(b) Migratory birds may arrive at feeding grounds before the main food supplies (insects, fruits) are ready (e.g. before plants are flowering). Even if the distribution of food resources is the same, the birds are not migrating as far south and may be disconnected from winter food supplies.

9. Bird Migrations in New Zealand (page 14)

1. (a) Wrybill breeding: Riverbeds in Canterbury and Otago.
   Wrybill overwintering: Harbours and coastline in the Auckland region (e.g. Firth of Thames, Manakau and Kaipara Harbours).
   (b) Pied stilt breeding: Wetlands and suitable wet areas in farmlands in the North and South Islands.
   Pied stilt overwintering: Move northwards to the coast.
   (c) SI pied oystercatcher breeding: East of the Southern Alps in the southern half of the South Island.
   SI pied oystercatcher overwintering: Estuaries and harbours in all other parts of the country.
   (d) Banded dotterel breeding: Lake shores and inland riverbeds.
   Banded dotterel overwintering: Move to the coast and northwards of both islands and even to Australia.
2. Overwintering areas are subjected to fewer climatic extremes (they are often coastal regions) than the breeding areas and this enhances survival through the winter period. The breeding areas, which tend to be further inland and more seasonally variable, have an abundance of seasonally available food suitable for raising broods and preparing birds for winter.
3. There is a considerable risk in flying to a remote location. It requires a large expenditure of energy and there are unknown threats associated with moving through unfamiliar territory.

10. Migratory Navigation in Birds (page 15)

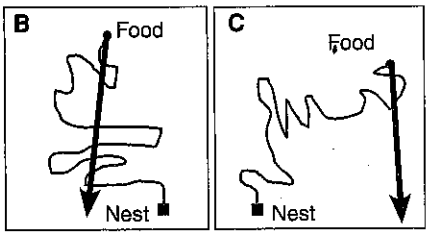
1. (a) Sun compass: In natural conditions, the birds consistently orientated with respect to the direction of incoming light. The experiment supported the use of a sun compass.
   (b) Star compass: When the planetarium 'sky' was rotated 90°, the birds altered their orientation to compensate. No visible sky resulted in confused, apparently random responses. The experiment supported the use of a star compass.
   (c) Magnetic compass: The birds realigned their position to what they sensed to be magnetic north. The experiment supported the use of a magnetic compass.
2. Birds using a sun compass must have a biological clock of some kind to calibrate the Sun's movement to time of day (to allow for the sun's changing position).
3. (a) They continued to fly in a SW direction towards Spain, and did not fly to their winter home (France, Britain, Ireland).
   (b) The experienced birds still flew towards their normal winter homes.
   (c) Juveniles have only their innate (genetically programmed) flight paths to go by, and they continued to follow this direction once they were relocated. Experienced birds can modify their innate behaviour and learn to correct for deviations from their flight path.
4. (a) The hybrid blackcaps flew a path that was between the paths normally flown by the Western and Eastern blackcap populations.
   (b) The blackcap sense of direction is genetically determined.

11. Cuckoo Migrations (page 17)

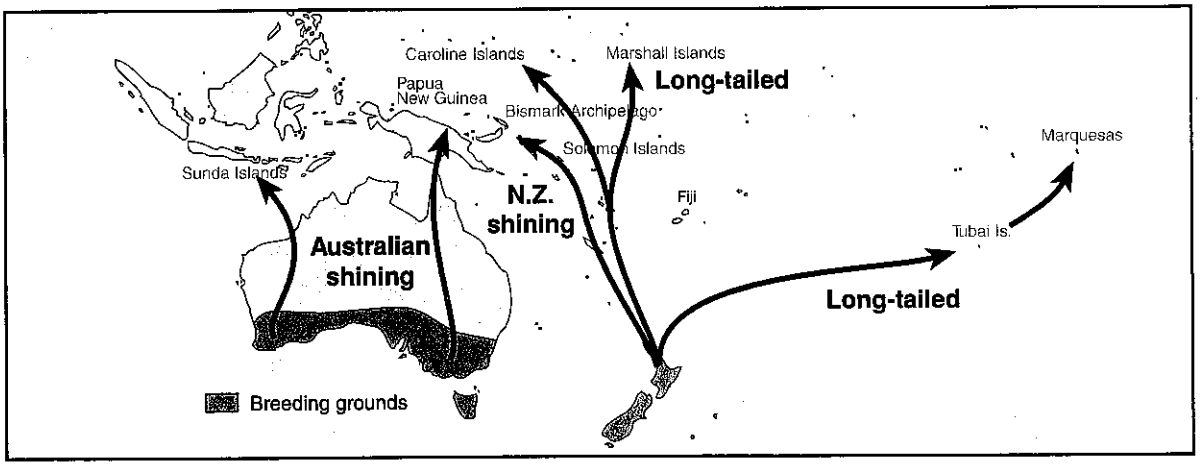
1. Migration routes: see diagram at the bottom of the page.
2. (a) Marquesas Islands: 4000 km
   (b) Solomon Islands: 4000 km
   (c) Papua New Guinea: 3000 km
3. For long-tailed and NZ shining cuckoos, star navigation at night, sun compass, and geomagnetic compass are all likely. There are no landmarks over the sea so it is unlikely they would be using visual cues. The Australian shining cuckoo could use all four methods of navigation.
4. The adaptive advantage of the migration is related to increased and reliable food supplies (and more daylight hours for foraging) in the islands when it is winter in NZ and Australia, and availability of breeding hosts in the NZ/Australian summer to provide nests for these brood parasites.

12. Sun Compass Navigation (page 18)

1. Position of the sun during the day.
2. (a) Bee communicates the location of a food source (direction and distance) using the waggle dance. The bee's movements on the comb give the angle of the food source relative to the Sun. The duration and speed of the waggle in the abdomen indicates how close the food source is.
   (b) This behaviour increases the efficiency with which bees in the colony can locate food. Clear communication about food sources prevents bees wasting energy searching for food and enables the colony to exploit available food sources efficiently (essential to successful survival and reproduction).
3. It adjusts the angle of the dance to account for how much the Sun has moved between when the food was found and when the bee danced.
4. Polarised light
5. Rotating the plane of polarised light meant that the ants followed a path at the angle of the rotation. They would then not be navigating to correct position of the food source.
6. B and C below



7. Animals that can detect polarised light (caused by scattering



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