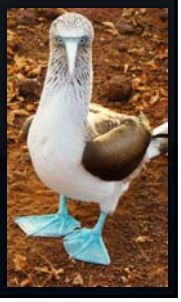
SEABIRDS

ECOLOGY & ADAPTATIONS

MAJOR GROUPS

COLONIAL REPRODUCTION

CONSERVATION & CHALLENGES



Oceans = Source of Food

Marine birds = 3.8% of world spp.
70% of planet for foraging

Peru: 16 million seabirds
2.5 million tons fish / y

N-transfer: marine --> terrestrial

terrestrial--> marine

rat eradication: *Jones 2010*
McCauley et al. *2012*

?

Oceans = Source of Food

Marine birds = 3.8% of world spp.
70% of planet for foraging

Peru: 16 million seabirds
2.5 million tons fish / y

N-transfer: marine --> terrestrial

terrestrial--> marine

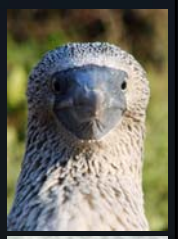
rat eradication: ▲ nesting seabirds
▲ plant, soil N
▲ offshore plankton
▲ manta rays
**post-rat recovery = few decades*

Adaptations to Fishing

Keen Eyesight:
squid, surface fish
krill bioluminescence (*dinoflagellates*):
illuminate predators (fish) for birds

Sense of Smell:
dimethyl sulfide (DMS) from plankton
fish respond to DMS

Streamlined:
webbed feet, set back
fusiform shape (*when diving*)
countershading



Adaptations to Fishing

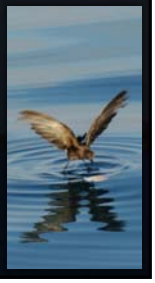
Foraging Methods:

1) surface feeding: dip, skim, patter
storm petrels, skimmers, frigates, albatross, gulls

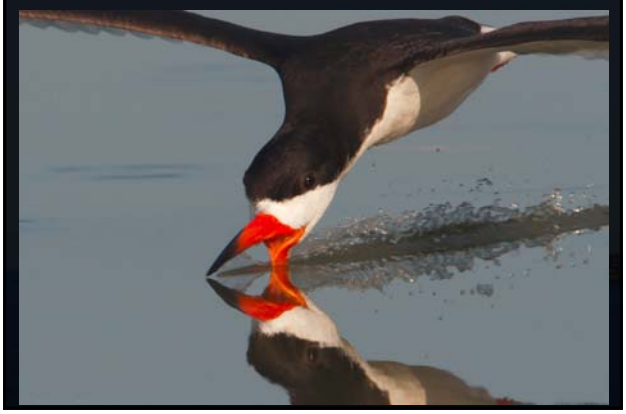
2) plunge diving (="surface plunging"):
petrels (220 ft)
boobies (80 ft)
pelicans (15 ft)

3) pursuit diving (="pursuit swimming"):
penguins (wings) & cormorants (feet)

4) aerial pursuit ("kleptoparasitism"):
frigates



Skimming: Black Skimmer



Elliot's Storm-Petrel

Pattering & 'Kiting'

Adaptations to Fishing

Foraging Methods:

1) surface feeding: dip, skim, patter
storm petrels, skimmers, frigates, albatross, gulls

2) plunge diving (="surface plunging"):
petrels (220 ft)
boobies (80 ft)
pelicans (5 m)

3) pursuit diving (="pursuit swimming"):
penguins (wings) & cormorants (feet)

4) aerial pursuit ("kleptoparasitism"):
frigates

Blue-footed Boobies Plunge Diving

Adaptations to Fishing

Foraging Methods:

1) surface feeding: dip, skim, patter
storm petrels, skimmers, frigates, albatross, gulls

2) plunge diving (="surface plunging"):
petrels (220 ft)
boobies (80 ft)
pelicans (5 m)

3) pursuit diving (= "pursuit swimming"):
penguins (wings) & cormorants (feet)

4) aerial pursuit ("kleptoparasitism"):
frigates

Pursuit Swimming: Penguin

Adaptations to Fishing

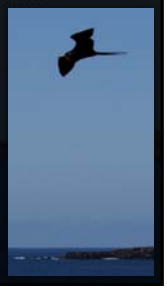
Foraging Methods:

1) surface feeding: dip, skim, patter
storm petrels, skimmers, frigates, albatross, gulls

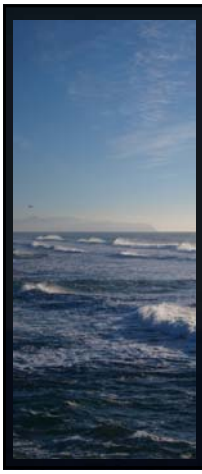
2) plunge diving:
petrels (220 ft)
boobies (80 ft)
pelicans (5 m)

3) pursuit diving (="pursuit swimming"):
penguins (wings) & cormorants (feet)

4) kleptoparasitism:
frigatebirds



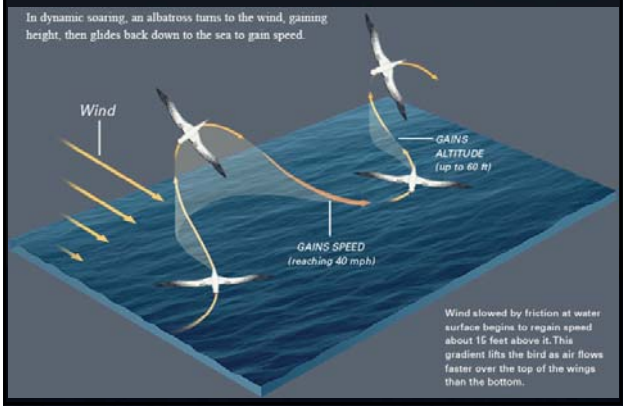
Kleptoparasitism: Great Frigatebird

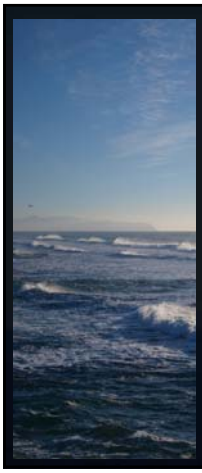


Oceans = Very Very Big

Adaptations to Long Flight:
- **light weight** *but* **large bodied**
- **long wings**
- **rapid digestion** *(protein-rich food)*
- **dynamic soaring: albatross** *(locking humerus)*
- **updraft surfing: pelicans, boobies**

Dynamic Soaring: Albatross





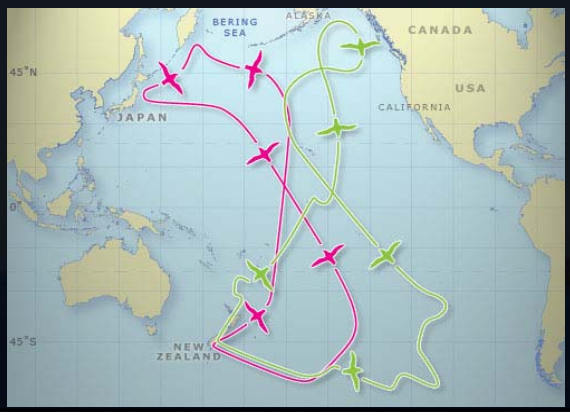
Oceans = Very Very Big

Adaptations to Long Flight:
- light weight *but* large bodied
- long wings
- rapid digestion *(protein-rich food)*
- dynamic soaring: albatross *(locking humerus)*
- updraft surfing: pelicans, boobies

Migration:
- **breeding to feeding**
  Arctic Tern = S to N. polar
  Manx Shearwater = 740 km/day

Navigation:
- **coastlines**
- **ocean swells**
- **magnetic fields**

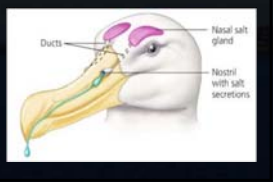
Migration: Sooty Shearwater



Oceans = Salty, Cold & Wet

Salt:
- salt glands
- orbit, top of skull --> nostrils
- 5% NaCl solution = 2X seawater (10X power of kidneys)

Buoyancy & Insulation:
- dense feathers
- oil preen gland near tail
- resist water & trap air



Oceans = Limited Coastline

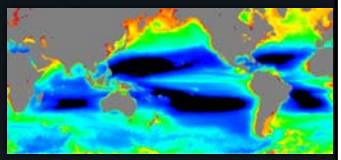
1. Nesting sites few
   must be near water
2. Seabirds heavy
   prefer cliffs for takeoff
3. Seabirds ungainly:
   predator defense/escape
   predator-free islands
   group defense rare
4. Tolerance of nearby birds
   promotes colonial nesting

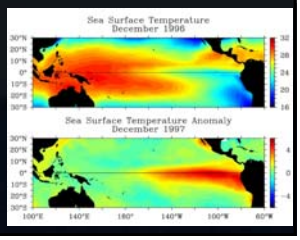
Oceans = Variable in Productivity

1. In Space:
   upwellings
   long-distance flight
2. In Time:
   seasonal breeding
3. El Niño:
   major declines
   chick starvation

1982-83 ENSO event:
Peru: 9m Boobies, Pelicans, Cormorants, and more ...
fell to 1 million

75% of Galapagos Penguins died





SEABIRDS by ORDER

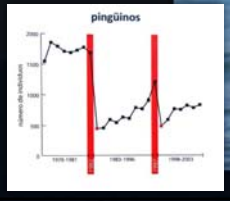
PENGUINS

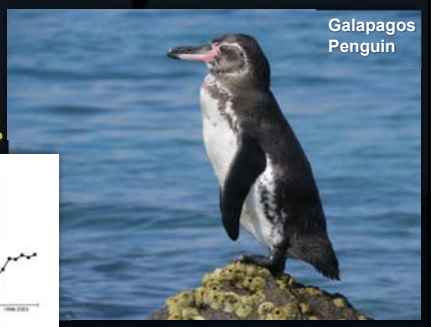
Order Sphenisciformes

forelimbs = flippers
feet = rudders
3 feather layers

piscivorous
pursuit swimming

El Niño: ▼ 75%, 65%



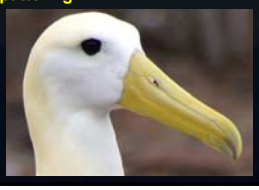


Albatrosses, Diving Petrels & Shearwaters, Storm Petrels

Order Procellariformes

tubular nostrils
enlarged olfactory bulbs

krill + fish (*& DMS*)
surface feeding
plunge diving + pursuit plunging
pattering



Albatross

huge (wingspan to 12')
feed over deep water
surface + shallow plunge

Waved Albatross

Petrels & Shearwaters & Storm Petrels

small to medium sized
surface feed + plunging + pattering
some Shearwaters plunge to 65 m !

White-faced Storm Petrel

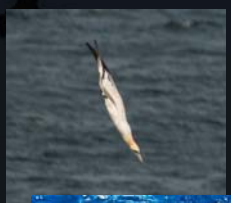
Galapagos (Audubon's) Shearwater

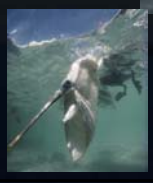
Pelicans, Tropicbirds, Frigatebirds, Boobies, Cormorants, Anhingas

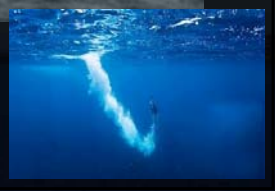
Order Pelecaniformes

totipalmate

shallow plunge diving (Pelicans)
deep plunge diving (Boobies)
surface feeding (Tropicbirds)
kleptoparasitism (Frigates)
pursuit diving (Cormorants)







Totipalmate Feet

Pelicans

huge (among heaviest fliers)
shallow plunge divers
fill pouch & strain

Brown Pelican (breeding plumage)

Pelicans 'Surfing'

Frigates

long pointed wings,
forked tail (“*tijeretas*”)
lack oil gland (cannot get wet)
kleptoparasites

Juvenile Magnificent Frigatebird

Tropicbirds

superb fliers ... but atrophied legs
plunge divers
cliff-nesters

Red-billed Tropicbird

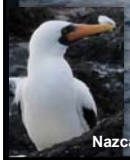
Boobies & Gannets

medium size
fusiform body

plunge divers *(fish)*
often in large flocks
accelerate by flying ▼

near-shore vs. offshore
blue nazca

clown-like *(“bobo”)* courtship



Nazca Booby

Blue-footed Booby

Cormorants

pursuit swimmers
no oil gland (- buoyancy)
must dry feathers
Galapagos sp. = flightless

El Niño effects: ▼50%

Neotropical Cormorant

Shorebirds, Gulls & Terns, Skimmers, Auks

Order Charadriiformes

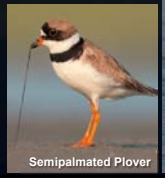
diverse & varied

shorebirds: soft substrate infauna
gulls: surface feeding, generalists
skimmers: sub-surface feeding

SHOREBIRDS *(“PEEPS”)*

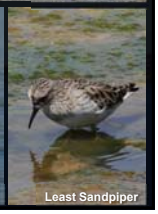
1. **“Run & Stab”**
   plovers
2. **“Chisel or Hammer”**
   turnstones
   oystercatchers
3. **“Probe & Peck”**
   sandpipers
   whimbrels

Ruddy Turnstone



Semipalmated Plover

Lesser Yellowlegs



Least Sandpiper

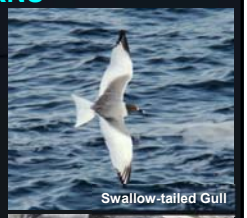
GULLS & TERNS

Surface feeders, scavengers

Uncommon in tropics
crabs?

Lava Gull: *"world's rarest"* ~ 400 pairs

Swallow-Tailed Gull: nocturnal feeding
echolocation?


Swallow-tailed Gull


Lava Gull


Swallow-tailed Gull

COLONIAL REPRODUCTION

Overview

>95% of seabirds = colonial
"shorebirds" = solitary nesters

maximum colony size ?

serial monogamy

1 brood annually (1 - 3 eggs)

nesting sites: ~~predators~~

REPRODUCTION

Nests

shallow scrapes
guano ring
egg "pointyness"

Breeding Season

high latitude = shortest
non-annual (some tropical spp.)
inter-spp. synchrony
food availability

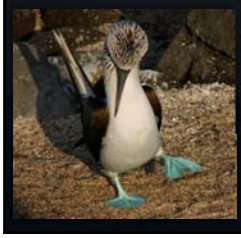

Blue-footed Booby nest & egg

REPRODUCTION

Courtship

evaluate mate fitness
blue feet

establish pair bonds
elaborate 'dances'



Waved Albatross Courtship

CONSERVATION & MAJOR THREATS

Seabirds = most numerous ***and*** most threatened spp.

#1 ... *by far!*) Loss of Breeding Habitat
coastal construction
artificial lights
loud sounds
watercraft

CONSERVATION & MAJOR THREATS

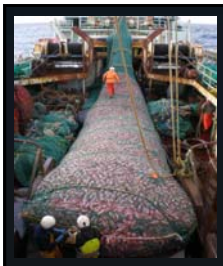
#2) Introduced Predators

on nests *and* adults
cats, rats, dogs, snakes
nest tramplers: donkeys, goats, pigs, cattle

Eliminate Rats:

nutrient cycles recover in 15-50 y
chain: rats → seabirds → N → plants → plankton → mantas

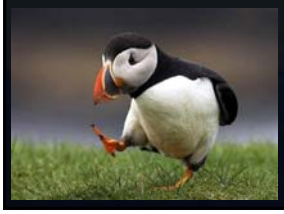
MAJOR THREATS



#3) Decline of Fish Populations

North Sea fishing intensified
Norwegian puffin chicks -- mass starvation

Scottish sandeel fishery
breeding failure: terns, fulmars, kittiwakes



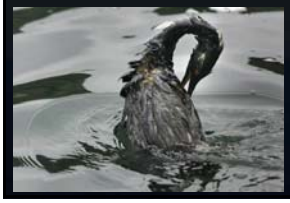
CONSERVATION & MAJOR THREATS

#4) Contaminants & Toxins

organochlorides, metals
egg shell thinning; impaired development, nervous system

oil spills
poisoning, hypothermia

plastics + other jetsam
ulcerations, starvation, entanglement



CONSERVATION & MAJOR THREATS

#5) Entrapment in Long-line Fishing

no liftoff = starvation, hypothermia
1960's Japan: 44,000 albatross / y

streamers effective *(by day)*
▼ mortality by 80-10%

CONSERVATION & MAJOR THREATS

#6) Tourism

Visitors to breeding sites:
Antarctic: 1950s = 300 people/year
1990s = 5,500 p/y

Galapagos: 1970s = near zero
2018 => 250,000

Tourist effects on colonies:
Chile: trampling
~28% of penguin burrows

CONSERVATION SOLUTIONS

National & International Marine Island Reserves

Limits on Fishing Gear

Oceanic No-Take Zones

Predator Removal

Seabird Reintroduction

Protect Breeding & Stopover Areas

Limit Disturbances (noise, light, etc)


Blue-footed Booby Courtship