NOTE ON THE USE OF PHOTOGRAPHS

Please note that this material is being circulated for the personal educational use of the student of Travis Audubon Society classes. Please do not distribute, copy, post, share, or further disseminate any of this material.

Photographs used in these presentations are credited to Jeffrey E. Patterson or the eBird contributors named in the photographs and to the Macaulay Library of The Cornell Laboratory of Ornithology. Other photographs are credited as indicated.

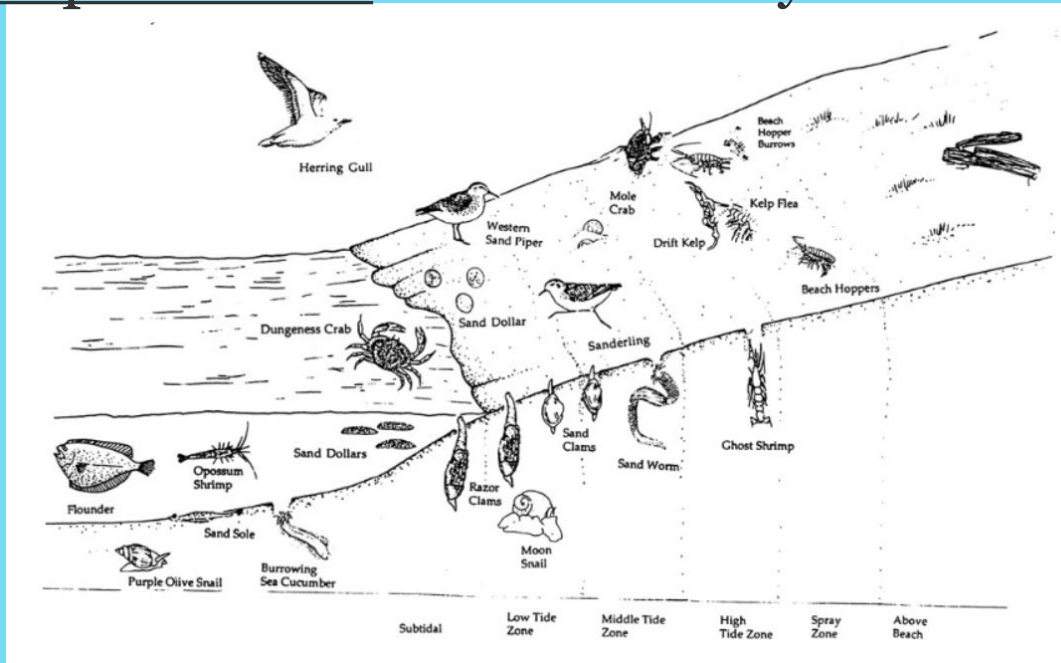
FEEDING TIME

- What I hope to show:
  - "Niches – we don't need no stinkin niches"
    - Shorebirds use tools adapted to their specific niches
  - How shorebirds find food
  - How shorebirds capture food
  - What shorebirds eat

HABITAT AND NICHE

- **Habitat –** general place where a species lives
  - Gets what it needs to live
  - Food, water, shelter & space (e.g. to raise young).
- **Niche** – the **interrelationship** of a species with all the biological & physical factors affecting it
  - – a species address & profession within an ecosystem

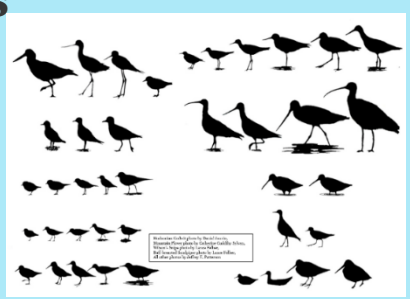
Habitat = address
Niche = profession



BOLIVAR FLATS, SPRING 2022
SHALLOW WATER/MUD/SAND HABITAT

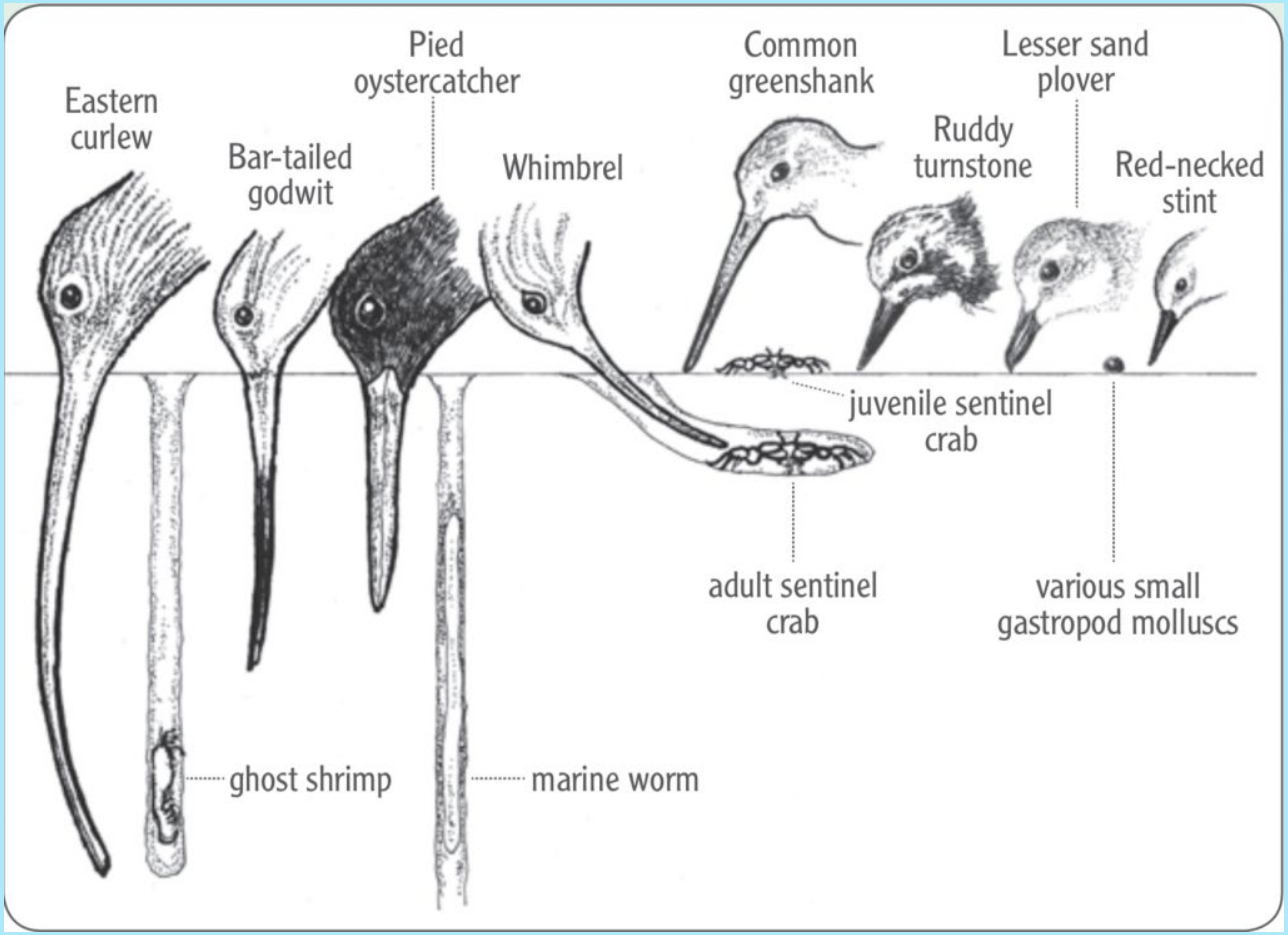
SHALLOW WATER & MUD HABITAT

- Consider **Natural Selection** in this habitat over evolutionary time
- Why doesn't 1 species dominate the habitat, out-competing all others?
- It's not a single habitat – it's **a collection of microhabitats**!!!
- Species diversify to **take advantage of different microhabitats**
- Different species **occupy different niches within the habitat**
- They have different **professions at the same (general) address**
- **Ecosystem = inter-relationships between microhabitat + niches**



THE NO-COMPETE CLAUSE

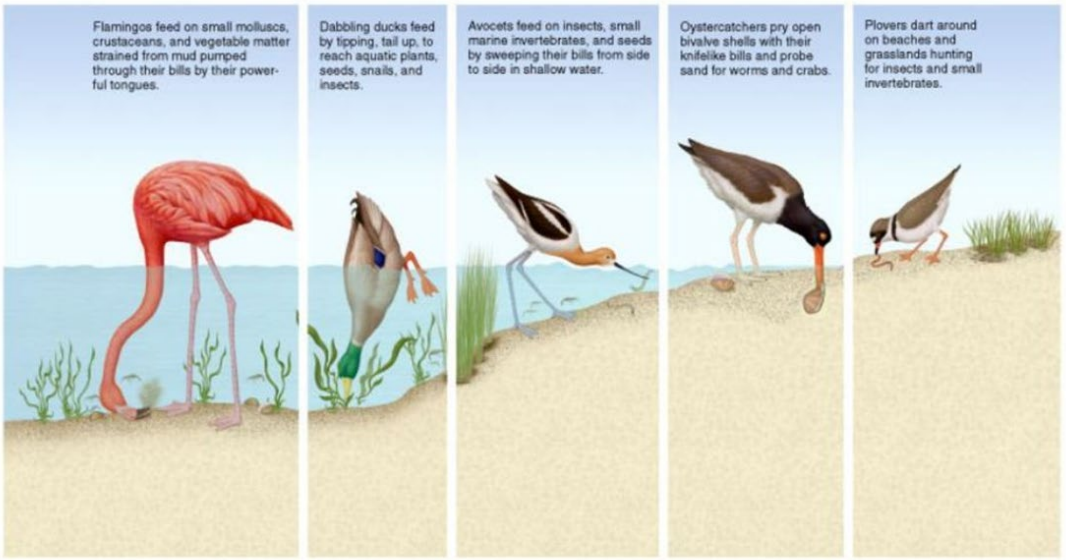
- Different bills = less competition in same **habitat**.



HOW TO BE SUCCESSFUL

- Out-compete the competition !!!!
- Go to another habitat
- Go to another niche

Niche – each member of this community gathers food in a unique way

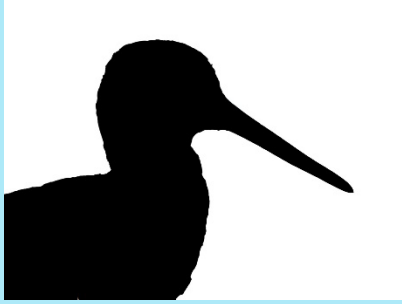


NICHE PARTITIONING

- **Microhabitats** – Slightly different habitat
  - Depth
  - Water level
  - Vegetation
  - Detritus
  - Salinity
  - Etc…
- **Niches** – slightly different role

- Both predators & prey adapted to **microhabitats**
  - Size
  - Hunting technique (e.g. visual, vs tactile…)
  - Speed, strength, skill set
  - Size & type of tool
- **Niche partitioning –** Competing mostly with their own species

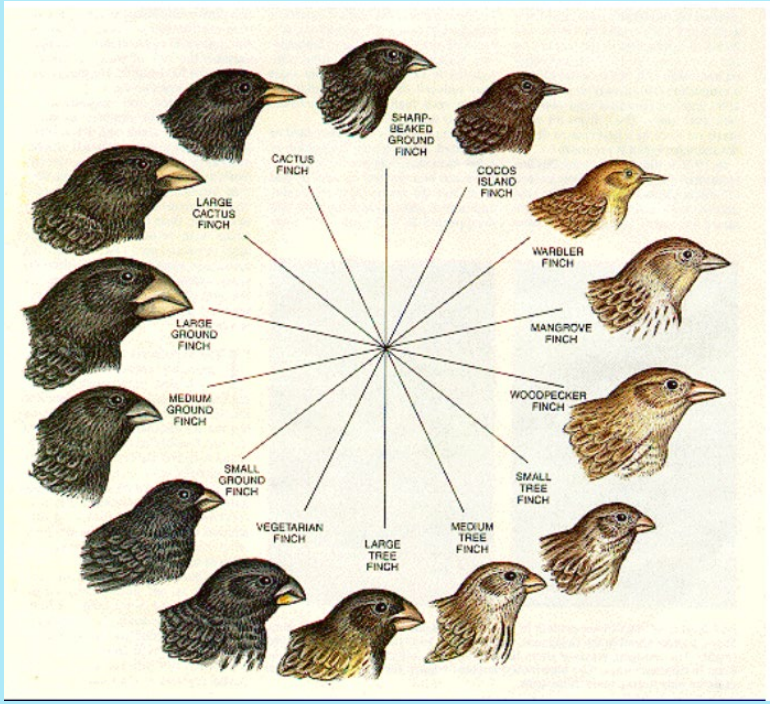
DIFFERENT TOOLS



- For birds – primary tool – the bill !!!!
- Different job – different tool!!
- Right tool for the job !!!
- For birders – Primary ID tool – the bill !!!

DIFFERENT TOOLS
IT'S DA BILL BABY !!!!!

- Length
- Curvature
- Thickness
- Shape (spoon, scythe…)
- Cross section
- Flexibility
- Sensitivity



DIFFERENT JOBS – DIFFERENT TOOLS

a) mud snails

b) moon snails

c) soft-shelled clams

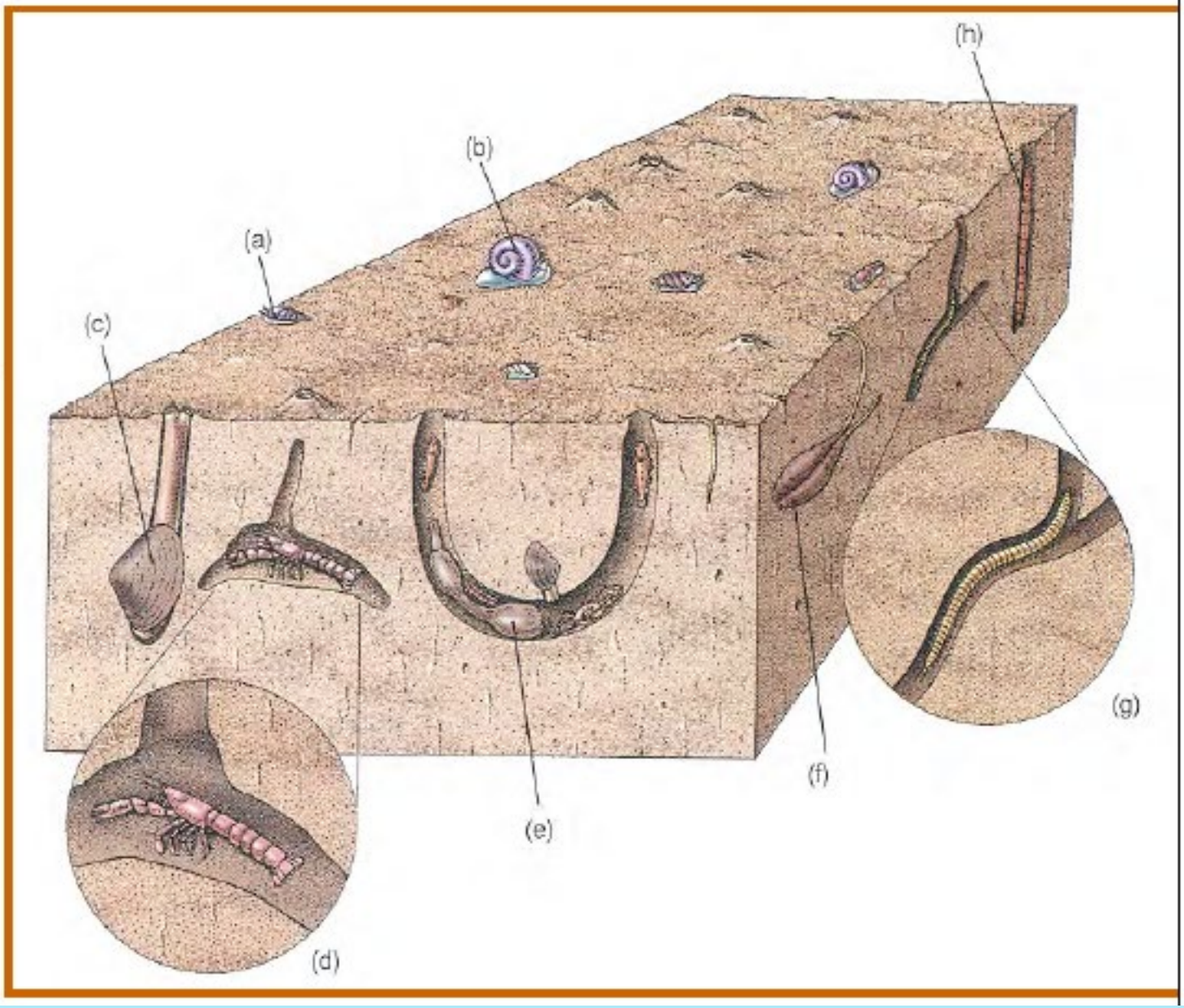
d) ghost shrimps

e) fat innkeeper worms

f) bent-nosed clams

g) sandworms

h) bamboo worms



DIFFERENT TOOLS



Each is uniquely adapted to thrive in their specific habitat & niche





Photos by Jeffrey E. Patterson

SUBTLE VARIATIONS

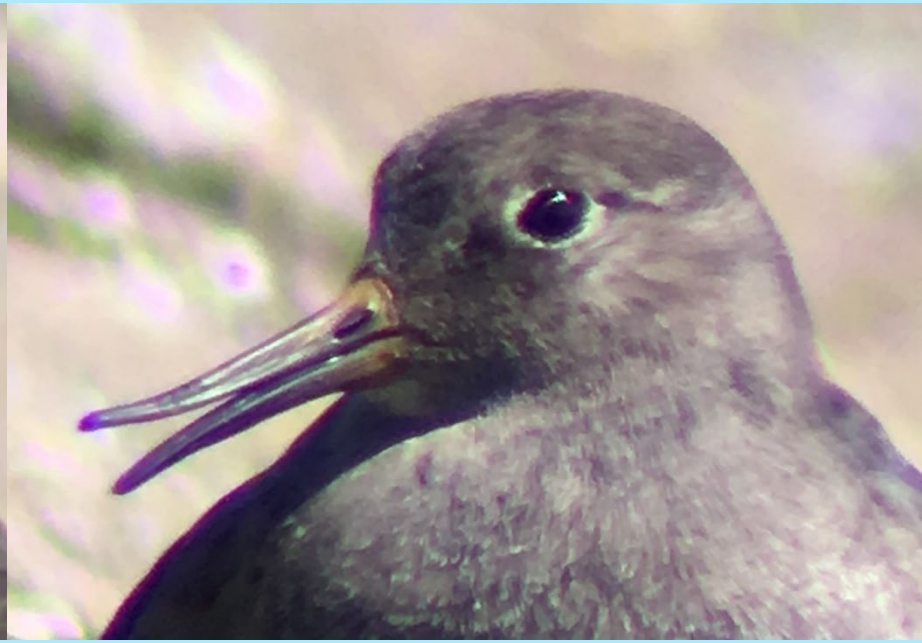
Photos by Jeffrey E. Patterson

THE BILL

Keratin –
continuously
growing and
wearing

Purple Sandpiper

It’s flexible !!!



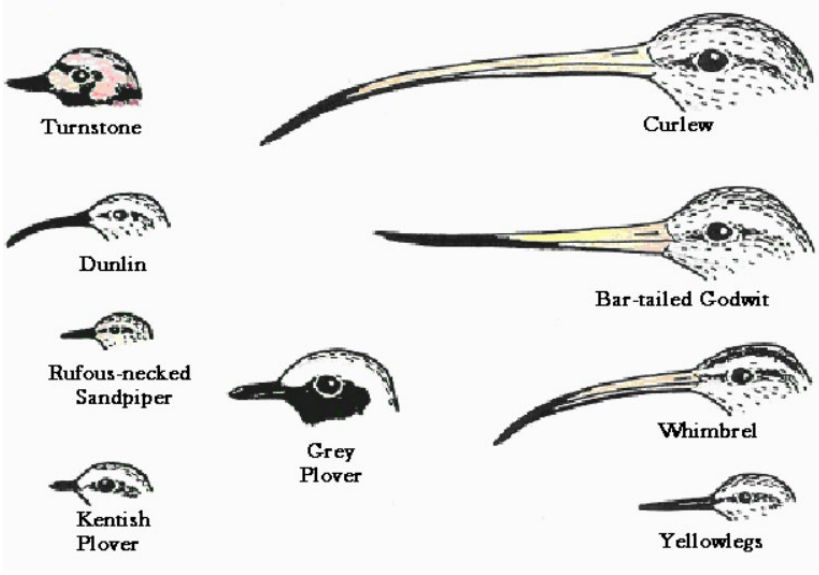
Photos by Jeffrey E. Patterson

Short-billed Dowitcher

MORPHOLOGY

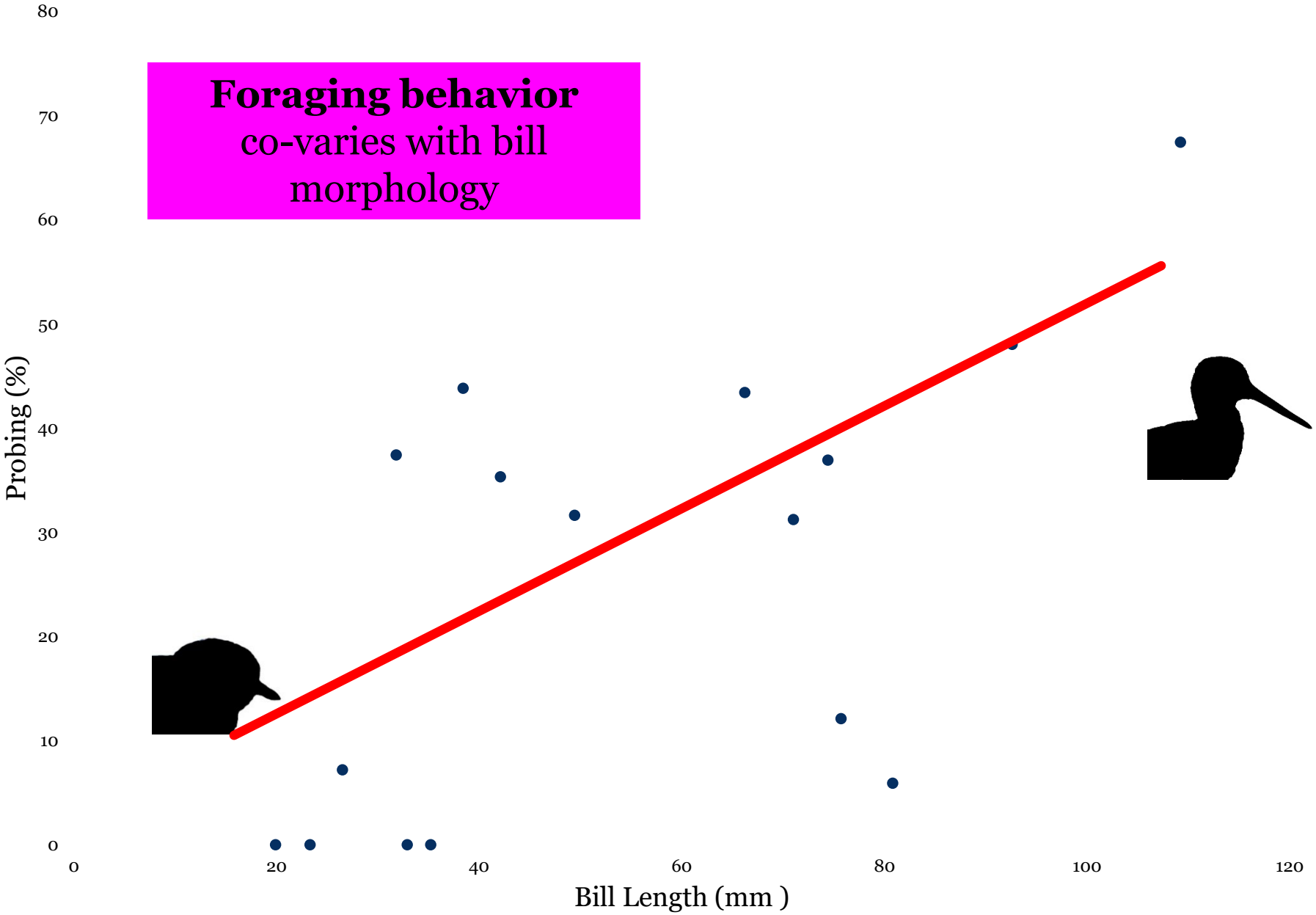
- **Morphology**:
  - Study of organisms structures
  - And the relationships between these structures

- Shorebirds morphology varies
  - Between species
  - Within species
  - Geographically
  - **Between sexes**



Bill Length vs Time Spent Probing

Foraging behavior
co-varies with bill morphology



HOW DO SHOREBIRDS FIND (DETECT) FOOD?

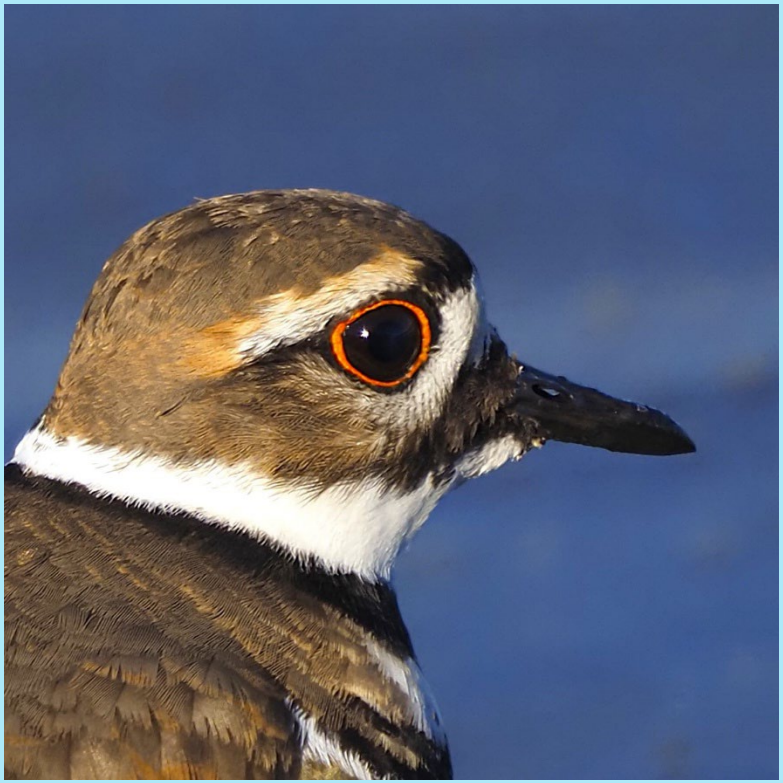
Visual

Tactile

Photos by Jeffrey E. Patterson

HOW DO SHOREBIRDS FIND (DETECT) FOOD?

Visual



Tactile

Photos by Jeffrey E. Patterson

HERBST RECEPTORS

Tactile

- **Herbst receptors** – pressure receptors all over the body
- Detect pressure changes
- **Bill & tongue –** Especially numerous
- Birds sense vibrations of prey under wet sand, soil or water
- **Tactile hunters** – many receptors
- **Visual hunters** – fewer receptors

Photos by Jeffrey E. Patterson

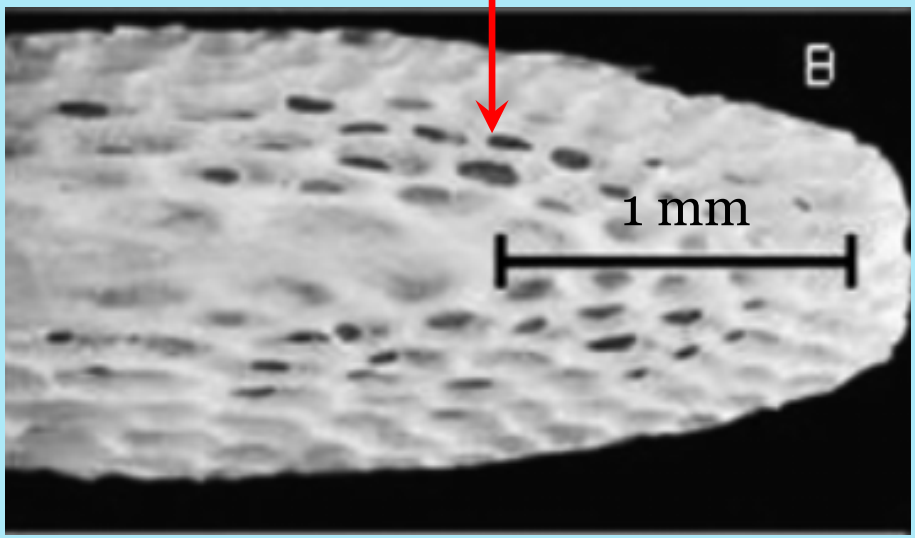
HOW DO SHOREBIRDS DETECT PREY?

Western Sandpiper

Tactile hunter

Photo by Jeffrey E. Patterson

Herbst receptors
found in cavities of bill



HOW DO SHOREBIRDS CAPTURE FOOD ?

Visual

Tactile

VISUAL FEEDING METHODS

- Pecking – straight bills capturing prey at the surface
- Plunging
- Snatching – mid air insect snatch
- Stone-turning
- Oyster-catching
  - Stabbing – stab into open bivalves, sever muscle, consume
  - Hammering– break into bivalves, sever muscle, consume
  - Probing – in mud, etc
- Surface tension
- Grazing ------ Grazing ????

TACTILE FEEDING METHODS

- Probing – facilitated by curved bills at depth
- Bill Pursuit – Opening and closing bill, while simultaneously moving it erratically along the water's surface
- Filtering
- Scraping –scraping mud surface
- Plowing – pushes through the water with open bill
- Scything (single, multiple, dabble)
- Foot tapping – tactile + visual
  - Feel movement of prey (e.g. worms) with sensitive feet
- Grazing ------ Grazing ????

PECKING

Photo by Jeffrey E. Patterson

SNATCHING

Photo by Jeffrey E. Patterson

PROBING

Video by Jeffrey E. Patterson

FOOT TAPPING

Video by Jeffrey E. Patterson

FLOAT FEEDING

WATER SPINNING

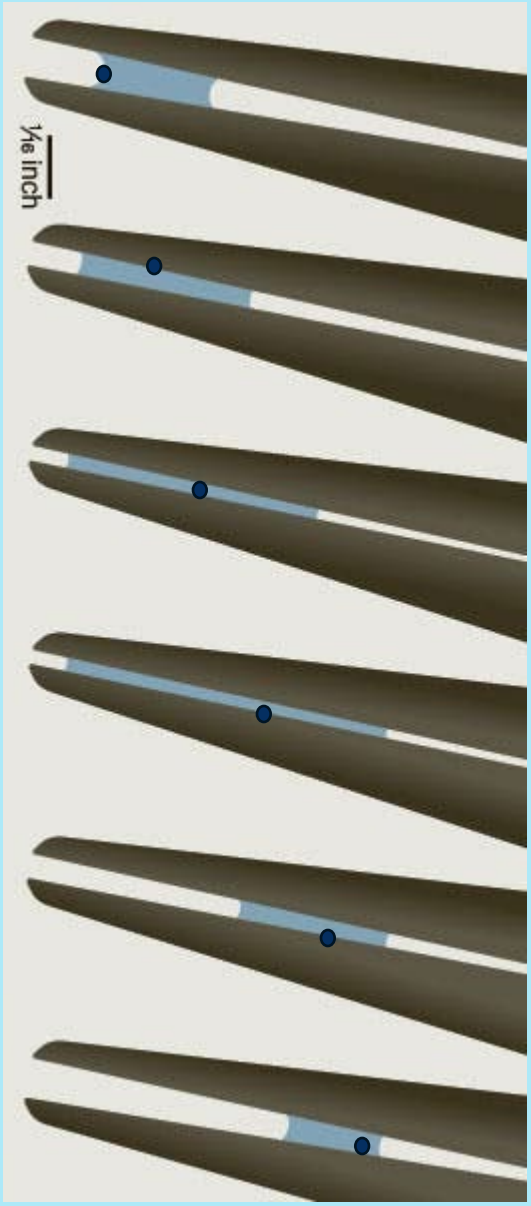
Photo by Brian Sullivan Cornell Macaulay library asset 482696

https://macaulaylibrary.org/asset/482696

Video by Brian Sullivan Cornell Macaulay library asset 482696

MUD SPINNING

SURFACE TENSION



Photos by Jeffrey E. Patterson

SURFACE TENSION

Video by Jeffrey E. Patterson

SCYTHING

Video by Jeffrey E. Patterson

REDUCING COMPETITION
2 CLOSELY RELATED SPECIES

- Similar, but slightly different bills
- Feed at slightly different depths
- Use slightly different techniques

Photos by Jeffrey E. Patterson

REDUCING COMPETITION

Photo by Jeffrey E. Patterson

Photo by Jeffrey E. Patterson

		Black-necked Stilt	American Avocet
Visual	Pecking	X	X
	Plunging	X	X
	Snatching	X	X
	Stone-turning		
	Oyster-catching		
	Surface tension		
	Grazing		
Tactile	Probing		X
	Bill Pursuit		X
	Filtering		X
	Plowing		X
	Scraping		X
	Scything	rarely	X
	Foot tapping		

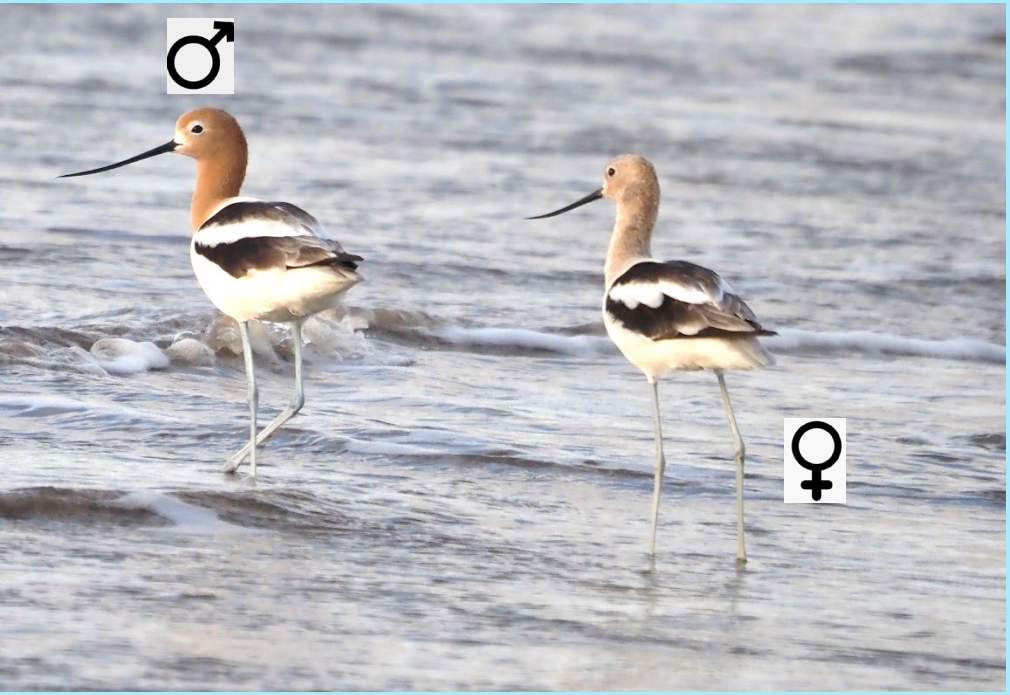
Use slightly different methods

Stilts occasionally scythe – poor visibility

REDUCING COMPETITION MALES & FEMALES

Feed at slightly different depths

Use slightly different methods.



Photos by Jeffrey E. Patterson

Western Sandpiper

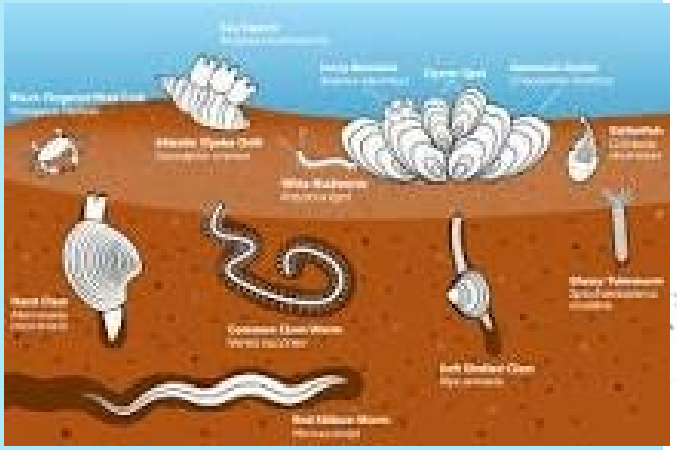
Male or female has longer bill?

♀ Females have longer bills

Reduces competition

♂ Males winter further north

♂ Males need to get back to claim breeding territory



Depth of prey increases

Length of Bill increases

♀ Females winter further south

WHAT DO SHOREBIRDS EAT ?

LARGE SHOREBIRDS

- Insects
- Crustaceans
- Benthic invertebrates
- Crabs
- Shrimp
- Earthworms
- Some small vertebrates
- Plant tubers
- Leaches
- Small fish
- etc

WESTERN SANDPIPER DIET ON BREEDING GROUNDS

	Adults	Pupae	Larvae	Eggs
Flies				
Midges				
Craneflies				

Beetles

Spiders

Small crustaceans

WESTERN SANDPIPER DIET AT MIGRATION STOPOVERS

Aquatic Beetles

Bivalves

Shore flies

Tiny crustacae

Brine shrimp & amphipods

Amphipods – tiny crustaceans

WHAT DO WE HAVE AT HORNSBY IN ABUNDANCE?

WHAT DO WE HAVE AT HORNSBY IN ABUNDANCE?

FLIES, PUPAE, LARVAE, EGGS

3 TECHNIQUES

- Long thought that small shorebirds used 3 feeding techniques:
  - 1) pecking at surface prey
  - 2) probing into mud
  - 3) picking prey out of water

- In 2005 a 4th method was discovered:
  - 4) grazing on biofilm

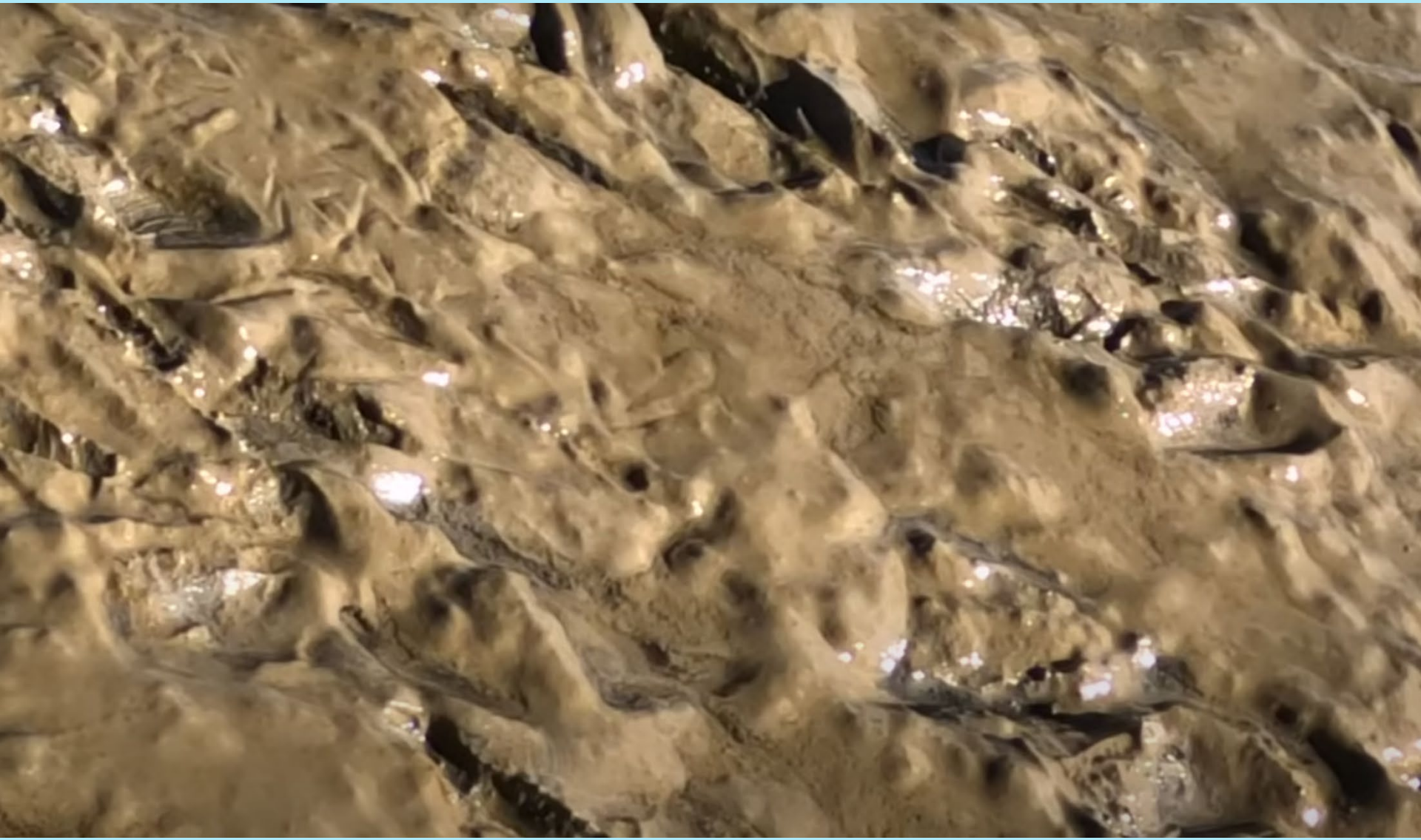
BIOFILM

- Grows on the surface of mudflats, wet beaches…
- Thin layer of microbes, organic detritus, benthic invertebrates & sediment
- Bound together by secretions of **bacteria & diatoms** (single-celled algae)
- **Bacteria & diatoms** photosynthesize nutrients (carbohydrates, poly unsaturated fatty acids (PUFA)…).

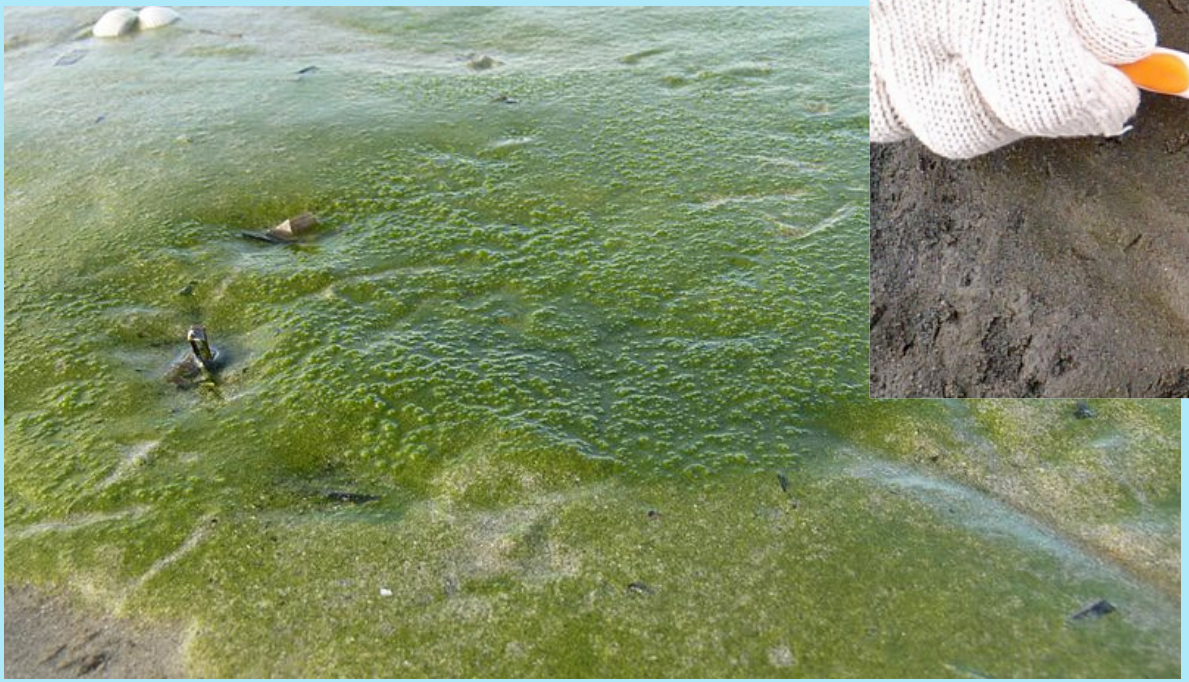
BIOFILM

https://www.youtube.com/watch?v=8P8Gmfr9Pb0

BIOFILM

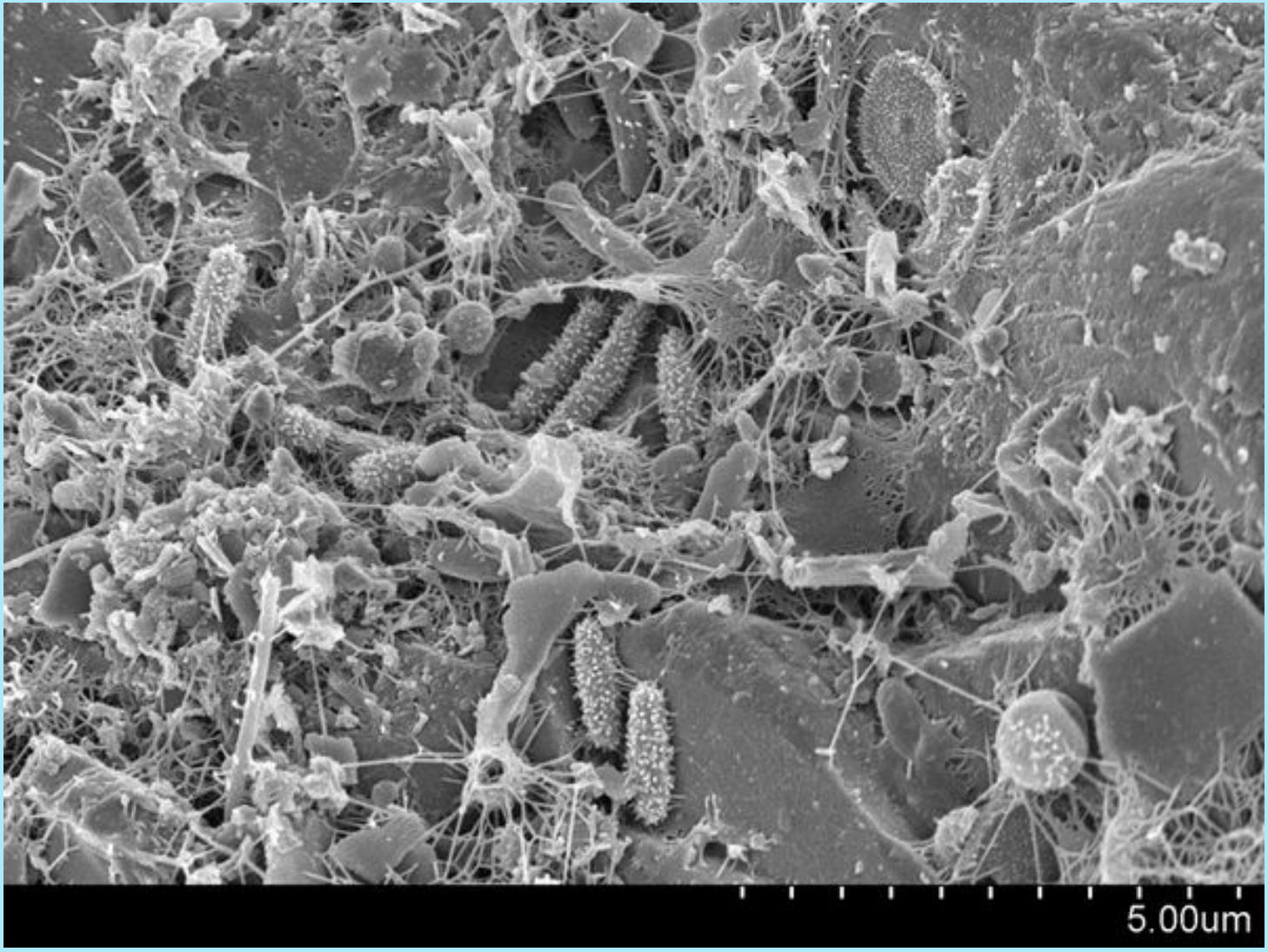


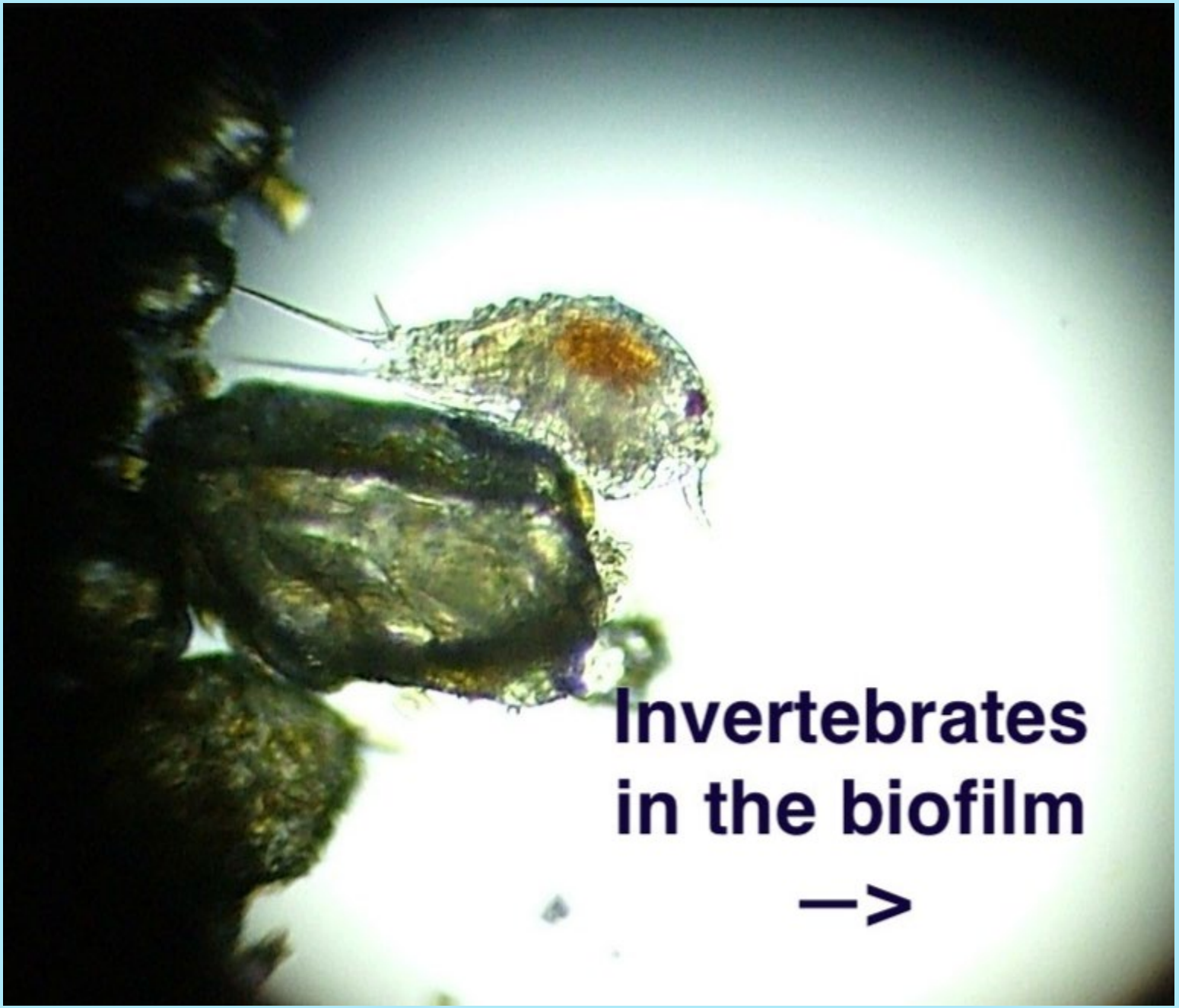
BIOFILM



https://hakaimagazine.com/features/slime-shorebirds-and-scientific-mystery/

BIOFILM

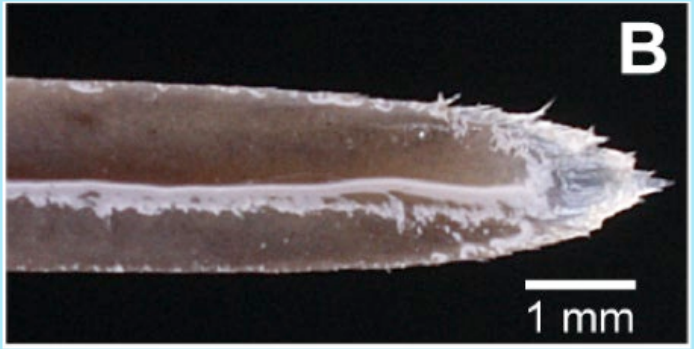


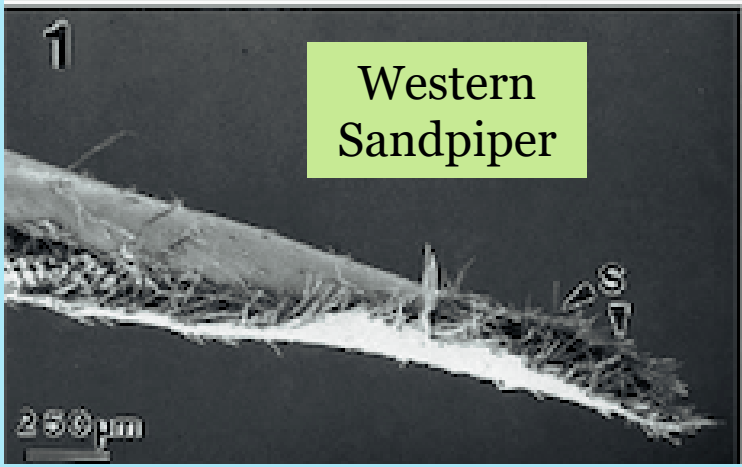

Invertebrates
in the biofilm
—>

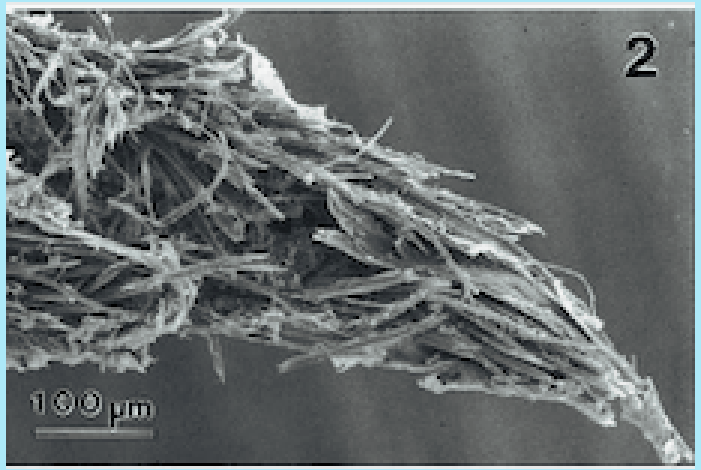
SANDPIPER TONGUES

Long-billed Curlew

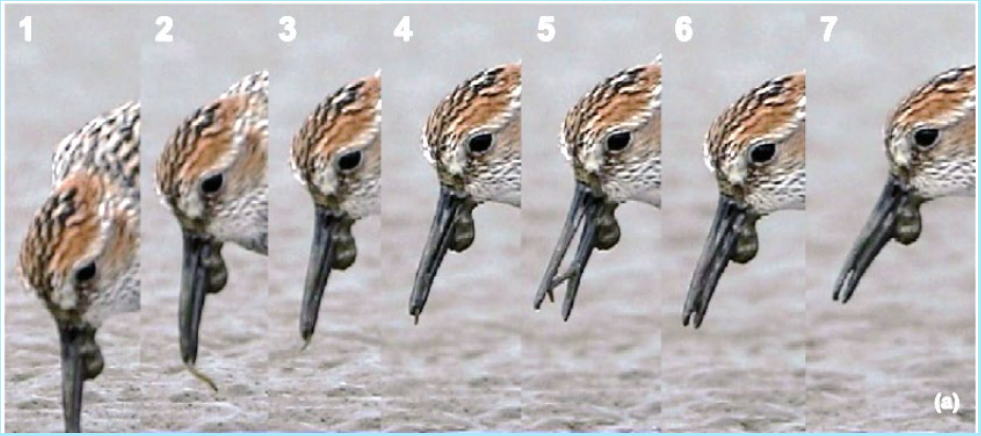
Pectoral Sandpiper







Bird Photos by Jeffrey E. Patterson



WESTERN SANDPIPER GRAZING ON BIOFILM

Video by Jeffrey E. Patterson

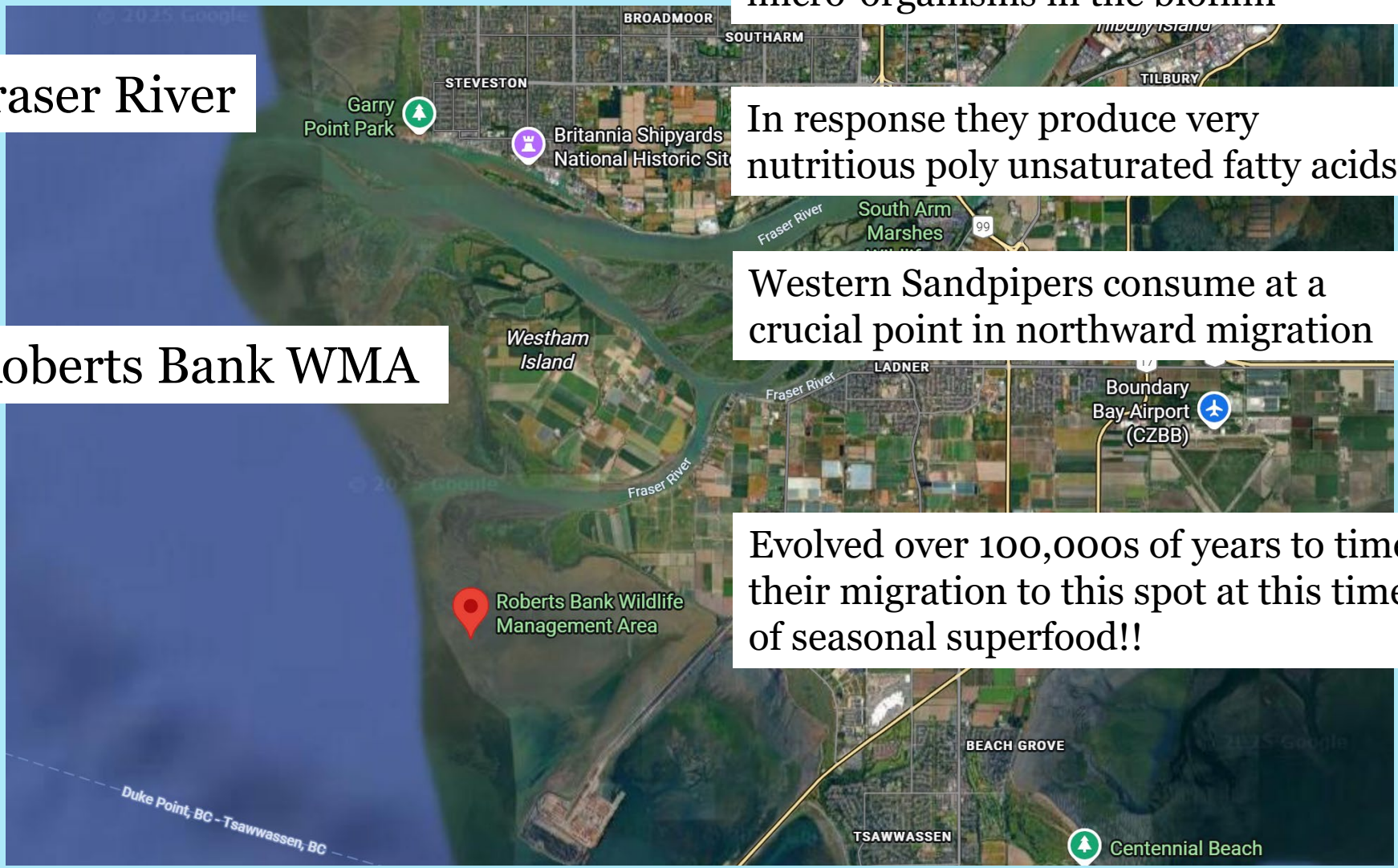
Video by Jeffrey E. Patterson

TIMING IS ESSENTIAL

TIMING IS ESSENTIAL

Spring rains & thaw cause in-flow of fresh water, which “shocks” the benthic micro-organisms in the biofilm

Fraser River



In response they produce very nutritious poly unsaturated fatty acids

Western Sandpipers consume at a crucial point in northward migration

Roberts Bank WMA

Evolved over 100,000s of years to time their migration to this spot at this time of seasonal superfood!!

WESTERN SANDPIPERS

- Consume up to 190 grams/day
- body weight = ~35 grams
- – 45-60 % of diet