Literature on birds in & around N. Kanara.

(1) VIDAL, G.W. (1880) 'First list of the birds of South Konkan' Stray feathers. 9: 1–96

(2) DHARMAKUMARSINHJI, K.S. (1961b) 'Rufous-bellied Hawk-Eagle Lophotriorchis kienerii kienerii (E. Geoffroy) in N. Kanara'. JBNHS 58: 514.

(3) DHARMAKUMARSINHJI, K.S & LAVKUMAR, K.S. (1956) 'The white-bellied Sea Eagles of Kanara [Haliaetus leucogaster (Gmelin)] JBNHS 53: 569–80

(4) DAVIDSON, J. (1898a) 'The birds of north Kanara' JBNHS. 2 parts vols 11, 12.

(5) ABDULALI, HUMAYUN (1967b) 'On the occurrence of the Black necked stork [Xenorhynchus asiaticus (Latham) in the Bombay Konkan' JBNHS 64: 367

(6) DAVIDSON, J. (1895) 'The birds of the Bombay Presidency' JBNHS 9: 489-9.

(7) KOELZ, WALTER (1942). 'Notes on the birds of the Lonar neighbourhood, Bombay Presidency' & JBNHS 43: 11–33

Avian Ecology – Perrins & Birkhead.

How do birds time their breed?

' answer is " certain endocrine & physiological processes are the causal mechs. i.e. they cause the bird to breed at a certain time, stimulated by proximate factors, such as daylight.

why do birds breed at specific times?

' living breed at a particular time is " it results in ↑ no. prods of young. The best time to breed is determined by ultimate factors, such as food availability for ↑ rep.

Territoriality common guillemot (common murre) req. a few sq km " is defend for breed. Golden eagles defend as much as 90 sq km – individually.

– Competition for resources is an ↑ factor for ↑ degree of territorial behaviour.

– overall ca 13% of all birds breed in colonies.

FLOCKING

– flock feed birds have developed a strategy for exploiting food supplies which tend to be patchily distributed & ∴ difficult to locate.

– an ↑ in ↑ no. of birds in a feed patch suggests an ↑ in abundance of food.

– a large (largest!) colony of guillemots may contain upto ☆ one a million birds. They may capture a total of 200 Tons of food from surrounding waters in a day!

– In guillemots where the chances of egg + ~~nest~~ egg getting onto up is ↑. However each parent is able to identify its own egg / chick by ' colour pattern of egg + call of ' chick.

2 main factors decide whether spp live solitary or socially. It are (1) uneven distribution of resources such as food + nest-sites. + (2) ~~need~~ vulnerability to predators.

If resources are clumped in birds feed + breed in flocks + colonies. If they are evenly distributed birds tend to be solitary defend large territories.

Why if prey bird is camouflaged - its spp tend to be solitary. where it (are conspicuous +) need a flock to defend themselves, they are colonial.

Mating systems - there are 4

① Monogamy - 92%
② Poly gyny - 2%
③ Poly andry - 0.4%
④ Promiscuity. - 6%

In precocial spp the extent of monogamy is only 83%. as compared to altricial birds (93%)

OSR - operational sex ratio - ie, the no. of receptive ♀♀ in relation to the no of sexually active males.

If all ♀♀ become receptive simultaneously the OSR is 1:1 but if OSR is deviate from 1:1 the chances of polygamy is >.

BROOD PARASITISM

about 1% of all birds ie, ca 80 spp are brood parasitic.

- Honey guides (by have symbiotic bacteria to digest bee wax) are parasites on barbets + woodpeckers - host-species.

Brood parasitic birds

Cuculidae	Cuckoos	Old world + S America	ca 50 spp.
Phoeniculidae	Indigobirds + a weaverbird	Africa	10 + 1 spp.
Icteridae	Cowbirds	N + S America	5 spp.
Anatidae	Black headed duck	S. America	1 sp.
Indicatoridae	Honeyguides	Africa/Asia	11 spp.

Of 130 spp of cuckoos on the world only 40% are brood parasitic.

The ca 50 spp of Old world cuckoos occur in either Africa + Asia (some in Australia + Europe). Nearly all parasitic on smaller passerines + insectivorous.

Indigobirds + parasitic on estrildid finches. Both chicks are reared in the same nest.

Cowbirds have a wide range of host spp.
(+ mostly in Central + S. America - one sp Brown headed cowbird in N America)

The egg-shells of parasitic cuckoos are often thick. Pied Crested cuckoos egg is double-shelled + hence not damaged even if dropped from a perch into the nest.

Egg colour mimetic + most clutches of host. Egg in different areas is seen in European cuckoos.

In cowbirds + all females parasitize a variety of hosts. Yet there is no mimicry of eggs.

[Very little is known about the population dynamics of brood-parasites.]

Inter-specific brood parasitism in European starlings in which they often lay eggs into nests of other sp.

' natural selection acts on indivs rather than on gps.
& it follows from this " in order to gain genetic representation in subsqt generations, indivs might be expected to behave selfishly (Dawkins 1976)

COOPERATIVE BREEDING

Helpers - some indivs forego breeding in order to help a breeding pair raise young.
~ has been observed in > 150 spp in 10 orders.
> common in passerines. Others mostly in tropics
~ australia. rare in Europe & N America.

Most cooperative breeders have low breeding rate, high adult survival rate, low dispersal & deferred maturity.
Birds may not breed until they are 2 yrs old spending intervening period as helpers. Sexual dimorphism is rare/slight. Monogamy is > freq. They prefer stable ecosystems in which chances of breeding is <.

(eg) Florida Scrub Jay, Babblers (Turdoides spp) etc.
& Superb blue wren.

Helpers are (i) genetically related to breeding pair* - offsprings of previous brood
(ii) predominantly ♂♂. [*only one pair breeds]

There are other spp " don't fall into the categories
(eg) Mexican jay & Acorn woodpecker - 2 pairs breed
Pied Kingfisher - 1 helpers are genetically unrelated to 1 breeding pair.

EGG WEIGHTS

Ostrich weighs 90 kg   one egg weighs 1.6 kg

~~Vervain~~ Vervain humming bird weight 2 gm   eggs – 0.2 gm.

" > in clutch-size

In N. hemisphere, the summer days are longer as one goes north. Parents have > time to gather food & hence raise a larger no. of young – larger clutch size."

This explanation is not valid as owls are also showing the same that are not supposed to do so being nocturnal. It should be the reverse in their case.

∴ hence the most most likely explanation for this could be the relative product of an area than daylength.

In the Arctics fluctuations in the availability of food is enormous with the season.

- The main factor governing clutch size is food availability & predation – vulnerability to preds. (predation alone) This is > expressed in precocial birds.
- "Lack's hypothesis says that clutch size is governed by the ability of a bird to produce & raise the max. no. of young possible."
- variability in clutch size bet. & w/in spp is by latitude, habitat, temp etc. which ~~directly~~ directly reflect on the availability of food.
- In tropical passerines the adult mortality rate is lower than temperate spp.

Manx shearwater – young birds migrate 8000 km from Britain to coasts of Brazil & Argentina. fly cover the distance in 14 d. (ca 570 km/d)

Smaller birds surface/volume ratio is > than larger birds & hence require > food to maintain a given body wt.

Migration < migrant / partial migrant / irruptive birds

Avian Breeding Cycles
(Murton + Westwood.)

Male breeding condition is stimulated by responses to light cycles. In ♀♀ this is minimum + final growth phase occurs during the 6–12 d period of pre-incubation courtship c̄ male. During the (flight) muscles accumulate reserves of labile protein ‖ > to 80% in Quelea ♀♀ before breeding + in ♂♂ it's only 14% – this is transferred rapidly to follicles + even determines the clutch size.

Birds of prey + > affected by DDT + dieldrin etc.

Apart from photoperiod + courtship there are other factors ‖ regulate the breeding in birds.

The effect photoperiod has on bird activity changes c̄ > of latitude. The seasonal activity of a wild bird is extremely complex – an intricate but endogenous, autonomous component, which are expressed as self sustaining diurnal + annual rhythms + environmental stimuli. There are considerable species-specific variation. Closely related spp have a common pattern.

Body wt in birds >s c̄ > in latitude but the metabolic rate <s. In temperate equatorial region, the survival rate + life span of birds >s but rate of reprodn <s.

Reprodn is essentially a matter of temporal organisation in relation to the metabolic + environmental seasons. Photoperiodism is a process whereby the animal adaptively synchronizes an internal rhythm of body fn c̄ the external chronology of day + night + seasons.

In tropics clutch size is smaller, breeding seasons longer + adult survival >. These changes occur c̄ the > in latitude + not proportional to the >/< in daylength.

In the stable tropics adult life span is > but the (eggs +) nestling survival is less

In tropical birds 1 pair but > larger + > brain but to be monomorphic. The opposite is true in temperate regions

BODY SIZE

Bergmanns rule - an > in body size in polytypic spp to colder part + an latitudinal + altitudinal gradient is observed.
- > body size, less metabolic rate.
- non-passerines have a lower metabolic rate than passerines - hence can achieve smaller + larger body size. > in size is lim by the thermoregulatory capacity of 1 bird. < in size lim by 1 capacity to mobilize energy.
- Evolution to smaller size demands > energy. But it happens to suit some ecological niches.
- Large body size is related to stabilized habitat - large body size is a buffer against environmental changes + def. against predation.
- large body sizes ↓ in birds, related to < metabolic rates.

∴ Altricial birds (eg) Blackbird / midicolous
Precocial birds (eg) Pheasant / nidifugous

- the endocrine system, provides a special co-ordinated link bet the physical body apparatus of 1 bird & 1 environment, thereby 1 capacity of feed-back relationships which can monitor normal + abnormal functions.
- all birds are photoperiodic

THE NEUROPHYSIAL SYSTEM

Pituitary gland - master gland of the body - located at 1 base of 1 brain = hypophysis

Pineal gland - related to Circadian periodicity + photosensitivity

REPRODUCTIVE APPARATUS OF MALE

Photoperiodic stimuli, modified by other physiological factors including 1 plane of nutrition, allow 1 gonads to attain a functional order.
- ♀♀ have right ovary - 1 left one is functional. In some spp known - the Kiwi Apteryx australis, Accipitridae, Falconidae, Bucerotidae + Caprimulgidae both the ovaries are functional. Exceptional occurrence has been noted in Pigeons + Herring gulls.

SEX REVERSAL

- In ♀♀ if the fertile ovary is damaged surgically or thro a disease, the other can develop into a testis or ovo-testis. If it is at an early age, it develops spermatozoa. If later only ovules are produced. This is common in domestic chickens. Hens drop ♂ plumes, crow + tread ♀ fertile ♂ like females.

Intersexuals are common in pigeons.

THE ♀ APPARATUS

the oviduct can be ÷d into 5 regions — infundibulum, magnum, isthmus, shell gland (uterus) + vagina.

The eggs spend ca 0.25–0.5 hr in infundibulum, 2–3 hr in magnum, 1–2 hr in isthmus, 19–24 hr in shell gland — in Quail, turkey + chicken. Fertilization occurs in infundibulum. In domestic hens fertile eggs can be laid 10–14 days after a single copulation.

The white albumen is formed in the magnum.

Yolk contains 50% water + solids are protein + lipids (as lipoproteins) in ratio 1:2.

Albumen is solid mostly protein — of solids 92% are protein + ca ½ of rest - CHO., + 1 other ½ inorganic ions. Otherwise it is water. The ratio of water to protein is 8:1.

- conduct ♀s in light during period of active most briskly + ♂s after egg laying.

The shell membranes (2 membranes) are laid over the albumen in the isthmus

Actual shell + pigment are secreted / deposited in the shell gland / uterus. Ground colours are given during first stages of shell deposition + blotches / streaks + spots after the shell is complete. Since / egg rotates on a vertical axis the markings have a characteristic configuration.

- Normal structure of eggs can / incubation behaviour.
- Clutch size is influenced by latitude.

REPRODUCTIVE BEHAVIOUR: vocalization plays a greater role in pairing in nocturnal birds & in thick woodland birds. Birds of open resort to display flights.

- 1st activ. of pairing is territory & song.
- ♀♀ are interested only in territory holding ♂♂.
- Androgen levels stimulate 'bowing' behaviour in Pigeon ♂♂
- courtship feeding & copulation occur after 8-9 before ovulation.
- during courtship feeding & copulation period male also does the 'nest-demonstrating behaviour'.
- nest building stimulates oviduct develop. & egg-laying
- Progesterone is the factor for incubation in males / ♀♀
- Central nervous system is also involved in Rep. beh.

ENERGY BUDGETS

- A chicken during deposit deposits 1.8% of its body wt in the egg.
- Catabolism — break down of fats, carbohydrates & proteins provides heat to maintain the birds' temp above that of the environment. Normal body temp of birds when awake 41°C. may fall during night by 4-6°C & > with activity to > 43°C.
- metabolic rate is measured by the oxygen used in oxidation
- Basal metabolic rate — when at rest, at night, & starved to a pt when there is no absorption of nutrient from the digestive tract, the body temp is maintained by heat loss; the metabolic rate remains constant. There is a range of environmental temps called the zone of thermal neutrality.
- Heat regulation is achieved largely by the insulating property of plumage. ~~fluffing~~ fluffing of feathers during cold tends to insulate.
- Birds can't lose heat by sweating & hence they require panting to evaporate water thro' respiratory passages & tongue
- some plover & marine spp have insulating subcutaneous fat deposits
- lowest temp tolerance for house sparrow is —35°C.

Migration + fat stores

- fat gives 9.5 k cals/g
- American golden plover flies nonstop 2000 miles from Arctic breeding grounds to Hawaii for wintering.
In birds like wheatears + garden warblers which cross the Sahara in one hop - 30-40% of body wt consists of fat.
- The metabolic rate during flight would be 7-8 times basal rate of metabolism.
- Fat accumulation is done in a short time of 6-9 days in white-crowned sparrows.
- Birds also accumulate protein in their muscles which is metabolised during migration.
- small body size is an advantage for migrant as in one is a larger diff bt available + required power.
- in plovers of hop & night, birds accumulate fat during diurnal hours to use for night.
- in birds (pigeons + chicks) the place of active synthesis of fatty acids is the liver.
- during moult in non-migratory spp, muscle tissue is broken down to provide amino acids for feather synthesis.

Physiology of moult

Feather design - Thyroid hormone (Thyroxine) is essential for feather design.

An egg (poultry) of 58 gm contains 7.0 gm protein, 6.2 g fat 0.3 g CHO, 2.0 g Ca, 0.5 g minerals, 3.0 g other non metallic elements 39.0 g water. yolk weighs 17 gm. The shell contains 10% of g, total body calcium.

- yolk proteins are synthesised in the liver.
- follicle maturation takes 7-10 days on an average.
- Avian lungs - the design of avian lungs enables birds to achieve a remarkably efficient uptake of O_2 + loss of CO_2. One of the diff bt the + mammalian lungs is that birds' alveoli are very small + if they become collapsed they can't be inflated.

A chick on hatching weighs only 2/3rds (⅔) of an egg (original wt)

– In birds photoperiodism plays a hypothalamic neuroendocrine role which controls reproductive migratory flocking, moult, gonad development & other periodic functions.

– Bunnings hypothesis (1936) 1st proposed to explain photoperiodism in pl. fns.

X.

Warbler spp migrate	Breeding range	winter range	migratory movement (miles)
Blyths reed warbler –	Central Palaearctic (52°N)	India	2600 +
Paddy field warbler –	SE & Central palaearctic (45°N)	India	1600 +
'Great reed warbler –	W. Palaearctic (45°N)	Africa	3200 °
Booted warbler –	Central Palaearctic (47°N)	Middle east	3000 +
Common white-throat –	W. Palaearctic (50°N)	Africa	3600 °
lesser " (3 ssp) –	Central/S. Palaearctic (34°N–48°N)	India	1600–2000 °
W. crowned leaf warbler (P. occipitalis) –	Oriental (32°N)	India	1100 °
Greenish leaf warbler (P. t. viridanus) –	Eastern & central palaearctic (54°N)	SE asia	3000–5000+
Bright green leaf warbler * (P. (trochilloides) nitidus) –	S Central Palaearctic (36°N)	S. India	2000+

+ nuptial moult in winter grounds
° " " " summer grounds.

1 Great reed warbler (A. orientalis) has been considered as a spp by Ali & Ripley (Eurasian great reed warbler) but as a subspp (A. arundinaceus orientalis) by Munton & Westwood.

* In avian breeding cycles it is considered a separate spp. But Ali & Ripley call it a subsp.

(1) VOCAL COMMUNICATION IN BIRDS

Clive K. Catchpole, 1979, Edward Arnold Ltd UK.

The functions of calls

Echo-locating sonar system in Oil birds (S. America) + Cave swiftlets - Collocalia vanikorensis SE Asia
— GRIFFIN + SUTHERS, 1970

swiftlets produce 'clicks' freq. 4.5 – 7.5 kHz, can avoid wires as small as 6 mm diameter.

X calls are not ultrasonic to bats.

Alarm calls 1115 but alarm calls of passerine birds
— MARLER (1957)

'Time differences' are obtained by interrupted, repetitive + modulated

X 1 > distance but can - ear of a bird, > obvious is 1 time diff.

Humans + birds are able to locate sounds by a bifaural comparisons of phase, intensity + time diffs.

a call pitched at ca 7 kHz., would be too high for detectable phase diffs, to a med. sized bird of freq - + too low for a sound shadow intensity effect. 5 diff birds - Reed bunting, Blackbird, Great tit, Blue tit + chaffinch have alarm calls at range of ca 7 kHz (MARLER, 1957)

Phase diffs are > effective at low freqs.

Intensity diffs " " at high " (bec. sound shadow formed by 1 head of 1 bird (listening), only operates if 1 head dimension is > than wavelength).

an alarm call has (no) modulation, repetition, interruption + perceptible gradual start / finish.

- a high, thin, whistle - easy to hear but extremely difficult to locate - much the same for humans.

XX But Shalter (1978) has shown captive Red bird of prey do use alarm calls to orient towards 1 birds XX

on seeing an owl during the day

— call carries 'directional information' — harsh, repeated 'clicks', loud — easy to locate & attract more birds to the ~~scene~~ scene — i 'mobbing'. these calls are generally Interspecific communication vs 'flying hawk call' i.e., Intra-specific.

Calls & indiv ~~sex~~ recognition — calls have suff. information to identify the particular indiv calling. 'Indiv recognition' by sound alone possible to others in a pop'n. The sea-

X bird parents easily recognise the young in big colonies.

TSCHANZ (1968) ~~[illegible]~~ 1st to report indiv ~~sex~~ recognition in guillemot.

Indiv recognition is done by a partner hearing the other's call after pairing — X.

Songs & communication BREMOND, 1968

① S's spp. recognition Robin song — ① all phrases are diff in a song

② all songs in a run of consecutive songs are diff

③ successive phrases alternate in high & low freqs.

Syntactical rules

— the 3rd is X in species recognition.

= Syntax — "overall pattern of the general structure of a song" — is the most X — BREMOND.

Syntax feature need not be rigid in other species of birds — Bremond (1976) — Bonelli's warbler (Phylloscopus bonelli) is a sp. that contrasts the robin in this ~~[illegible]~~ sp — the actual structure of the elements themselves are of prime X'ce for sp. recognition

subtle diff — as freq. shifts & called REJECTION MARKERS (BREMOND) 1 call of wood warbler P. sibilatrix is 11h to P. bonelli except 11 1 former's call is 1 KHz higher. so 1 freq shift is considered as a mechanism for sp recognitn — in closely allied spp in 1 same ecosystem.

(1) Recognitn of 1 same sp.
(2) rejectn of 11h & closely related spp } fns of song.

[The role of songs in the Ecological balance of Birds
(— a possible field of investigatn RPS — 9.6.84)].

INFLECTION POINT

elements contain many up & down freq. modulatns & where 1 change in directn occurs is called inflectn pt.

— from Indigo bunting — SHIOVTIZ (1975) — showed 11 1 rhythm / Temporal patterning c̄ in 1 song appears to be an X. factor in spp recognitn.

-X: In each sp. several parameters appear to be involved in spp recognitn, 1se diff from sp — sp & in in relative X.ce.
- 1y s̄d be relatively constant for 1 communicatn system to functn effectively c̄ in a popln.
(eg) time intervals bet elements of indigo bunting popln measured by EMLEN (1972) & remarkably constant & show extremely low coeff of variatn.

MINIMAL VARIATN c̄ in a popln. is 1 most X. clue for investigators to consider, in a search for parameters X. in spp recognitn.

(2) S't indl recognits

1 males recognise indl songs + 1 sound positions of its neighbouring males.

- 1 indl information appears to be contained in 1 freq. pattern of 1 1st few elements,
- 1 parameters of song in which indl recognits should vary but ~~not~~ indls, but remain constant ~~in~~ in each indl.
- 1 parameter of song should be constant but indls in species recognits.

Functions of song

Territorial vocal defence is > related to ecology - habitat where visibility is poor -

- song is for territory claim + attract of ♀ in some vs. attract of ♀♀ alone in others.
- initially song has a role in territorial defence. its 'first line', followed by visual display + attack.

-X. great tits - in an area of 6 ha normally we are 8 territorial males.

(1) keeping away rival males
(2) attracting females
(3) diff. reproductive cycle of ♀♀ - nest building, courtship etc.
(4) Pair-bonding.

VCB ③

① The birds have innate capacity to learn the songs of related spp. i.e., young birds can learn only the songs of those birds quite resembling to our spp — related being X. However this is not true for all birds②. (eg) for the 1st case — swamp sparrow not learning the song sparrow's song.

for the 2nd case — Zebra finch learning the song of Benghalese finch (Lonchura striata — wh. backed munia)

The reason being — the ecology of the birds. Finches live in communities & it's best to perfectly learn the 'fathers' song before mixing with other spp.

X — Geographical variation in songs — Read Thielcke (1976)

— on dialects — Nottebohm (1970).

— sound propagation in diff habitats — MORTON (1975)

in forests a narrow freq. range of bet 1.5 & 2.5 KHz showed less ~~attenuation~~. attenuation.

~~[illegible]~~ Inverse-square law — 'sounds of higher freq. attenuate with the > in distance.'

X vegetation absorb freqs differentially.

X average freq of forest bird is 2.2 KHz.

3 qltys of Passerine songs

① Elaboration.

② Redundancy = removal of elements doesn't affect the communication.

③ Repertoires = a variety of songs (of the same bird)
(Ref: Krebs et al, 1978)

Antiphonal singing = male singing a few elements followed by the female completing the song.
(eg) African shrikes (Laniarius spp)

PESTICIDES AND THE REPRODN OF BIRDS

— David B. Peakall April 1970

Most endangered birds are ↑ birds of prey
- Peregrine falcon / Dark haunch entwist in Eastn US
Osprey. ~~Golden eagle~~, Cooper's hawk, Bald eagle to
Golden Eagle + Kestrel in Europe.

∴ Cause is due to drastic drop in reprodn.

① delayed breedg
② failure to lay eggs
③ thin shells + breakage.
④ High mortality of embryos + fledglings.
⑤ failure to lay > eggs as ↓ loss of a clutch.

DDT + Dieldrin are extensive factors — < thickness of egg shell

∴ Birds of prey are a top of ↑ food chain. so ↑ y + more
> vulnerable.

DDE a principle metabolic prodt of DDT is equally dangerous.

DDE in brown pelican eggs 2500 ppm — ↑ eggs could
even be pricked up & not damaging.
Large nos of pelican (300 pairs) could not rear viable eggs.

∴ DDE 75 ppm can < ↑ shell thickness by 20%.

∴ Polychlorinated biphenyls (PCB) now used widely as
plasticizers — another threat to birds of prey.
↑ delay onset of breedg. PCB is found / given out when
plastic is burnt. ↑ resemble DDT in retention structure
+ physiology + have same effect on animals.

∴ Breedg cycle is initiated by seasonal / climatic
factors in birds — long days of spring in Temp. zone
+ rainfall in arid + tropical zone.

Pesticides affect ↓ Ca supply

Ca supply 60% from food + rest from bone reserves.

Deficiency of Oestrogen – reduces Ca deposit on egg shell. depression in oestrogen level is brought about by induction of liver enzymes by Dieldrin & PCB

PHYSIOLOGY AND SONG

INTRODN BARRY W. WILSON

Features common to birds + reptiles

1. Large-yolked eggs
2. Nucleated red blood cells
3. Egg tooth to help muscle.
4. Vestigial claw on some birds wings
5. Pecten in eye
6. Scales
7. Hollow bones
8. Single ear bone
9. Special rib process
10. Supporting bones in eye
11. Air sacs
12. Fine skin glands
13. Ball + socket articulating skull to neck.

generally only left ovaries are functional. (except in Ire)

White muscles in birds give a fast reaction but can't sustain
- ī blood myoglobin, some capillaries + mitochondria

Red muscles - slow reaction but can sustain
- ī rich myoglobin supply, > mitochondria + capillaries

X Bird lungs are in clusters
flow of air (which is continuous) aids body heat.
Gizzards can be absent in fruit-eating birds
+ large in those that eat oysters etc.
Birds have no urinary bladder.

SALT-GLANDS - Knut Schmidt-Nielsen, Jan. 1959

Petrels - tubular nostrils are for excreting the excess salt that accumulates.

THE BRAIN OF BIRDS — Laurence Jay Stettner & Kenneth A. Matyniak. June 1968.

HOW AN EGGSHELL IS MADE — T.G. TAYLOR ~~Mar 1970~~ May 1970

Eggshell is largely crystalline $CaCO_3$. It comes from the bones largely.

Medullary bones — bone spicules in the bone cavity interspersed c̄ the marrow — supplies Ca for eggshell — develops only in breeding ♀♀.

HOW BIRD EGGS BREATHE — HERMANN RAHN, AMOS AR & CHARLES V. PAGANELLI

Feb 1979.

An egg ~~loses~~ loses 15% of its wt during incubation

BEHAVIOUR (INTRODN)

— is both innate (hereditary) & (learned) modifiable.

Innate — instinctive.

Megapodes of Australia + New Guinea — incubate the eggs in mounds / pits of rotting vegn. substitute (in body heat ē ⁊ produced by bacterial decomposition of Org. matter.

— Territory formed to help rear / provide desert in an area.

X. — / area defended may be ca an acre for a bird of size sparrow / warbler.

Community — intricately related grps of pls + animals.

HOW AN INSTINCT IS LEARNED — Jack P. Hailman Dec 1969

instinct — a stereotyped pattern of activity — common to spp — inherited + not learned.

new born chicks fail to recognise obvious diff bt 2 spp of gulls.
Laughing gulls + Herring gulls.
(red beak + bl head) (yel beak + red spot + white head)

— he calls response 'perceptual sharpening'

A chick learns to recognise food — ⁊/c accidentally.

MIMICRY IN PARASITIC BIRDS — Jurgen Nicolai oct 1974

X. / no of eggs a ♀ animal produces is $\frac{1}{\alpha}$ ⁊ the probability / egg will give rise to a ♀ / produces > eggs.

Laysan albatross — breeds in / S. Hemisphere on isolated Islands. / ♀ lays one egg / yr — since / y are least distributed. whereas tits + gold crest of Europe respond to severe stresses of winter + preds by laying 2 yearly clutches of eggs each numbering bt 8 + 12.

Birds incubating eggs in a nest are at a reproductive disadvantage — / stress from environment + predation + more on small birds.

while there are birds that evenly distribute their eggs @ one per nest of a host — parasite!

Parasitic birds — Cuckoos, some spp of American Cowbirds, Bl headed duck of S. America, all honey guides, & some weaver birds of Africa.

X.

① the parasitic reproductive cycle must be synchronized ē that of the host spp.

② if the host rejects the young / egg of parasite, it would be fatal.

Parasitic Cuckoos lay eggs closely resembling the host spp's eggs.

Parasitic cowbirds punch holes on host eggs before depositing their own so some of them don't hatch.

An African honey guide chick emerges ē formidable hooks on its beak that wounds the host offsprings to death.

Cuckoo's nestlings nudge the host's siblings out of the nest during the first few days of life. Others drop at a faster rate as the foster parent's chicks die due to inhibited development.

However — the parasite cannot afford to dwindle the foster / host birds population in the long run.

The parasitic widow birds of Africa — chicks closely resemble the host chicks in color size, voice etc & so they are brought up alongside.

X. No 2 of the 125 estrildid finches have identical mouth markings.

Parents will feed the nestlings only ē the appropriate sp. specific markings — prove empty.

The synchrony in the maturation of gonads of parasite and host & development of breeding plumes is regulated by the seasons (rainy & dry) in Africa.

X. This specificity in mouth marking rules out the chances of hybrid offsprings' survival — it has an intermediate mouth design.

Contd on ②

X
Widow birds are Polygamous.
male widow birds learn to mimic calls of their foster parents.

a finches calls
① long distance calls
② contact calls
③ distress calls
④ anger calls
⑤ greeting phrases
⑥ routine songs.

X
Bird songs are an adornment of the identif
straw-tails & shaft tails
2 spp of widow-bird are known of genus Tetraenura
by parasitize 2 finches of the genus Uraeginthus. 1

INCUBATOR BIRDS - H.J. FRITH, 1959 Aug.

Malleefowl of Australia — constructs huge mounds of sd & veg matter & manages to keep temp at 92° ± 1 F. Chicks hatch beneath sd & dig their way up & run away into a bush.

X
A spp of megapode exists in Nicobar Islands — in 2 subspp.
lays eggs in mounds ~~near~~ in forests close to sea in the sand.
(Megapodius freycinet)

The type of mound constructed & material used varies in locality & amount of heat available. varies from only sand — only organic matter.

Malleefowl female — does all the work in constructing mound & regulating heat at various times. A mound may be of 10–15' dia. Its largest worker of all 7 spp occupying various Islands of South Pacific. To get nothing known in Australia is diff. & with extremes of continental climate its worse.

The male bird does all manipulate to maintain the temp at 92°F as if he can measure the internal temp.

A mallee chick hatches 3 ft. beneath the sand & has to struggle up for 15–20 hrs to come out. It runs to the nearest bush for shelter after coming out. In a few hrs it can run swiftly & soon is able to fly or to a perch to roost!

"IMPRINTING" IN A NATURAL LABORATORY – Eckhard H. Hess 1972

Konrad Z. Lorenz – "some animals learn / capacity to learn rapidly & ~~permanently~~ permanently at a very early age. This is called "imprinting"

But the statement "permanence" has been disputed lately as it has been observed // 'lab imprinting is reversible'

Natural imprinting is permanent & irreversible – (eg)

Ducklings hatched with a fear for man // is there till the last, even after 4y nature.

BEHAVIOUR (Contd)

THE LEK MATING SYSTEM OF THE SAGE GROUSE

– R. Haven Wiley, Jr. May 1978.

Lek system – a large %tage of the ♀♀ mating with a small %tage of ♂♂.

Lek – a communal gathering of several males & ♀♀ – the ♀♀ however mate / copulate with the same male & several males can't mate at all. Other birds like sandpipers, weaver finches, manakins & cotingas of C & S. America, Birds of paradise, grouse etc., have a lek system.

X. most biologists now agree that the evolution of social behaviour like the evolution of any other trait, is best explained in terms of the optimization of the so-called "Darwin's fitness", i.e., the optimization of the rate of conveyance of the genes of an individual to its descendants

A delay in reproduction >s the generation time & thus lowers the rate at which descendants multiply

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ECOLOGICAL CHEMISTRY – Lincoln Pierson Brower Feb 1969

Asclepiads – contain cardiac glycosides. that cause rapid fluttering of heart in vertebrates & even death.

3 glycosides were identified in the plant & butterflies – Calactin, Calotropin & Calotoxin.

The toxins in the butterflies are those derived from the plants they fed on during larval stage.

Batesian mimicry – palatable sp. resembling unpalatable spp

Mullerian mimicry – unpalatable spp resembling each other.

Auto mimicry – ~~species~~ individuals of (same species) mimicing the unpalatable ones (eg) Monarch butterflies – the unpalatable ones serving as a defence for the palatable ones..

Bird notes:

Birds as flying machines – Welty, C. 1955 march Scientific American.

Fuji to bird 7' wing span has a skeletal system weighing one 4 oz. (Robust Cockroach weighs)
Skeleton of a pigeon is only 4.4% its weight.

ratio of wt. ostrich : hummingbird = 20,000 : 1
Blue whale : masked shrew : 22 mn : 1

Bird skulls are proportionately light. Have no sweat glands.
Birds are fastest creatures on planet. Peregrine falcon diving speed 180 mph.
Penguins underwater – 22 mph.
Bird temp – 107° – 113° F – "velocity of chem. reacts doubles i.e. every 10° rise in Temp" – chemical law.

Bird – faster heart beat – Large heart – canary 514 beats/minute
Pigeon 135 + heart hummingbird 615 – man 72
birds have > sugar in blood + High BP.

Golden plover – non stop flight 2400 miles over sea.

The Geography of birds – Welty C. 1957 Scientific America
no finches in Australia? No parrots in S. America.
S. America – 400 spp of hummingbirds. Birds of Madagascar + Africa – dissimilar.
Old world cattle Egret – reached S. America in the 1930s + has then reached N. America + is breeding.
Sea birds are > in cold latitudes as Arctic waters are > fertile than equatorial.
Birds are > in tropics – 85%. By region warm moist zones to satisfy their requirements of high body T, > heart beat + water consumption
In Greenland – 56 spp breed
" Antarctica – 3 " "

Birds of cold climate are ① larger ② shorter in beak, legs + wings
③ Large egg clutch size. ④ less melanism

Dispersal tendency of herring gulls – 1 yr old birds more further than older + adults – least (5 yr old)

X. Dispersal tendency in young birds relieves population pressure on natal areas

Lack – 2 spp of the same genus with the same diet rarely live in the same habitat. –X.

Flight
Oil birds (S American caves) use echolocation like bats to move in & out of the caves. Favorite food – palm nuts.

Savile, D.B.O, 1957 Wings

(1) Elliptical. Birds that live in the forest or the ground, gallinaceous, doves, woodpeckers & passerines have short, wide wings with many slots (variable spaces bt. the primary feathers.) Such a design confers high maneuverability & rapid take offs.

(2) High-speed, long, relatively slim wings without slots are found in birds that feed in the air, like swifts / make long migrations, like terns. This wing is better suited ~~for~~ for fast, level flight than to fast take offs & maneuvering in close quarters.

(3) High-aspect ratio wing. Soaring sea birds, e.g., albatross & shearwater. Very long, slim, for high-speed gliding in strong steady winds.

(4) Slotted-high lift wings: Birds that soar over land, such as Condors, vultures, hawks, & owls, have long, wide wings with many slots. The design combines maneuverability with efficient gliding, enabling the birds to circle in small updrafts of warm air that occur over land.

–X. Arithmetically a bird's wing ~~weight~~ area should be ca 2/3 its body wt.
birds with area-to-weight ratios < 2/3 eg hummingbirds, loons, geese soar poorly
& those with > 2/3 herons Eagles etc soar well.
(wing area in cm^2 & wt in gms.)

BIRD AERODYNAMICS – John H. Storer, 1952 April Scientific American.

Dark hawk – 175–180 mph (measured by plane)

THE SOARING FLIGHT OF VULTURES – C.J. Pennycuick Dec. 1973. SA.

> Vultures in Serengetti N.P due to favourable weather all year round for soaring.

Rupell's griffon Vultures – Africa – travel 100 km in search of food for their nestlings each day.

Best soaring time is bet 11.00 AM & 4.00 pm.

In dry weather – thermals provide a climb from 1600 m MSL to 3500 m MSL in 10 min.

Vertical glide speed is 70–85 kmph (45–55 mph)

V = flight speed – forward.

V_s = Sinking speed – a downward pull. Glide Ratio = V/V_s

∴ soaring birds extend their power of locomotion by using a source of energy external to their own bodies

THE ENERGETICS OF BIRD FLIGHT Vance A. Tucker May 1969

Fat gives 1 most energy. 2cc as much as protein & 8 times > carbohydrate.

> 70% of flight energy comes from fat metabolism.

[Calories per gram hr = 20 g Cals needed for a bird to move a gm of body wt at a given speed for an hr.]
CPGH

some birds can fly 2500 miles ∈ one flight. (eg)

Golden plover 2100 miles from Alaska – Hawaiian Islands.

CPGH is less in birds than in rats (pigeon heart) (locust heart is most)

heart – salmon.

MIGRATION & NAVIGATION

Introduction N American Bobolink - flies from Canada to Argentina (10000 – 12,000 km) 6000 – 7000 miles

about 1/3 of the migrating birds are killed due to storms, predators & starvation.

Bird banding began circa 1740, Johann Leonhard Frisch of Berlin tied strings to legs of swallows.

Arctic tern – 15000 – 19000 km (9000 – 12000 miles) Arctic to Antarctic.

Birds return to same breeding site year after year

(eg) birds wintering for 7 yrs. near San Francisco. ~~birds in Mexico~~ W. in Mexico.

Ht of flight: Generally 1500 m above GL/UL. Some at 2400 – 4500 m. some 6,400 m. Yellow billed Chough on Mt Everest at 8200 m. Bar headed goose (Himalayas) 9,100 m. (Remarkable the size lose consciousness at such heights)

50 kmph is average speed for most small birds

75 m change in altitude = ca a journey of 1° in latitude climatically (Barry W. Wilson) (69 miles)

Homing Manx shearwater. (R. M. Lockley – Birds on the Right

44 removed from its nest in Wales & transported to Switzerland & Venice returned in 2 wks.

another transported across Atlantic to Boston in light-tight box was on its nest in < 13 days.

Stephen T. ~~Emlen~~ Emlen – Indigo buntings navigate at night using stars as compasses. (The stellar orientation system of a migrating bird).

William T. Keeton (The Mystery of Pigeon Homing)

use sun & in its absence magnetic field of earth.

Both pigeon & bunting seemed to lack an "inner clock" ie., by which to determine the longitude – ~~Could~~ compensate for movement of sun & stars. The inner clock is needed to compensate for movement of sun & stars.

✓ AN OCEANIC MASS MIGRATION OF LAND BIRDS

Timothy C. Williams & Janet M. Williams Oct 1978

migration starts during Sept (last week) — Oct. 1st week.

migration was in waves — several days ē no activity & a day or 2 with mass flight. (results of bypass study in US)

86 hrs of non-stop flight has been recorded.

True migrants — on sea

unsuccessful migrants — on land but blown out to sea.

X. Birds orient direction based on Sun, stars & magnetic field & coast. May change when they encounter wind.

For identifying birds — 1 airspeed is taken into consideration most small song birds fly at < 45 km/h & water birds & shore birds fly faster.

Warblers — true migrants

Efficiency of energy consumption in a Blackpoll warbler is as good as a vehicle going 720,000 miles to a gallon of gasoline!

✓ THE STELLAR-ORIENTATION SYSTEM OF A MIGRATORY BIRD — Stephen T. Emlen Aug 1975

Blackpoll warbler - wt. < 20 gm — non-stop flight of 2400 miles over water.

when migratory song birds were kept in Cl. cages, their activity was oriented in a direction in which they would fly if let free

N. American Indigo Bunting (Passerina cyanea)

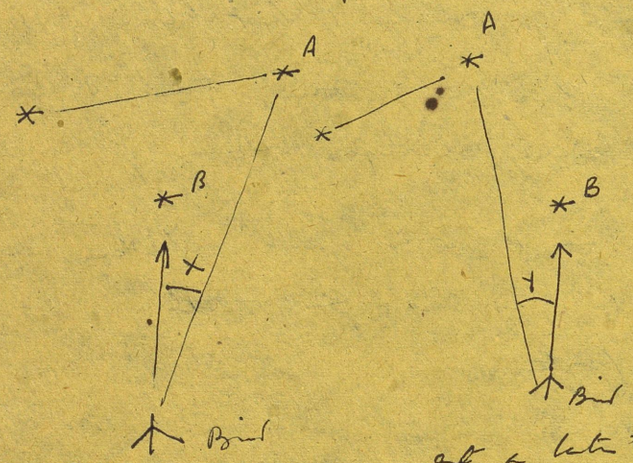
Breeds in E. US, & during fall flys flies 2000 miles to winter in / Bahamas, S. Mexico, C. America & South to Panama.

Captive birds — exhibit intense nocturnal activity during April - May & Sept - Oct their normal migratory time.

Cage — a rolled + stapled funnel of blotting paper (white) i an ink pad as base + a transparent cover. The bird can see only the sky above it. Each time it hops up the ft prints are left in 1 sides.

When tested on moonless clear night 1 activity was towards South in direction of flight in Sept – Oct. + N.East in April May.

Hypothesis (1)



at a given time 1 flight angle is X to 1 guide star A Critical

at a later time 1 bird continues in same direction regardless of 1 change in angle of the guide star. so 1 angle of bird flight may now be Y.

·X· according to 1 hypothesis, when 1 bird's physiological time is 9.00 Pm + 1 presented star time is 3.00 Am, it should compensate in 1 wrong direction i.e., it should orient at an angle X. i respect to 1 critical star instead of an angle Y.

Hypothesis (2) Birds use patterns of stars

·X· Each star bears a fixed geometric relation to other stars

·X· – a compass direction can be determined from 1 geometric pattern of 1 stars independently of an internal time sense, or "biological clock".

Result. 1 bird when tested at 12 hrs, 6 hrs + 3 hrs ahead of local time in a planetarium, bird maintained their normal migratory route.

Apparently indigo buntings do not make use of internal time sense to obtain orientation but rely on star patterns.

(contd on (2))

The birds rely on a / northern circumpolar stars. When one is out of view, they rely on an alternative.

X. The orientate towards / away from / circumpolar northern stars is under hormonal control.

young birds make use of / exposure to the night skies during their early phase before migration & orient them selves correctly.

Summary ① young birds drop North-South ref. axis as a result of early exposure to celestial rotation.

② precise point it is selects depends on / hormonal & physiological state of bird & not a seasonal diff in / position of / stars.

③ / star-orientate powers of / indigo bunty is basically one of 'pattern recognition' - doesn't involve an internal time sense.

✓ THE MYSTERY OF PIGEON HOMING

William T. Keeton Dec 1974.

Best speed is 50 mph.
best pigeon can cover 600 mile & reach home in a day

① Pigeons are able to home in total overcast.

② They use sun compass when available & substitute celestial when not.

③ / alternative information used in lieu of the sun compass doesn't require time compensation

④ The alternative system can't be pinpointed by familiar landmarks, tho pigeon can correctly orient in unfamiliar homeward under overcast even in distant unfamiliar territory.

Pigeons use the magnetic field as a cue.

Pigeons carried to distant places in actively caged & under deep anesthesia - returned home without any difficulty

Pigeons i frosts contact lenses in eyes too reached home,
when released at a distance of 80 miles away
Homing pigeons do well with age + experience
Pigeons are sensitive to pressure changes.
They can detect Polarized light (It's how they are able to orient
themselves on overcast days)

Evolution

Intro. Barry W. Wilson

"E - process by which new spp arise - is difficult to study. Much of what we want to know happened long ago, & kinds of controlled experiments lab scientists do can't be applied."

"No contemporary pl/animal is an ancestor to any living thing."

E - works by slow screening of chance genetic variations, which results in selection of traits which enable an organism to survive longer & reprod better than its less fortunate relatives. Genes that enable an organism to establish a separate ecological niche & reduce its need to compete with other creatures have great selective advantage.

Geographic isolation is one of several ways pops can be caused reproductively isolated, a necessity for formation of new spp.

DARWIN'S FINCHES David Lack April 1953

Evidence from study of finches suggest that when 2 pops are isolated for a long time, so many hereditary diffs will have accumulated that the genes will not combine well. Any hybrid offspring will not survive as well as parent types. Hence natural selection will tend to intensify the gap but 1 2 & 3 will continue to evolve into 2 distinct spp.

1. Darwin finches provide circumstantial evidence for the origin of new spp by means of geographical isolation.
2. Diffs in color pattern & songs keep birds from interbreeding when closely related spp exist side by side by have diff diets

Geographical isolate is now believed to be 1 only factor bringing about evolution of a new sp. particularly in birds

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VISUAL ISOLATION IN GULLS — Neal Griffith Smith. 1967 Oct

4 sp of Larus gulls superficially very similar are kept from interbreeding mainly by their eye-color

♀♀ choose males of their own spp. (It's likely each sp male has a distinct color pattern, song + behavior)

Leg tip & colors are also a part of visual stimulus in mating.

A STUDY IN THE EVOLUTION OF BIRDS — H.N. SOUTHERN May 1957

In crossbills some the crossing is on the left ie, upper beak overlaps + crosses the lower on the left + in others it is on right. + hence 'left handed' + 'right handed' birds are observed. In Europe RH. crossbills dominate + in US - left H. dominate. The way in which it crosses is opposite

X. Proportion of mutant genes maintained in a wild pop of animals is estimated as about 1/100,000 or 1/million. Mutations are usually detrimental.

X. If a parasitic cuckoo parasitizes its host too successfully then host population/species declines + as a result the cuckoo!