Dr. Vikash TATAYAH, Conservation Manager, Mauritian Wildlife Foundation

Is Global Climate Change affecting Native Mauritian Biodiversity?

Effects of climate change on biodiversity is a fast growing area of international ecological research

Not much attention in the Mascarenes

Availability of high quality meteorological data

Close monitoring of some focal native species being restored

Initial inference about the impact of climatic events and variability on ecosystems.

These links need to be confirmed as more data become available over the next decade(s).

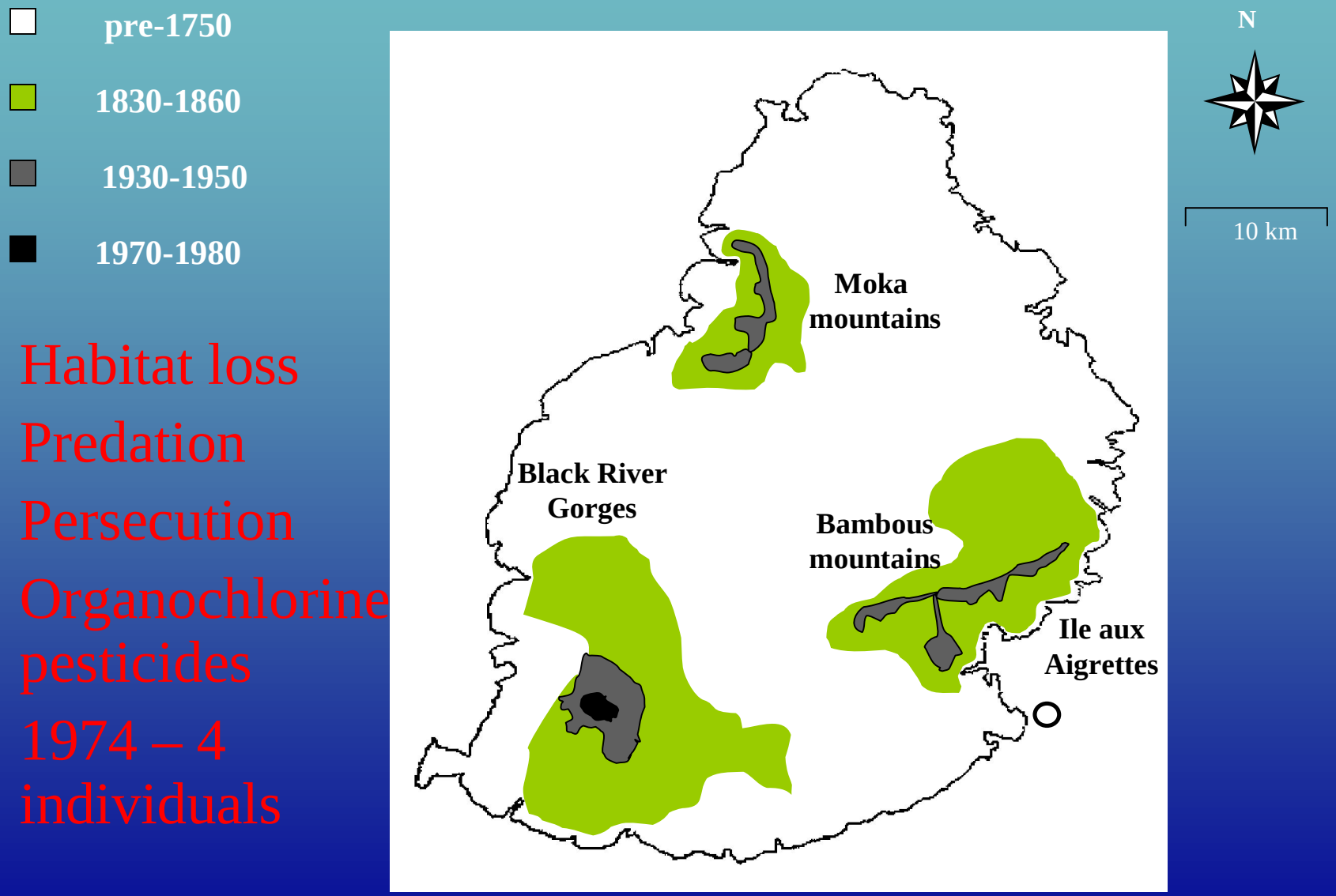
Climate and the Mauritius Kestrel

Introduction

- To conserve and manage species, we need to understand how their abundance and biology are affected by the environment they persist in
- To understand this we require information on the ecology of the species and its environment
- 25 years of detailed ecological data on a population of the Mauritius Kestrel and daily rainfall data for a comparable period
- An overview of our research into how rainfall influences the ecology of the Mauritius Kestrel

Mauritius Kestrel (*Falco punctatus*)

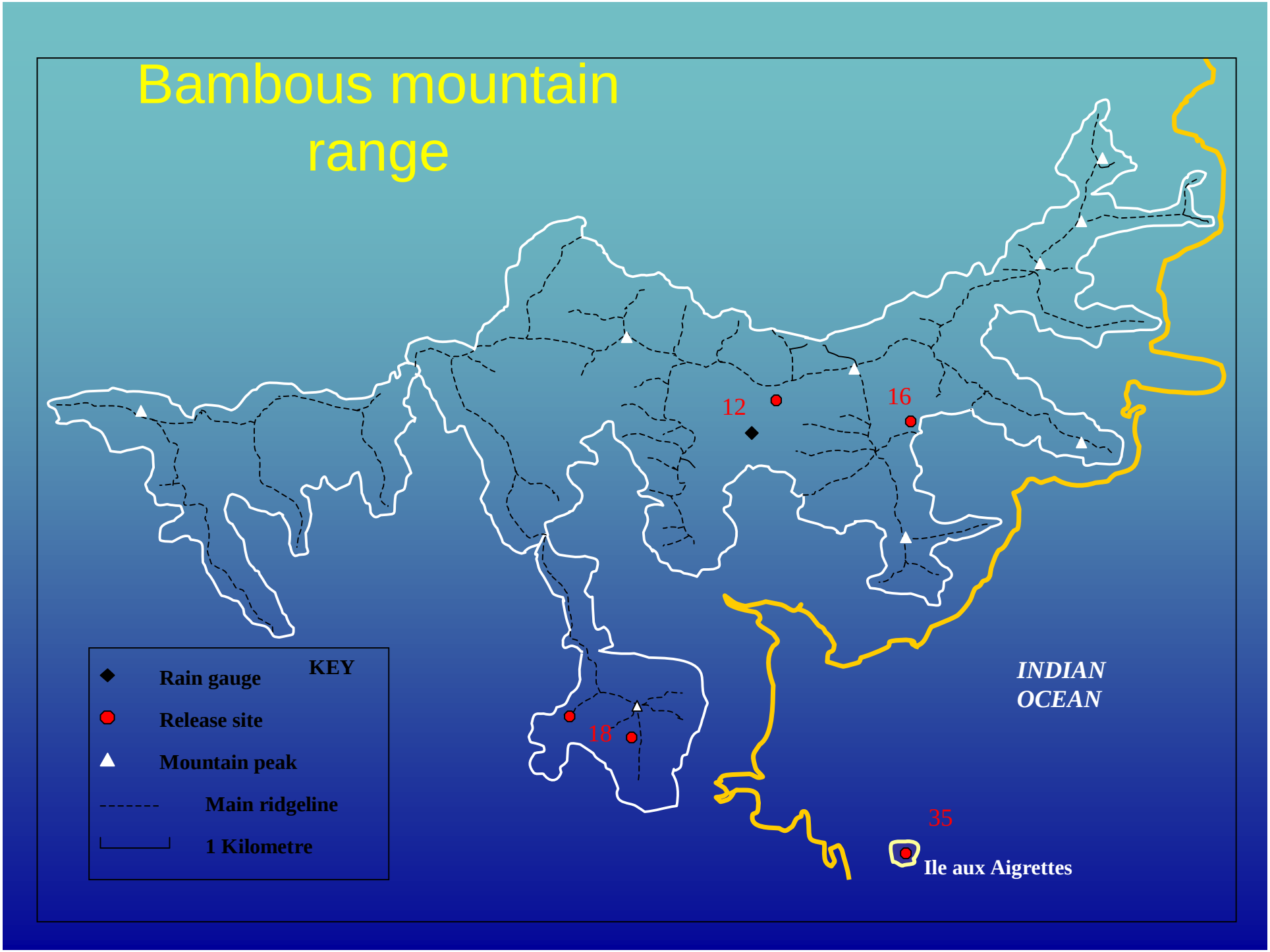
Historical distribution



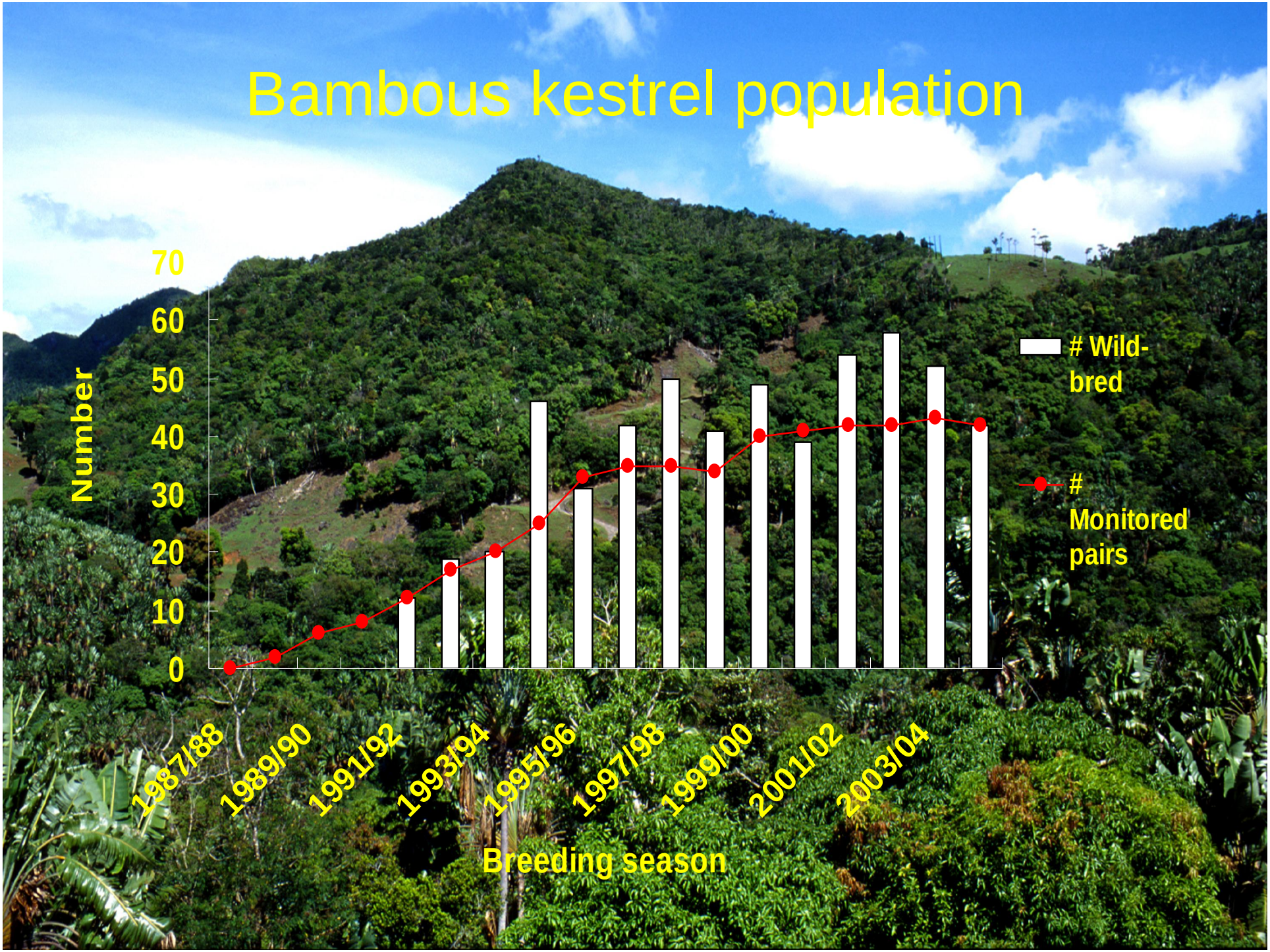
- Habitat loss
- Predation
- Persecution
- Organochlorine pesticides
- 1974 – 4 individuals

Recovery programme

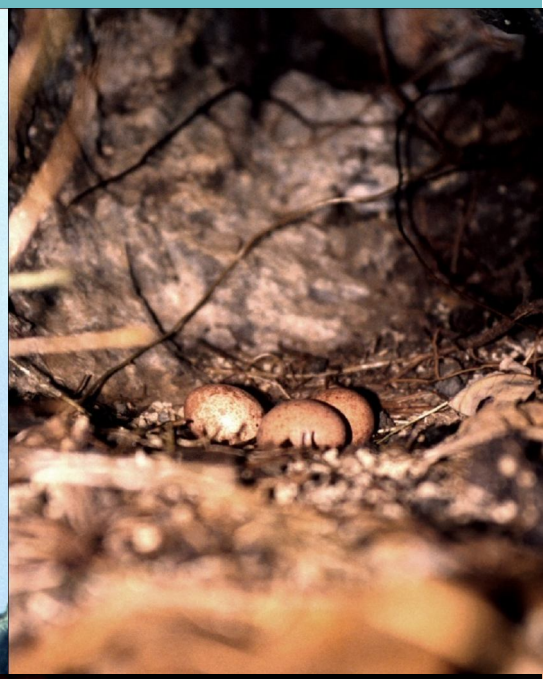
- Management of the remnant wild population
- Captive breeding
- Population supplementation
- Re-introduction
- 800 individuals
- Bambous mountain range


Bambous mountain range
12
16
18
35
Ile aux Aigrettes
INDIAN OCEAN
KEY
Rain gauge
Release site
Mountain peak
Main ridgeline
1 Kilometre

Bambous kestrel population



Mauritius kestrel breeding biology

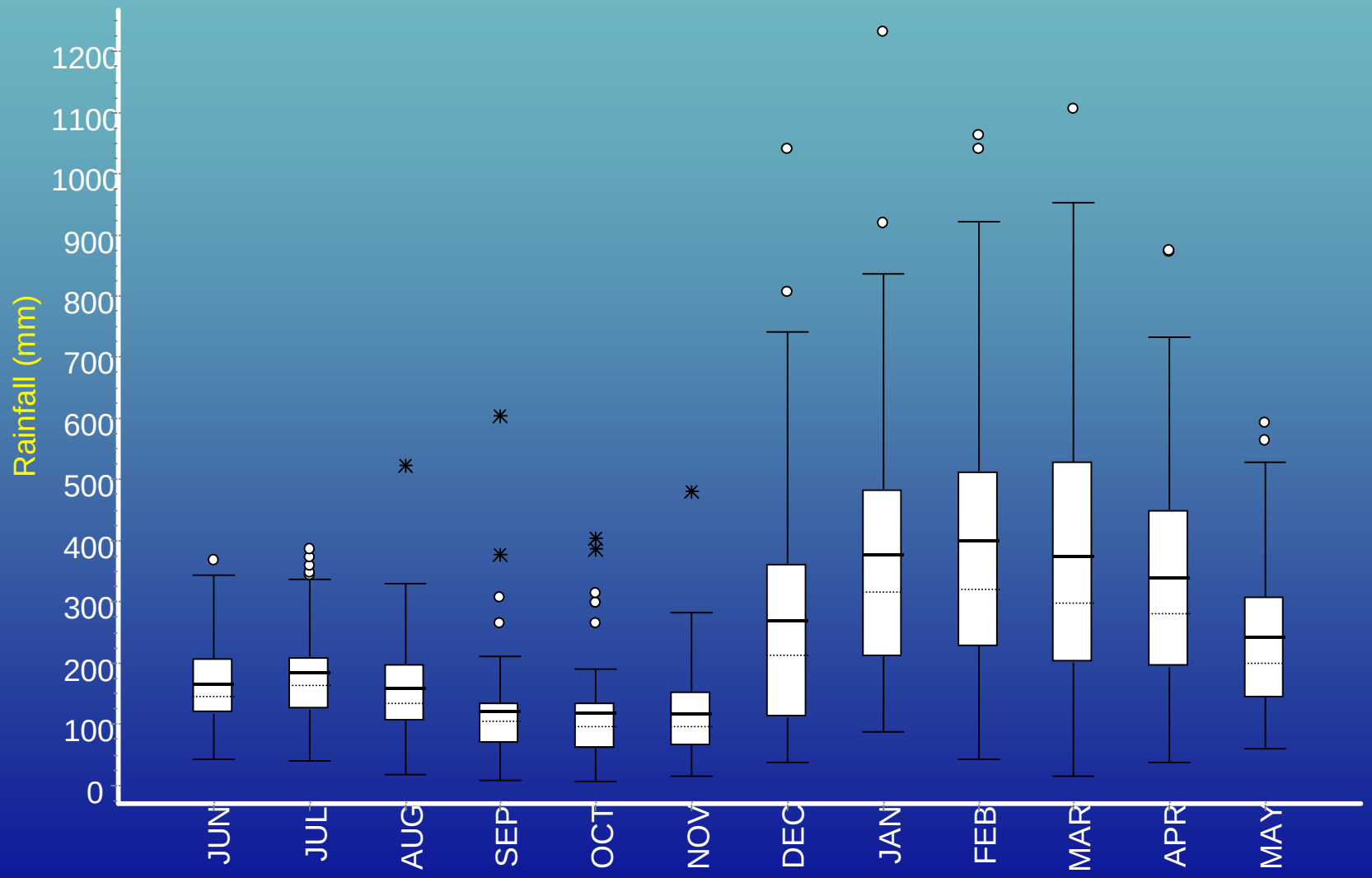


Monitoring programme

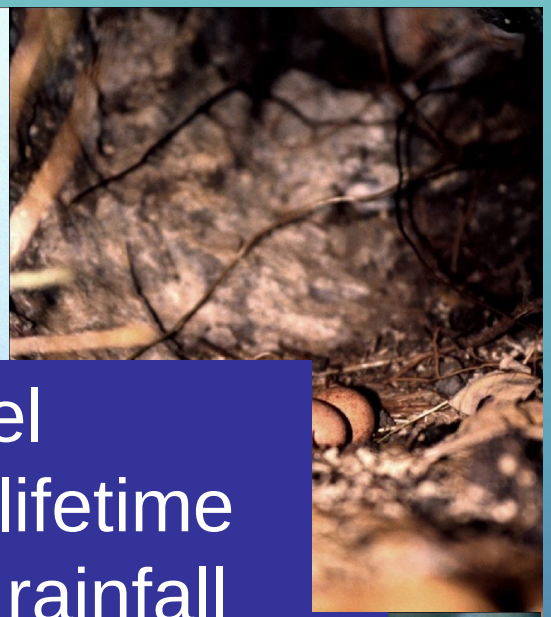
Bambous mountains: Rainfall patterns

- Monthly data for seven rain gauges across the mountain range: 1957-2005.
- Daily rainfall data for one gauge: 1962-2005

Monthly rainfall pattern: 1957-2005

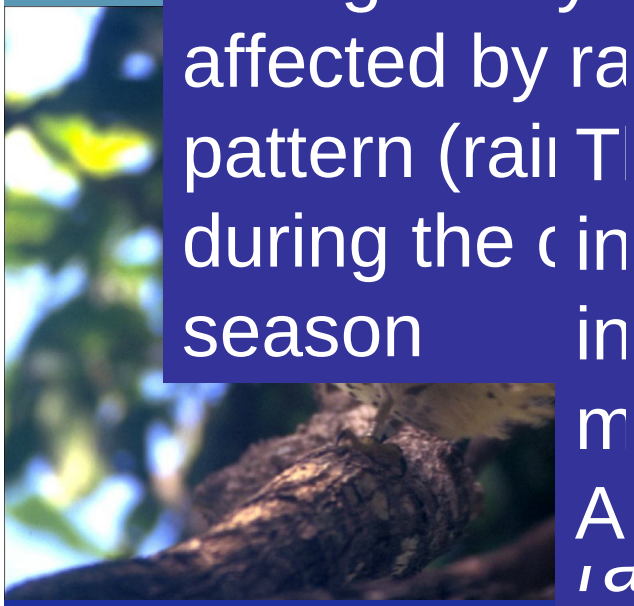


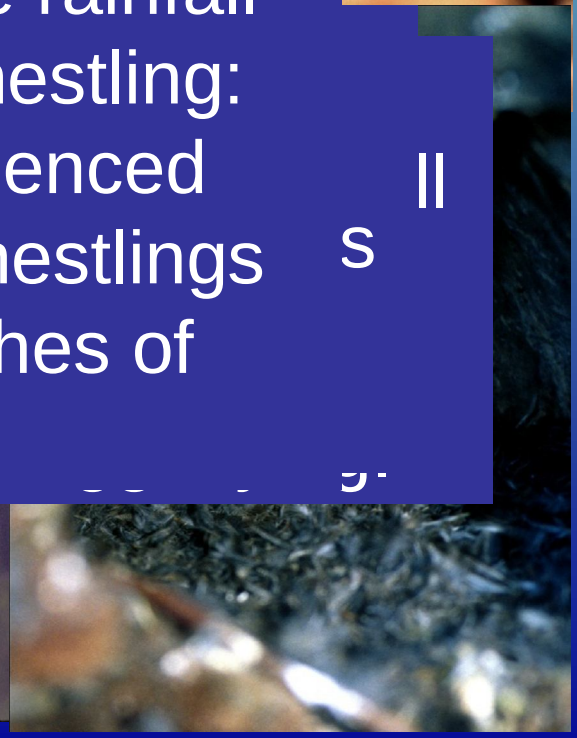
Rainfall & kestrel ecology



First year sur
is negatively
affected by ra
pattern (rai
during the
season

How a female kestrel performs across its lifetime is influenced by the rainfall experienced as a nestling: kestrels that experienced more raindays as nestlings layed smaller clutches of eggs later in life





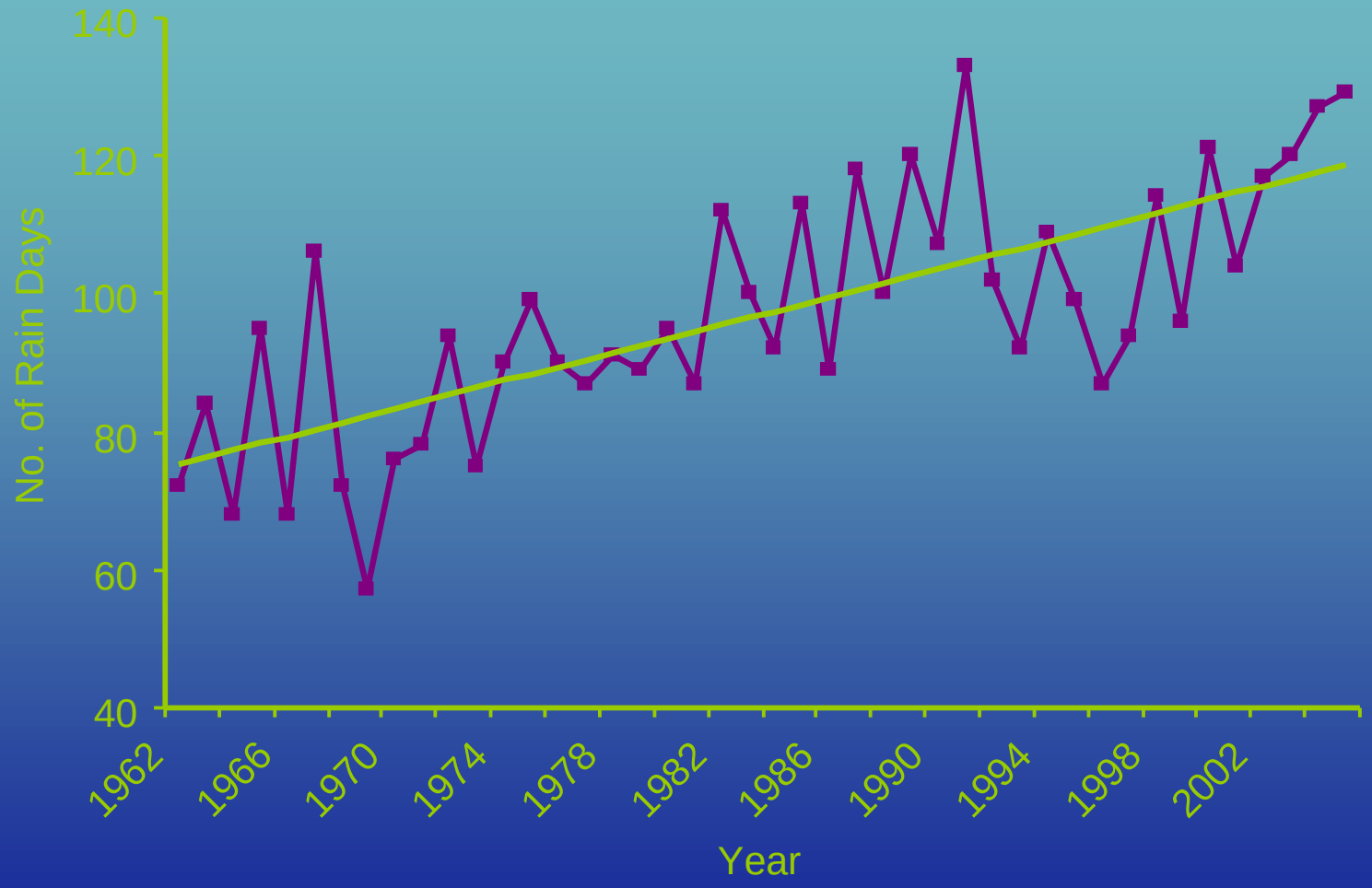
Trends in rainfall patterns: the Bambous mountains

- We used daily rainfall data (1962-2006) from Camizard rain gauge as a representation of seven sites across the Bambous mountains

- Data were divided according to the two principal climatic seasons (Jun-Nov & Dec-May) and for each season the total rainfall, number of raindays and mean rain per rainday were calculated

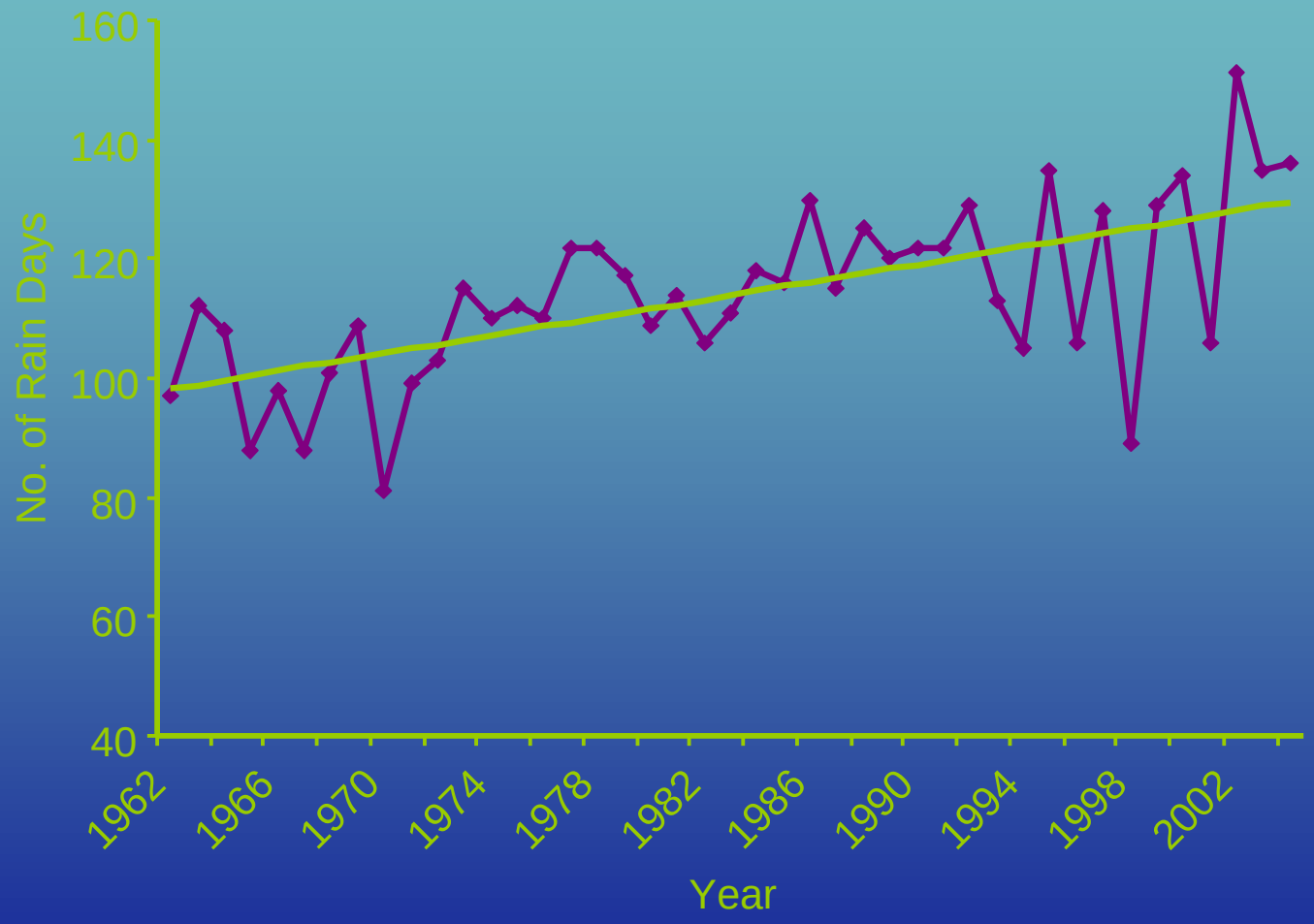
- We examined each of these rainfall measures for long-term changes

Raindays June to November: 1962 - 2006



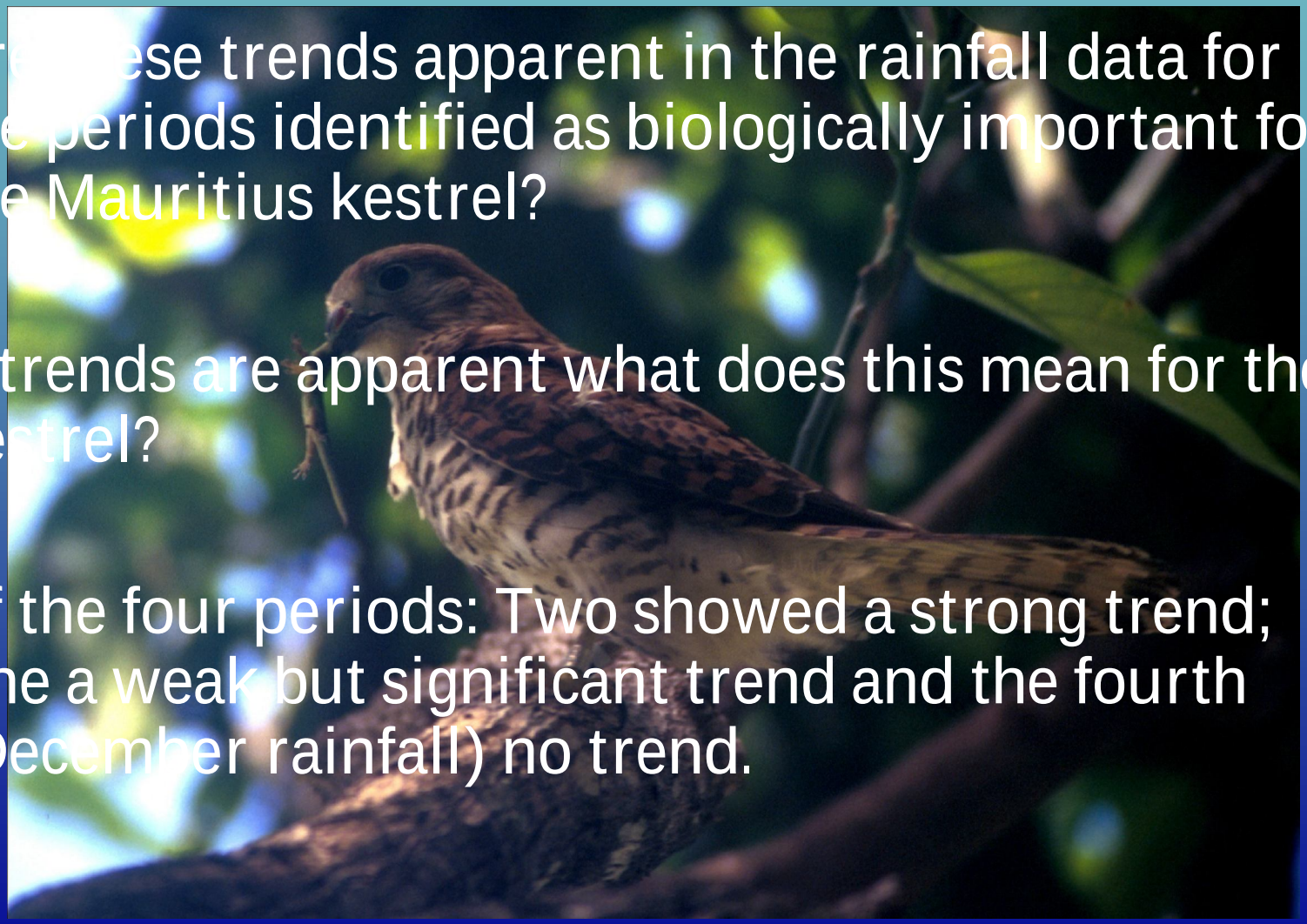
- No evidence for an increase in total rainfall

Raindays December to May: 1962 - 2006



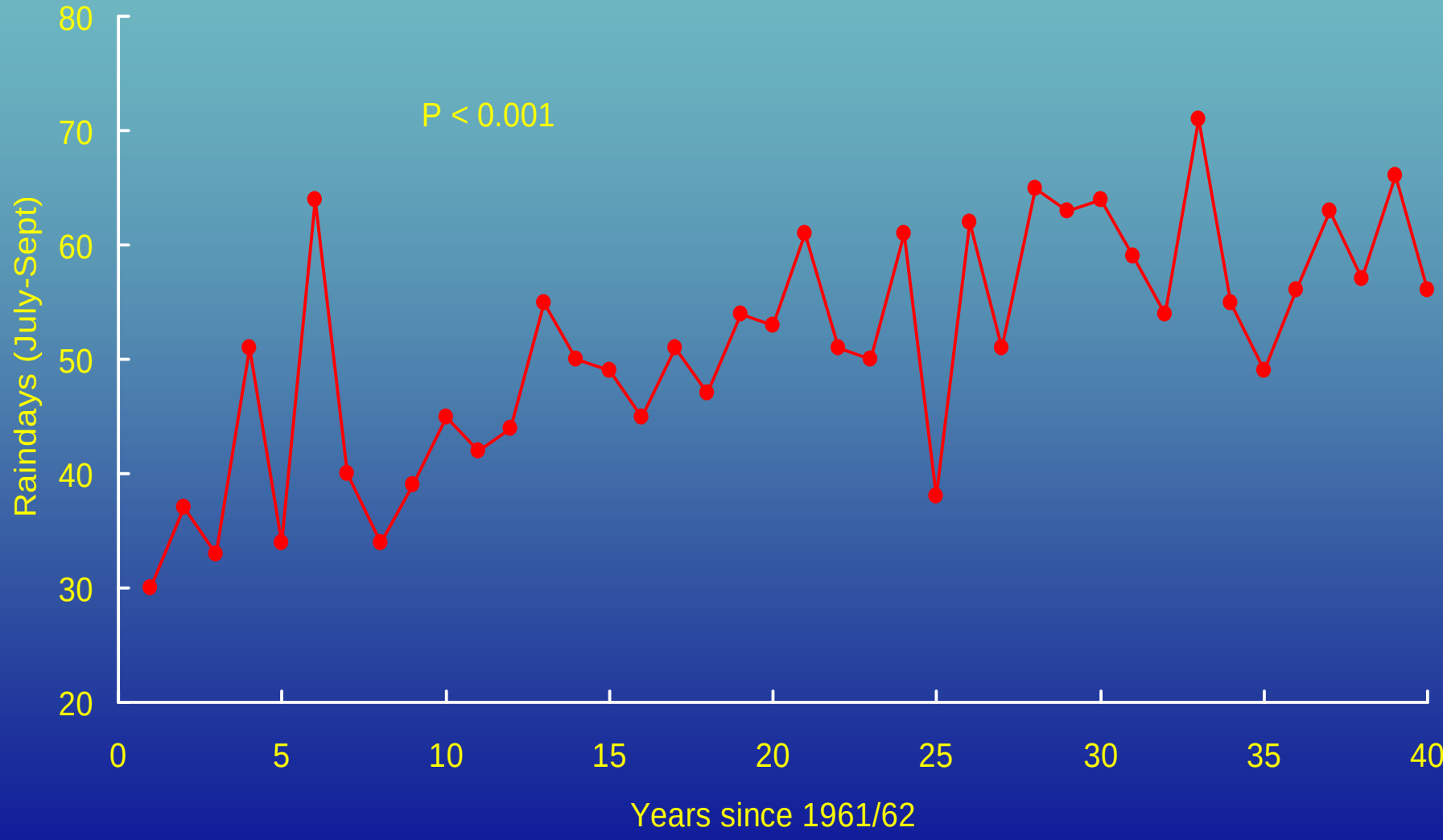
Weak evidence for an increase in total rainfall

Trends in rainfall patterns: a kestrel's perspective

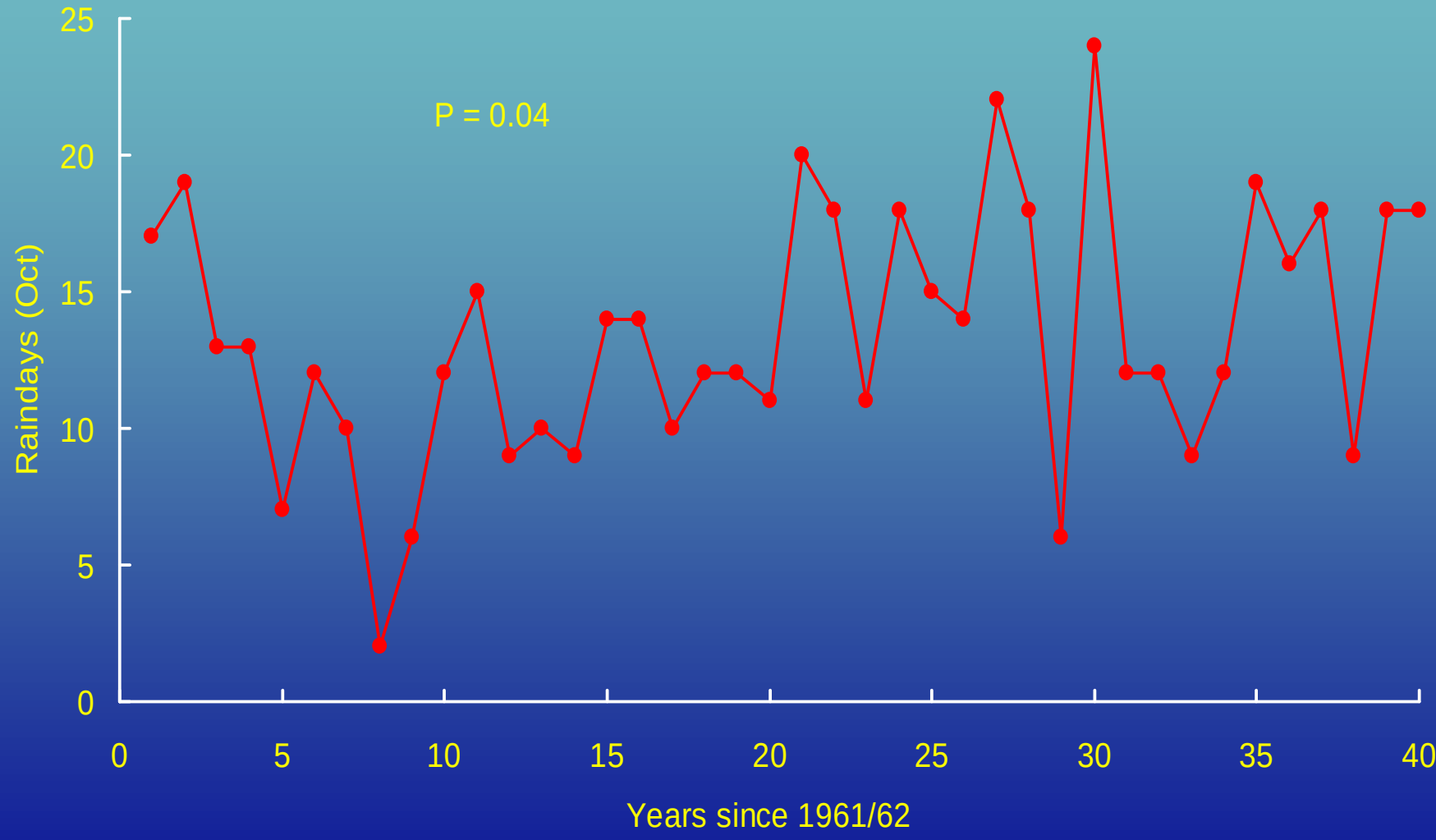


- Are these trends apparent in the rainfall data for the periods identified as biologically important for the Mauritius kestrel?
- If trends are apparent what does this mean for the kestrel?
- Of the four periods: Two showed a strong trend; One a weak but significant trend and the fourth (December rainfall) no trend.

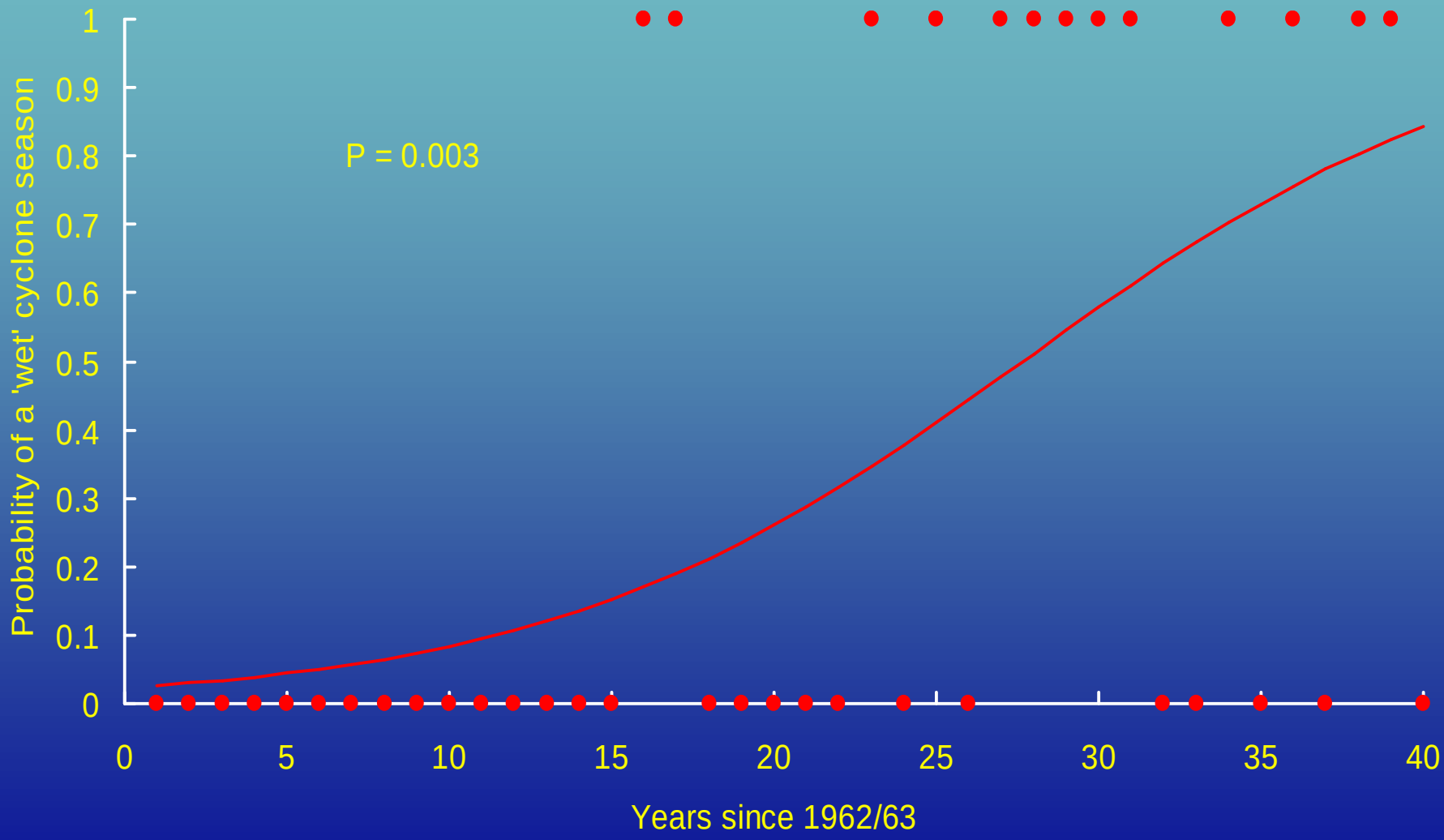
Pre-breeding rainfall



October raindays

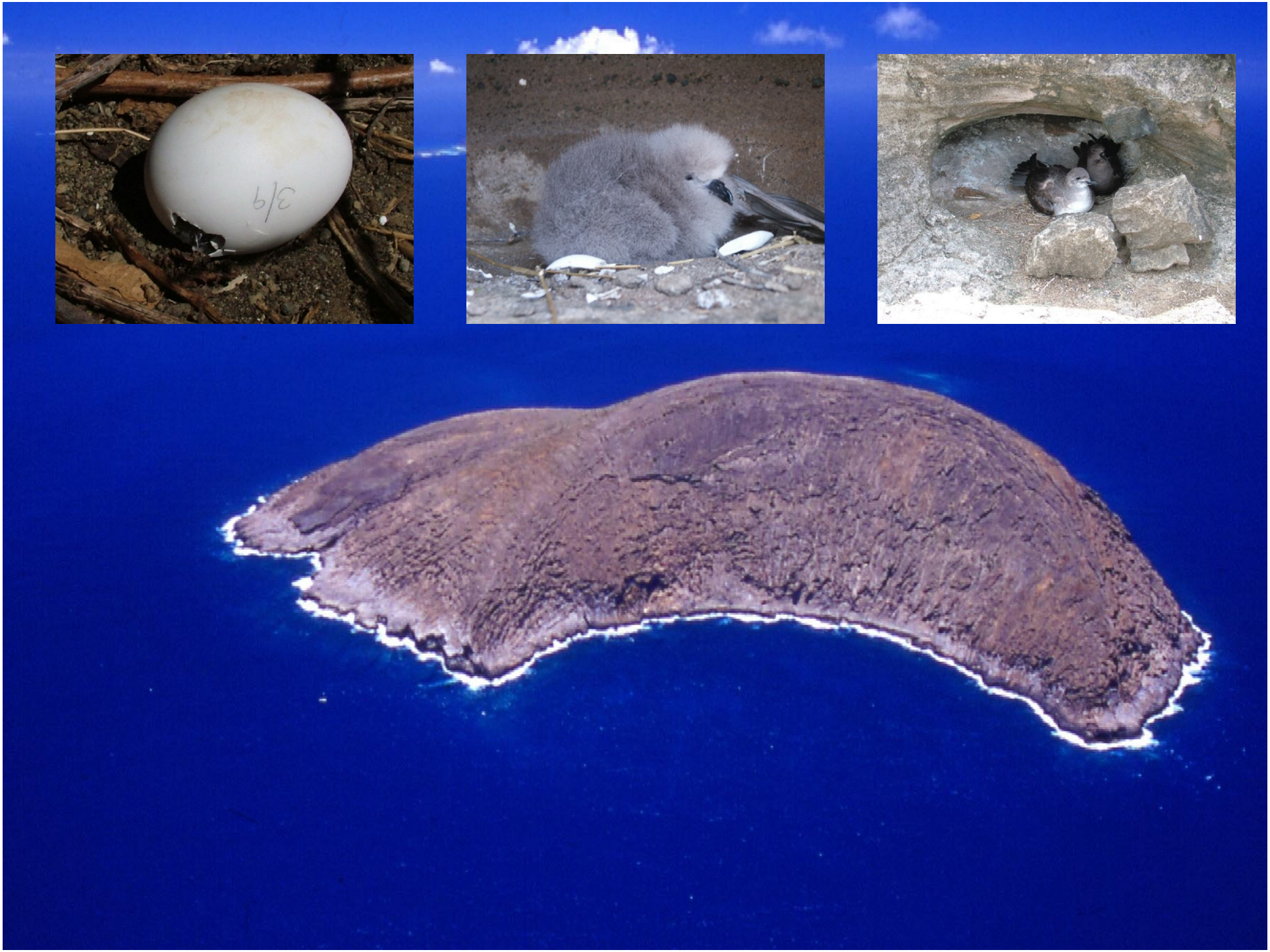


Cyclone season



Summary

- The timing and intensity of rainfall is extremely influential on the ecology and life history of the Mauritius Kestrel
- Rainfall patterns in the Bambous mountains have changed over the last 40 years
- Kestrels may currently be persisting under more adverse environmental conditions
- Future research will explore the impact of these changing environmental conditions on the viability of the population



THE HOME OF THE PAILLE EN QUEUE (*PHAETON ÆTHEREUS*) OR HAZEWADE BIRD, ROUND ISLAND, NEAR MAURITIUS


White-tailed
Tropicbird


Red-tailed Tropicbird


Wedge-tailed Shearwater


Round Island Petrel

Why is the Round Island Petrel special?

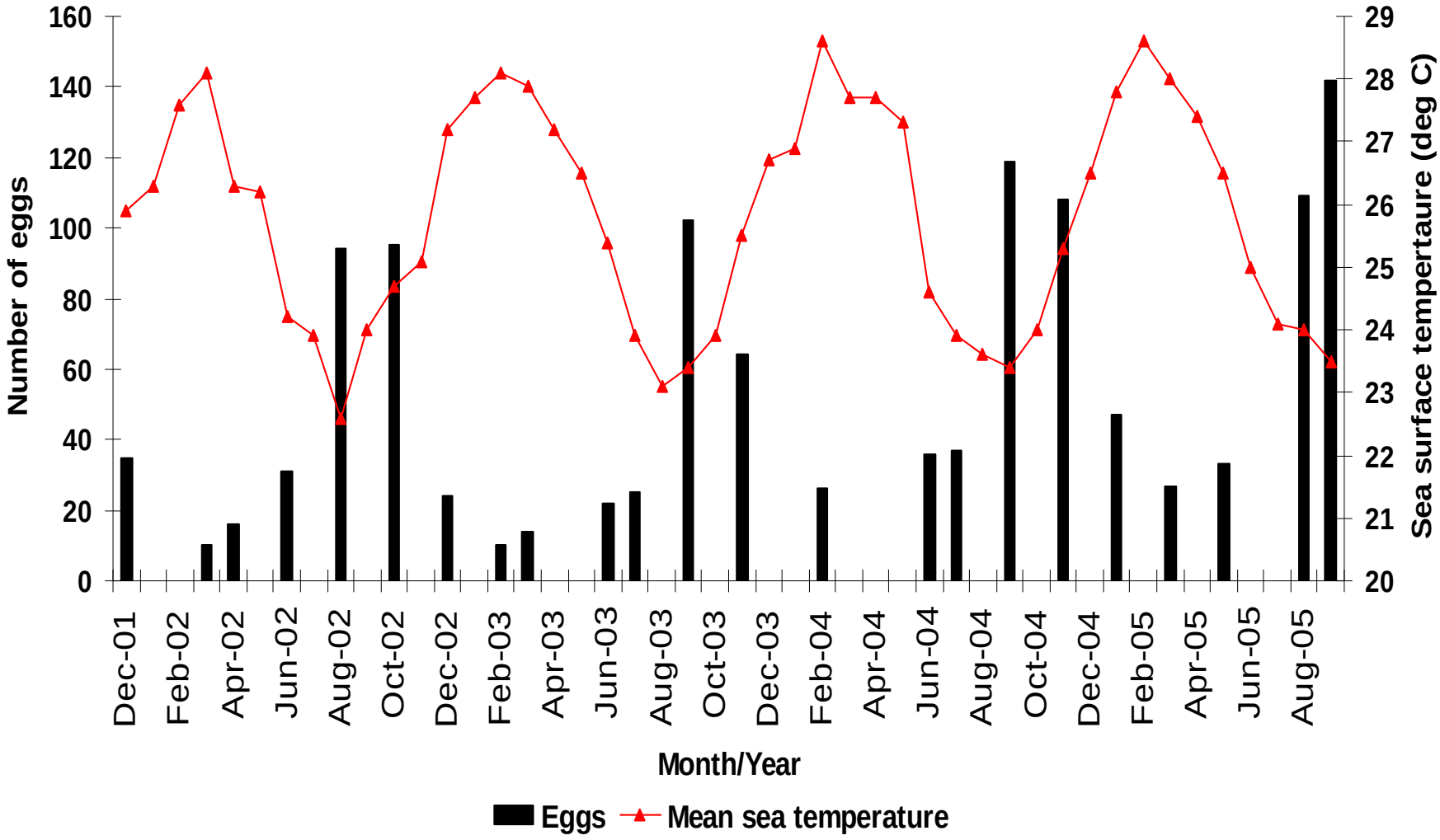
- Mainly derived from Trindade Petrel *P. arminjoniana.*
- Virtually closed population.
- >95% adults ringed.
- 41 years ringing data.
- Constant monitoring since 2000.
- Hybridizing with at least two other petrels – *P.neglecta* and *P. heraldica.*

- Only breeding site for this bird in the Indian Ocean
- Population estimate: 175-200 breeding pairs annually
- Peak nesting period: August-February, but nesting all year round
- Nest under ledges, amongst boulders, in grass and in the open
- All nest sites followed monthly.

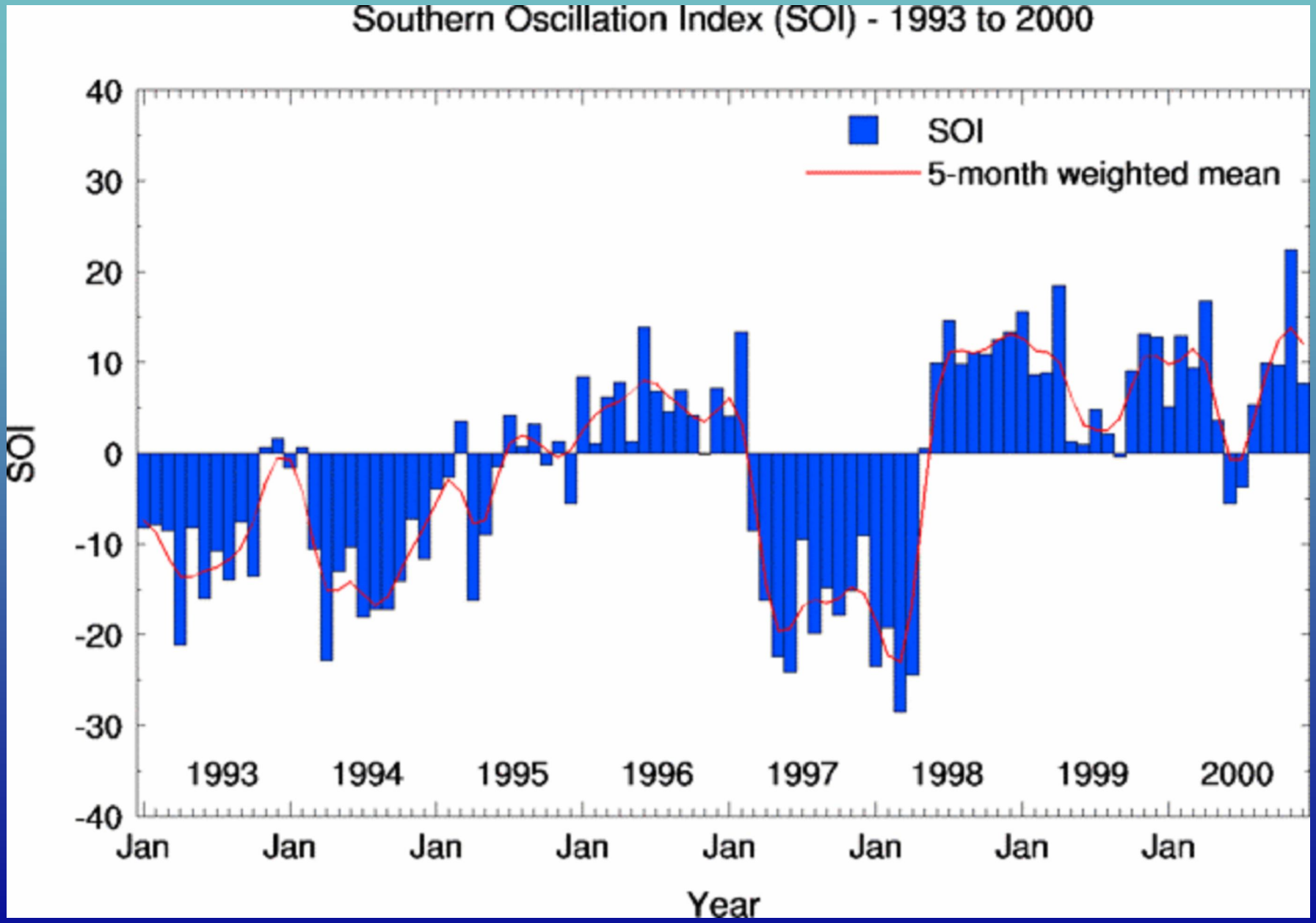
Round Island Petrel

ROUND ISLAND PETREL BREEDING BIOLOGY

Seasonal Trend in Round Island Petrel Egg Laying



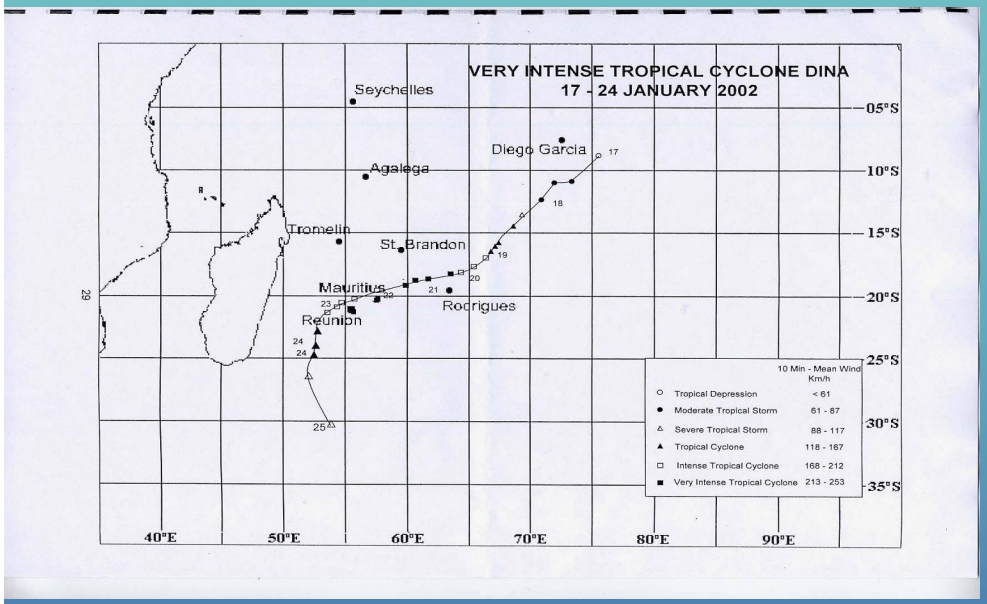
El Niño Southern Oscillation



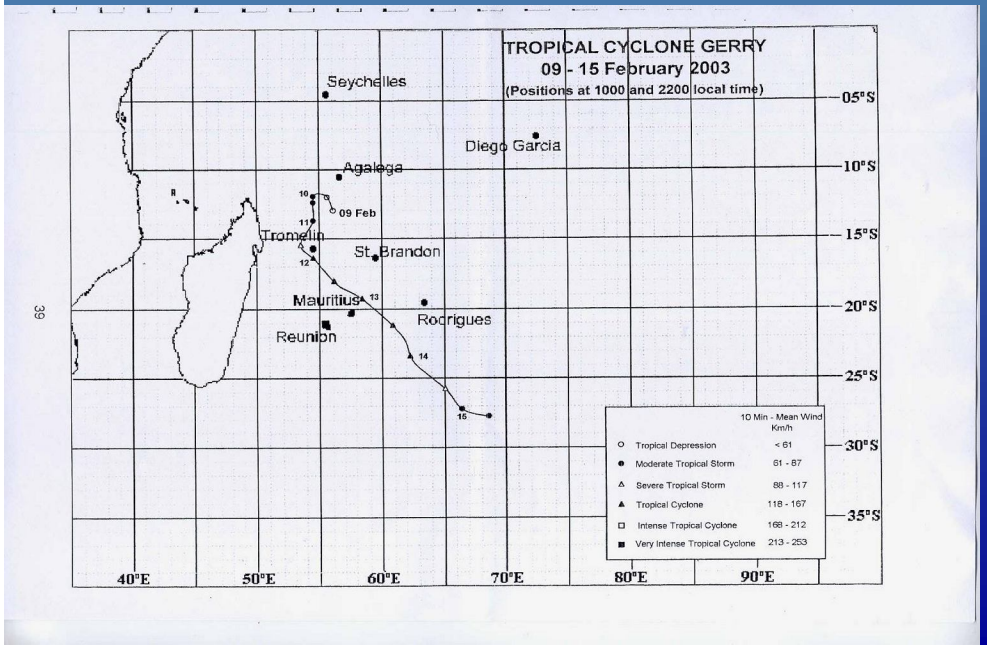
Effects of El Niño Southern Oscillation

Ringing Year	Number of chicks ringed A	Number of chicks recaptured as adults B	Number of chicks returning to breed on Round Island C	Minimum post fledging survival % B/A	Minimum Survival to breeding attempt % C/A	% of birds returning to Round Island and breeding C/B
1993	19	14	13	74	68	93
1994	36	20	19	56	53	95
1995	39	19	15	49	38	79
1996	44	27	26	61	59	96
1997 (ElNino)	46	18	16	*39*	*35*	89
1998 (ElNina)	17	13	12	*77*	*71*	92

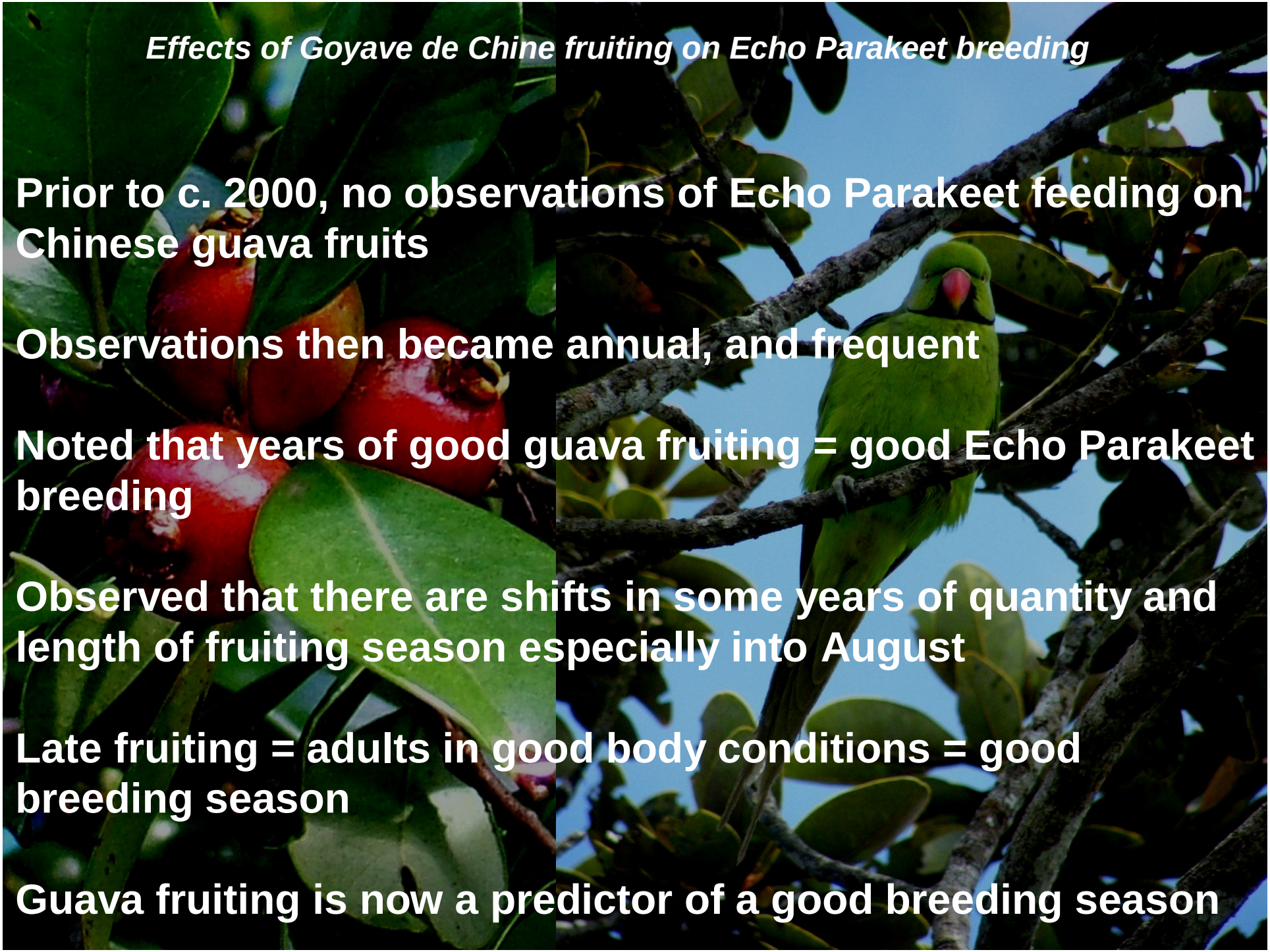
Effects of cyclones on breeding success



Cyclone Dina passed over Round Island on 21 January 2002 killing all the three known fledging chicks and destroyed 20 out of 28 (71%) eggs. (184 km/hr at Bain Boeuf)



Cyclone Gerry passed close to Round Island on 12 February 2003, and being of much lower intensity caused no known casualties. (112 km/hr at Bain Boeuf)



Effects of Goyave de Chine fruiting on Echo Parakeet breeding

Prior to c. 2000, no observations of Echo Parakeet feeding on Chinese guava fruits

Observations then became annual, and frequent

Noted that years of good guava fruiting = good Echo Parakeet breeding

Observed that there are shifts in some years of quantity and length of fruiting season especially into August

Late fruiting = adults in good body conditions = good breeding season

Guava fruiting is now a predictor of a good breeding season

PHENOLOGY OF FOOD PLANT SPECIES OF THE ENDEMIC PINK PIGEON AND ECHO PARAKEET


Pink Pigeon


Echo Parakeet

WHAT IS PHENOLOGY?

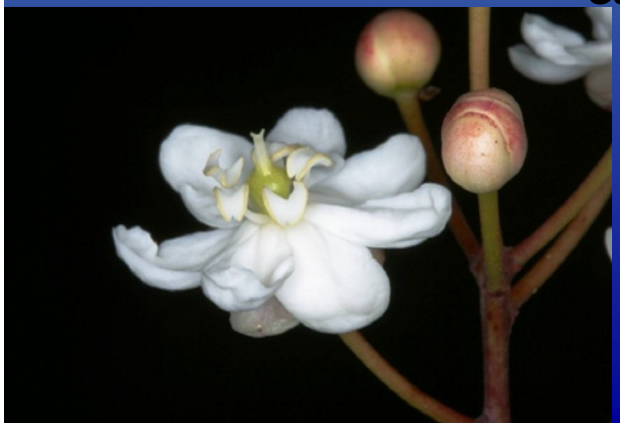
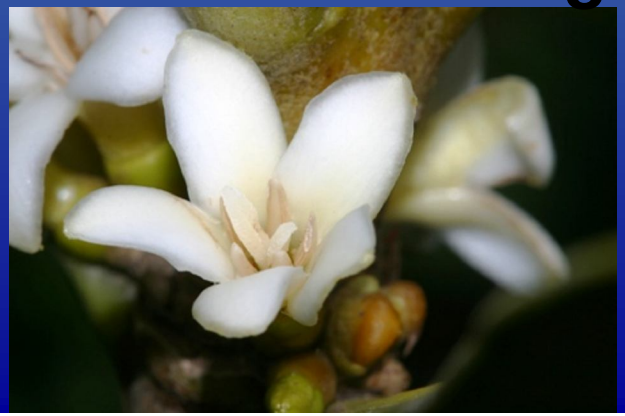
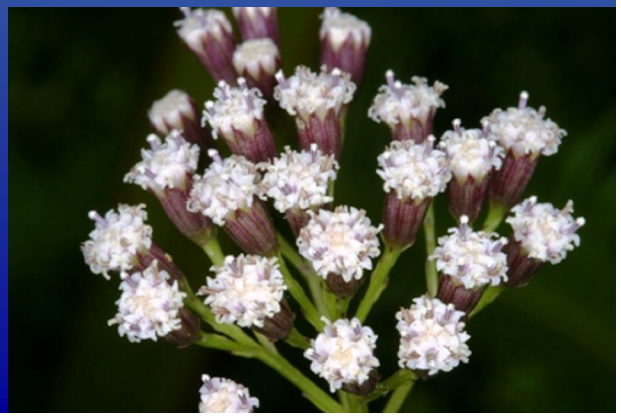
Phenology is the study of the response of living organisms to seasonal and climatic changes in the environment in which they live

e.g. blooming wildflowers, migrating birds, spawning fish, thunderstorms, falling leaves, frozen ponds

PLANT PHENOLOGY



Plant phenology is the scientific study of cyclic biological events of plants such as flowering, fruiting, leaf shedding, leaf flushing, seed setting in relation to seasonal and climatic changes

WHY IS PHENOLOGY IMPORTANT?

PHENOLOGY

1. **Phenology offers real evidence that climate change is happening now and that it is already having a significant effect on our wildlife.**
2. **Trees are coming into leaf sooner, and some typical spring flowers are increasingly being seen coming into bloom in November and December.**

There is a well established relationship between food availability (quantity, nutritional components and accessibility) and successful reproduction in a variety of avian taxa.

Extended pigeon moulting period and early breeding seasons of parakeets and passerines could be related to the changing phenology of their food plant species.

OBJECTIVE OF THE PROJECT

Main aim of the project is to study and compare the phenological behavior of the known food plant species of Pink Pigeons and Echo Parakeet at each sub-population in the Mauritian forest.

QUESTIONS BEING ADDRESSED

- What time of the year each species flowers?
- Is the flowering and fruiting of each species continual, sub-annual, annual, supra annual?
- Is the flowering and fruiting brief, intermediate, extended?
- How does weather/cyclones affect phenological activities?
- Does spatial variation affect phenological activities of a species?

METHODOLOGY

- 49 native and 16 exotic plant species are identified as important food plant species and monitored across five sites
- Variation in diversity and abundance of identified food plant species across sites thus variation in number of species monitored at each site
- Twenty (where available) random individuals of each selected plant species at each site is mapped and tagged with an aluminium identity disc
- Field staff are trained so ensure collection of good quality and consistent data across all sites
- Information on the phenology status of each plant is monitored monthly following a standard format.

Phenology monitoring manual

Chassalia spp

Bois Corail
Family: Rubiaceae

Conservation status: Vulnerable (*C.coriacea*),
Distribution: Upland forest and mossy forest
Critically endangered (*C.capitata*)

MORPHOLOGICAL CHARACTERISTICS

- *Habit*: **Small tree < 4m with lots of branches**
- *Bark*: Grey
- *Leaf Arrangement*: **Simple opposite, spread along the branch**
- *Lamina*: Yellowish green to light green, elliptical, about **10-15cm, thick and shiny, plastic texture, margin curled inside**
- *Apex*: Pointed
- *Base*: Tapering base
- *Petiole/sessile*: Petiole (about 1-2cm long)
- *Venation*: Reticulate, venation prominent on both the surfaces, distinct mid-rib
- *Inflorescence*: **Terminal, cyme, head**
- *Flower*: **White or purple or pink, conspicuous (about 1-2cm), long tubular corolla** resembling coral
- *Fruit*: **Berry, dark-red or waxy white in colour, oval or ellipsoid, about** 5-8mm
- *Expected flowering and fruiting:*

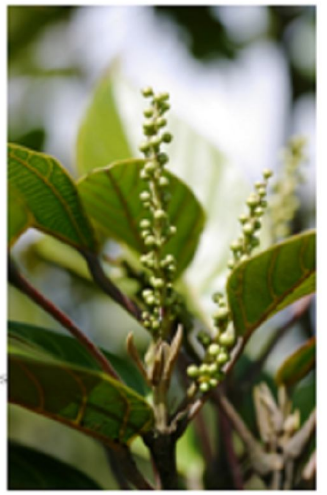
Cordemoya integrifolia

Bois pigeon
Family: Euphorbiaceae

Conservation status: Least concern
Distribution: Intermediate and upland forest

MORPHOLOGICAL CHARACTERISTICS

- *Habit*: **Tall tree** (8-15 m in height)
- *Bark*: Pinkish-brown bark, **watery sap,** branches covered with secretions
- *Leaf Arrangement*: **Simple alternate, leaves grouping at the end of the branches**
- *Lamina*: Dark green, elliptical, **large 20-25cm long,** glabrous, entire margin
- *Apex*: Pointed acute apex
- *Base*: Rounded
- *Petiole/sessile*: **Long reddish petiole up to 15-20cm long, thick**
- *Venation*: Reticulate, **midrib and primary veins are prominent and yellowish-white**
- *Inflorescence*: **Axillary, simple raceme,** sometimes
- panicle, **small orange flowers in sprays**
- *Flower*: **Small about 12mm, orange-yellow,** lower buds globular, long and glabrous pedicel, separate male and female inflorescences, male inflorescences with lots of flowers compared to female inflorescences.
- *Fruit*: Capsule **12-14 mm, roundish, horned fruit in 3 sections**
- *Expected flowering and fruiting:*



PHENOLOGY MONITORING SHEET

Sub-population: **Start time:** **End time:**

Observer (full name): **Date:** **^Weather during the walk:**

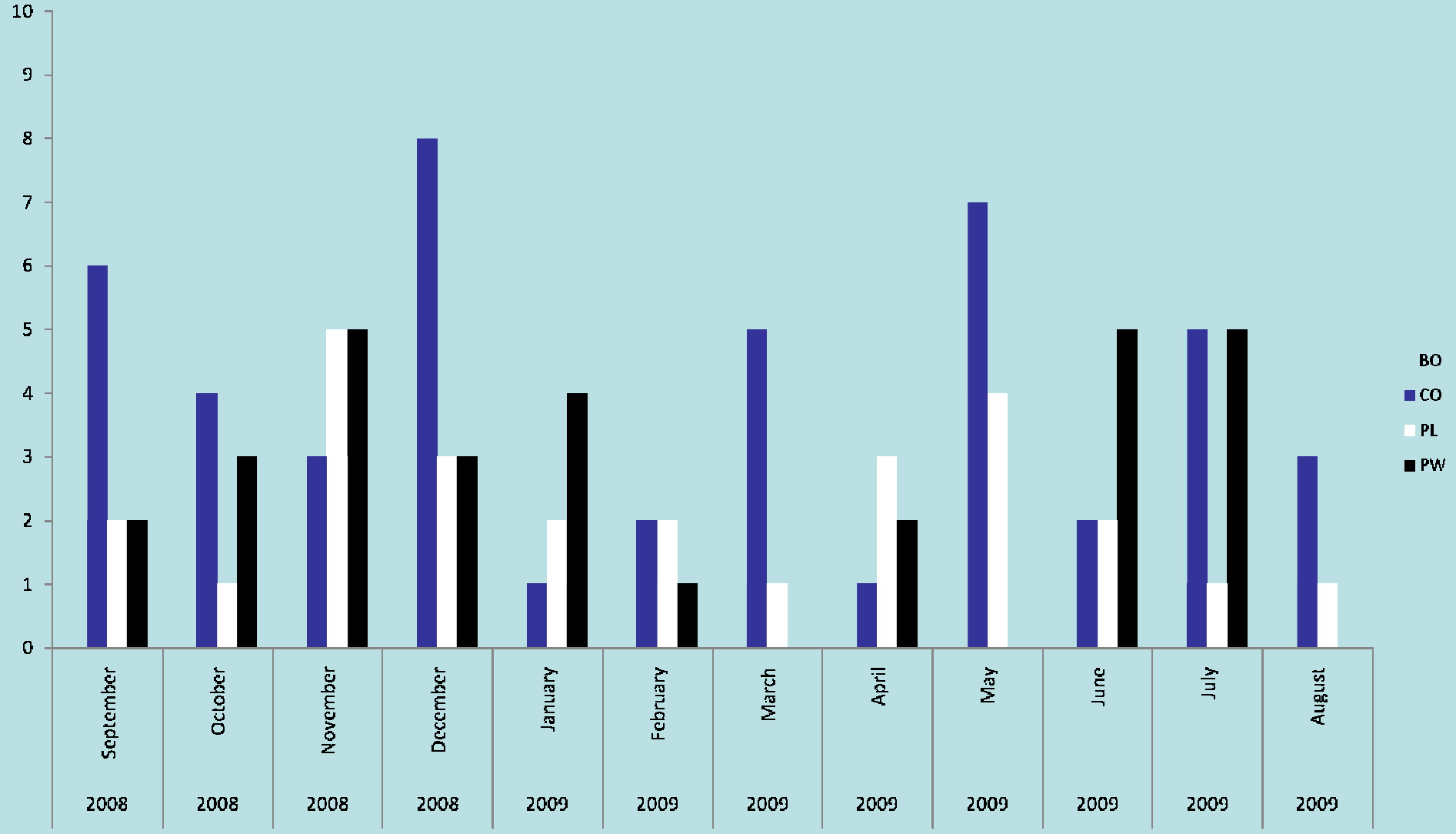
Sr. no.	Observed Tree	Tree no.	Inflorescence species	*FlB	*Fl	*Fr	*Yl	*Lv	ºGround Fl	Fr	¯ Comments no.
1	OCHMAU	4	Terminal/Cyme								Fruits did not look healthy

^ Fill in the appropriate: - cloudy/drizzling/ light shower/ heavy rain/ windy/ sunny (it can be just sunny **or** sunny, windy n sunny)

- Please note down presence(tick) or absence(cross) of flower buds **(FlB)**, flowers **(Fl)**, fruits **(Fr)**, young leaves **(Yl)** and leaves **(Lv)** on the tree

¯ Fill in the appropriate **A** - exotic/other native bird species seen feeding or pecking (specify the bird species), **B** - evidence of destruction caused by monkeys to the tree food source (you can illustrate), **C** - Tree dead, **D** - any other interesting observation (please specify)

Occurrence of young leaves in *Aphloia theiformis* at Bel Ombre, Combo, Plaine Lievre and Pigeon Wood from Sept 2008 to Aug 2009



CONSERVATION IMPLICATIONS

- Understand the role of plant phenology for long term conservation of Pink Pigeons and Echo Parakeets
- Understand role of supplementary feeding
- Suggestions for management strategies for habitat restoration essential for a long-term conservation of the endemic, endangered, frugivore Mauritian avian species with minimum or no management.
- Understand role of phenology of the endemic plant species in indicating climate change in Mauritius

Is Global Climate Change affecting Native Mauritian Biodiversity?

- Is climate change affecting Mauritius?
- Is climate change affecting biodiversity
  - Some evidence from the Mauritius Kestrel project
  - Preliminary evidence for the Round Island Petrel
  - Observations for Pink Pigeon and Echo Parakeet
  - Phenology showing differences between sites for some plant species, but is this climate change related?
  - Invasive species adaptation

Do not have strong evidence to prove effect of climate change on biodiversity (except for the effect of rainfall on Mauritius Kestrel)

ACKNOWLEDGEMENT

Malcolm Nicoll, Malcolm Burgess, Carl Jones, Ken Norris & Deepa Senapathi, Amruta Rane, Denis Li-Lung-Hok, Poonam Gangaram, Jean Claude Sevathian, Mr. Gabriel D'Argent, Ashok Khadun, Pink Pigeon team.


THANK YOU