Where will conservation efforts bring the greatest benefits for native birds?

Susan Walker
Landcare Research, Dunedin
Wednesday 13th September 2017
Wellington
Thanks

Funding
MBIE Core
Parliamentary Commissioner for the Environment
Thanks

Images
Neil Fitzgerald
John Innes
Craig Mackenzie
Rachel McLennan
James Mortimer
James Reardon
Glenda Rees
Peter Scott
DOC
Thanks

Adrian Monks
John Innes
Graeme Elliott
Josh Kemp

Data

Ornithological Society of New Zealand (bird atlases)
Department of Conservation (rodents)
MAINLAND
land birds

Ornithological Society of New Zealand
bird atlases

~25 YEARS
Bull et al. (1985)
1969-1979
Robertson et al. (2007)
1999-2004
‘Probability of occupancy’
Standardised for different:
- levels of effort
- spatial systems

Ornithological Society of New Zealand bird atlases
- Bull et al. (1985) 1969-1979
- Robertson et al. (2007) 1999-2004
Takahē

birds
potentially modelled

TOO RARE ON THE MAINLAND TO MODEL
Grey duck
Little spotted kiwi
New Zealand fairy tern
New Zealand shore plover
Marsh crake
Spotless crake
New Zealand dabchick
Takahē
Kākāpō
Red-crowned parakeet
Orange-fronted parakeet
North Island saddleback
South Island saddleback
South Island kōkako
Stitchbird
64 ‘taxa’

- NI brown kiwi
- Stewart Island tokoea
- Haast tokoea
- Fiordland tokoea
- Great spotted kiwi
- Rowi, Okarito brown kiwi

- South Island brown teal
- North Island brown teal

- Northern New Zealand dotterel
- Southern New Zealand dotterel

- Buff weka
- North Island weka
- Stewart Island weka
- Western weka
Local occupancy

Rifleman local occupancy
Atlas 1
1969-1979

Rifleman local occupancy
Atlas 2
1999-2004
Local occupancy

Rifleman local occupancy
Atlas 1
1969-1979

Change
Atlas 1 to Atlas 2
1969-1979 to 1999-2004

Decrease
Increase
Total range occupancy

Rifleman local occupancy
Atlas 1
1969-1979
8%

Rifleman local occupancy
Atlas 2
1999-2004
4%

Total range occupancy 26%

19%
Local richness

Number of native bird species

Atlas 2
1999-2004

Change in number of native bird species

Atlas 1 to Atlas 2
1969-1979 to 1999-2004

Decrease
Increase
Which birds were in most trouble, and where?

Endemism level
Habitat group
Environment
density of human occupation, land use, deforestation, temperature

Which groups of birds?

Where?
Which birds were in most trouble, and where?

- Endemism level
- Habitat group
- Environment
  - density of human occupation, land use, deforestation, temperature

Which groups of birds?

Where?
Level of endemism
Deep endemism
Deep endemism
Deep endemism
Deep endemism

NORTH ISLAND KOKAKO, JOHN INNES
Deep endemism
Coastal waders/terns/gulls
NZ dotterel

Forest birds
Grey warbler
Long-tailed cuckoo
NZ falcon
NZ robin
NZ tomtit
Parakeet species
Weka species
NZ fantail

Inland-breeding waders/terns/gulls
South Island pied oystercatcher
Black-billed gull
Black stilt
Black-fronted tern

Coastal waders/terns/gulls
NZ dotterel

Freshwater wetland
Brown teal
NZ scaup
Fernbird
Little shag
NZ dabchick

Open
Paradise shelduck
NZ pipit
Coastal waders/terns/gulls
- Variable oystercatcher
- Southern black-backed gull
- Red-billed gull
- Caspian tern
- White-fronted tern

‘Shallower’ (species-level) endemics

Inland-breeding wader
- Australasian pied stilt

Non-endemic native

Coastal wetland
- Reef heron
- Pied shag

Freshwater wetland
- NZ shoveller
- NZ kingfisher
- NZ black shag
- NZ crested grebe

Reef wetland
- Black swan
- Australasian bittern
- Black shag
- Little black shag

Forest birds
- Shining cuckoo
- Morepork
Freshwater wetland
Grey teal
White-faced heron
Australian coot

‘Shallower’
(species-level)
endemics

Non-endemic
native

Recently self-introduced
(since ~ 1850)

Coastal wetland
Royal spoonbill

Open
Australasian harrier
Spurwing plover
Welcome swallow

Forest
Silveryeye
Trouble

IN SERIOUS TROUBLE

TEETERING ON THE BRINK OF EXTINCTION

EXTINCT

IN SOME TROUBLE

DOING OK

Population size / range occupancy
Deep endemism = deep trouble

“Species which have had a long evolutionary history in New Zealand seem now to be susceptible to extinction.

This suggests some peculiarity in the evolutionary process ... which in a time related manner affects the present viability of the species” (McDowall 1969, p. 8).
Endemism = trouble


- Recently self-introduced
- Non-endemic native
- Species level
- Genus level
- Order, family and subfamily levels ('deep endemics')

Level of endemism >>>

DOING OK

IN SERIOUS TROUBLE
Spatial distributions vary with endemism level

Average local occupancy in 1999-2004

- Recently self-introduced
- Non-endemic native
- Species level
- Genus level
- Order, family and subfamily levels (‘deep endemics’)

Level of endemism >>>

SETTLED AND PRODUCTION LOWLANDS

REMOTE FOREST AND ALPINE
Road density as an index of human occupation
Recently self-introduced

NORTH ISLAND
1999 to 2004

SOUTH ISLAND
1969 to 1979

Relative road density (RD)

Effects of road density and endemism level

1969 to 1979
1999 to 2004

Change
Increase
Effects of road density and endemism level

- Recently self-introduced
- Non-endemic native
- Species level
- Genus level
- Subfamily levels
- Family level
- Order levels

Level of endemism

- Relative road density (RD)

NORTH ISLAND
- 1969 to 1979
- 1999 to 2004

SOUTH ISLAND
- 1969 to 1979
- 1999 to 2004

Local occupancy

0.6
0.3
0.0
Biotic homogenisation

- Recent arrivals increasing in human occupied landscapes
- Deep endemics decreasing in refuges mainly remote from human occupation
Six habitat groups

- **Forest**
  - Recently self-introduced: 1
  - Non-endemic native: 1
  - Species-level: 1
  - Genus-level: 1
  - Subfamily-level: 1
  - Family-level: 1
  - Order-level: 1

- **Wader/tern/gull (breeds inland)**
  - Recently self-introduced: 2
  - Non-endemic native: 2
  - Species-level: 2
  - Genus-level: 2
  - Subfamily-level: 2
  - Family-level: 2
  - Order-level: 2

- **Wader/tern/gull (coastal breeding)**
  - Recently self-introduced: 3
  - Non-endemic native: 3
  - Species-level: 3
  - Genus-level: 3
  - Subfamily-level: 3
  - Family-level: 3
  - Order-level: 3

- **Freshwater wetland**
  - Recently self-introduced: 4
  - Non-endemic native: 4
  - Species-level: 4
  - Genus-level: 4
  - Subfamily-level: 4
  - Family-level: 4
  - Order-level: 4

- **Coastal wetland**
  - Recently self-introduced: 5
  - Non-endemic native: 5
  - Species-level: 5
  - Genus-level: 5
  - Subfamily-level: 5
  - Family-level: 5
  - Order-level: 5

- **Other open habitats**
  - Recently self-introduced: 6
  - Non-endemic native: 6
  - Species-level: 6
  - Genus-level: 6
  - Subfamily-level: 6
  - Family-level: 6
  - Order-level: 6

Note: The diagram shows the number of bird taxa in each habitat group, categorized by taxonomic level with 'deep endemics' indicated.
Doing OK
Changes in average local occupancy over 25 years

Coastal-breeding wading birds, terns & gulls ($n = 6$)
Freshwater wetland birds ($n = 17$)
Birds of coastal wetlands and shores ($n = 5$)
Birds of other open habitats ($n = 7$)

Increase
In some, or serious, trouble
Changes in average local occupancy over 25 years

Forest birds
(n = 22)

Inland-breeding
wading birds, terns &
gulls (n = 7)

Decrease
Inland-breeding wading birds, terns and gulls
Inland-breeding wading birds, terns and gulls

Average local occupancy
Atlas 1
1969-1979

Average local occupancy
Atlas 2
1999-2004

Change
Atlas 1 to Atlas 2
1969-1979 to
1999-2004
Environmental predictors of local occupancy change

Distance from the coast (km)

Percent of square under crops, pasture or exotic forestry (in 2001)

Relative level of urbanisation (in 2001)
Land use and urbanisation effects

**NORTH ISLAND**

<table>
<thead>
<tr>
<th>High % agriculture and forestry</th>
<th>On the coast</th>
<th>Inland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low % agriculture and forestry</td>
<td>On the coast</td>
<td>Inland</td>
</tr>
</tbody>
</table>

**SOUTH ISLAND**

- 1969 to 1979
- 1999 to 2004

**Level of endemism >>>**

**Non-endemic native**
- Pied stilt

**Species-level endemics**
- Banded dotterel
- Black billed gull
- Black-fronted tern
- Black stilt
- SI pied oystercatcher

**Genus-level endemic**
- Wrybill

**Local occupancy**

- 1.0
- 0.5
- 1.0
- 0.5
Land use and urbanisation effects

**NORTH ISLAND**

High % agriculture and forestry

On the coast

Inland

Low % agriculture and forestry

On the coast

Inland

**SOUTH ISLAND**

1969 to 1979

1999 to 2004

Level of endemism >>>

Local occupancy

0.4

0.5

0.6

0.7

0.8

0.9

1.0

Urbanisation effect

Level of urbanisation

Low

Med.

High

1969 to 1979

1999 to 2004
Land use plays a role

Inland-breeding wading birds, terns and gulls

- greater declines in inland South Island breeding areas developed for agriculture and forestry
- greater increases in winter feeding areas surrounded by more urban development
<table>
<thead>
<tr>
<th>Remaining forest birds</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-tailed cuckoo</td>
<td>Yellow-crowned parakeet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rifleman</td>
<td>Kōkako</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Falcon</td>
<td>Kea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomtit</td>
<td>Kākā</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robin</td>
<td></td>
<td>Whitehead</td>
<td></td>
</tr>
<tr>
<td>Weka (all)</td>
<td></td>
<td>Mōhua</td>
<td></td>
</tr>
<tr>
<td>Grey warbler</td>
<td>Kererū</td>
<td></td>
<td>Brown creeper</td>
</tr>
<tr>
<td>Fantail</td>
<td>Tūi</td>
<td>Blue duck</td>
<td>Kiwi (all)</td>
</tr>
<tr>
<td>Shining cuckoo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silvereye</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morepork</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Forest birds need forest

Native forest cover

At human settlement

Now

Endemic forest birds

1999-2004

Average occupancy probability

WALKER & MONKS 2017 (LANDCARE RESEARCH REPORT FOR THE PCE)
Endemic forest birds need forest more
Endemic forest birds need forest more

<table>
<thead>
<tr>
<th>Non-endemics</th>
<th>Species- &amp; genus-level endemics</th>
<th>Deep endemics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of endemism &gt;&gt;&gt;</td>
<td>Level of endemism &gt;&gt;&gt;</td>
<td>Level of endemism &gt;&gt;&gt;</td>
</tr>
</tbody>
</table>

Forest now

WALKER & MONKS 2017 (LANDCARE RESEARCH REPORT FOR THE PCE)
Effects of forest cover and endemism level

- Subfamily levels
- Family level
- Order levels

NORTH ISLAND

- 1969 to 1979
- 1999 to 2004

SOUTH ISLAND

- 1969 to 1979
- 1999 to 2004

Local occupancy vs. Amount of forest

Level of endemism >>> 1.0 to 0.5

Order levels
Family level
Subfamily levels
Deep endemic forest birds

Average local occupancy probability
1969-1979

Change
1969-1979 to 1999-2004

Forest now
Effects of forest cover and endemism level on forest birds

Recently self-introduced  Non-endemic native  Species level  Genus level  Subfamily levels  Family level  Order levels

NORTH ISLAND

SOUTH ISLAND

Local occupancy

Amount of forest
0  100%

Level of endemism >>>

1999 to 2004

1969 to 1979

1999 to 2004

1969 to 1979
Not all forests are equal
Not all forests are equal

Ship rat
Predator patterns

Ship rats

‘Rat forest’ classes

WALKER ET AL (LANDCARE RESEARCH AND DOC, IN PREP)
DOC’s rodent tracking tunnel dataset

>250,000 records
1999 to present
HIGH, BEECHY IRRUPTIVE MICE, but RATS RARE

COLDER
LOW ELEVATION
ALWAYS RATTY
FEW MICE

COLDER

WARMER

HIGH, BEECHY
IRRUPTIVE
MICE, RATS RARE

LOW ELEVATION
ALWAYS RATTY
FEW MICE
‘Rat forest’ classes

Ship rat tracking percentile through time

Unmanaged tracking rate

RAT FOREST CLASS
A
B
C
D
E
F

most ‘continuously ratty’ forests
‘Rat forest’ classes

Unmanaged tracking rate

Ship rat tracking percentile through time

‘irruptive’ rat forests
Temperature

'Rat forest' class

Mean annual temperature

'Irruptive' rat forests

Most 'continuously ratty'
Ratty forests are warm non-beech forests
Mean annual temperature in squares with remaining forest
Mean annual temperature in squares with remaining forest

Temperature patterns
Endemic forest birds in forests

25 years later
1970s

Local occupancy

Mean annual temperature
Deep endemic forest birds depend more on cold forests
Deep endemic forest birds depend more on cold forests

- **Species level**: Local occupancy decreases from South Island to North Island as temperature increases from cold to warm.
- **Genus level**: Similar trend observed for local occupancy.
- **Family level**: Local occupancy continues to decrease as temperature increases.
- **Order level**: Local occupancy decreases from South Island to North Island.

**Level of endemism >>>

**Order level**: Cold > Warm

**Family level**: Cold > Warm

**Genus level**: Cold > Warm

**Species level**: Cold > Warm

---

Level of endemism >>>
Kākā

Local occupancy

NORTH ISLAND  SOUTH ISLAND 1970s

Early 2000s

COLD  >  WARM
Blue duck/whio

Local occupancy

NORTH ISLAND
SOUTH ISLAND

1970s
Early 2000s

COLD > WARM

WHIO FORAGING: NEIL FITZGERALD
Mohua

Local occupancy

SOUTH ISLAND

1970s

Early 2000s

COLD > WARM

Mohua in Red Beech Forest: Glenda Rees
Rifleman, Neil Fitzgerald

Local occupancy

COLD > WARM

NORTH ISLAND  SOUTH ISLAND

1970s  Early 2000s
Warm forests are a bigger management challenge than beech forest

Scale is key: ability to

• maintain low ship rat numbers
• over very large forest areas
• cost-effectively
• without unintended consequences
Conclusions

1. Homogenisation continues
   • loss of remaining deep endemics, in forests and the alpine zone
   • takeover by a recently arrived weedy avifauna, especially in human-modified landscapes
Conclusions

2. Humans have played and are still playing major roles
   • Past deforestation is likely to limit endemic forest bird recovery, and opportunity to keep and restore large populations lies in remaining forests.
   • Development of inland South Island basins is now foreclosing options for inland breeding wading birds, terns & gulls.
Conclusions

3. Not all forests are equal
   • Ability to effectively and cheaply control rodents at large scales in warm forests will be a key management tipping point
Acknowledgements

Adrian Monks
John Innes
Graeme Elliott
Josh Kemp

Craig Mackenzie
Rachel McLennan
James Mortimer
Peter Scott

Glenda Rees

https://www.facebook.com/NZBANP/
https://www.instagram.com/glenda_rees/