Global Warming and the Conservation of Amphibians in Changing Landscapes

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Amphibian extinctions

Bufo periglenes
Costa Rica
Extinct: 1988

Rheobatrachus silus
Australia
Extinct: 1980

Possible causes of amphibian declines

- Pollution
- Disease
- Introduced predators
- Ultraviolet radiation
- Climate change
- Habitat change and fragmentation

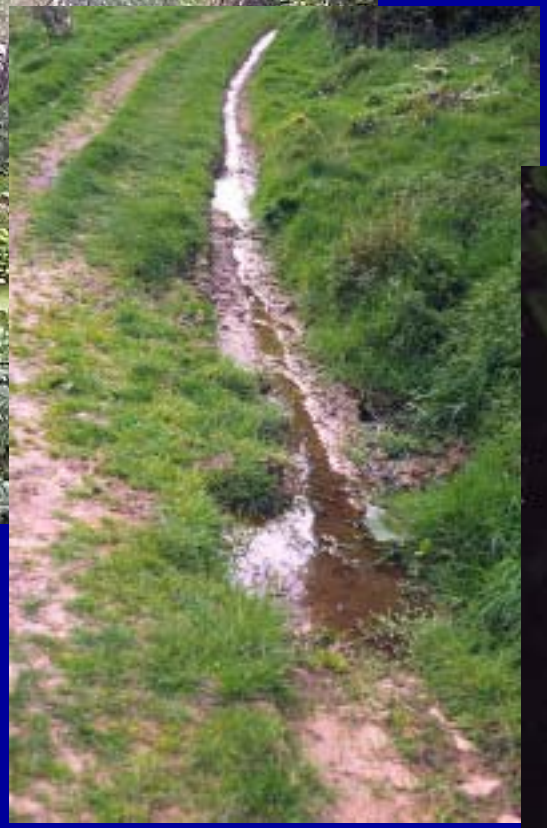
Climate change and amphibian declines

- Climatic stress (e.g. drought, desiccation of ponds)
- Shifts in the timing of breeding patterns
- Synergistic effects with other stressors (e.g. disease)

Changing landscapes and amphibian declines

- Habitat loss
- Habitat fragmentation
- Habitat neglect (e.g. abandoned ponds)

Diversity in amphibian habitats

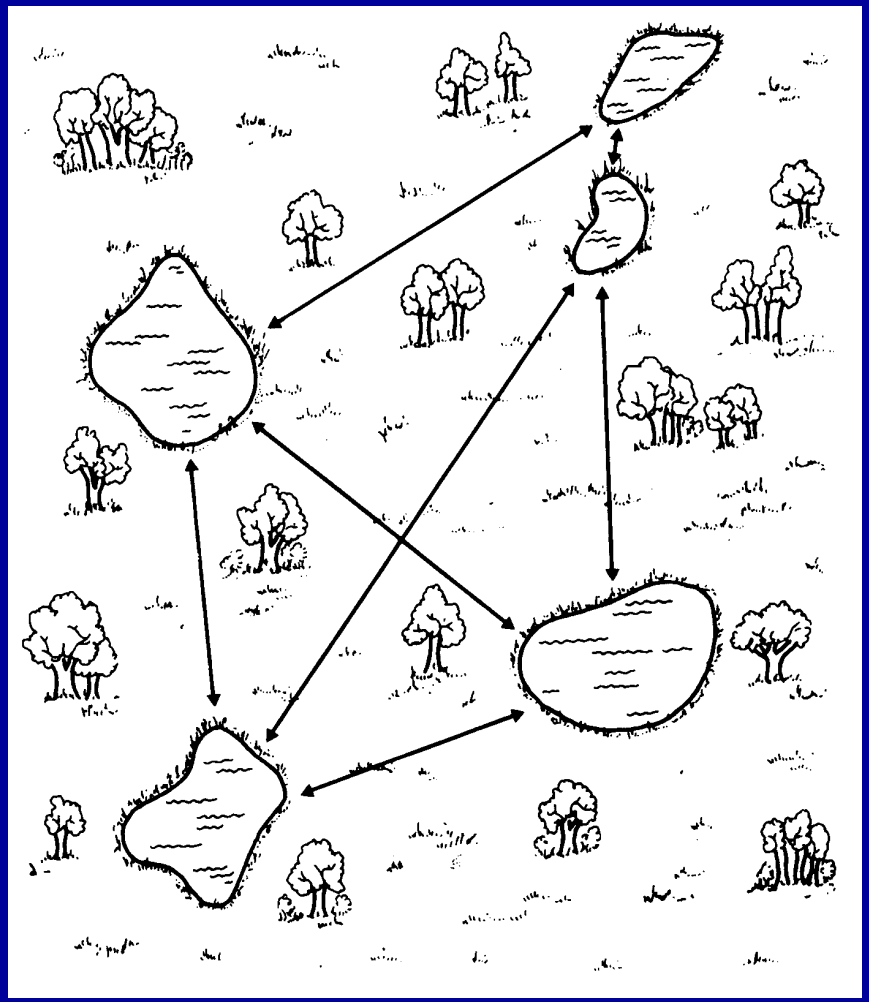


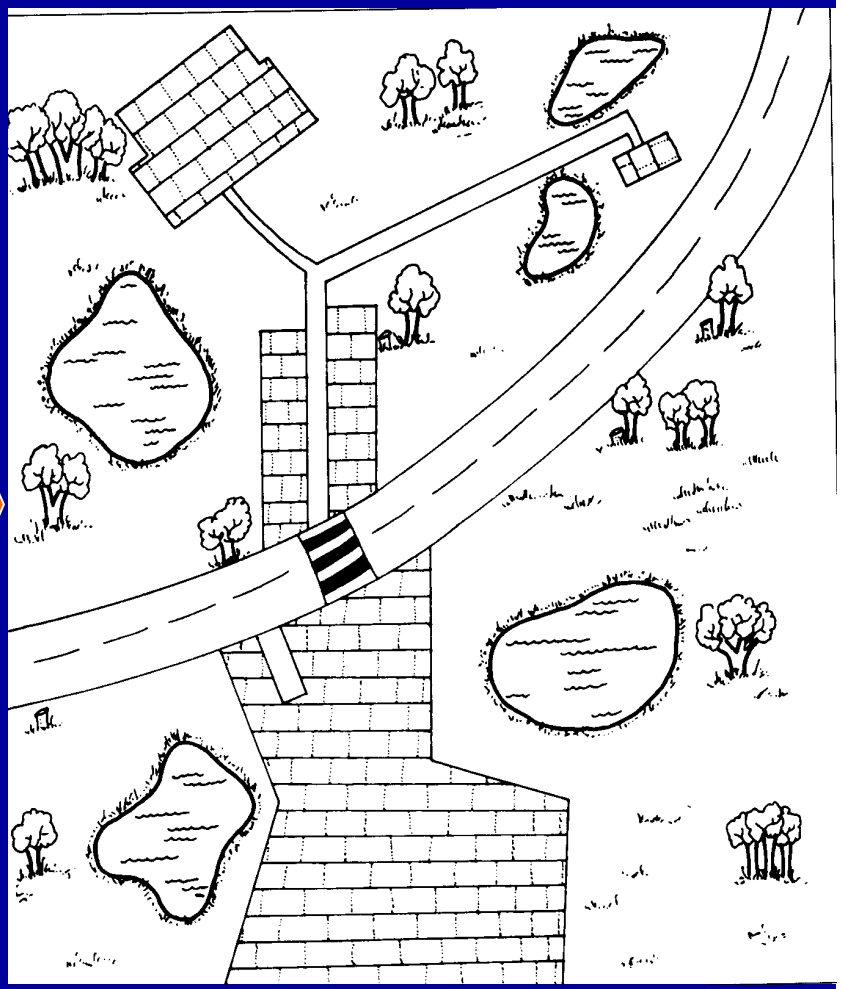
Temporary ponds as amphibian habitats

Habitat destruction and fragmentation

Habitat loss due to building development

Habitat destruction and fragmentation





Abandoned ponds: to manage…or not too manage…?

Climate stress and amphibian declines: Australian montane rainforest

Species	Status	Date of decline
Rheobatrachus silus	Possibly extinct	1979
Taudactylus diurnus	Possibly extinct	1979
Litoria pearsoniana	Very rare	1979
Mixophyes iteratus	Very rare	1979
M. fleayi	Very rare	1979
R. vitellinus	Possibly extinct	1985
T. eungellenisis	Very rare	1985
T. acutirostris	Possibly extinct	1989-1993
T. rheophilus	Possibly extinct	1989-1993
L. lorica	Possibly extinct	1989-1993
L. nyakelensis	Possibly extinct	1989-1993
L. rheocola	Very rare	1989-1993
L. nannotis	Very rare	1989-1993
Nyctimystes dayi	Very rare	1989-1993

Source: Laurance, W. F. (1996). Catastrophic declines of Australian frogs: is unusual weather responsible? *Biological Conservation* **77**: 203-212

Climate stress and amphibian declines: Australian montane rainforest

- Moderate (<25%) reduction in rainfall in the five years preceding frog declines
- Increase in the frequency of major drought months
- Increase in the number of months with high average temperatures
- But adults – not tadpoles – affected
- Moderate deviations in rainfall and temperature inadequate to explain the extent and severity of the declines

Source: Laurance, W. F. (1996). Catastrophic declines of Australian frogs: is unusual weather responsible? *Biological Conservation* **77**: 203-212

Climate stress and amphibian declines: Monteverde rainforest, Costa Rica

- Declines in 20 out 50 frog species after 1987
- Declines correlated with reduced dry season mist frequency
- Dry season mist frequency negatively correlated with sea surface temperatures in the Pacific
- Average altitude of the cloud bank raised
- Corresponding declines in birds and reptiles at the same place

Source: Pounds, J.A. *et al*. (1999). Biological responses to climate change on a tropical mountain *Nature* **398**: 611-615.

Breeding phenology of British amphibians 1978-1994

- Anurans at the edge of range (edible frog, natterjack toad) breeding earlier
- Anuran not at the edge of range (common frog) shows no change in breeding phenology
- Newts (smooth, palmate, crested – all not at the edge of range) show no change in the timing of arrival of first animals at the pond

Source: Beebee, T.J.C. (1995). Amphibian breeding and climate. *Nature* **374**: 219-374.

Breeding phenology of North American frogs 1980-2000

- Anuran breeding phenology related to temperature
- Anuran breeding phenology NOT consistently occurring earlier

Source: Blaustein, A.R. *et al*. (2001). Amphibian breeding and climate. *Conservation Biology* **15**: 1804-1809.

Breeding phenology of North American frogs 1900-1999

Species	Average date of 1st calling		Mean change (days)
	1900-1912	1990-1999	
Spring peeper	4 April	20 March	-13.6*
Wood frog	9 April	29 March	-13.0**
Bullfrog	5 June	22 May	-11.4 NS
Gray treefrog	4 May	14 April	-10.5*
American toad	18 April	11 April	-1.5 NS
Green frog	10 May	16 May	+5.5 NS

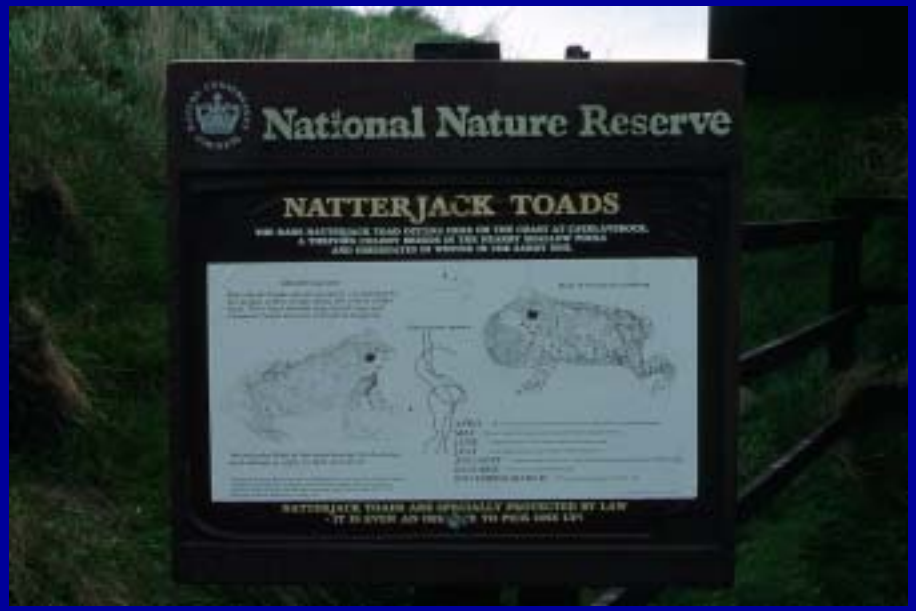
*$P<0.05$, **$P<0.01$, NS $P>0.05$

Gibbs, J.P. & Breisch, A.R. (2001). Climate warming and calling phenology of frogs near Ithaca, New York, 1990-1999. *Conservation Biology* **15**: 1175-1178.

Summary of all studies on long-term changes in breeding phenology in amphibians

Species	Location	Earlier/later/no change
Smooth newt	England	earlier
Palmate newt	England	earlier
Crested newt	England	earlier
Edible frog	England	earlier
Natterjack toad	England	earlier
Common frog	England	no change
Boreal toad	USA	no change
Cascades frog	USA	no change
Fowler's toad	Canada	no change
Spring peeper	USA	no change
Spring peeper	USA	earlier
Wood frog	USA	earlier
Bullfrog	USA	no change
Gray treefrog	USA	earlier
American toad	USA	no change
Green frog	USA	no change

A case study: the natterjack toad (*Bufo calamita*) in southern England



Natterjack toad

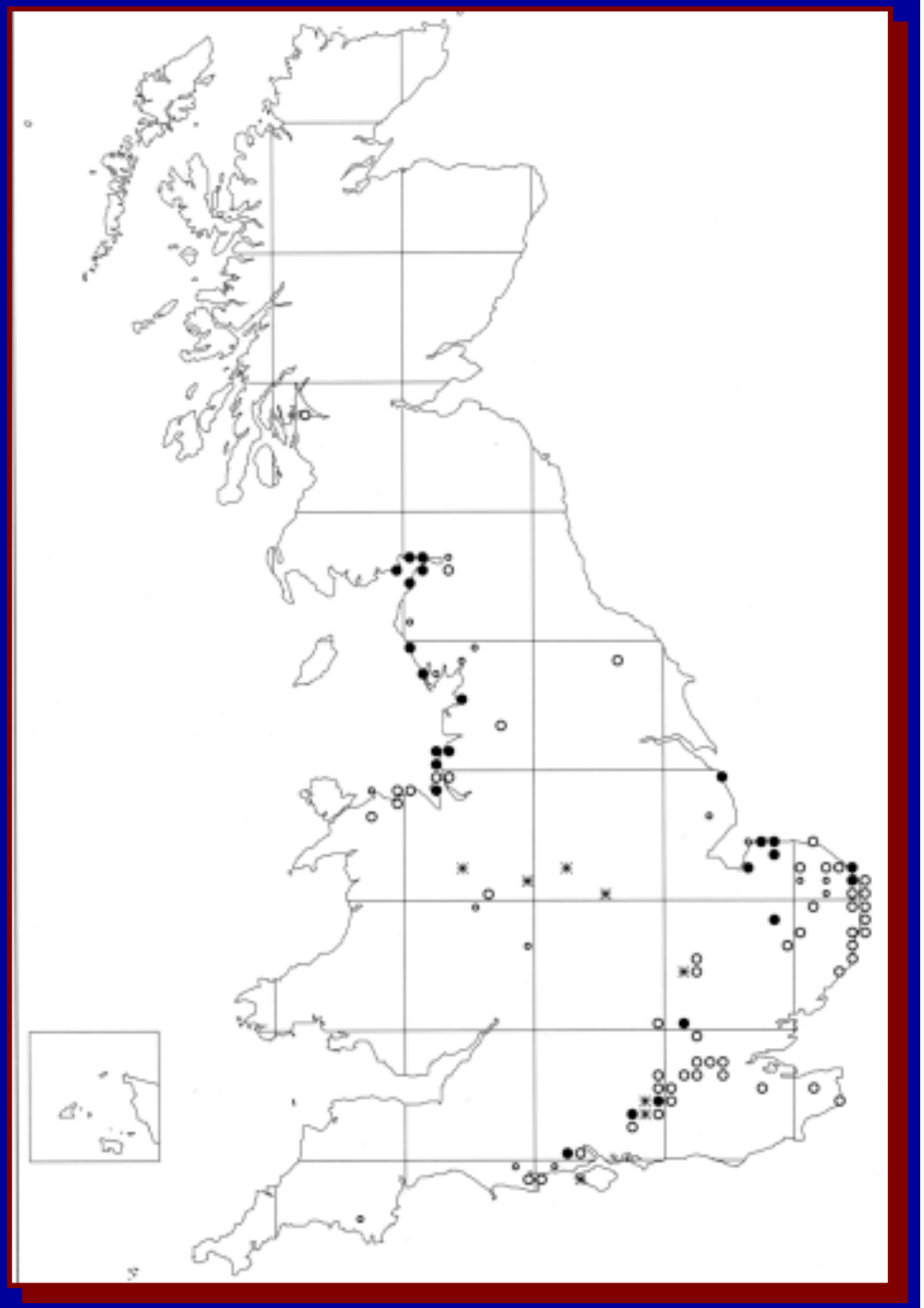
Up to only eight centimetres in length, the natterjack toad is smaller than the common toad and is easily distinguished from it by the distinctive yellow stripe that runs down the centre of its back. The back legs are shorter than those of the common toad which reflects a difference in the animal's behaviour. Whilst the common toad hops or crawls, the natterjack toad often runs. Another distinctive feature of the natterjack is the noisy croak of males during the breeding season, much louder than the choruses of common toads and frogs.

Of the six native amphibian species in Britain, the natterjack toad is undoubtedly the rarest. Its present range has been considerably reduced since the turn of the century and it now occurs at only some 40 sites in Dumfries and Galloway, Cumbria, Lancashire, Merseyside, Lincolnshire, Norfolk and Hampshire. It also occurs in Bedfordshire, Surrey, Suffolk, Dorset and Staffordshire as a result of recent introductions. Because of its endangered status it receives full legal protection under the Wildlife and Countryside Act, 1981. ▶

Species recovery programme

British Distribution

- At NW edge of European range
- 4 Scottish sites
- 35 English sites
- Extinct in Wales
- Reintroduced to 13 sites, including 1 in Wales



Natterjack toad habitats in Britain

sand dune systems

saltmarshes

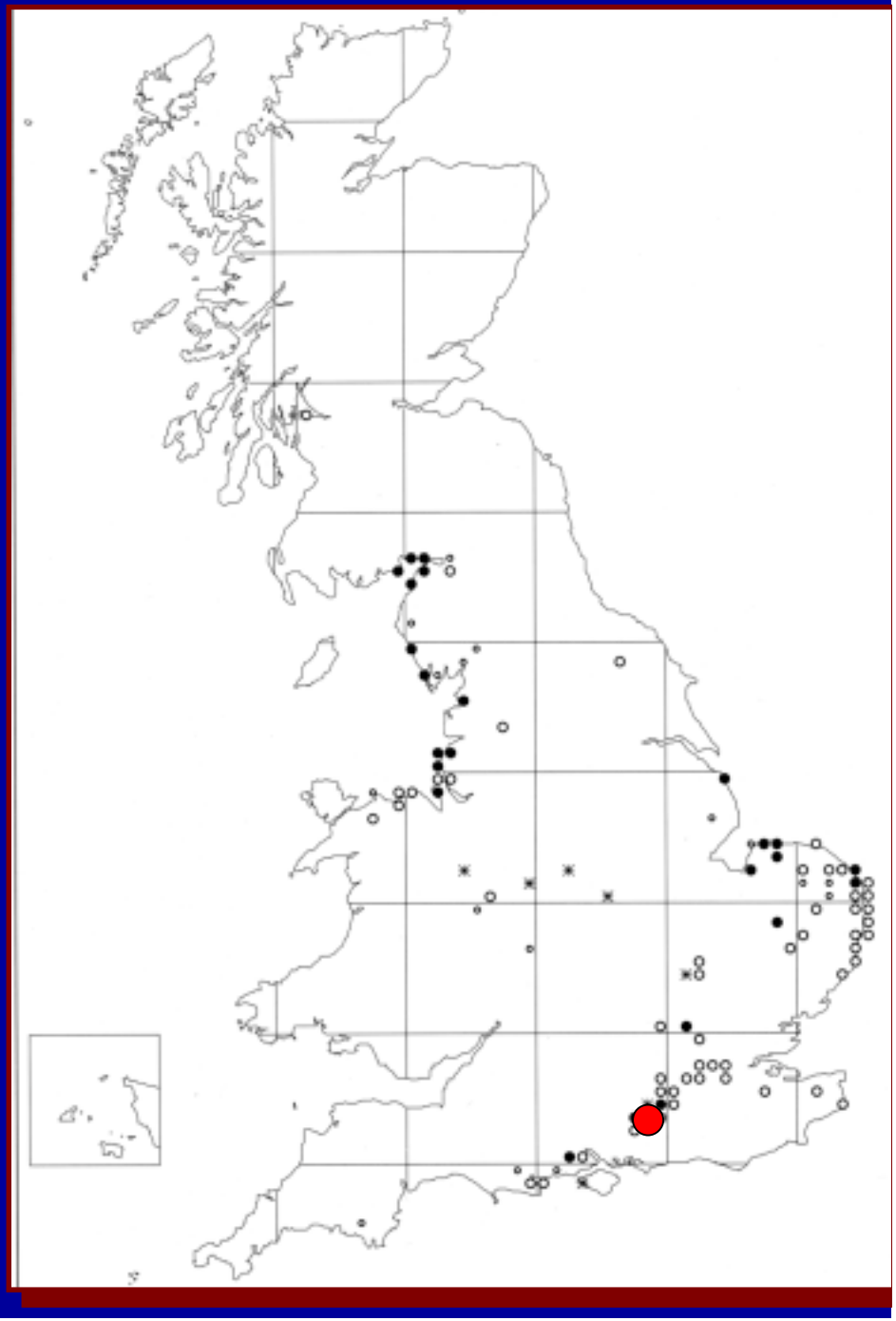
lowland heath

Natterjack toads: a pioneer species?

History of natterjacks at Woolmer Forest

- Small isolated relic population discovered on neglected heathland in early 1970's (~10s toads)
- Last surviving native natterjack population in southern England
- Site monitored and managed since 1972

- removal of encroaching pine and bracken
- grazing regime to maintain heathland
- liming of breeding pools to raise pH
- creation of new breeding pools
- control of predators and competitors

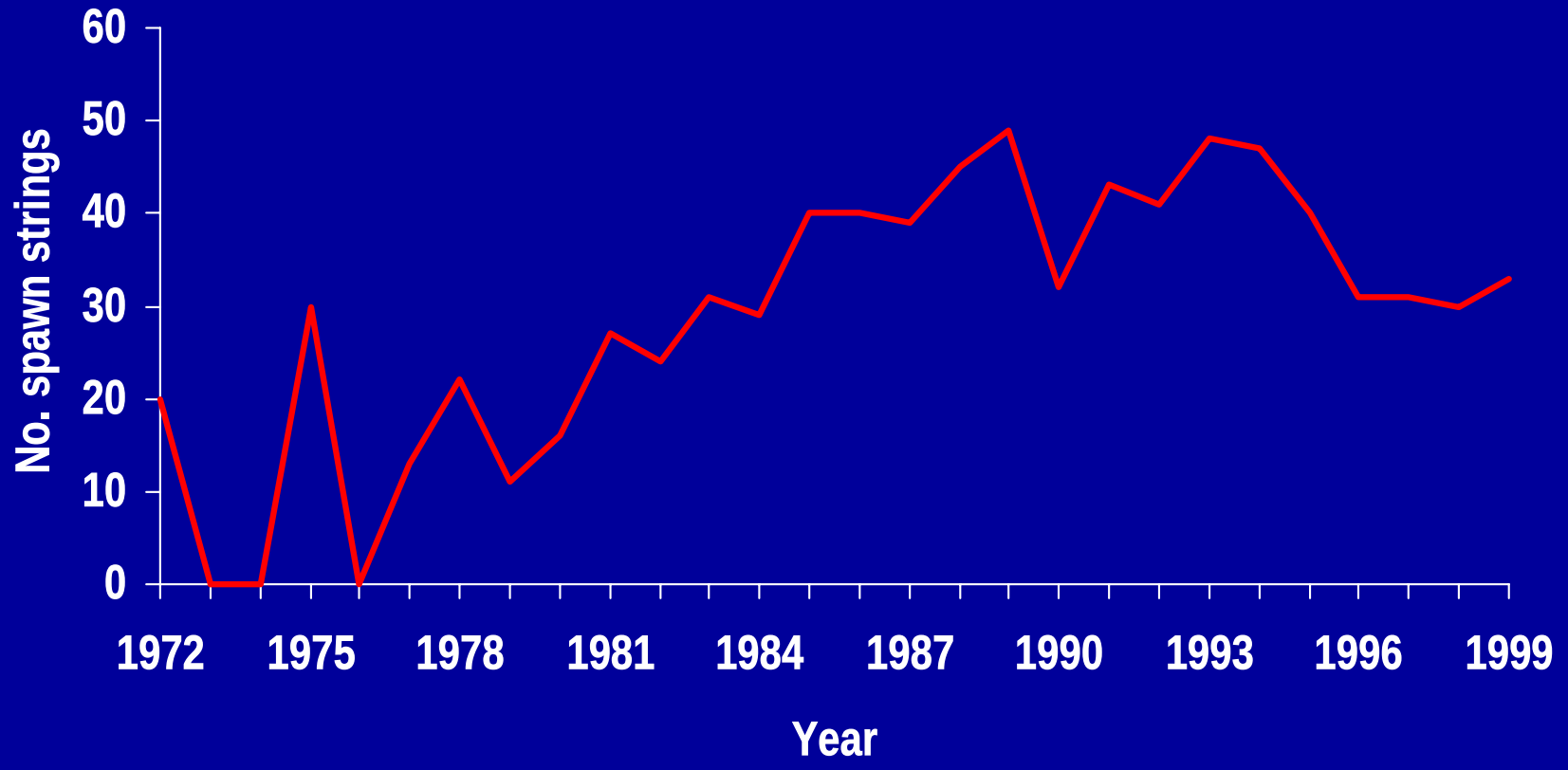


Woolmer Forest: bringing back natterjack toads to an abandoned heathland

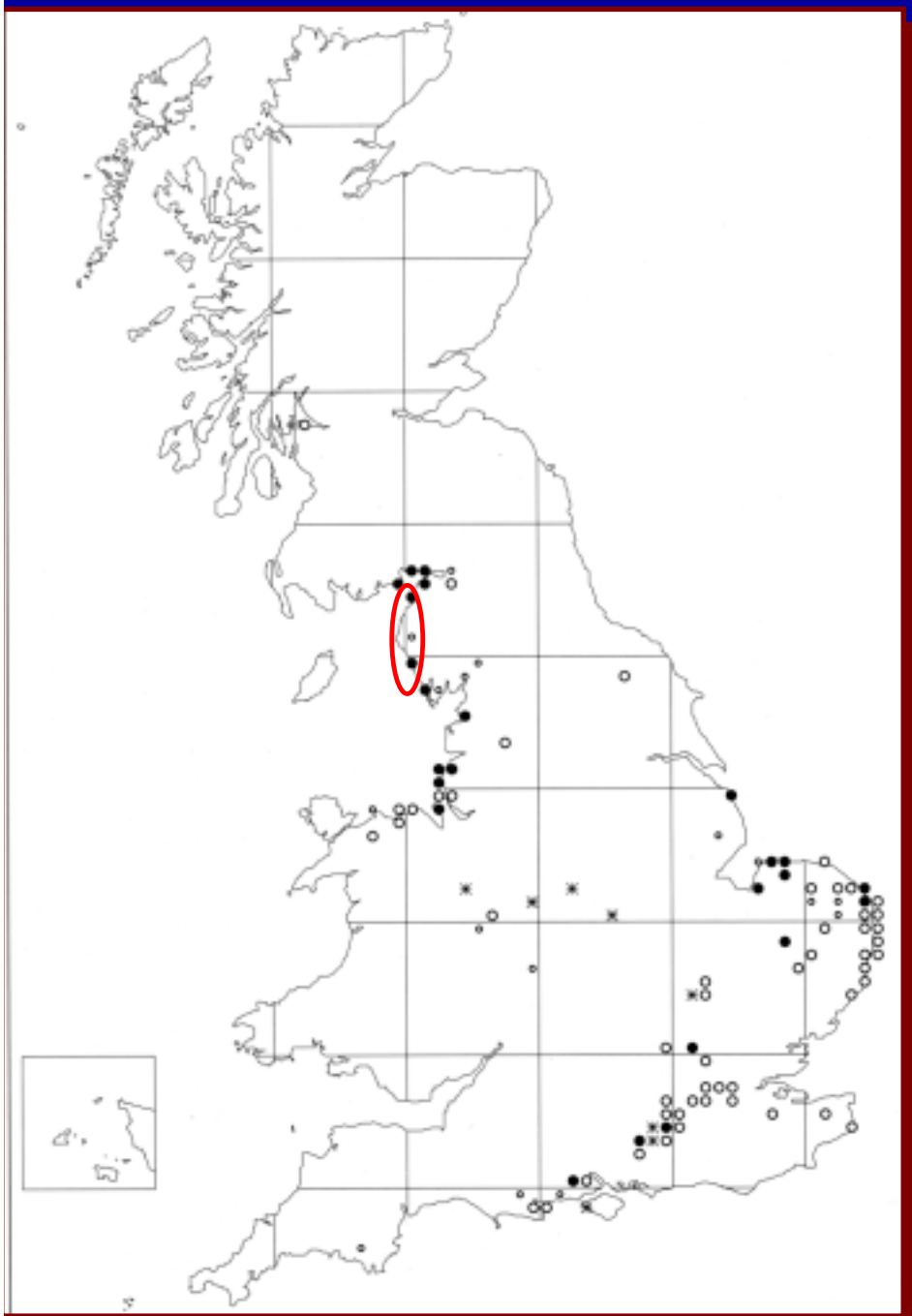
1980

1995

Woolmer Forest: response of natterjack toads to management



Beebee, T.J.C. and Buckley, J. (1999) *Natterjack Toad (*Bufo calamita*)site register for the UK 1970 - 1999 inclusive.* Unpublished report by University of Sussex and the Herpetological Conservation Trust.



Cumbria: a natterjack stronghold on an abandoned coastline?

Presence of Sellafield Nuclear Reprocessing plant is a disincentive to local development

Co-ordinating organisations

DAPTF - Declining Amphibian Population Task Force

- produces the newsletter ‘Froglog’
- co-ordinates information on amphibian declines
- allocates seed grants

GASG - Global Amphibian Specialist Group

- science and research
- Red listing of species
- training and capacity building
- information management

GAA - Global Amphibian Assessment

- categorize the status of all 5500 amphibian species
- organise regional workshops