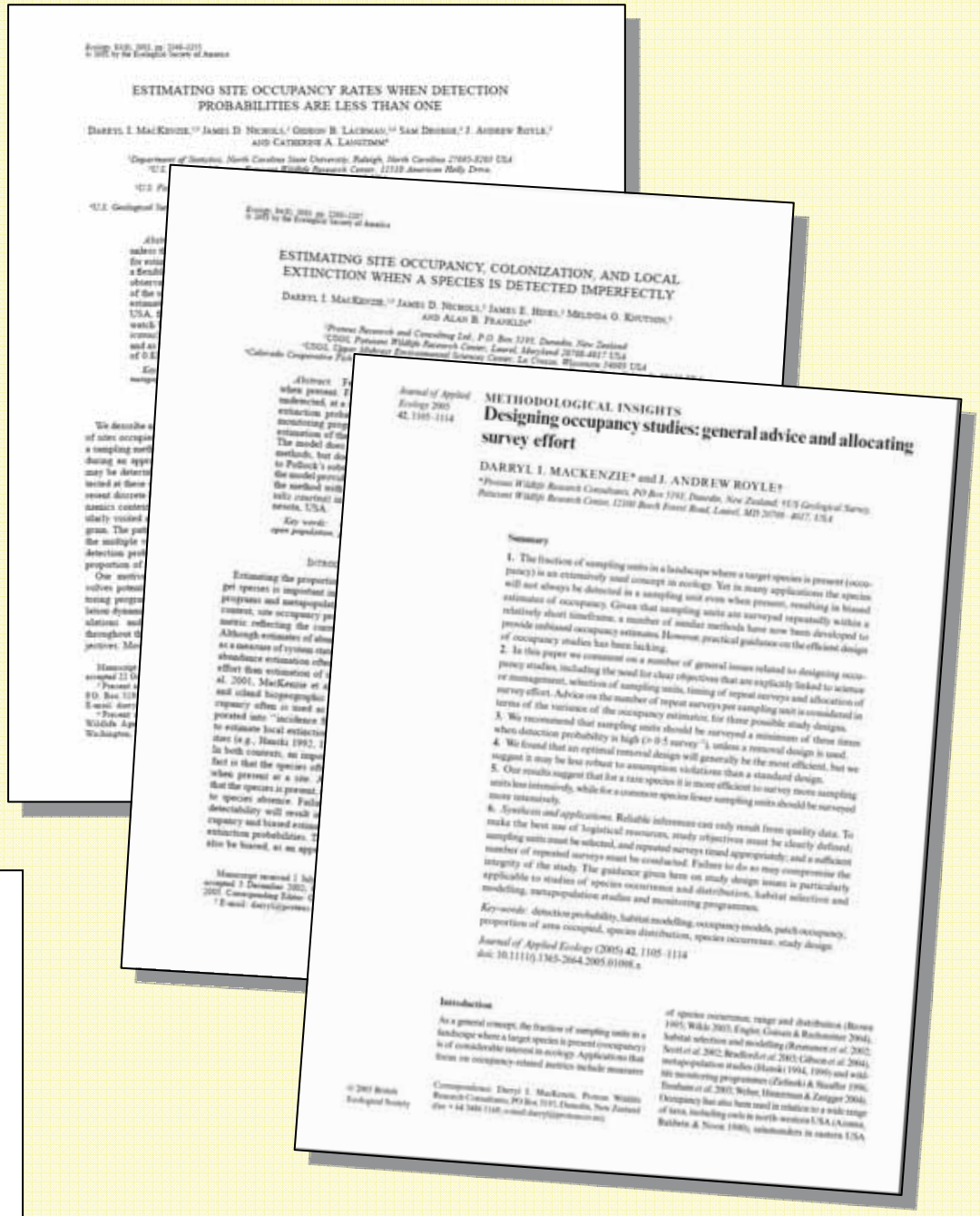




ESTIMATING SITE OCCUPANCY RATES WHEN DETECTION PROBABILITIES ARE LESS THAN ONE

ESTIMATING SITE OCCUPANCY, COLONIZATION, AND LOCAL EXTINCTION WHEN A SPECIES IS DETECTED IMPERFECTLY

METHODOLOGICAL INSIGHTS

Designing occupancy studies: general advice and allocating survey effort

DARRYL I. MACKENZIE* and J. ANDREW ROYLE†

Program PRESENCE

J. Hines

http://www.mbr-pwrc.usgs.gov/software/presence.htm)

Diseño del programa de seguimiento

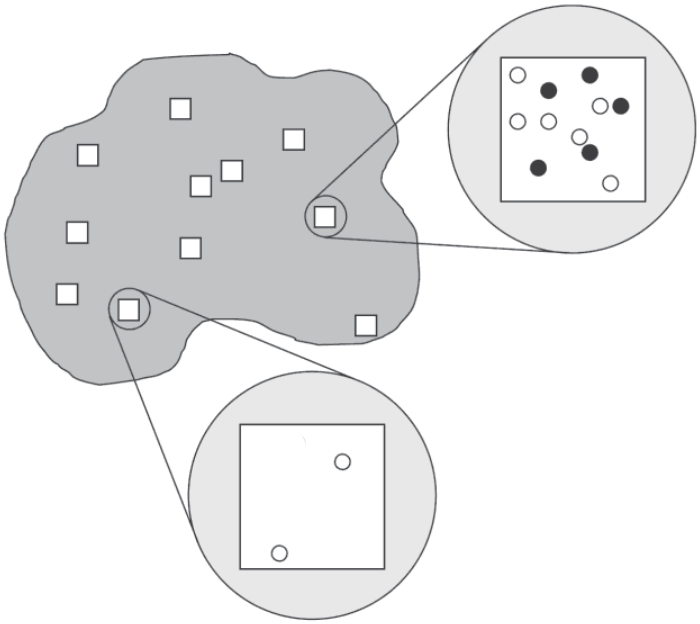


FIGURE 1.1 Illustration of the two critical aspects of sampling animal populations, spatial variation and detectability. The shaded region indicates the area or population of interest, with the small squares representing the locations selected for sampling. Within each sampling location, animals will be detected (filled circles) or undetected (hollow circles) during a survey or count.

- Número de repeticiones de cada sitio

- Número de sitios a muestrear

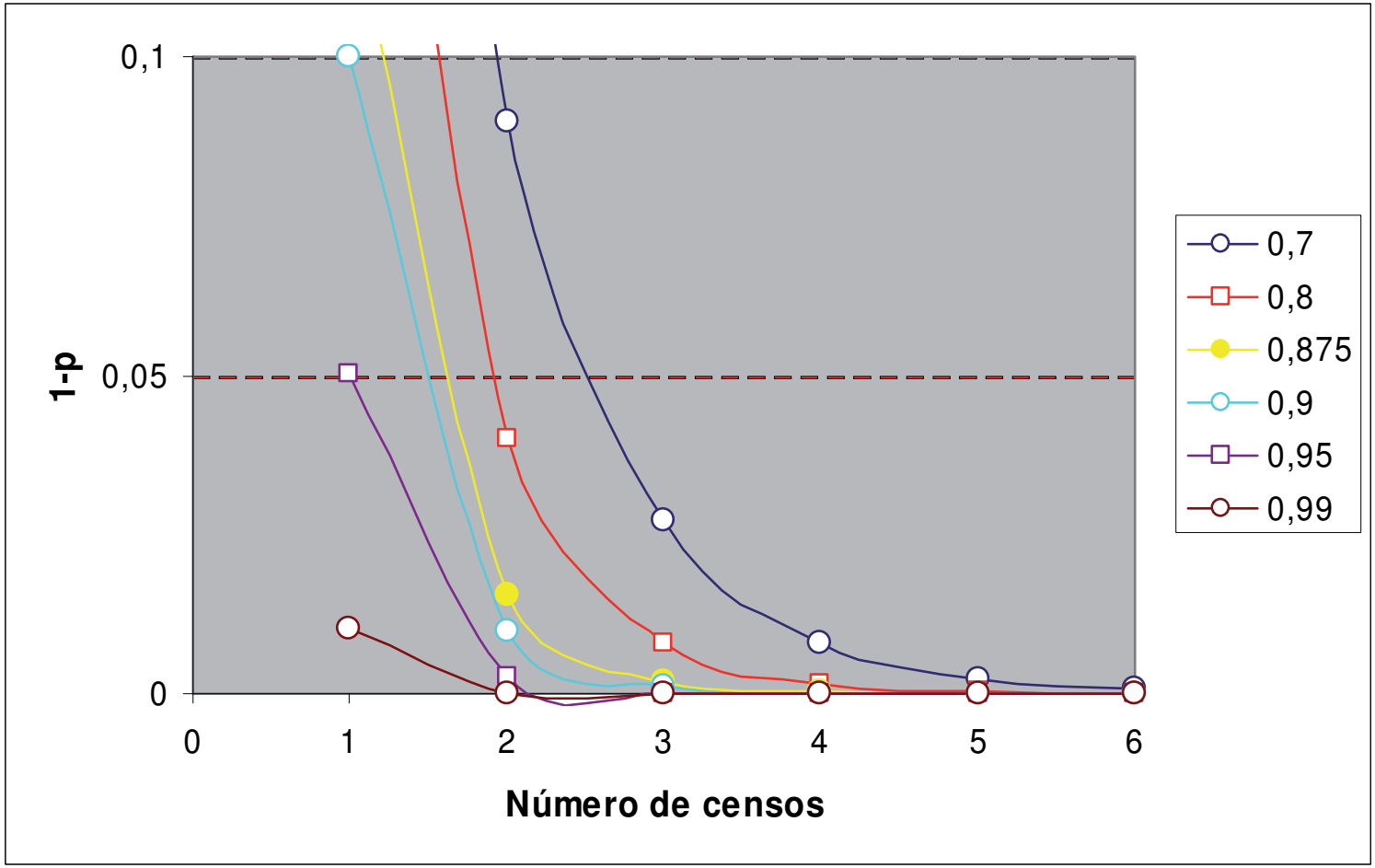
Topillo nival en el PNOMP

- Alta ocupación: ≥ 0,9

Topillo nival en el PNOMP

- Alta detectabilidad (≥ 0,9). Esfuerzo de muestreo: 20 trampas Sherman / 1 noche

Probabilidad de NO detectar la especie en función del número de censos



Journal of Applied Ecology 2005
42, 1105–1114

METHODOLOGICAL INSIGHTS

Designing occupancy studies: general advice and allocating survey effort

DARRYL I. MACKENZIE* and J. ANDREW ROYLE†

Proteus Wildlife Research Consultants, PO Box 5193, Dunedin, New Zealand; †US Geological Survey, Patuxent Wildlife Research Center, 12100 Beech Forest Road, Laurel, MD 20708–4017, USA

Table 3. Optimal maximum number of surveys to conduct at each site for a removal design where all sites are surveyed until the species is first detected, where cost of the first and subsequent surveys are equal

	ψ								
p	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
0·1	23	24	25	26	28	31	34	39	49
0·2	11	11	12	13	13	15	16	19	23
0·3	7	7	7	8	8	9	10	12	14
0·4	5	5	5	6	6	6	7	8	10
0·5	4	4	4	4	4	5	5	6	8
0·6	3	3	3	3	3	4	4	5	6
0·7	2	2	2	3	3	3	3	4	5
0·8	2	2	2	2	2	2	3	3	4
0·9	2	2	2	2	2	2	2	2	3

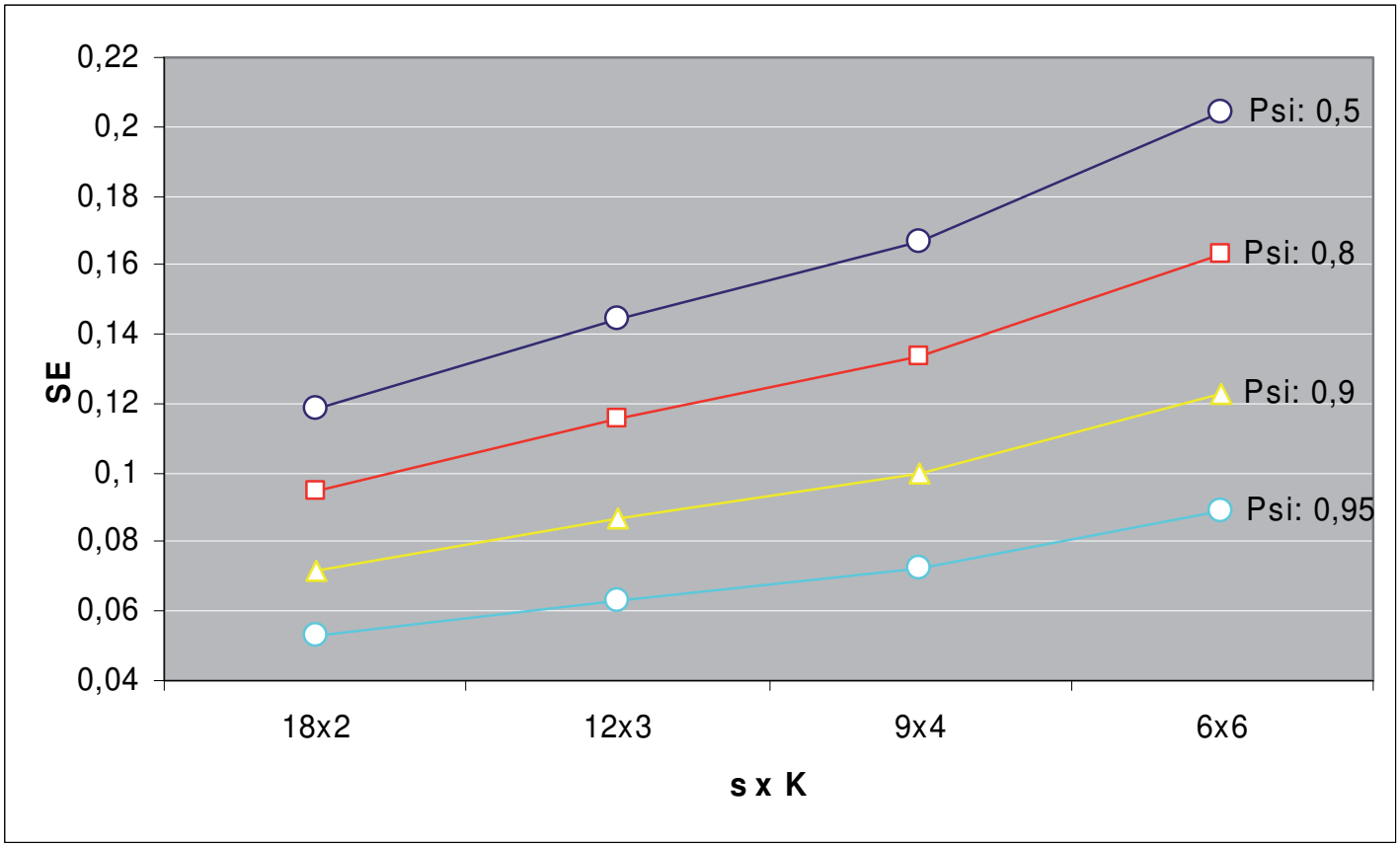
Table 4. Ratio of standard errors for optimal standard and removal designs, where cost of the first and subsequent surveys are equal. Values < 1 indicate situations where an optimal standard design has a smaller standard error

	ψ								
p	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
0·1	0·90	0·94	0·98	1·04	1·10	1·18	1·30	1·46	1·74
0·2	0·91	0·94	0·99	1·04	1·10	1·18	1·28	1·44	1·71
0·3	0·92	0·95	0·99	1·04	1·10	1·17	1·27	1·42	1·68
0·4	0·93	0·96	0·99	1·03	1·09	1·17	1·26	1·40	1·64
0·5	0·93	0·96	1·00	1·04	1·08	1·16	1·24	1·37	1·60
0·6	0·94	0·97	1·01	1·06	1·09	1·15	1·22	1·35	1·55
0·7	0·95	0·96	0·97	1·01	1·07	1·13	1·22	1·31	1·48
0·8	1·00	1·02	1·04	1·07	1·09	1·11	1·15	1·25	1·45
0·9	1·02	1·05	1·07	1·10	1·13	1·17	1·20	1·24	1·31

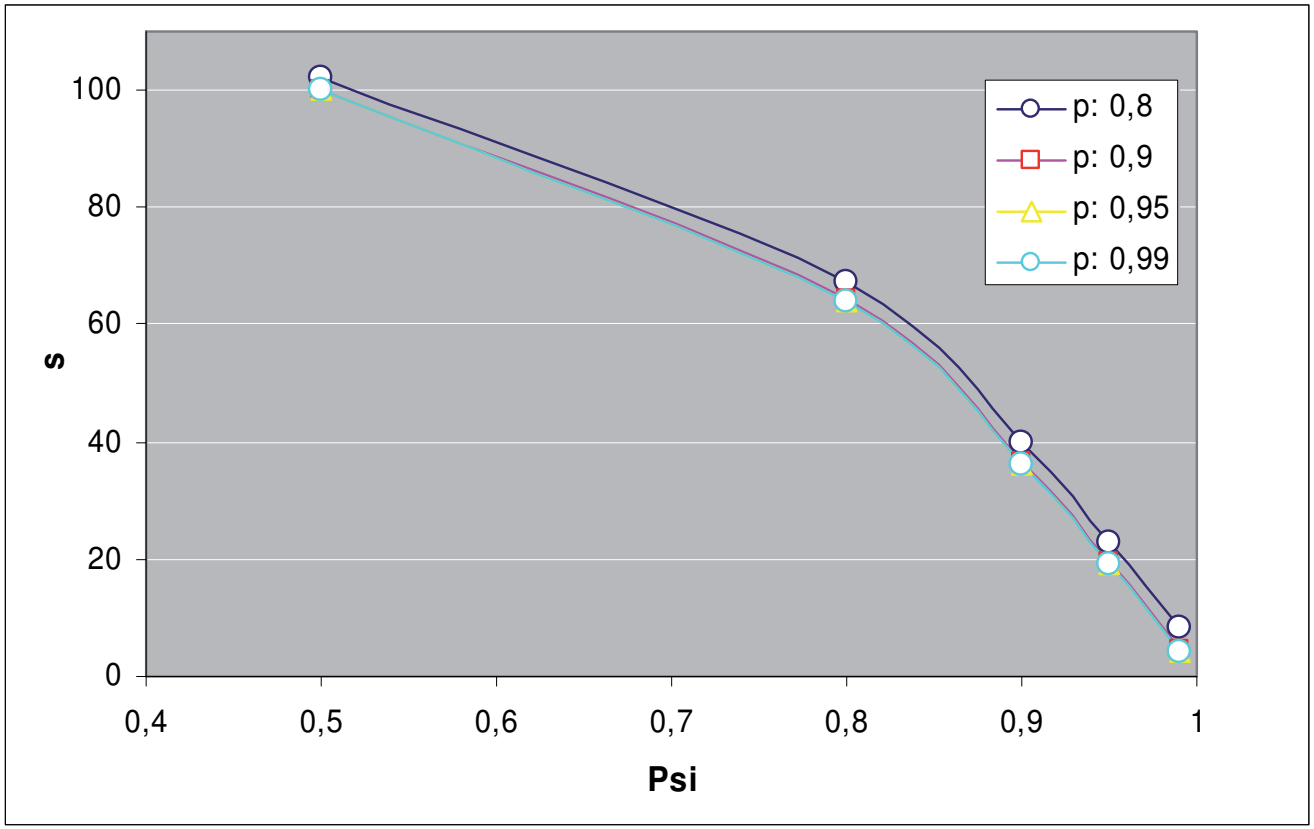
$$\mathrm{var}(\hat{\psi}) = \frac{\psi}{s}\left[(1-\psi) + \frac{p^*(1-p^*)}{(p^*)^2 - K^2 p^2 (1-p)^{K-1}}\right]$$

En la que Ψ es la probabilidad de ocupación estimada en la muestra, p es la probabilidad de deteccion, K es el numero de ocasiones a muestrear y $p^*=1-(1-p)^K$.

Número de repeticiones de cada sitio

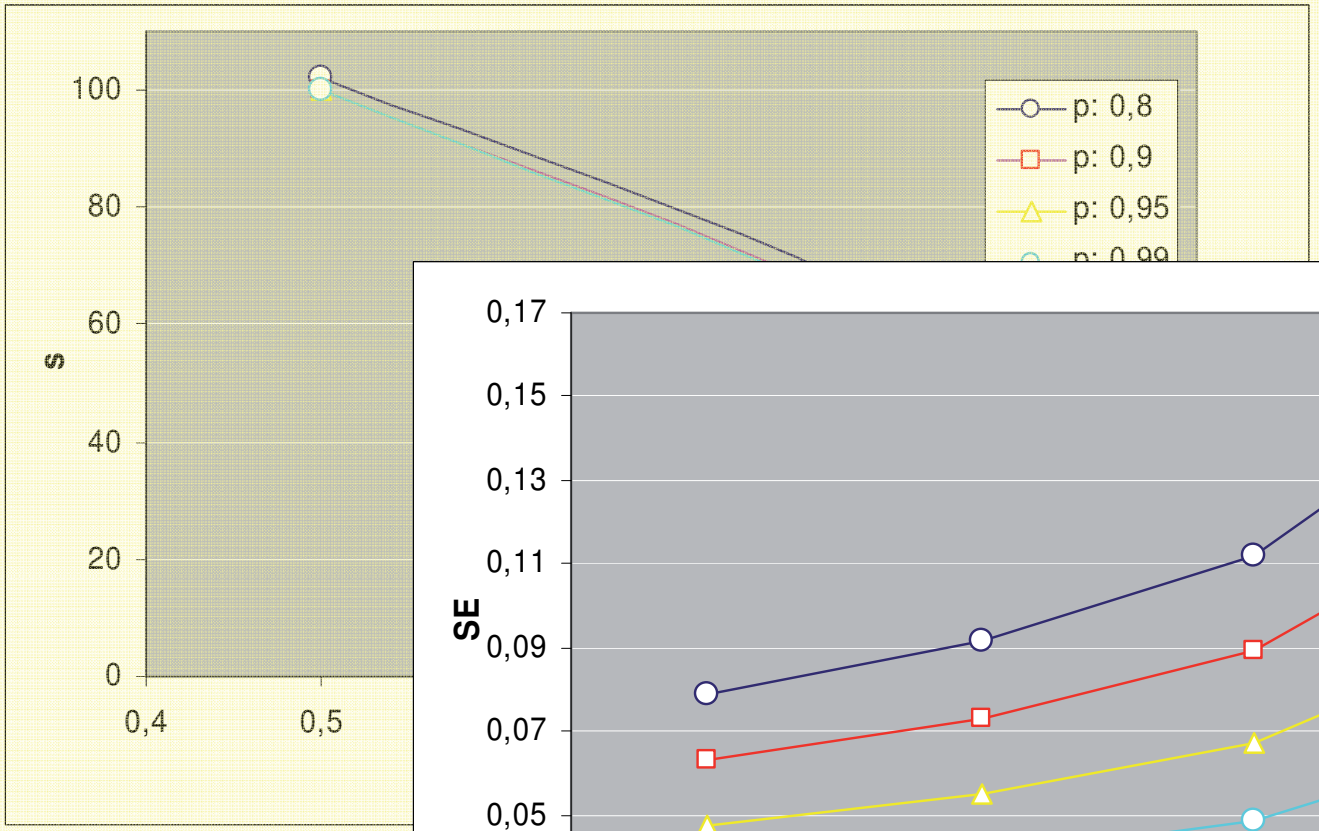


Número de sitios a muestrear

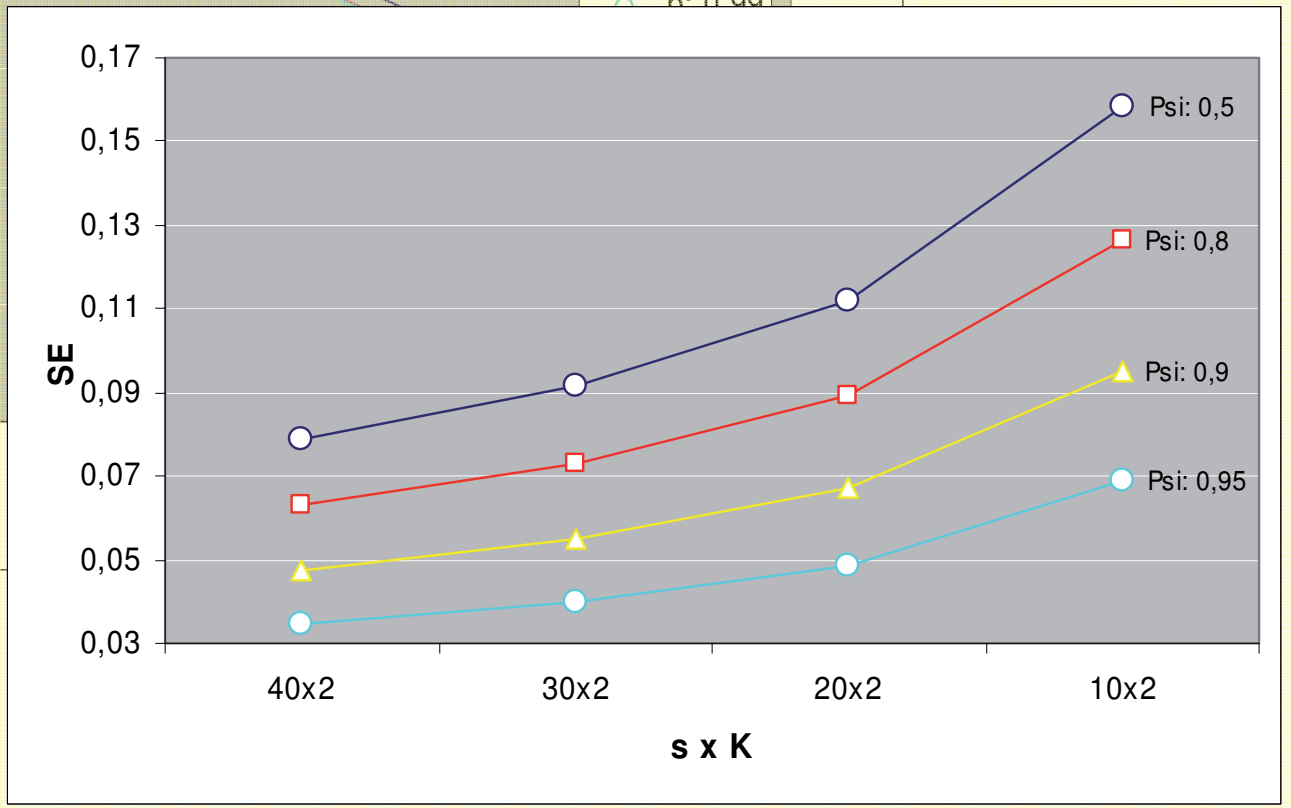


SE = 0,05

Número de sitios a muestrear



SE = 0,05



Conclusiones

- Utilidad del seguimiento de la ocupación para la monitorización del topillo nival. **Variable de estado alternativa** a la abundancia.

- **Alta ocupación** de la especie en el PNOMP (≥ 0,9).

- **Alta detectabilidad** (≥ 0,9): 20 trampas Sherman / 1 noche.

- Diseño con “eliminación” más eficiente.

- Un máximo de **dos visitas** si la especie no es detectada en la primera.

- **20-30 puntos de muestreo** pueden ser suficientes (SE ≤ 0,05).

Conclusiones

- Utilidad del seguimiento de la ocupación para la monitorización del topillo nival. Variable de estado alternativa a la abundancia.
- Alta ocupación de la especie en el PNOMP (≥ 0,9).
- Alta detectabilidad (≥ 0,6) 20 trampas durante / 1 noche.
- Diseño con "eliminación" más eficiente.
- Un máximo de dos visitas si la especie no es detectada en la primera.
- 20-30 puntos de muestreo pueden ser suficientes (SE ≤ 0,05).

GRACIAS POR SU ATENCIÓN