Lecture 2:

The Cetaceans

Cogs 143 * UCSD

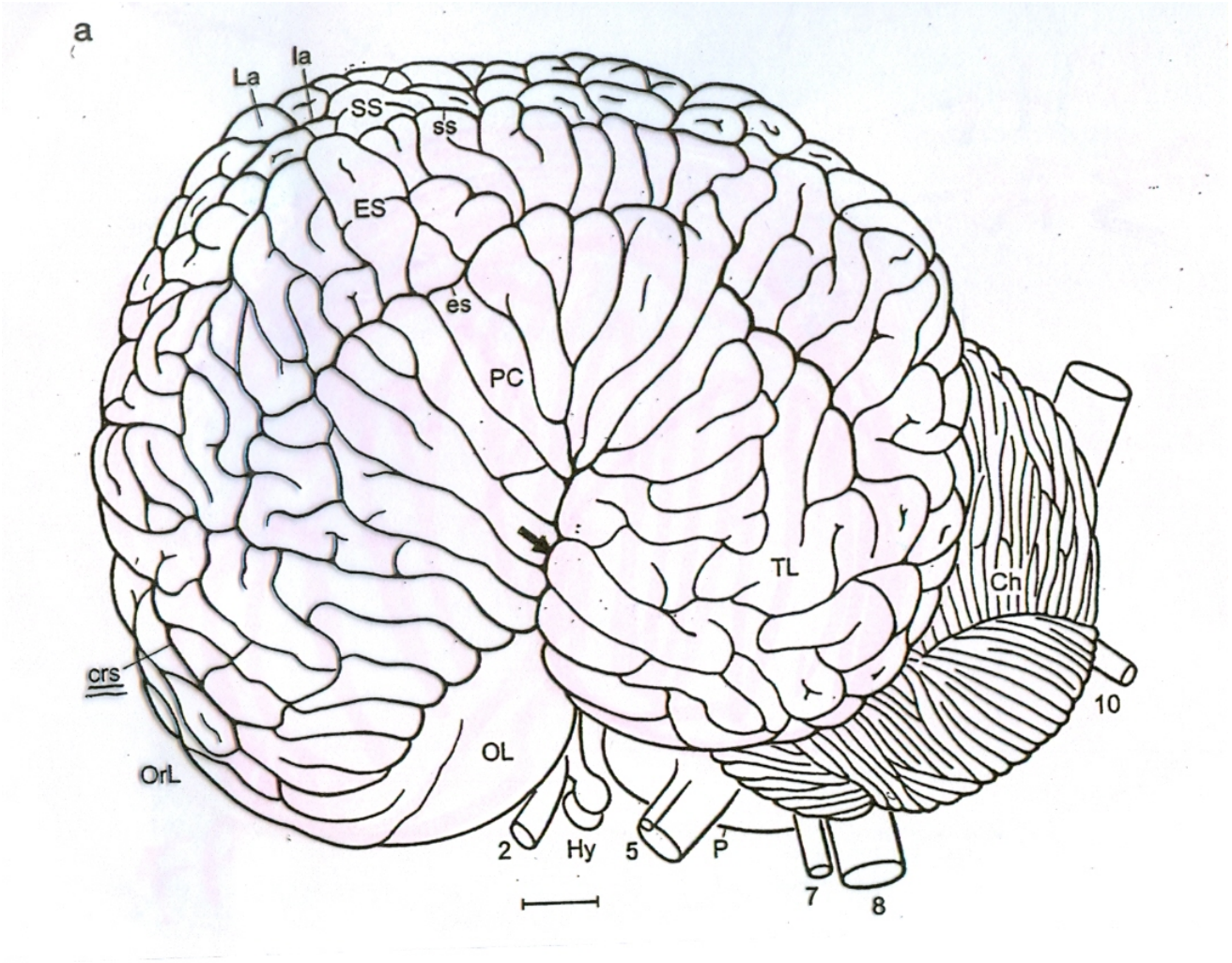
The Order of Cetacea

Like the primates, over 80 species!

Even fewer well-studied…

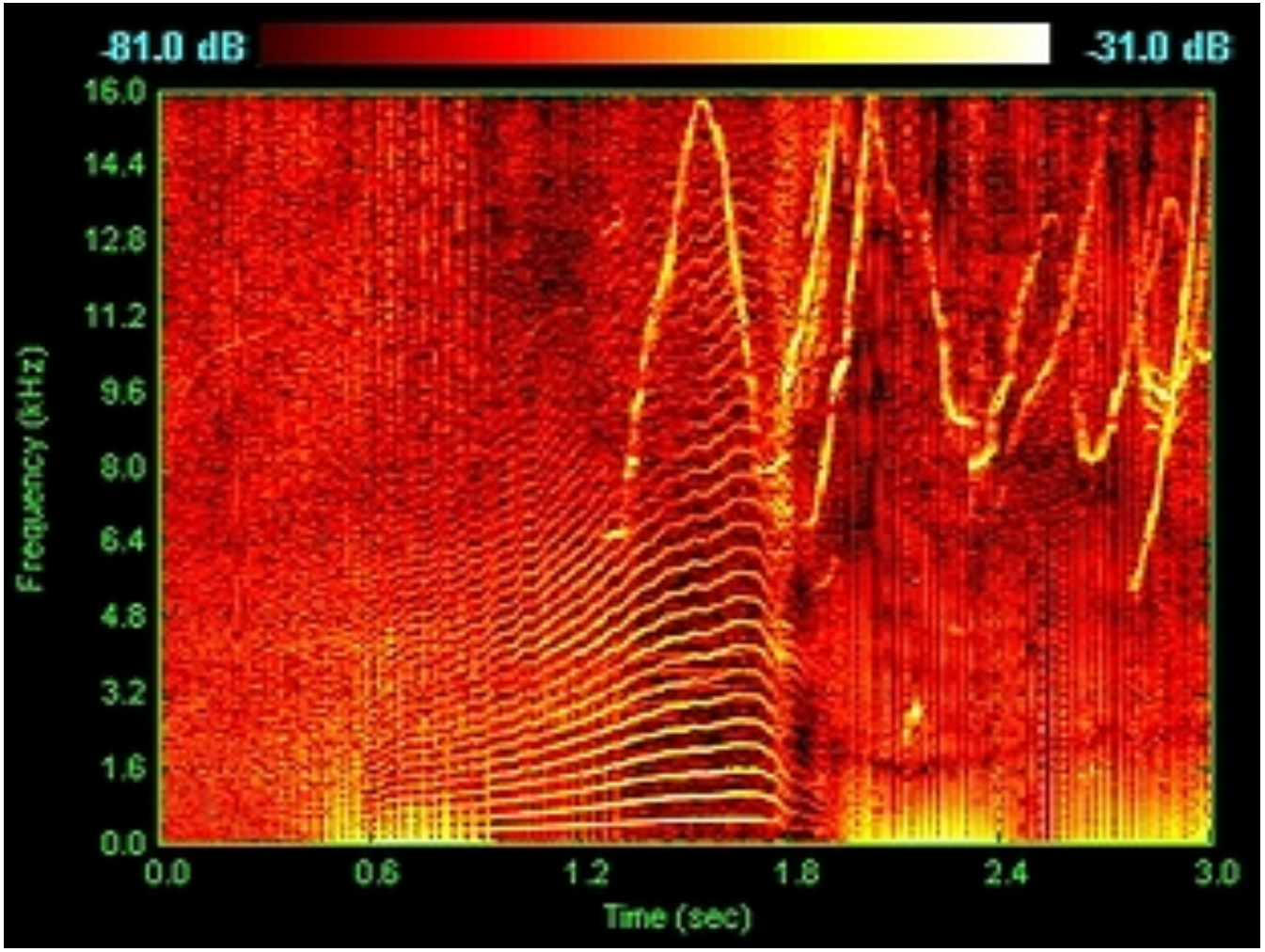
Highly Social

Large Brains



Cetaceans have the largest brains on Earth.

Acoustic


-81.0 dB
-31.0 dB
16.0
14.4
12.8
11.2
9.6
8.0
6.4
4.8
3.2
1.6
0.0
Frequency (kHz)
0.0
0.6
1.2
1.8
2.4
3.0
Time (sec)

Few, Long-dependent Young

Playful

Collaborative

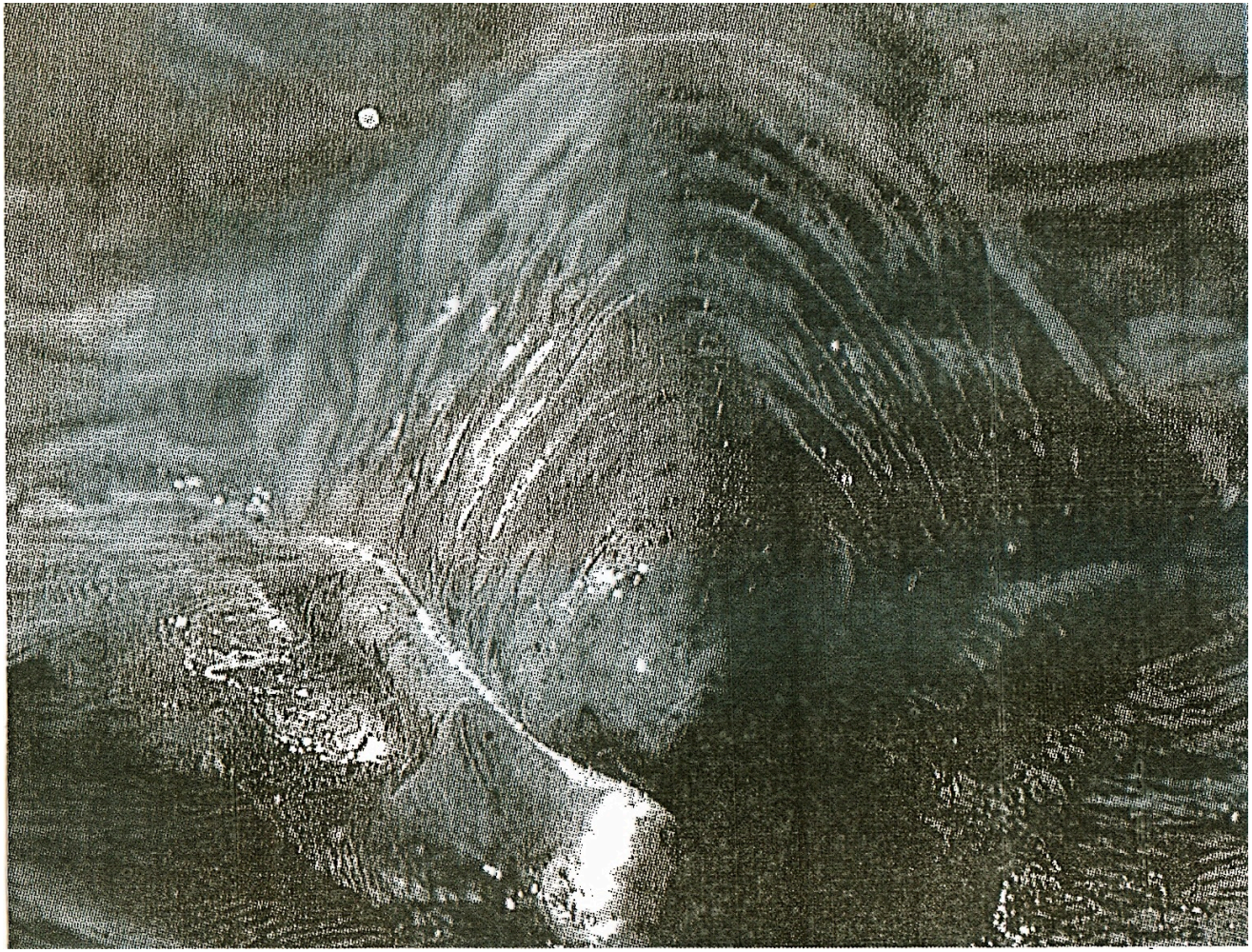
Cetacean are mammals

Warm blooded,
nurse their young

Cetacean are mammals

Breathe air

Even a few vestigial hairs . . .



Single offspring

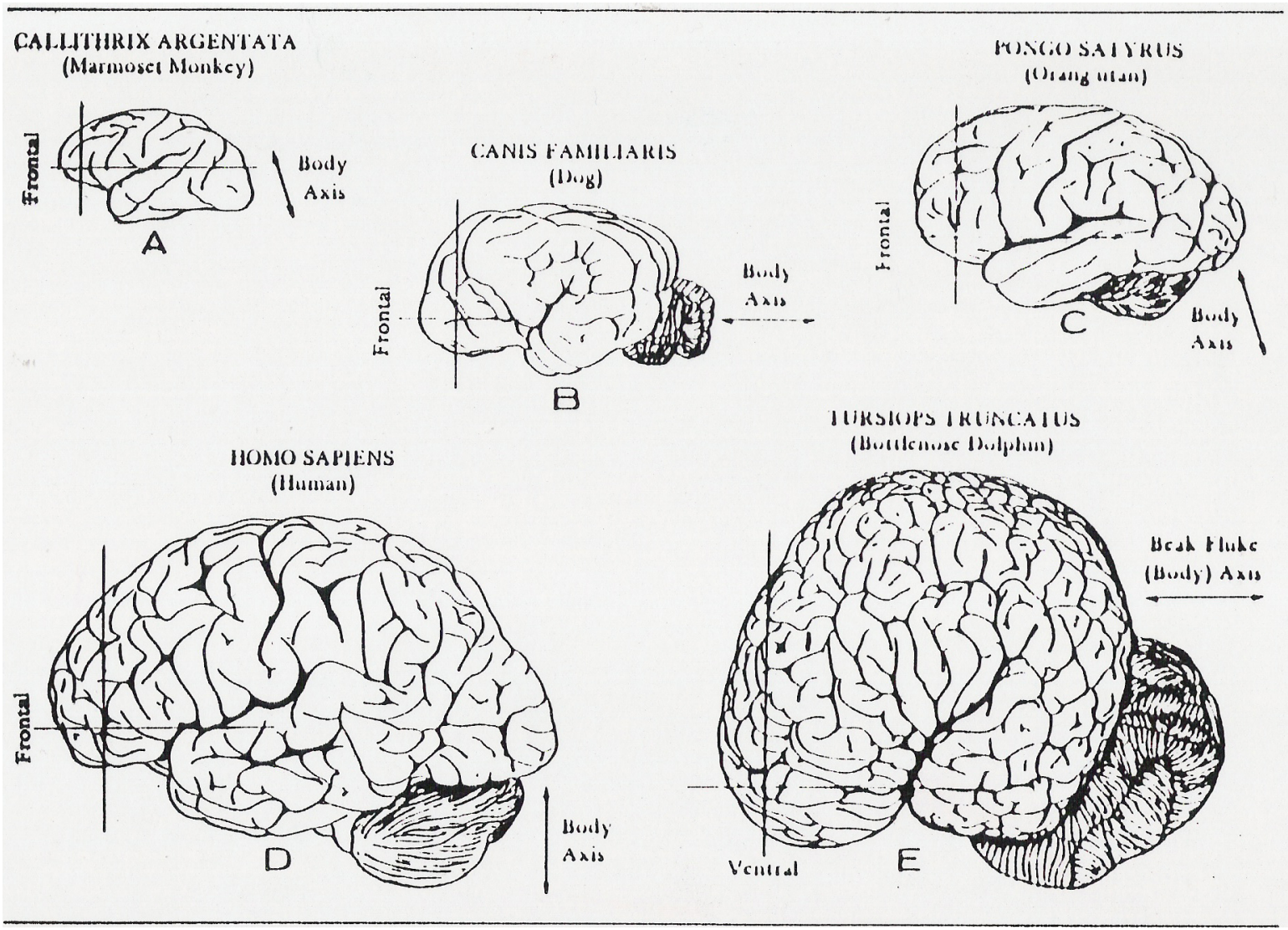
Nurse for two
to five years

Not sexually mature
until 10-12 years

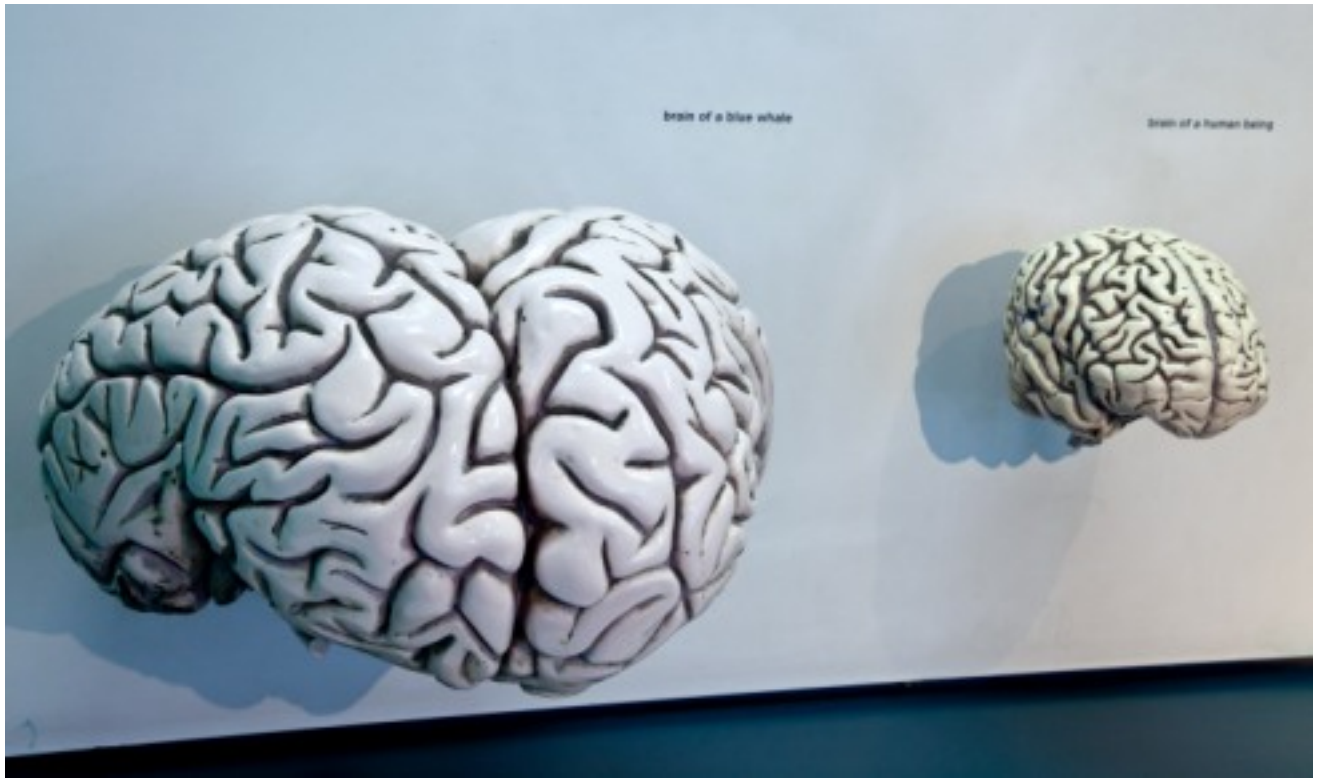
Few, Long-Dependent Young

Live in multi-age schools:
Lots to learn, Many to learn from

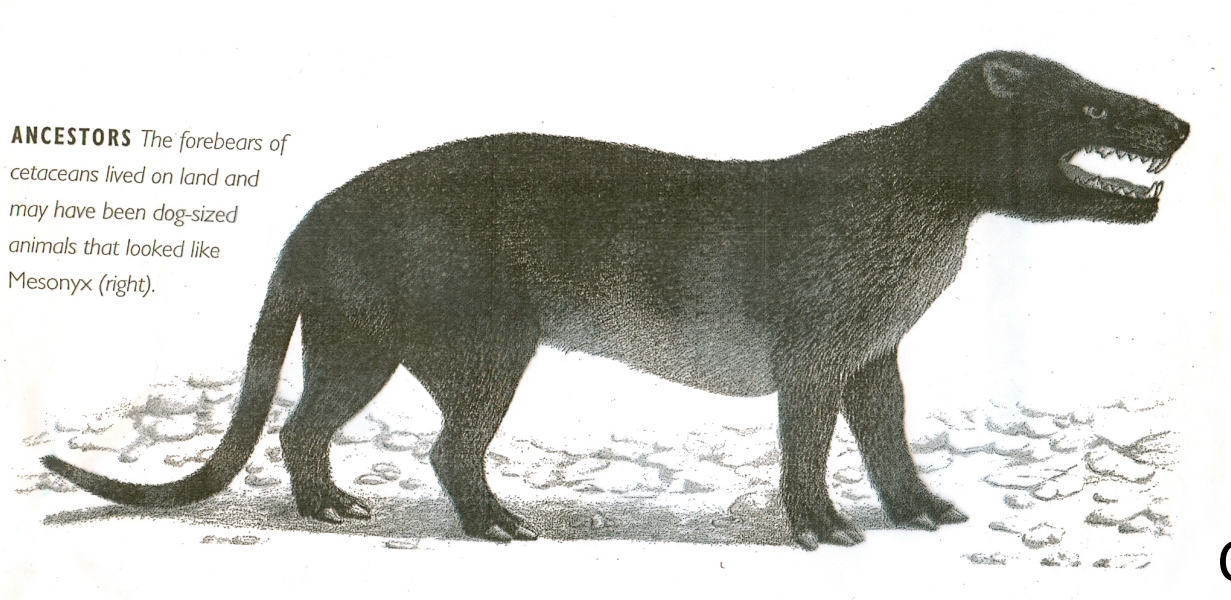
Large relative and absolute brain size.



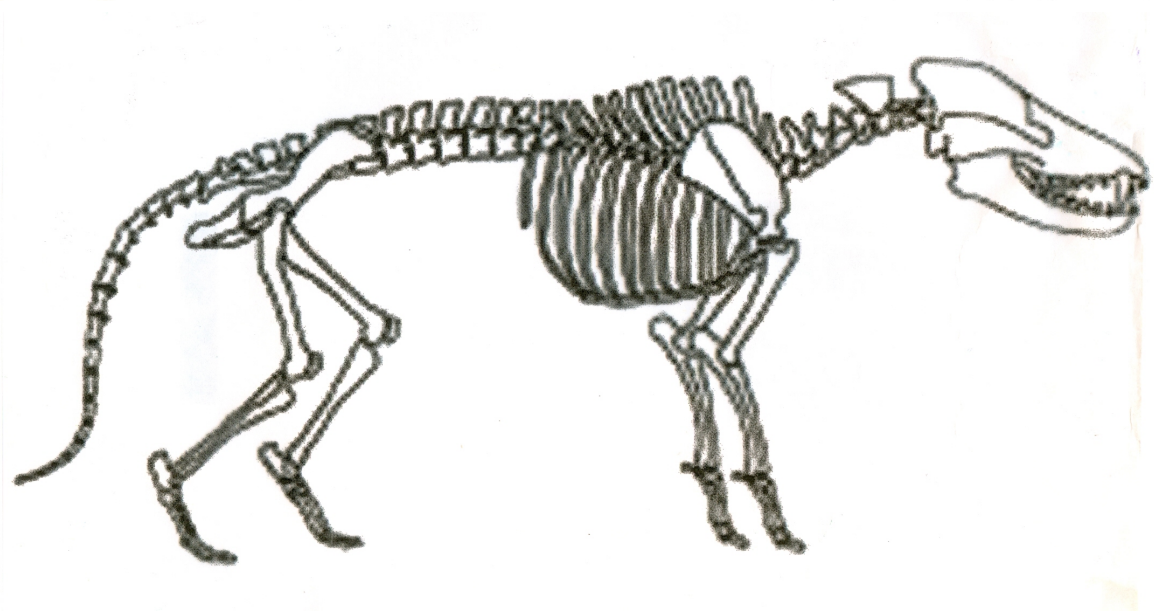
Largest brains on the planet



Cetaceans were once land animals



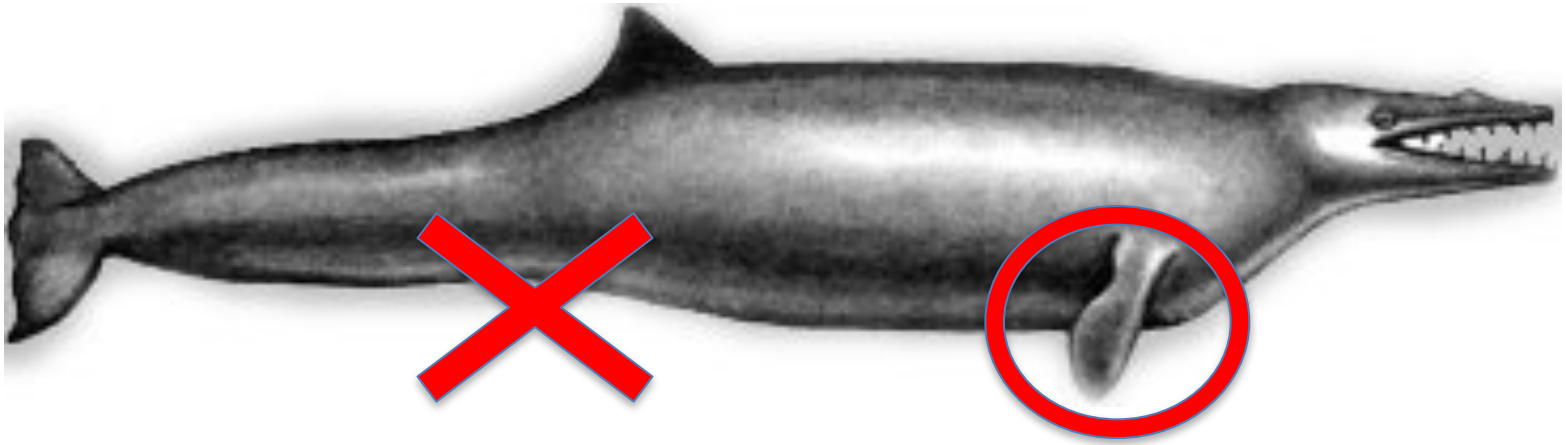
ANCESTORS *The forebears of cetaceans lived on land and may have been dog-sized animals that looked like* Mesonyx *(right).*

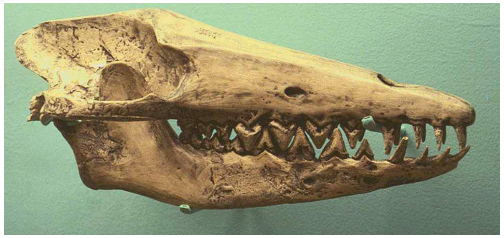


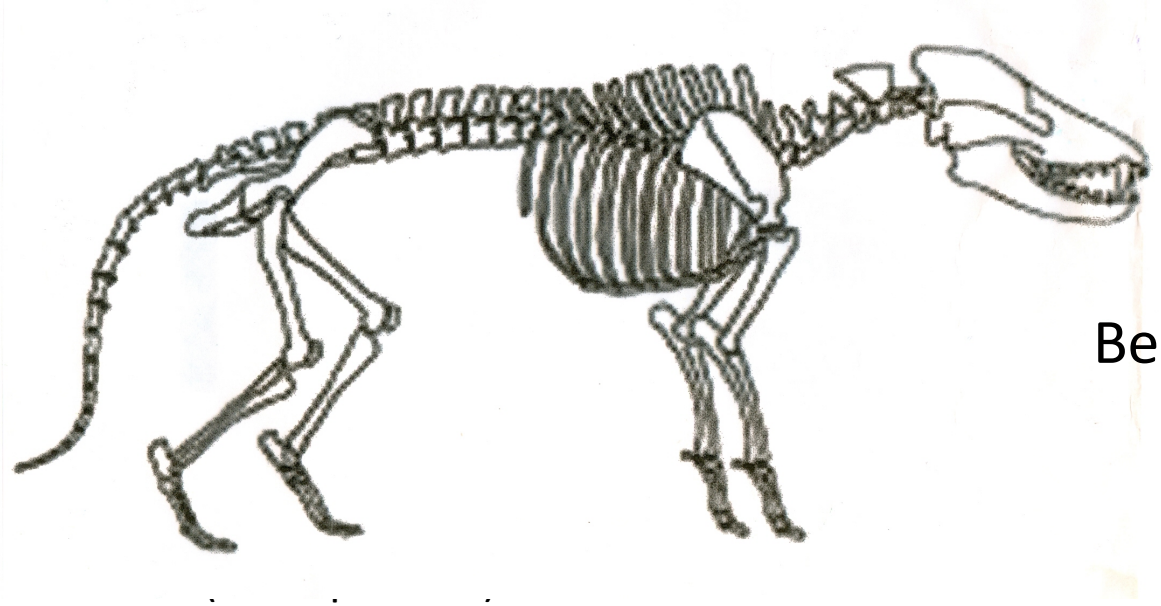
Cetacean ancestor:

A hoofed predator

Ancestral Cetacean

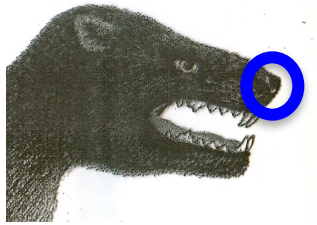




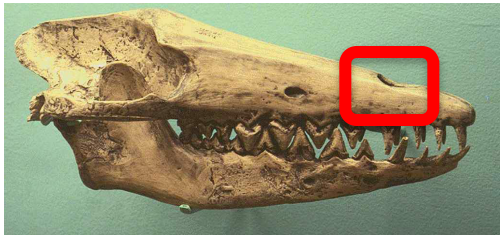


Became aquatic
tho still a predator

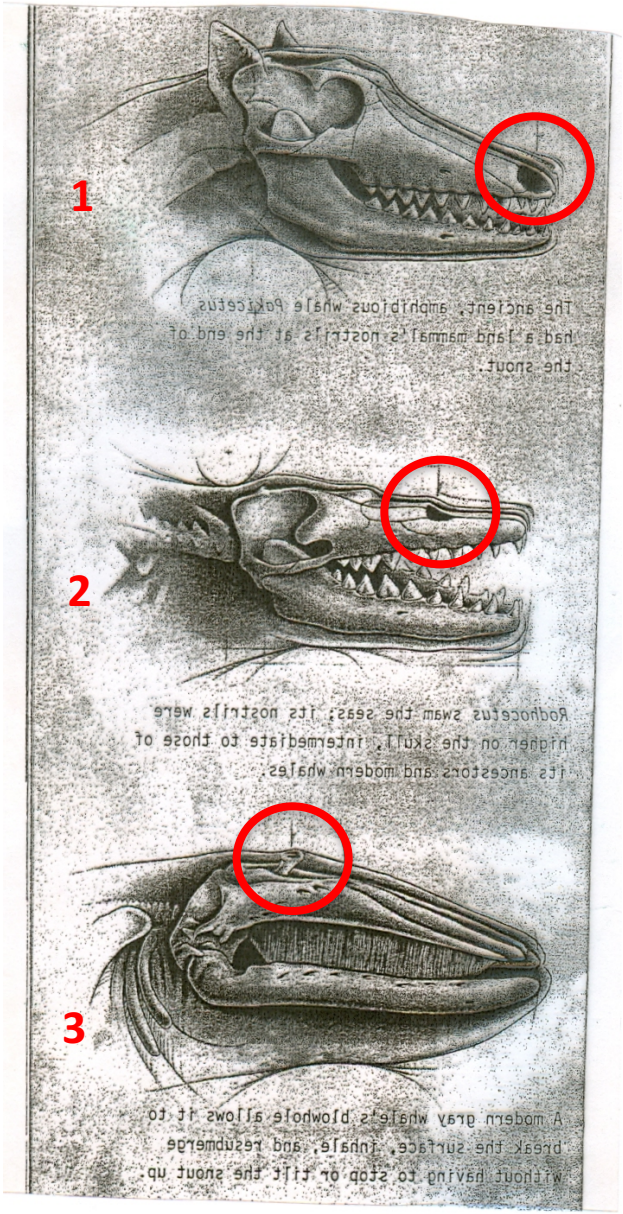
Ancestral Cetacean



Nares migrated to
the top of head,
close to surface of water



Ancestral Cetacean



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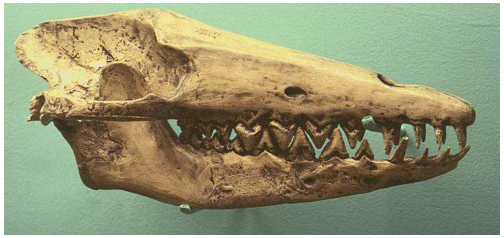
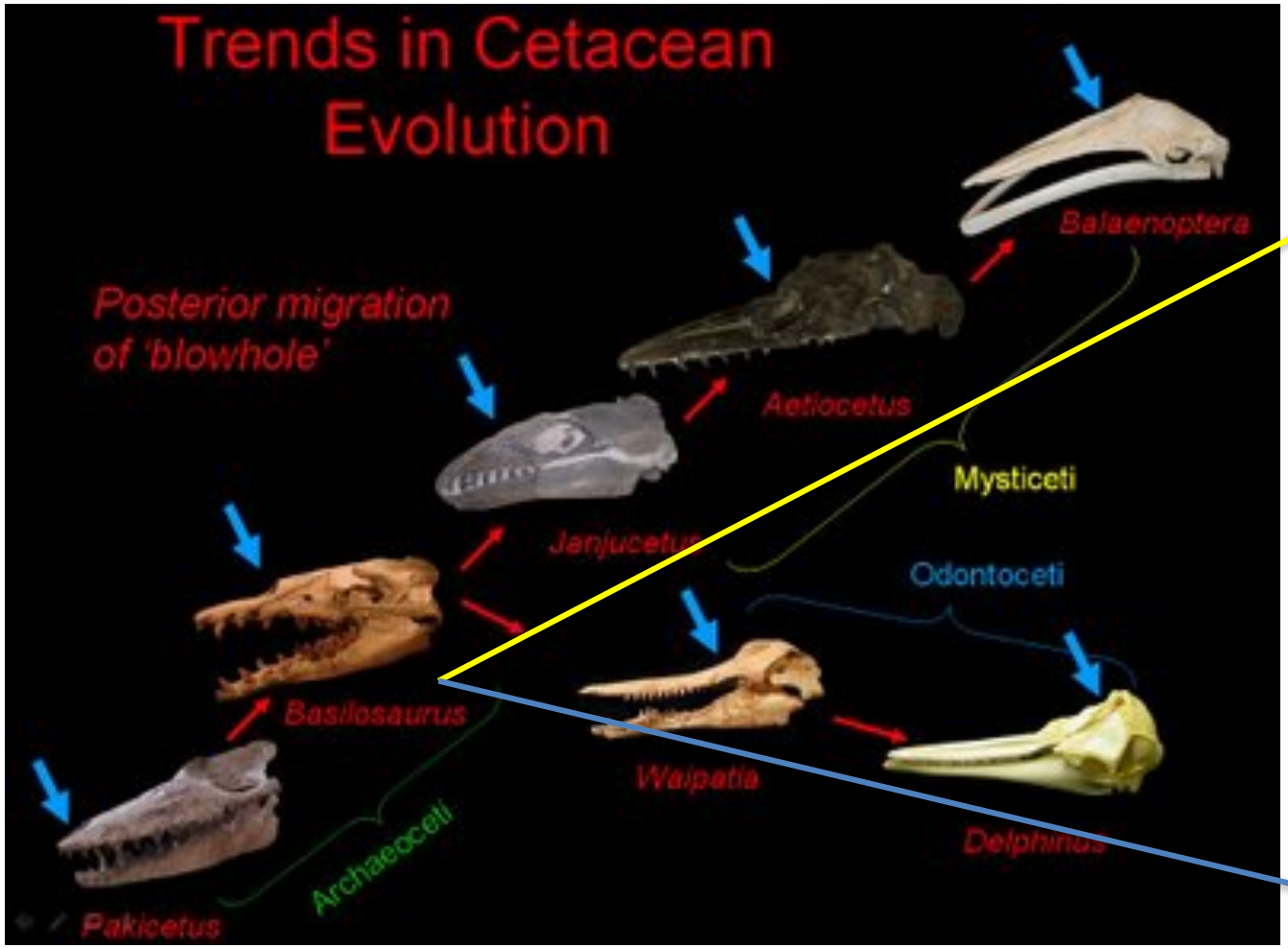


Two major divisions

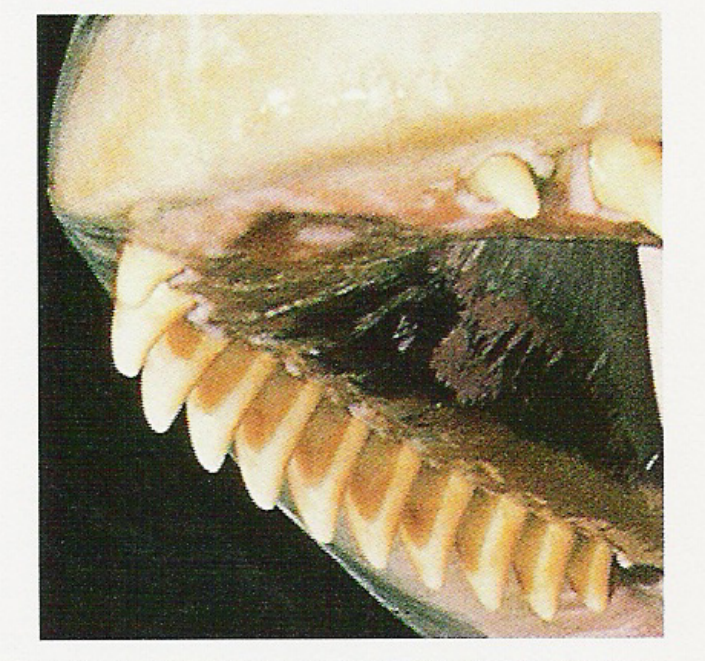


Baleen Whales

Toothed Whales

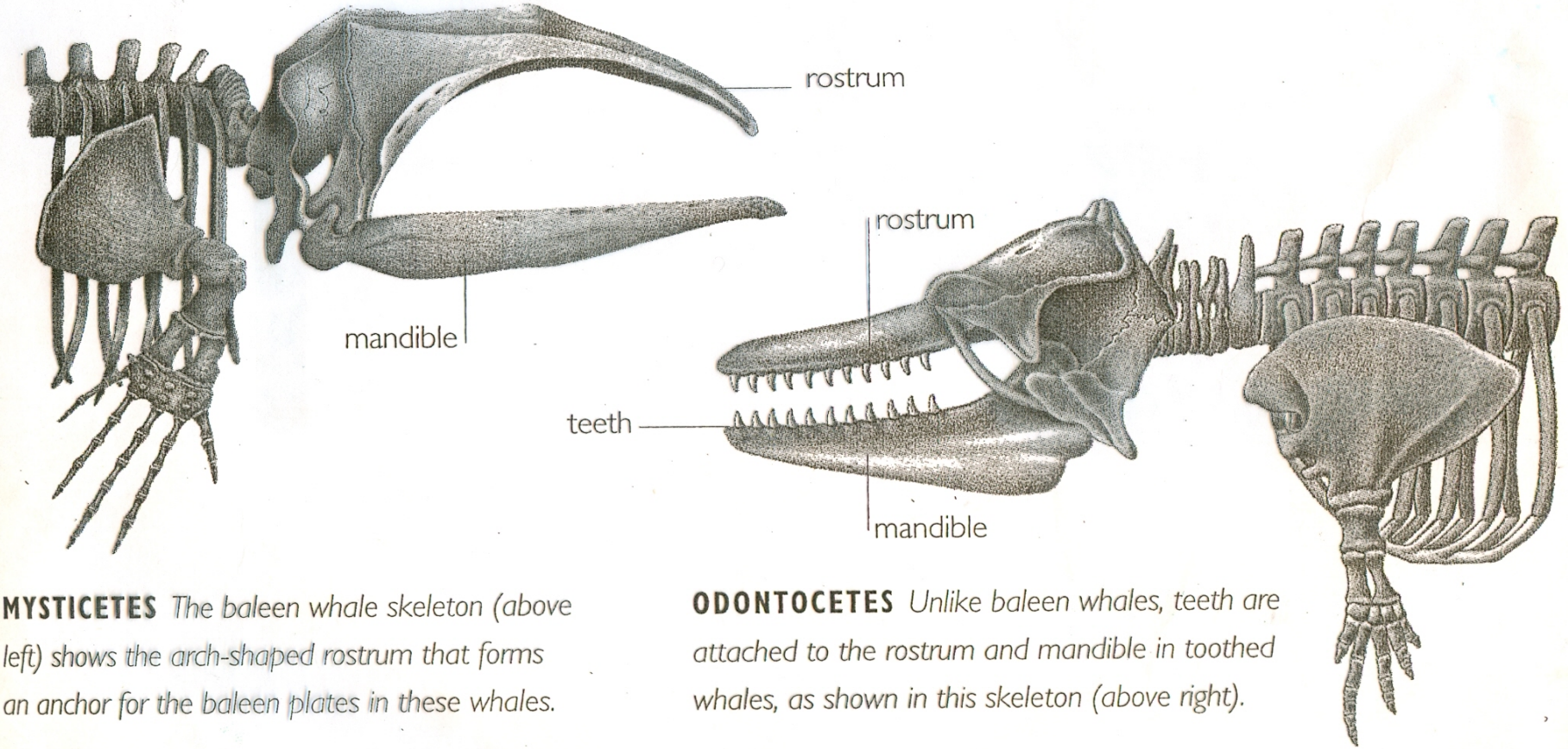
Two Major Divisions – *Mysticetes* & *Odontocetes*

Mysticeti:
The baleen whales



Odontoceti:
The toothed whales

Two major divisions

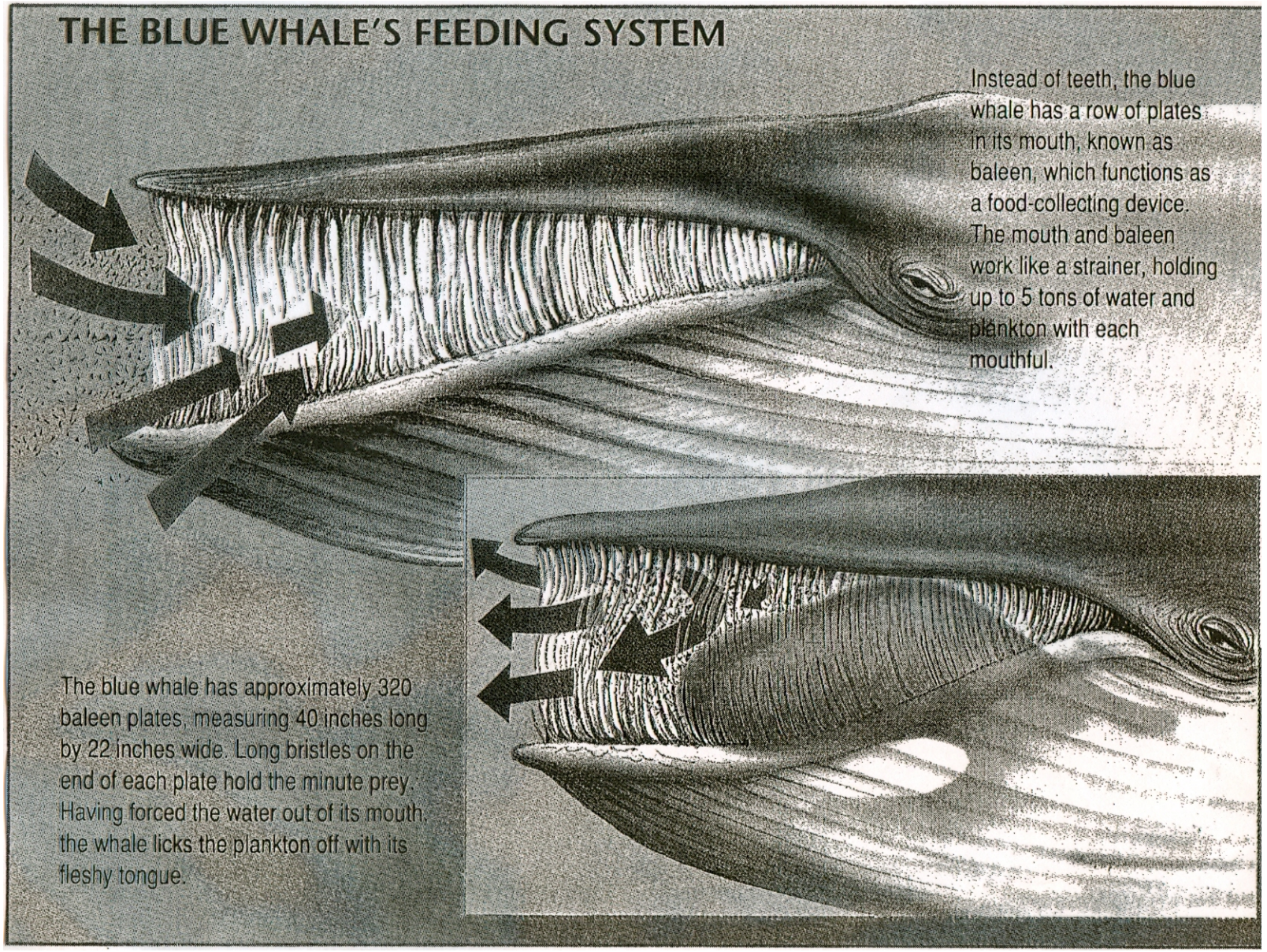


MYSTICETES *The baleen whale skeleton (above left) shows the arch-shaped rostrum that forms an anchor for the baleen plates in these whales.*

ODONTOCETES *Unlike baleen whales, teeth are attached to the rostrum and mandible in toothed whales, as shown in this skeleton (above right).*

Baleen

THE BLUE WHALE'S FEEDING SYSTEM

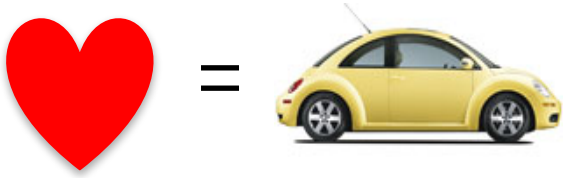


Instead of teeth, the blue whale has a row of plates in its mouth, known as baleen, which functions as a food-collecting device. The mouth and baleen work like a strainer, holding up to 5 tons of water and plankton with each mouthful.

The blue whale has approximately 320 baleen plates, measuring 40 inches long by 22 inches wide. Long bristles on the end of each plate hold the minute prey. Having forced the water out of its mouth, the whale licks the plankton off with its fleshy tongue.

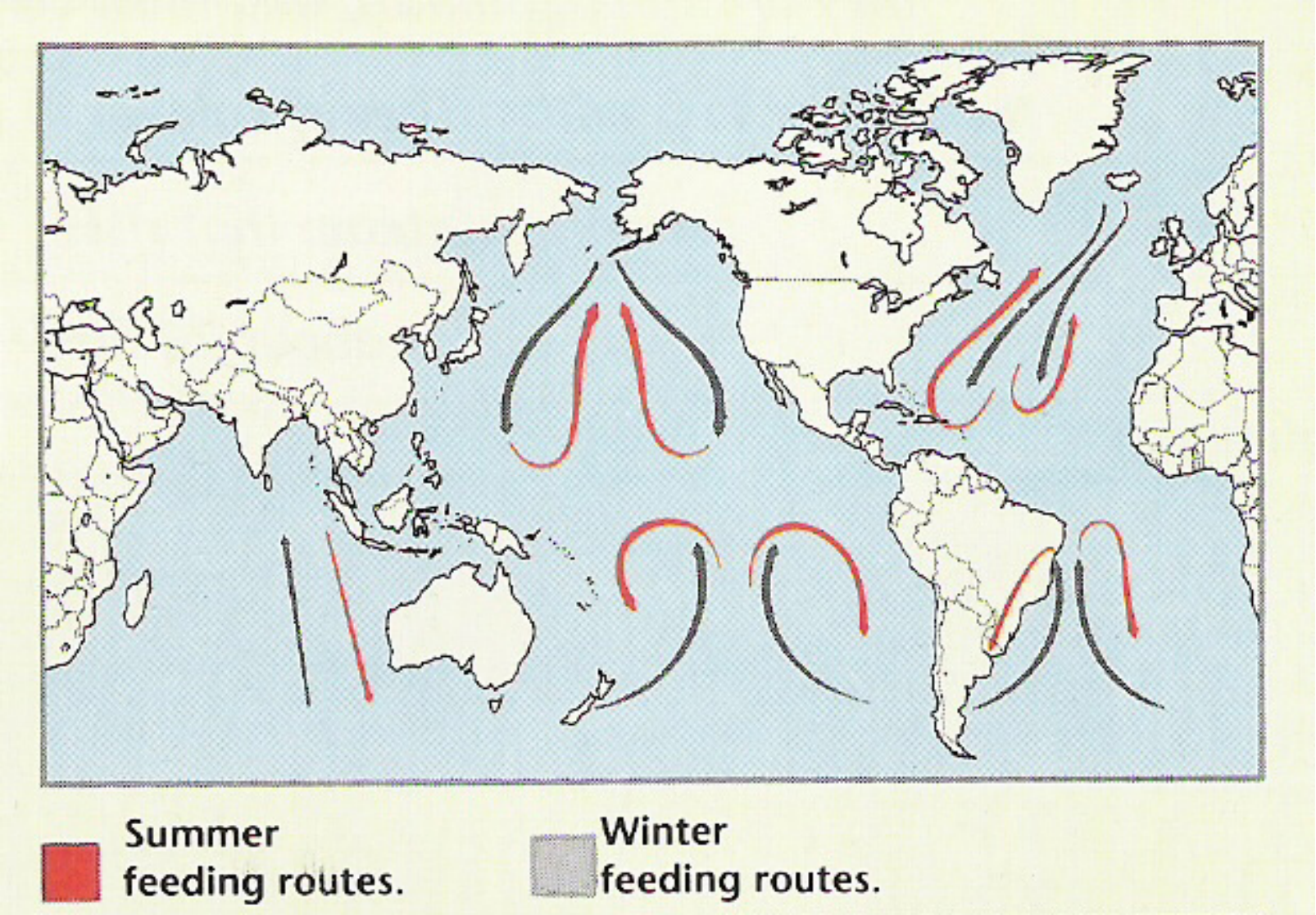
Krill – a principal food of many Mysticetes

The Blue Whale



Largest animal on Earth, ever

All Mysticetes are Marine



Baleen whales have two obvious nares

Odontocetes have a single visible blowhole.

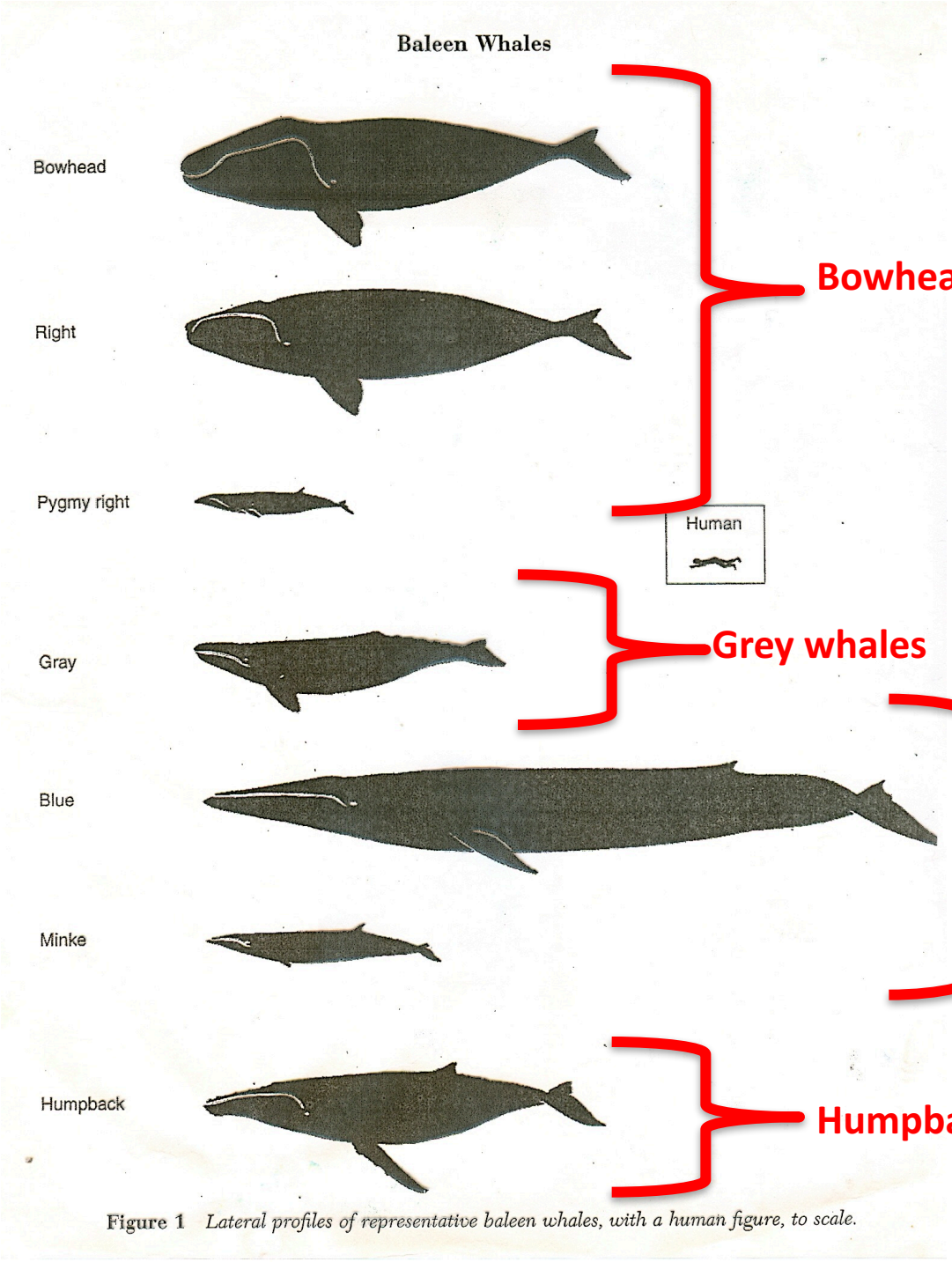


Figure 1 *Lateral profiles of representative baleen whales, with a human figure, to scale.*

Mysticetes:
A variety of forms and feeding strategies

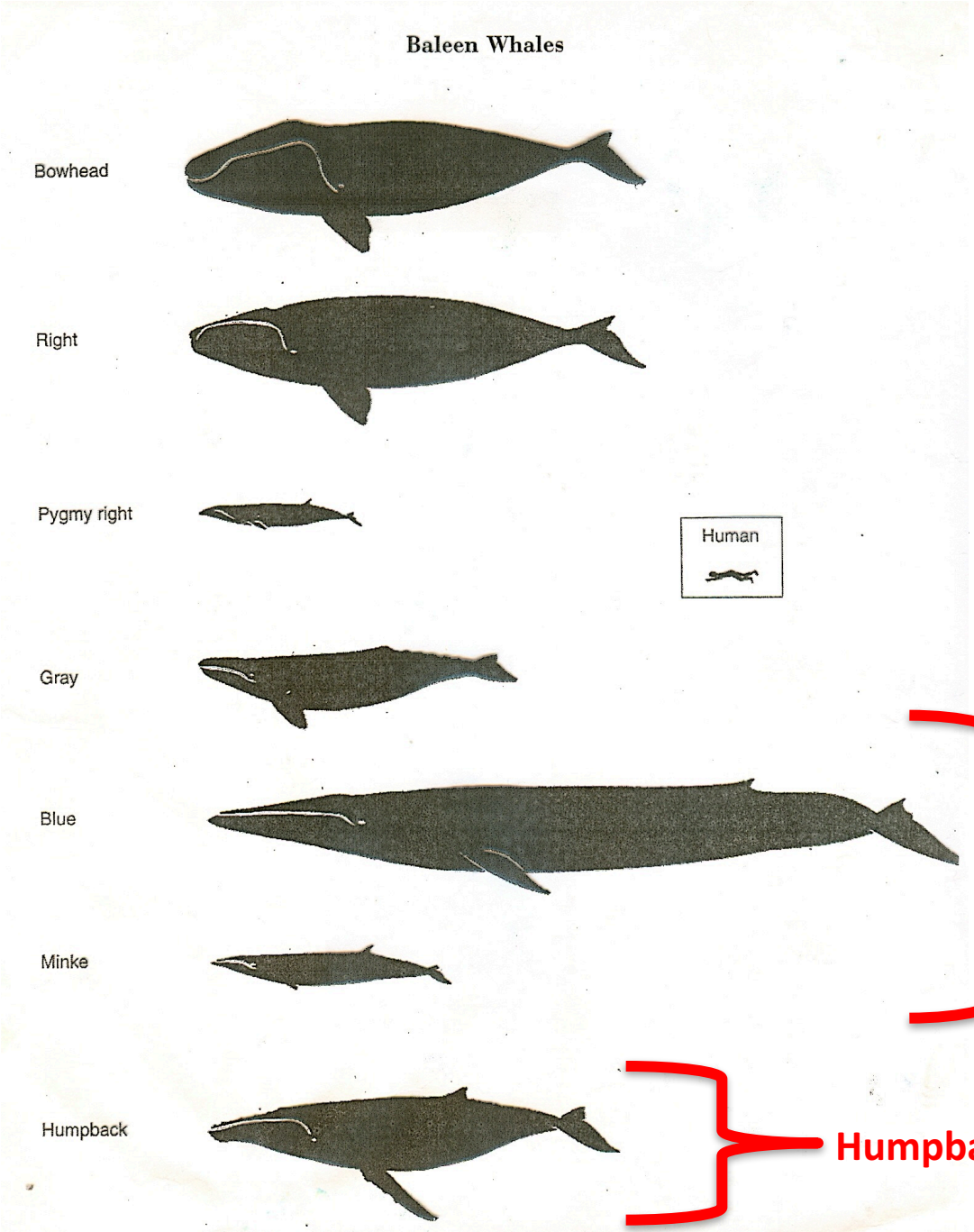


Figure 1 *Lateral profiles of representative baleen whales, with a human figure, to scale.*

Mysticetes:
A variety of forms and feeding strategies

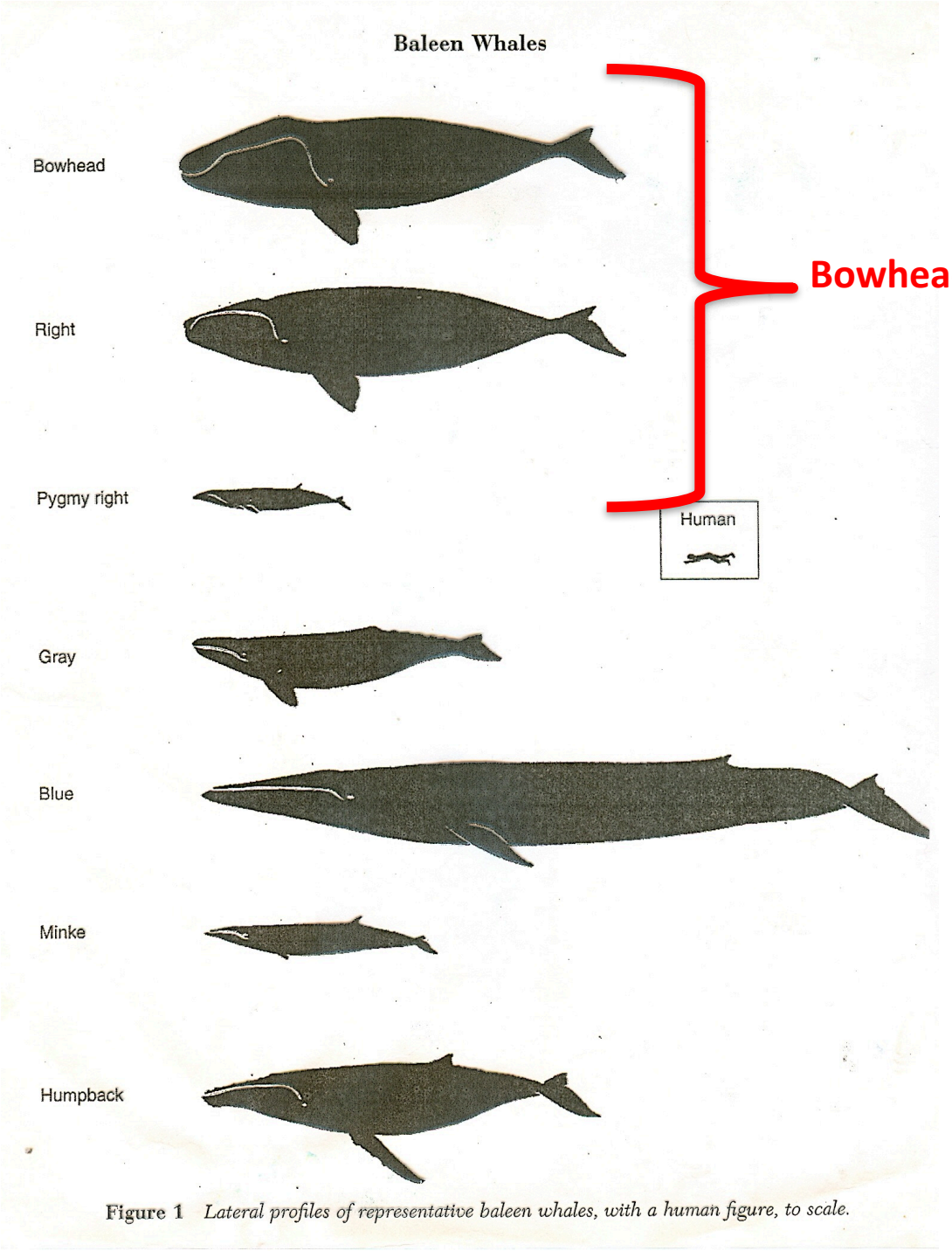
Rorquals (many sizes)

Humpback whales

Rorquals & Humpbacks are “Gulpers”

Pleated throat sack expands as it fills with seawater

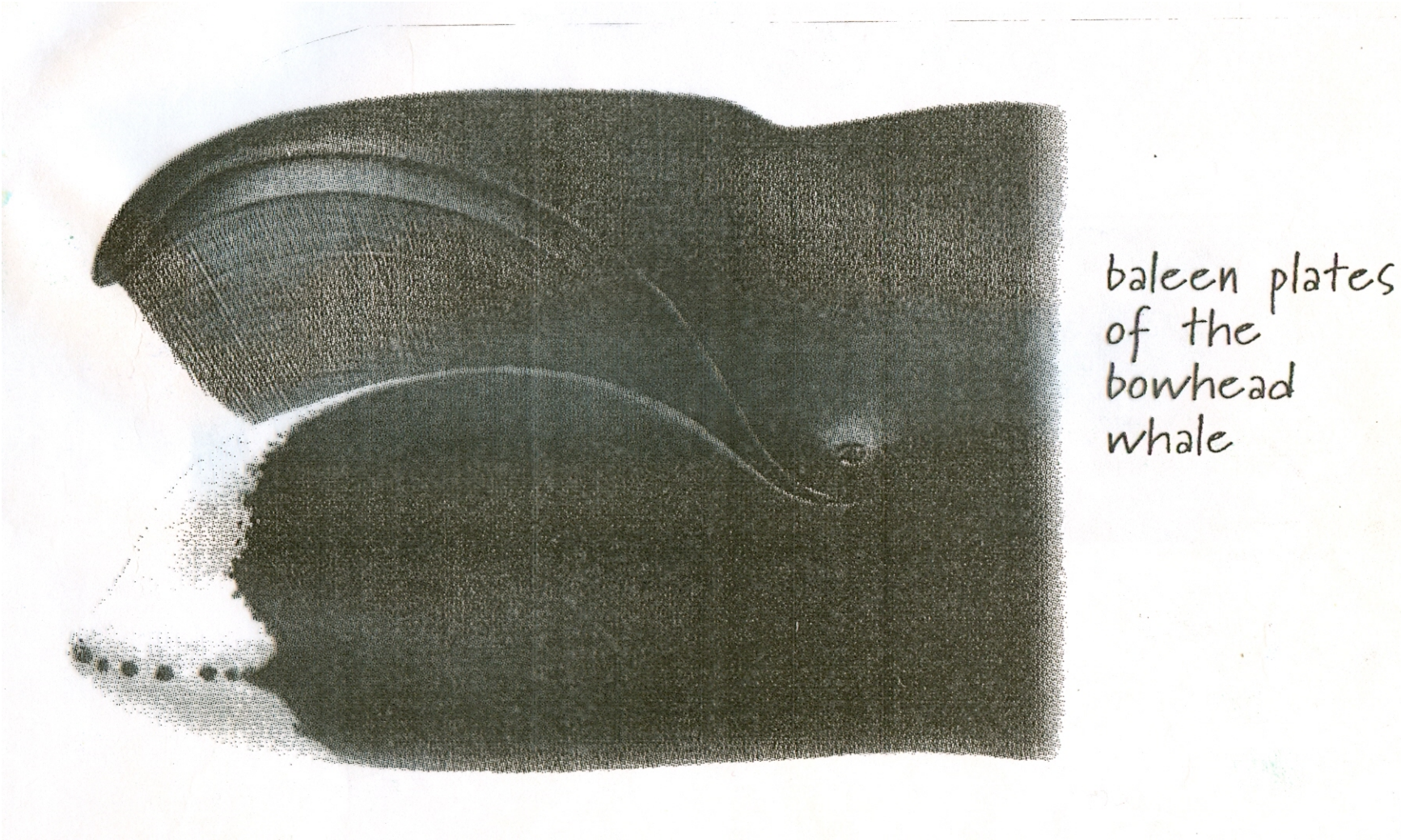
The whale strains out the water and swallows what remains trapped in its baleen



Bowhead & Right whales

Mysticetes:
A variety of forms and feeding strategies

Right Whales & Bowheads are “Skimmers”



Baleen strains seawater for krill and other organisms

The “Right” Whale to Hunt

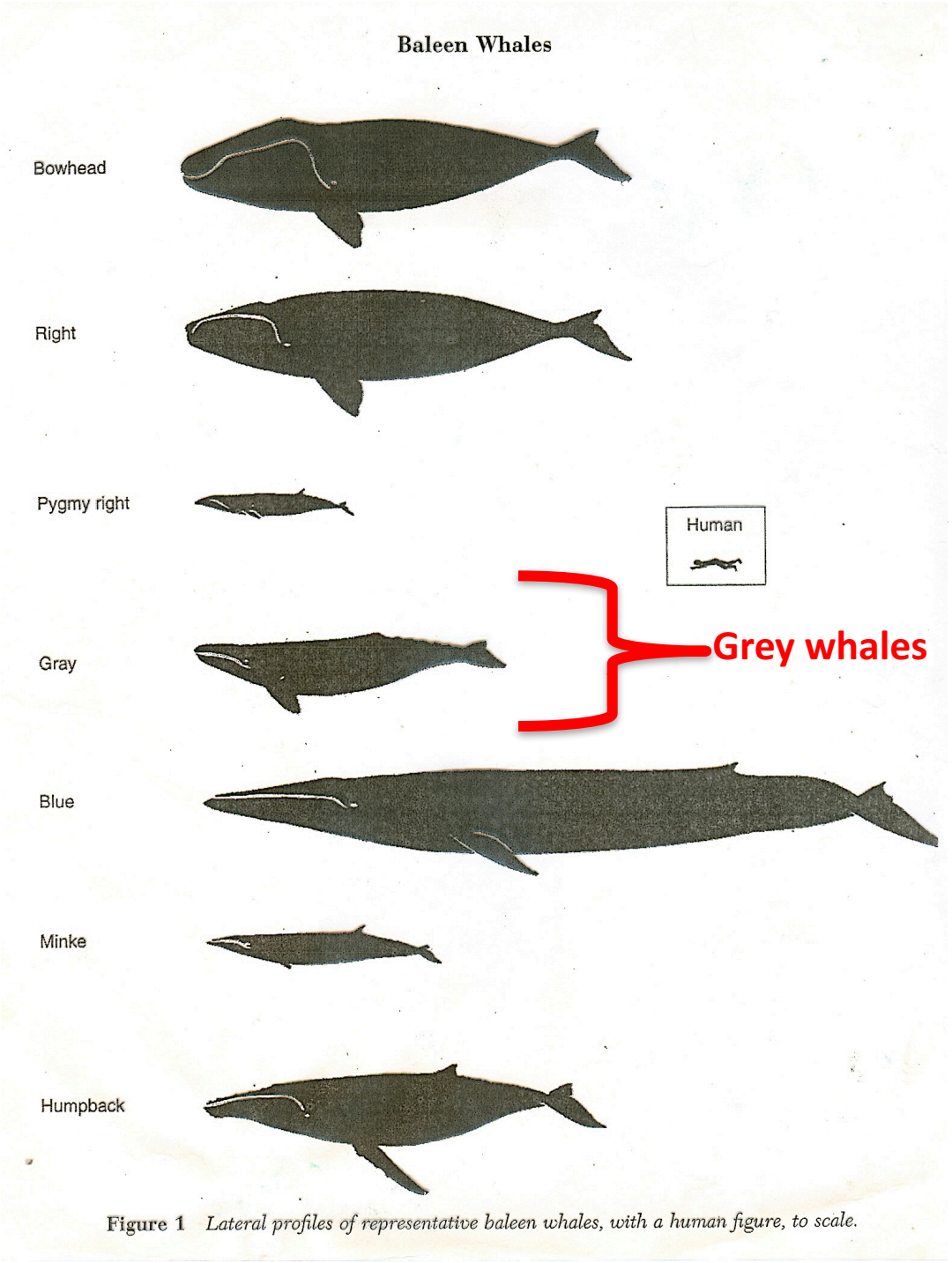


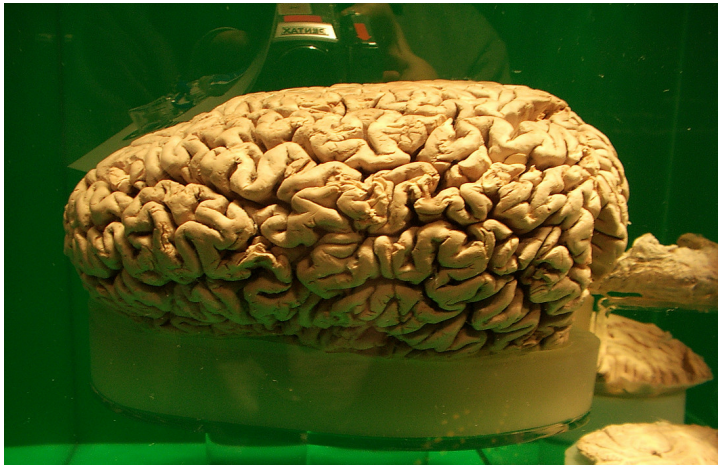
Figure 1 *Lateral profiles of representative baleen whales, with a human figure, to scale.*

Mysticetes:
A variety of forms and feeding strategies

The Grey Whale - Mud-grubbers

Mysticetes emit, and are most sensitive to, low frequency sounds

Mysticetes have very large brains



but smaller than Odontocetes

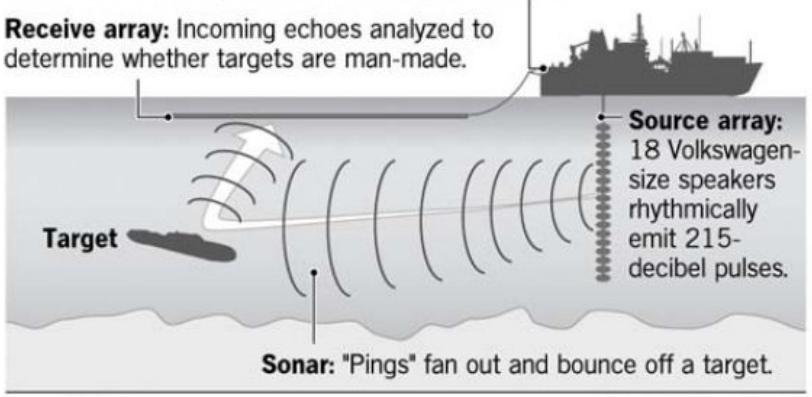
Controversy over impact of noise pollution…

Undersea sound

A recent study by the U.S. Navy concluded that its new, low-frequency, sonar system will not have a negative impact on marine life. Some environmentalists disagree. A look at the new technology:

Navy sonar ship: Carries low frequency active sonar equipment capable of detecting near-silent enemy submarines.

Receive array: Incoming echoes analyzed to determine whether targets are man-made.



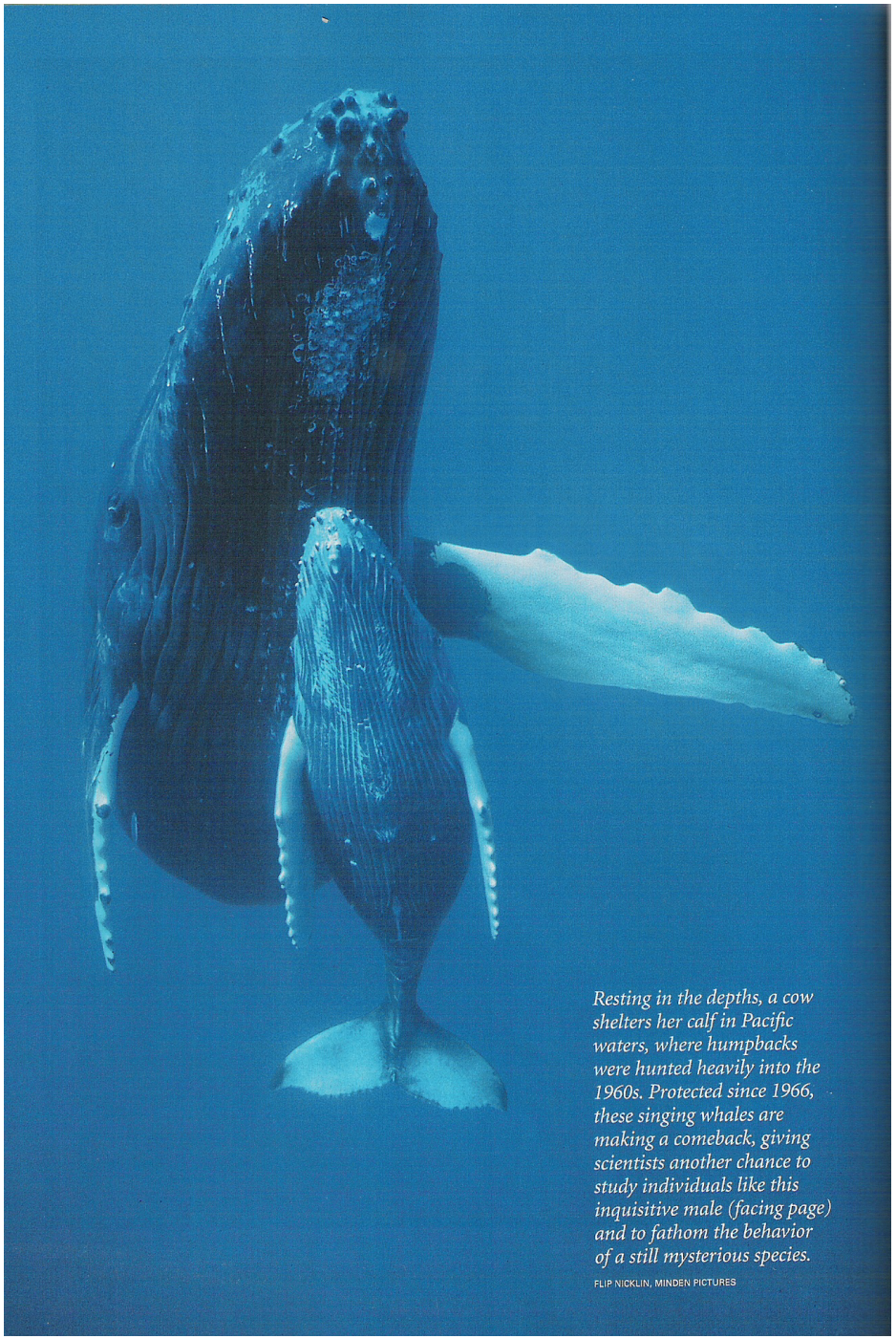
Source: U.S. Navy

Associated Press Graphic

Humpback Whale

Mysticete of special interest…

Megaptera novaenglia

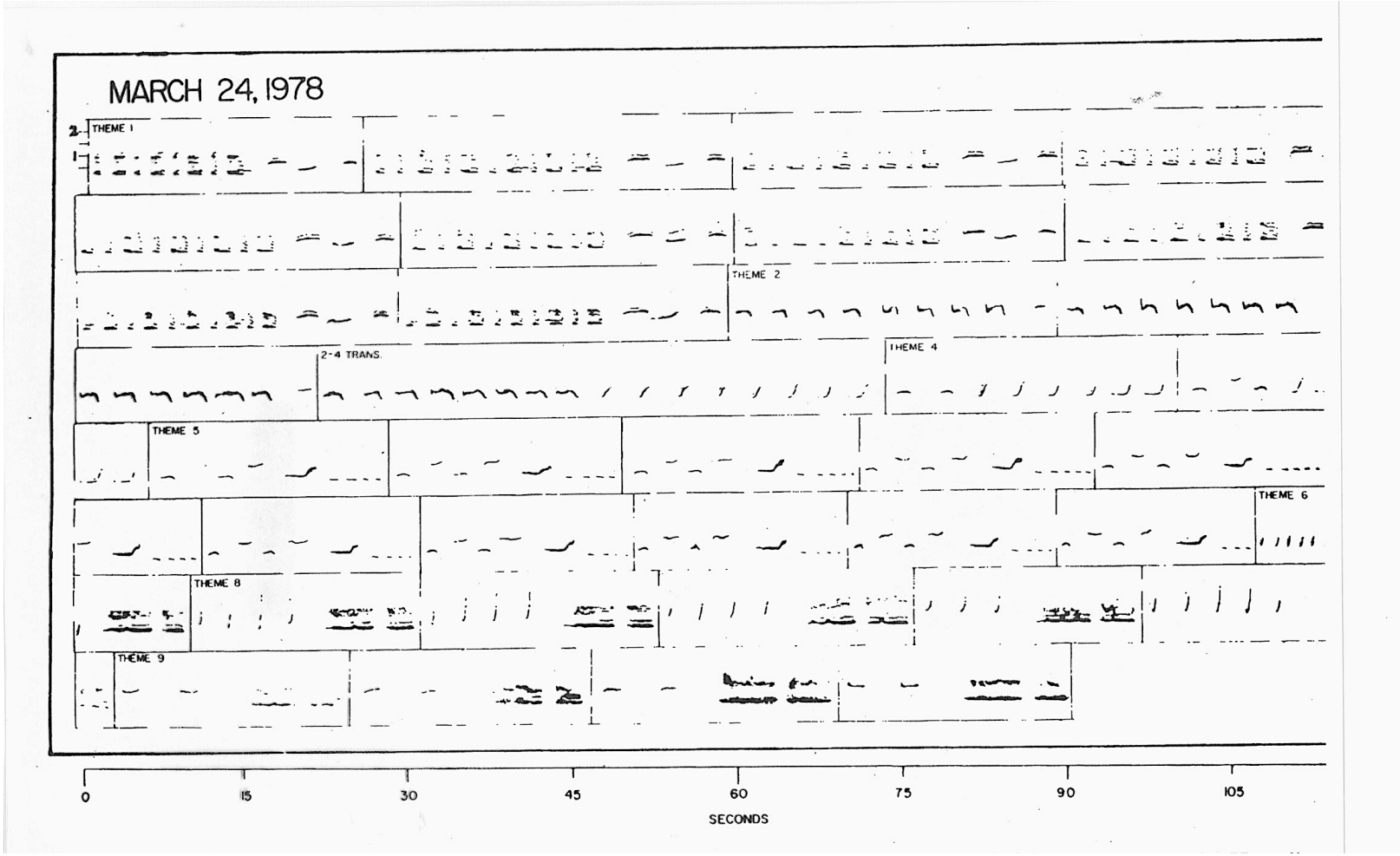


Humpback Whale

Social displays,
like breaching

One of the few Mysticetes that feeds cooperatively.

Humpback Whale Song

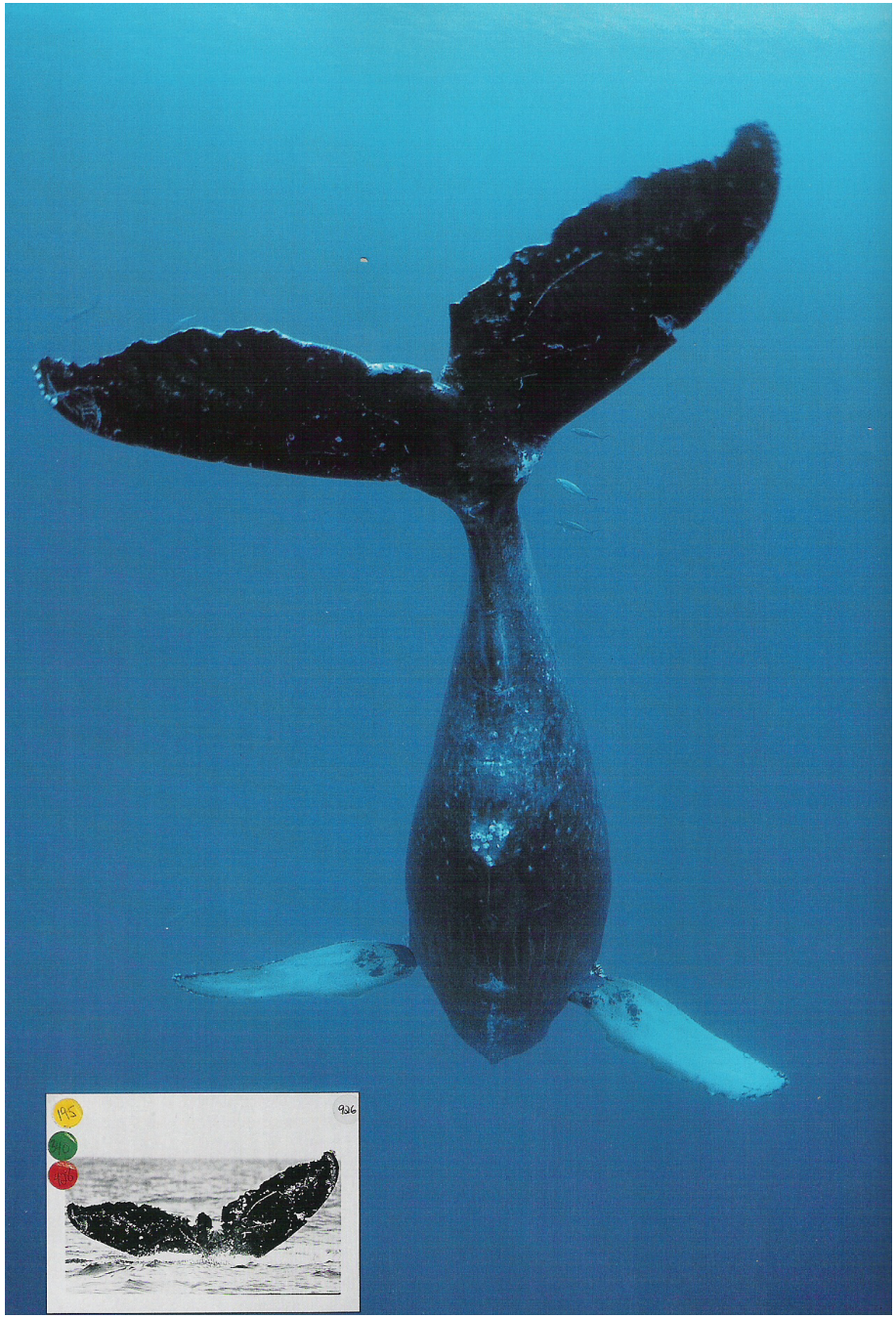


Long, elaborate song, repeated.
Changes are learned by all local males

Humpback Whale

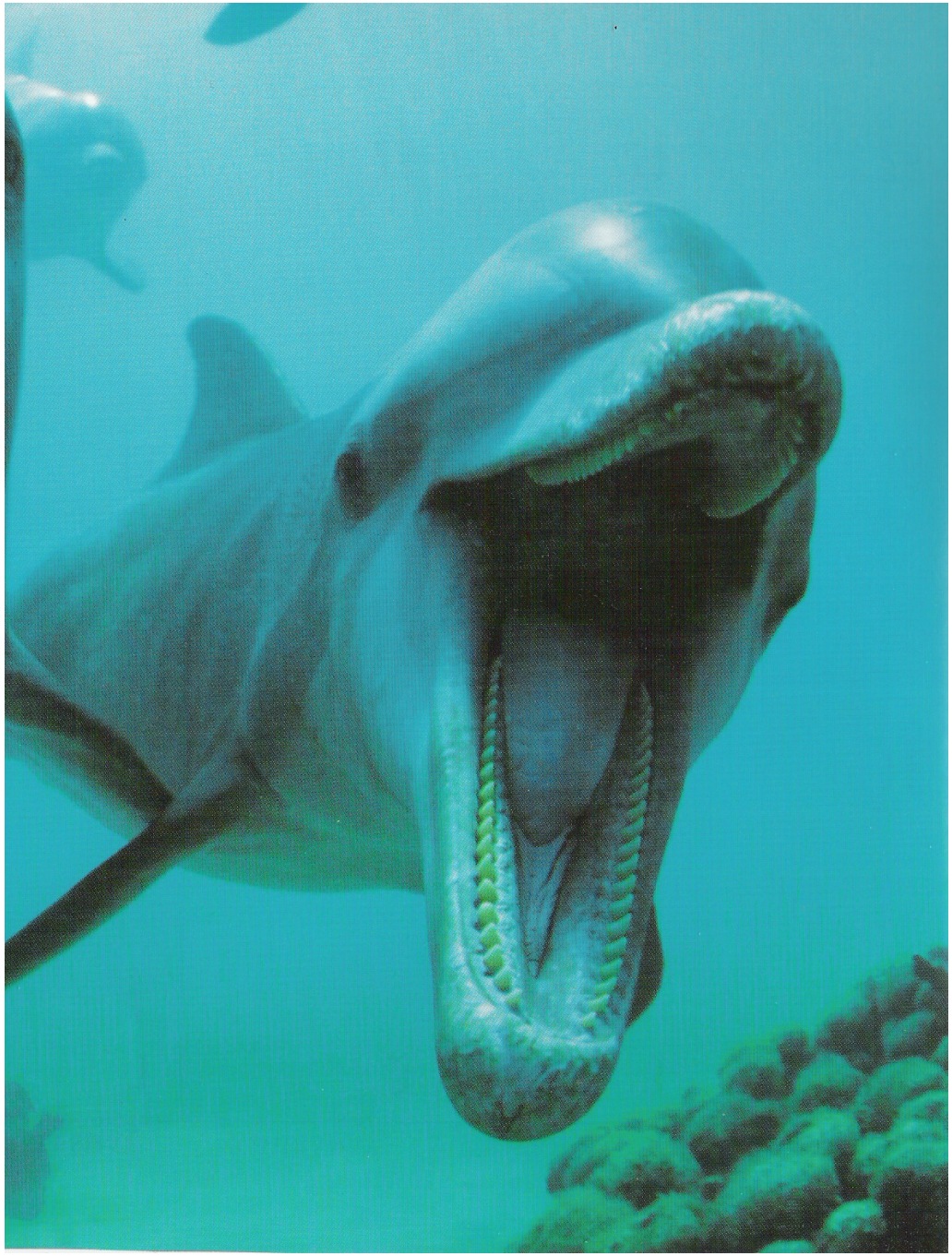
Male hangs head down
while singing.

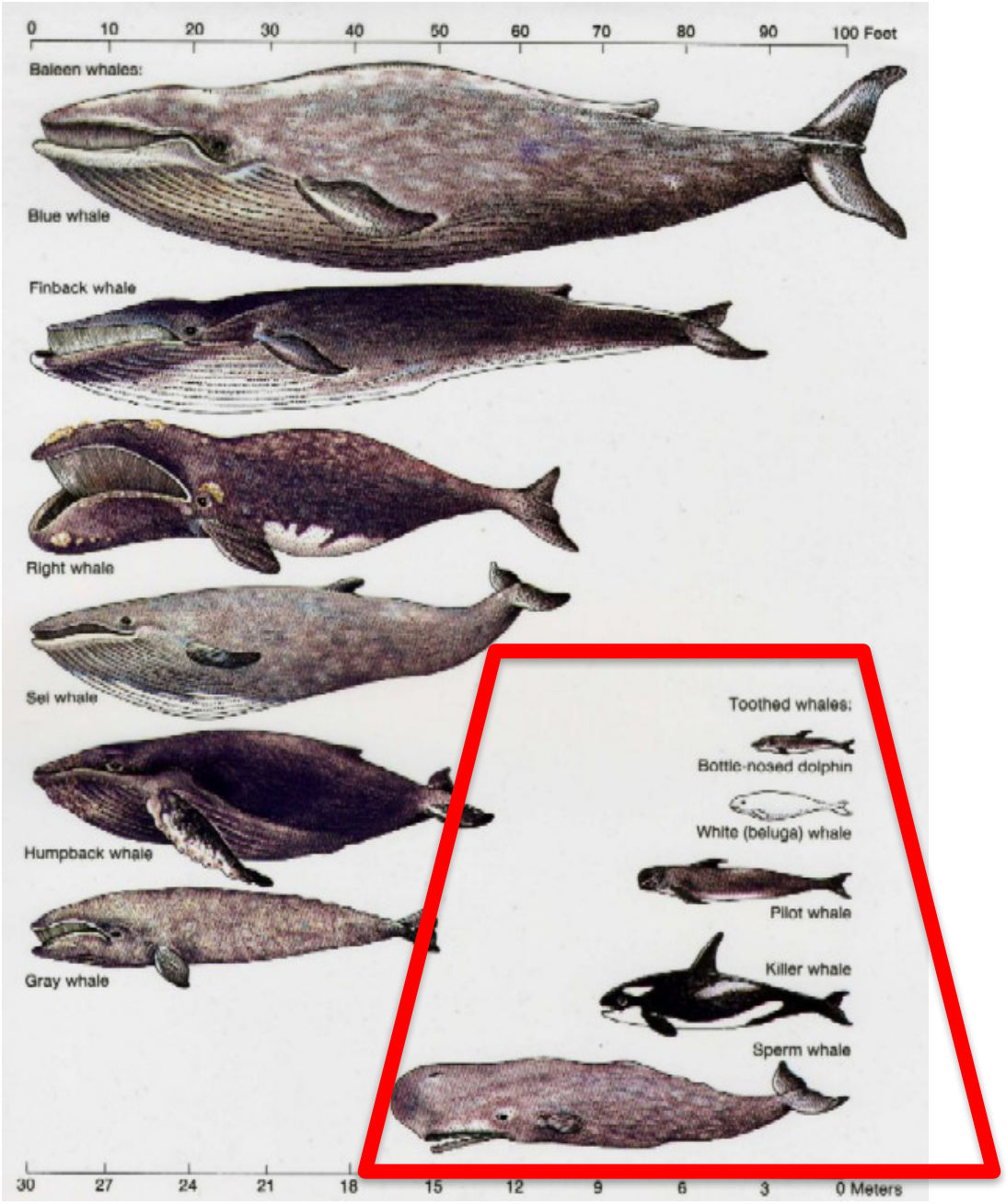
Attracts females to,
repels males from,
his “territory”



Odontocetes:
The Toothed Whales

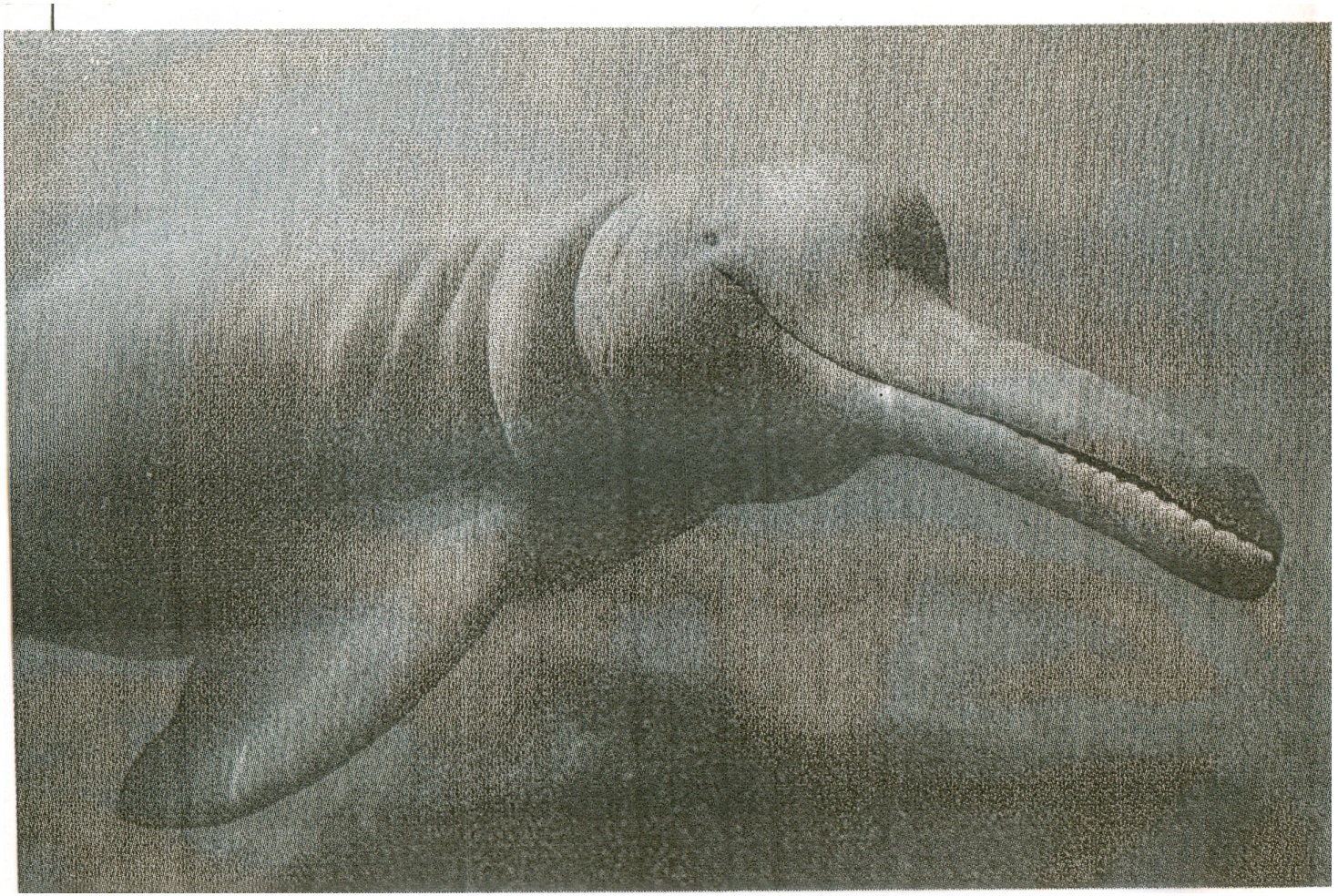
ALL are Hunters





Toothed whales –
large, but most not giant

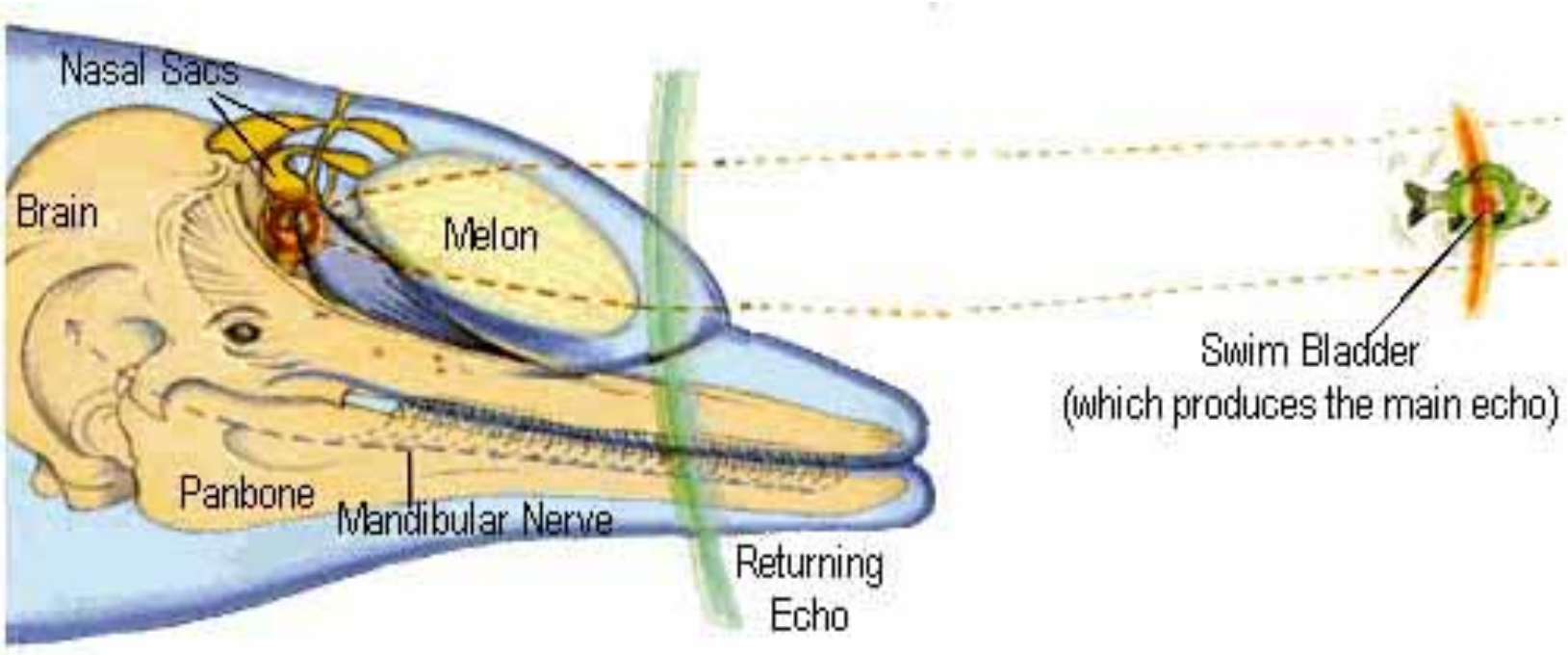
Most marine, but some riverine species



Riverine species tend to retain primitive characteristics of early Odontocetes

Smaller brains, bigger teeth, poor vision, but still echolocators

All Odontocetes are specialized for Echolocation



Many forms

Collaborative hunters

Opportunistic feeders, many strategies

Species of special interest…

Bottlenose dolphin

Tursiops truncatus (Atlantic),
Tursiops gilli (Pacific),
Tursiops aduncus (Indo-Pacific)

Species of special interest…

Killer Whale

Orcinus orca

Species of special interest…

Beluga

Delphinapterus leucas

Species of special interest…

Sperm Whale

Physeter catadon

The Sperm Whale is kind of a giant dolphin...

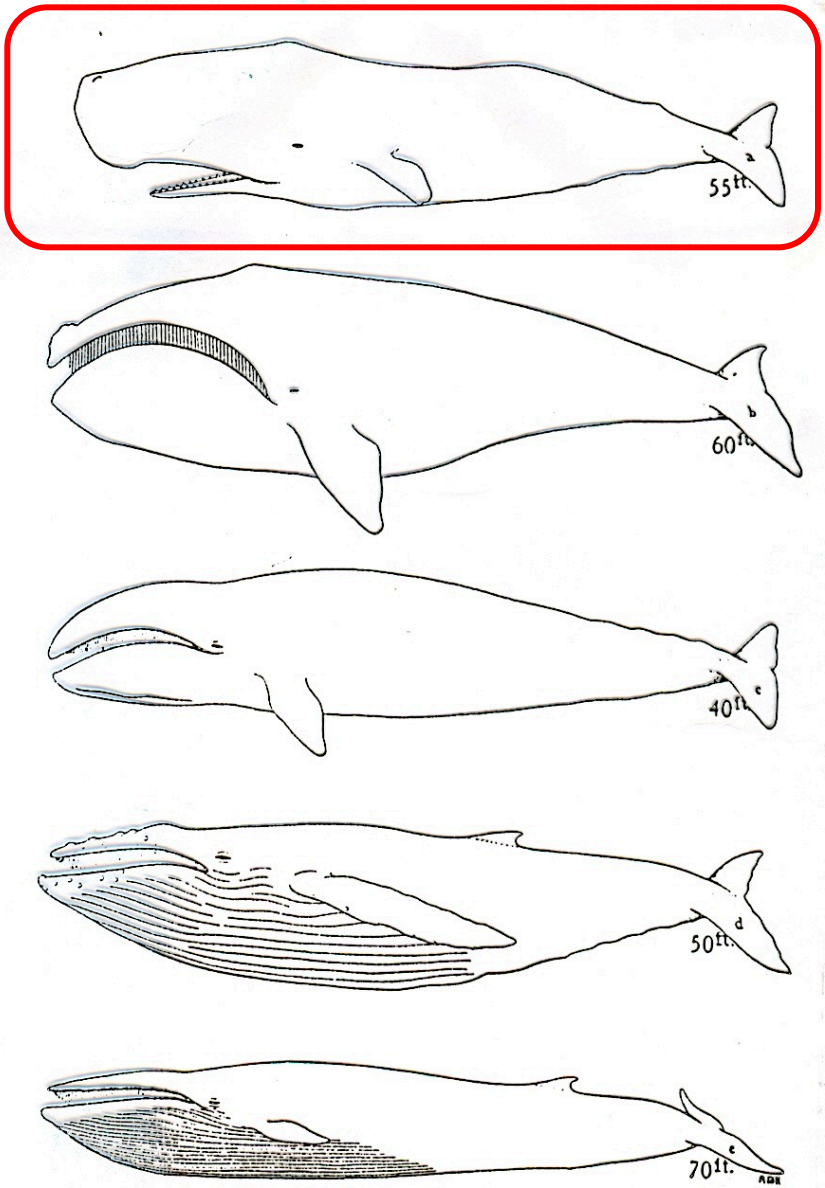
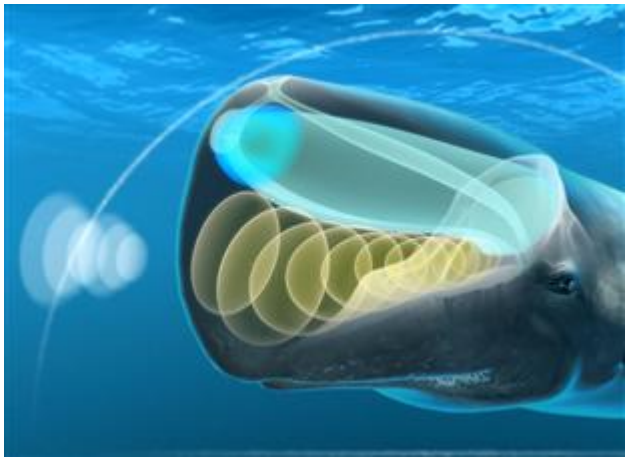


FIGURE 9. Some of the larger whales, to illustrate type (compiled from various sources): (*a*) *Physeter*, the sperm whale or cachalot (an odontocete); (*b*) *Eubalaena glacialis*, the right whale; (*c*) *Rhachianectes*, the gray whale; (*d*) *Megaptera*, the humpback; and (*e*) *Balenoptera physalus*, the finback. The last four are mysticetes or baleen whales.

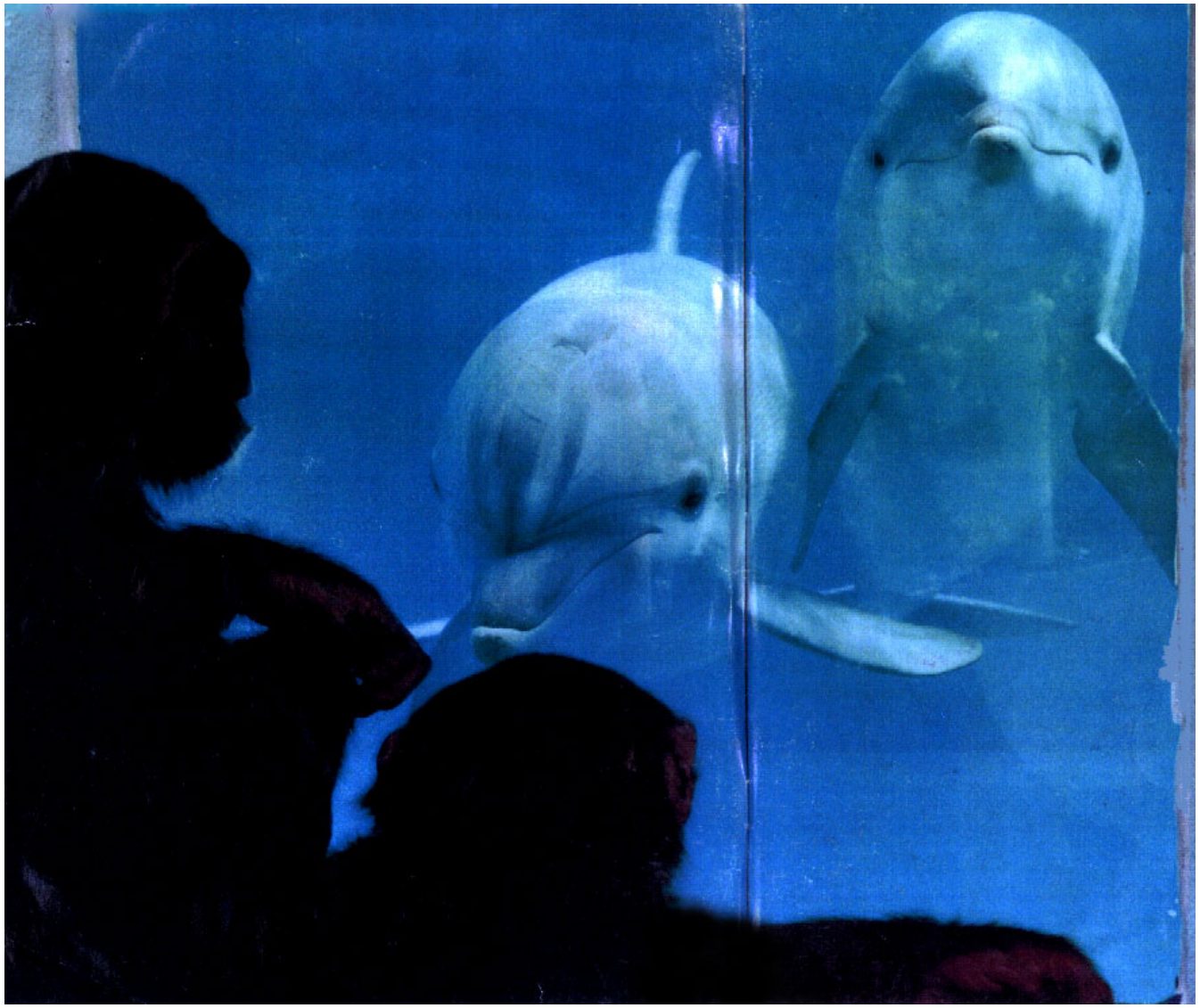
[50]

Sperm Whale – The one giant Odontocete

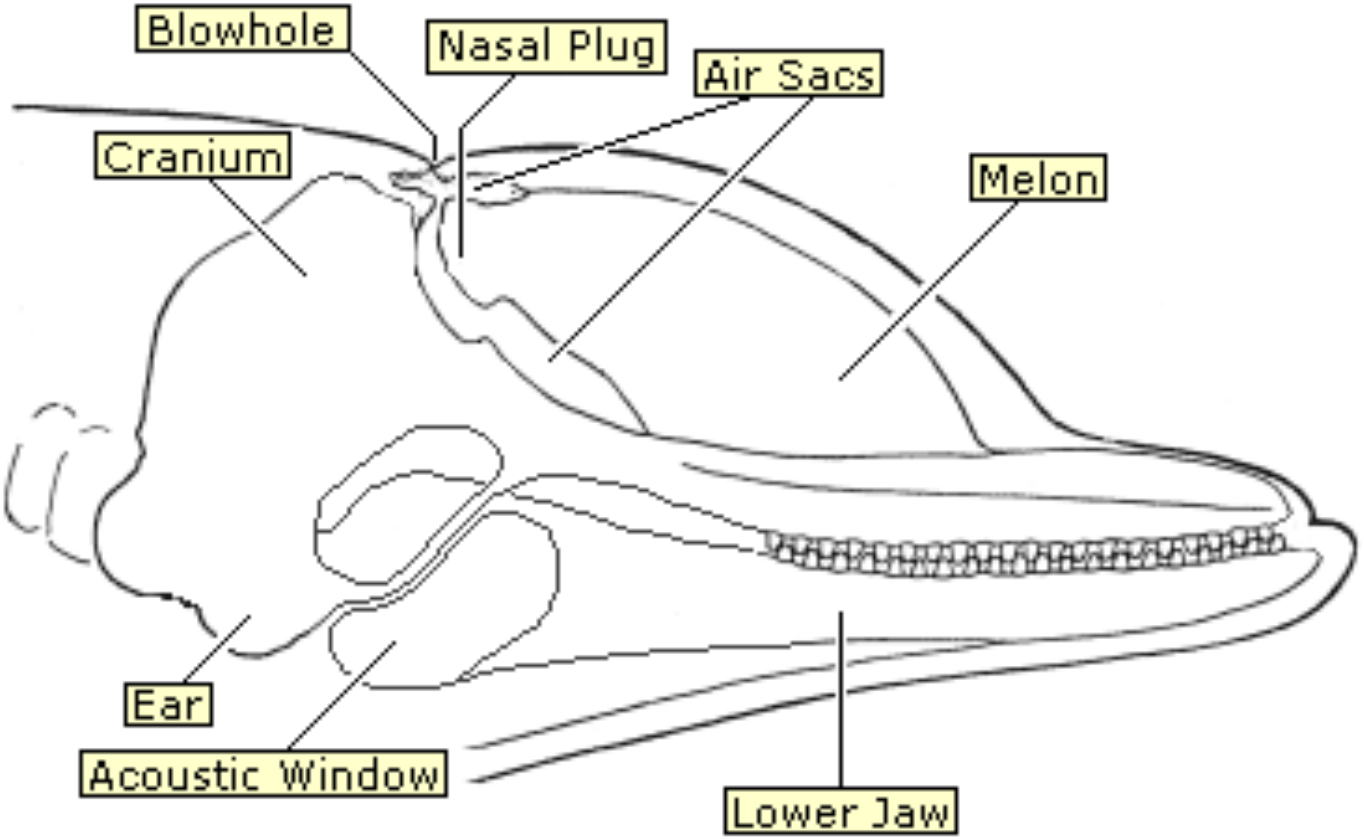


Note huge head – for echolocation

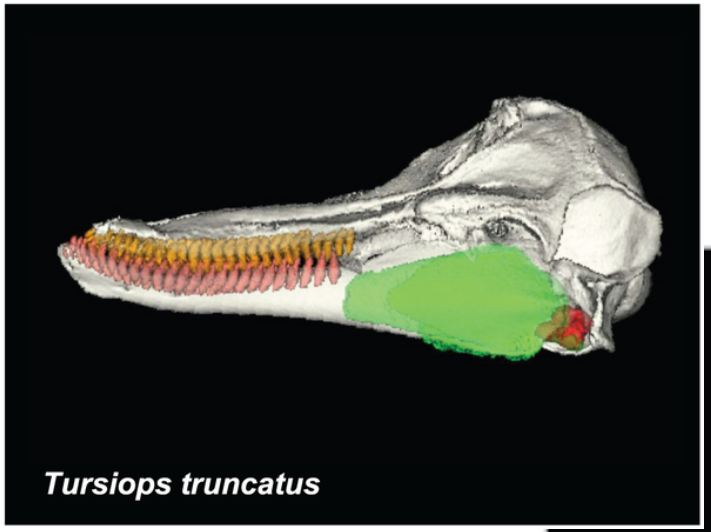
Perceptual and Motor Constraints on Cognition

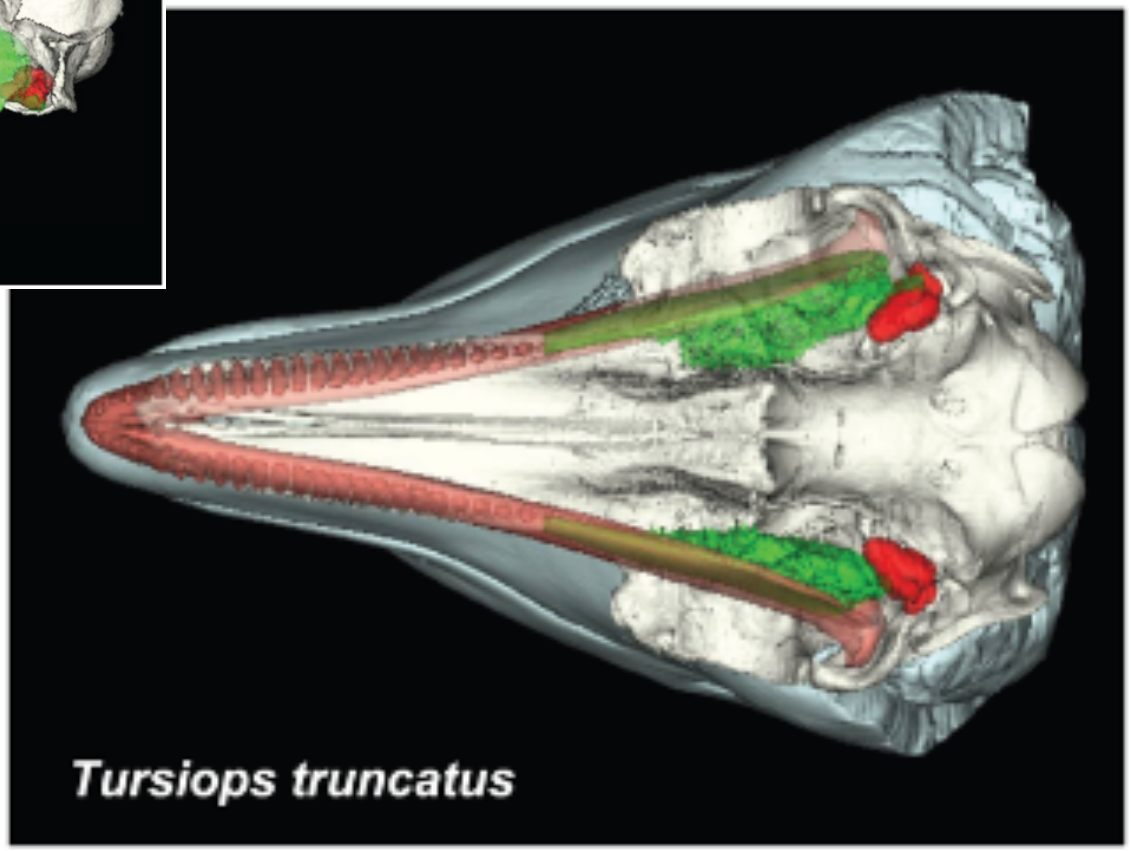


Vocalization / Hearing Specializations



Sound travels along throat & lower jaw to inner ear

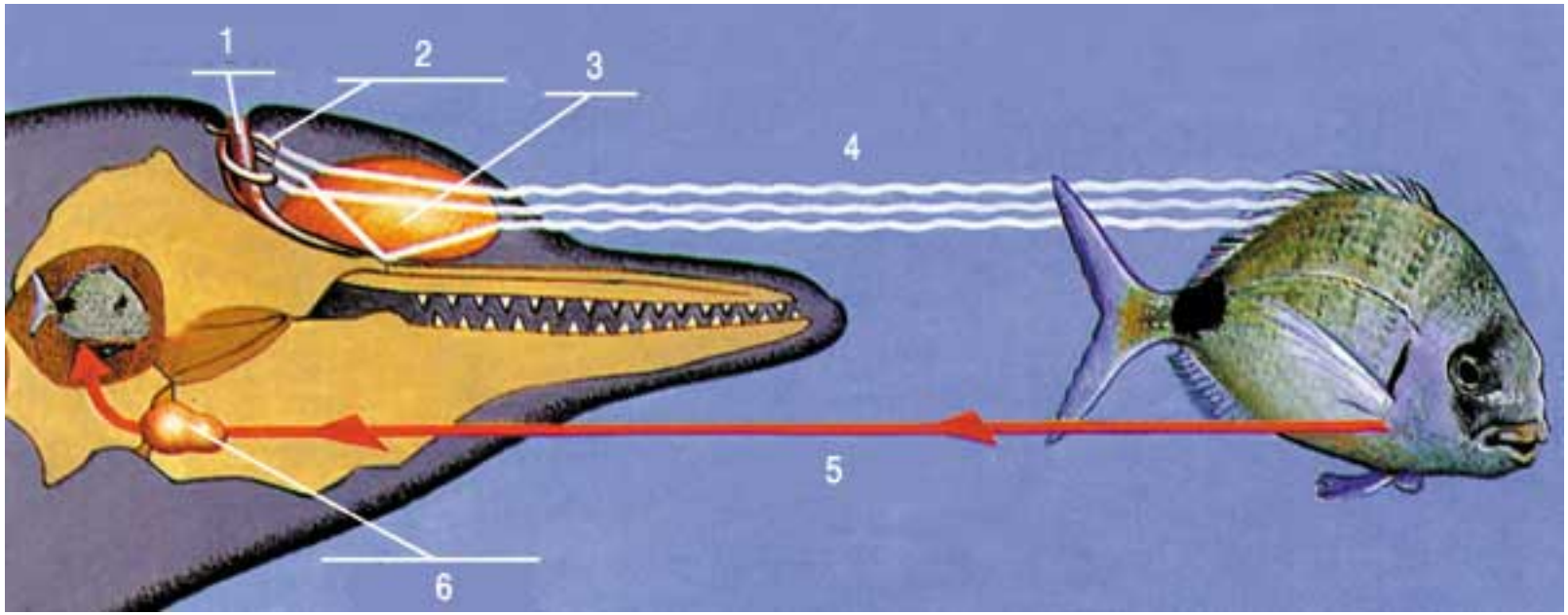




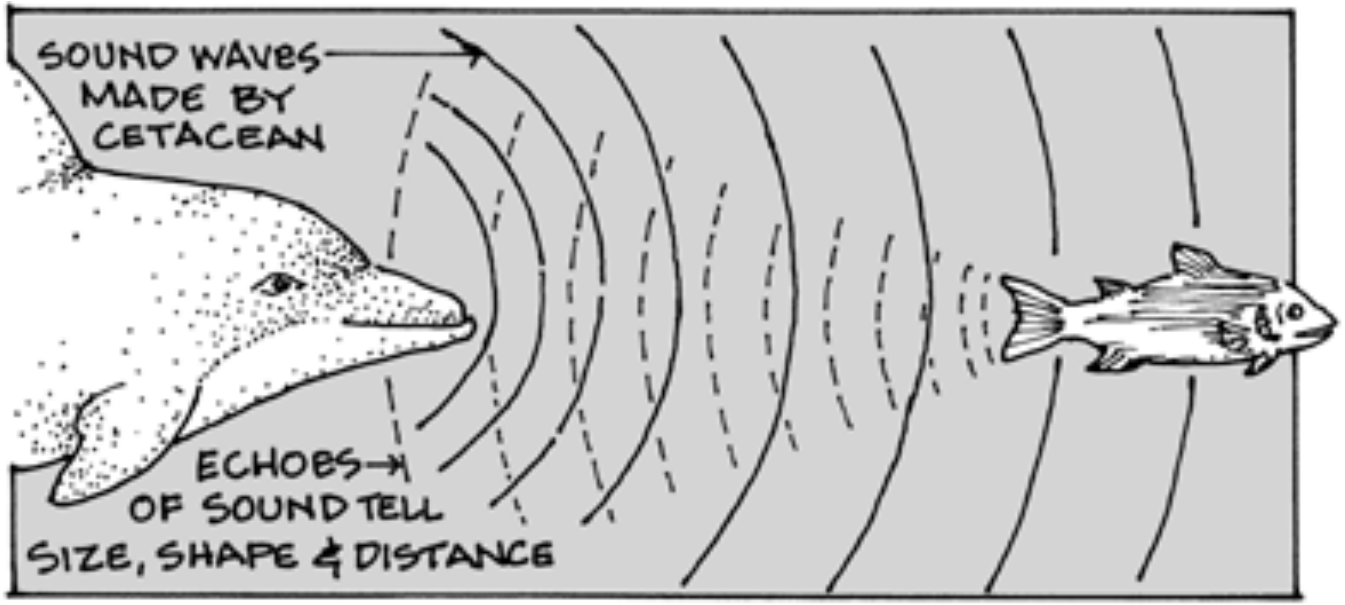
Cranford, Krysl
& Amundin 2010

Hearing tests show can detect over 150 kHz (human range 2-20 kHz)

Echolocation

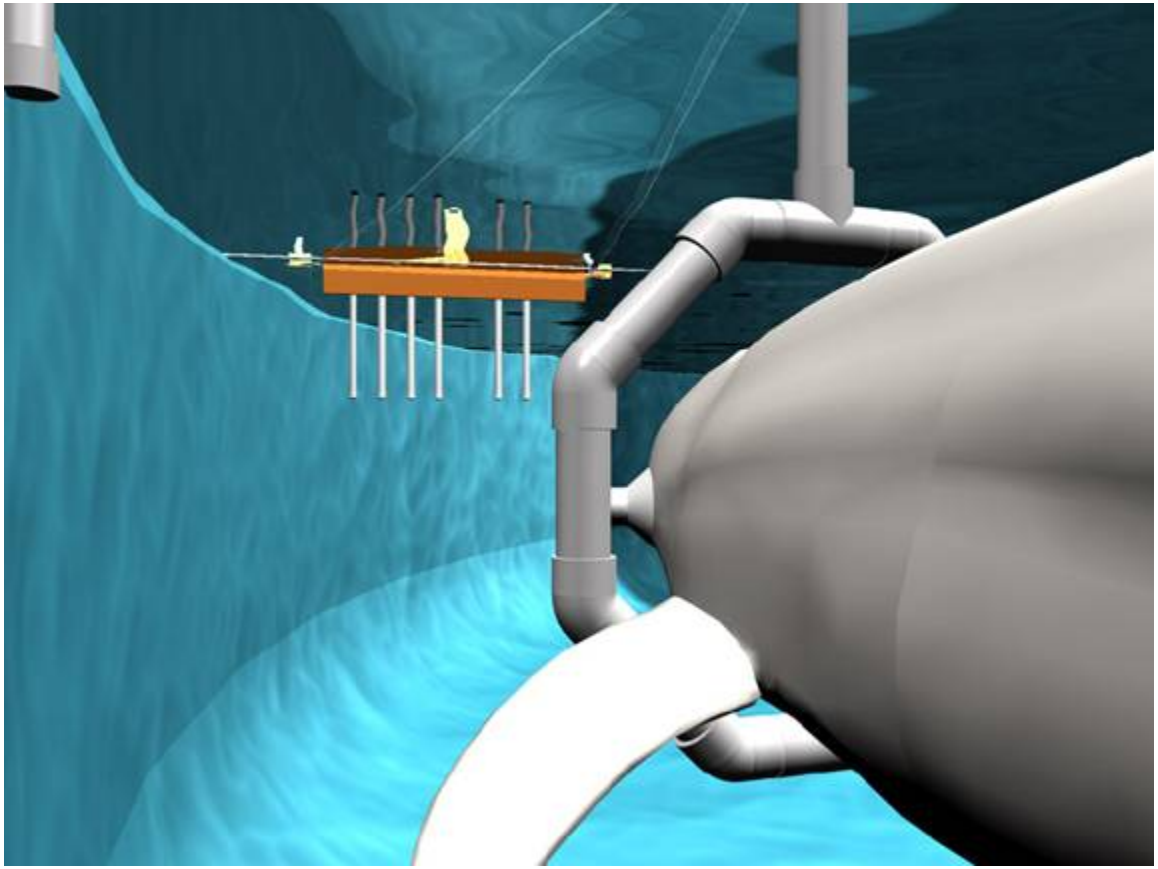


Discriminate size, distance, content, etc.
(e.g. get different echos from flesh, bone & air sacs)



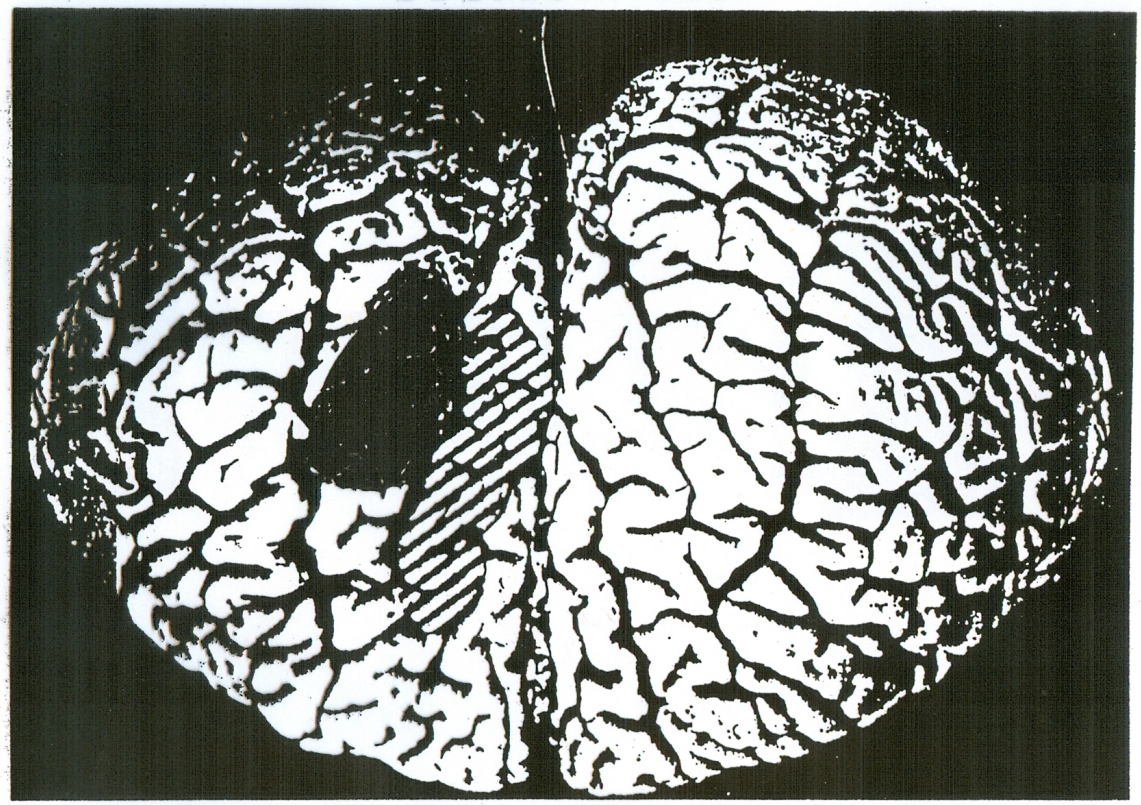
Exquisite acoustic discrimination

e.g. Discriminate ball bearings
differing by ¼ inch
at half a football field!



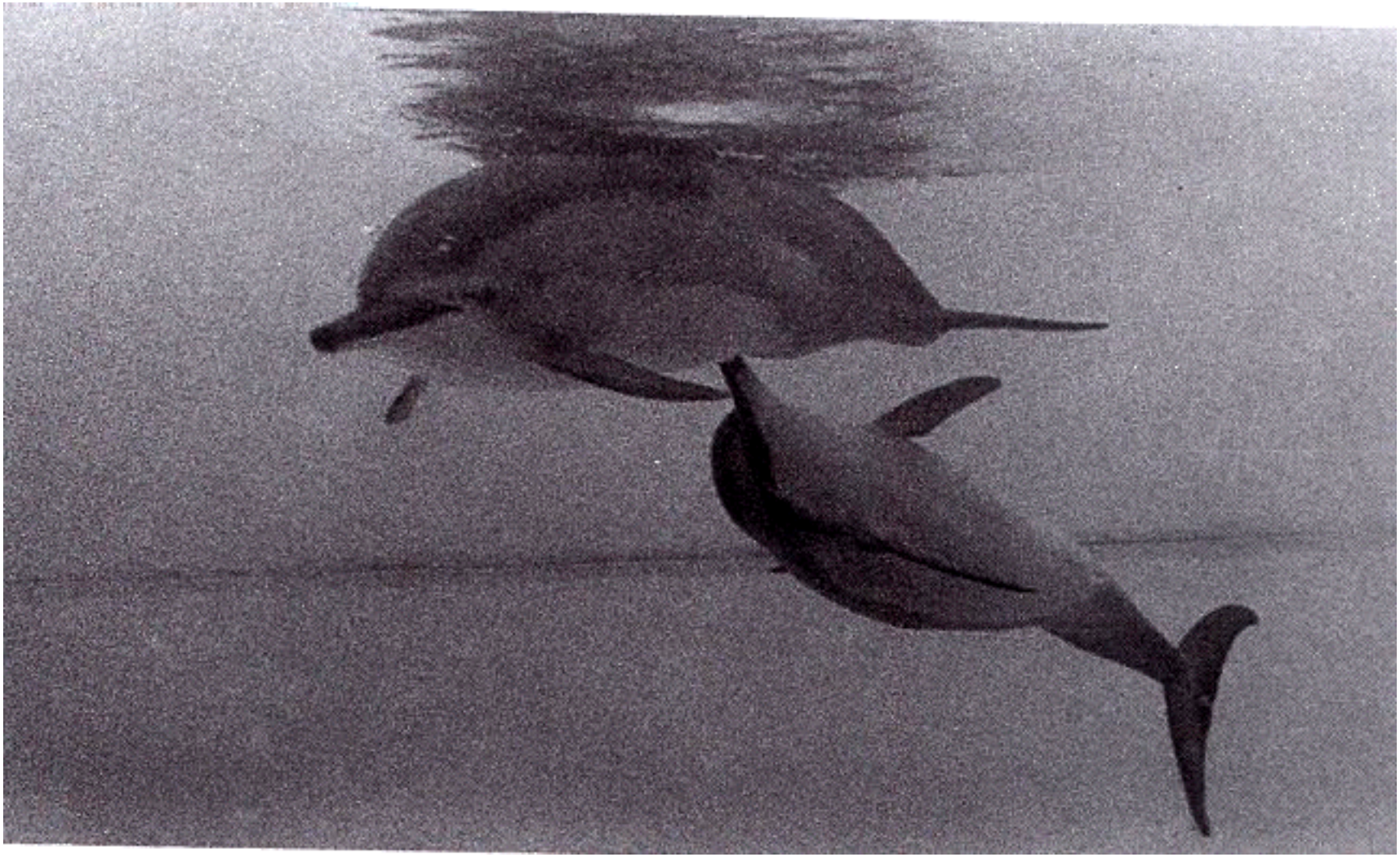
Tacto-Acoustics

UNUSUAL SENSORY CORTEX in TURSIOPS TRUNCATUS WHICH RESPONDS TO BOTH TACTILE and ACOUSTIC STUMULATION



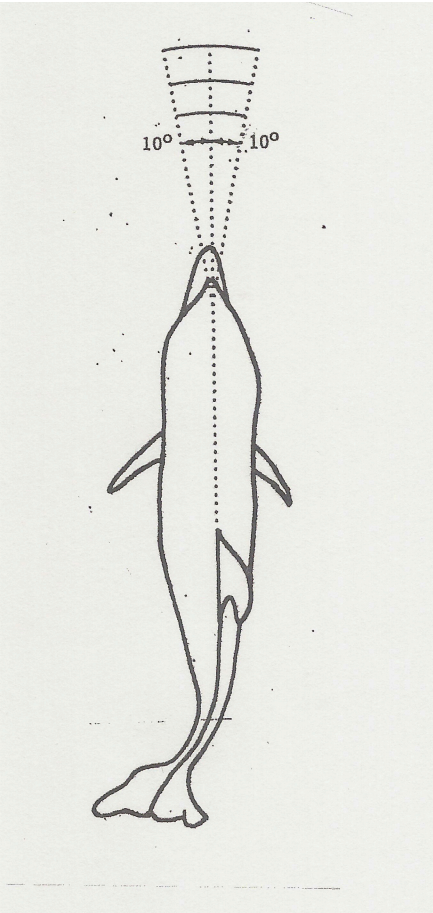
SOURCE: LENDE & WELKER, 1972

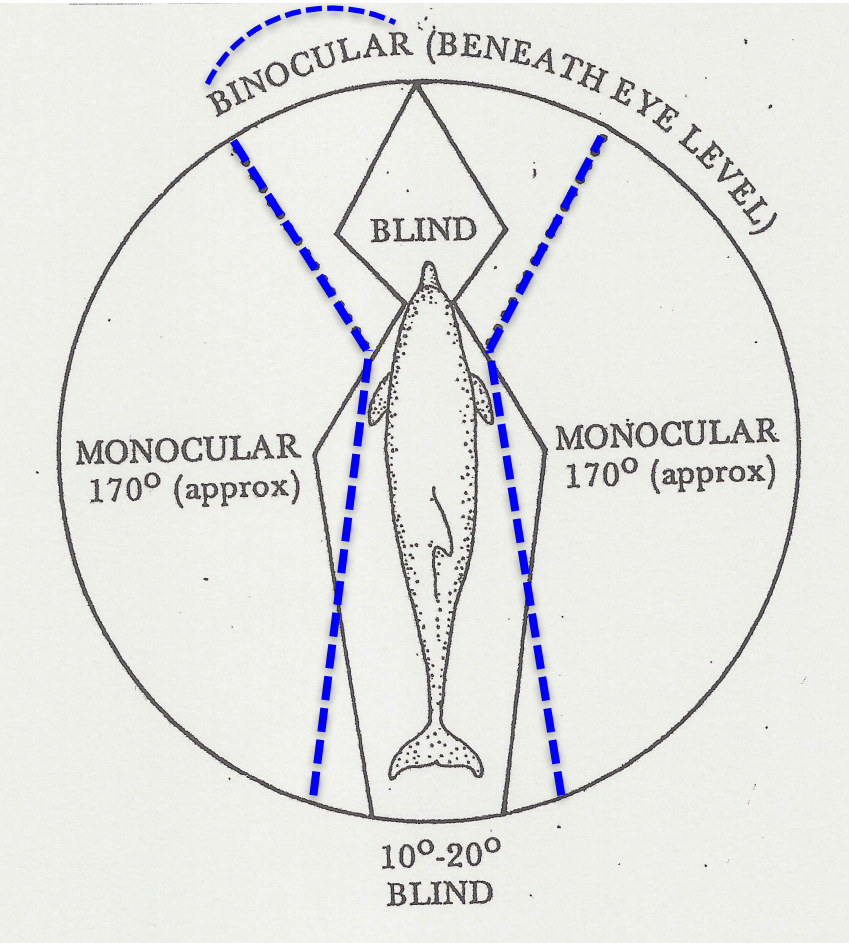
Tacto-Acoustics



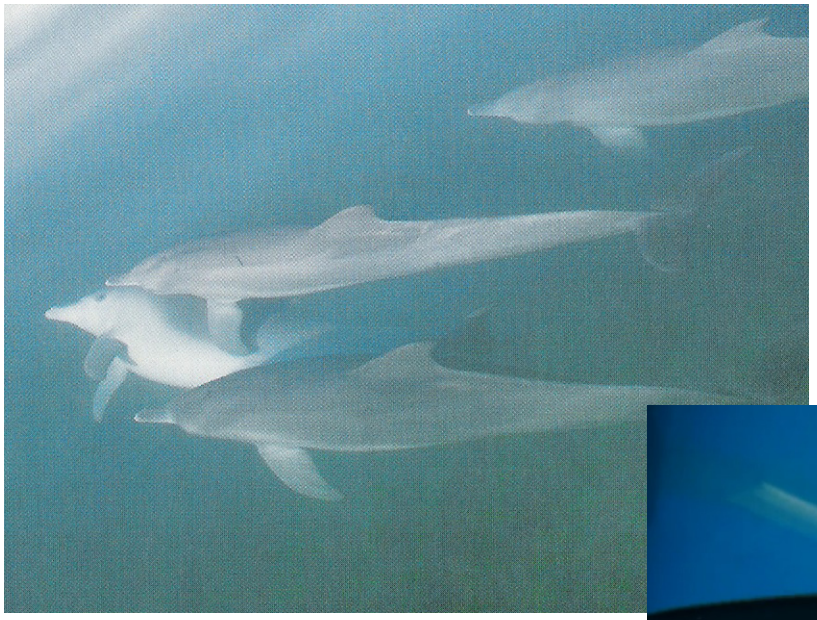
Echolocation emitted in a forward beam.

Vision is mainly lateral.





Vision, esp for intimate social



Vision especially sensitive to motion

No fovea

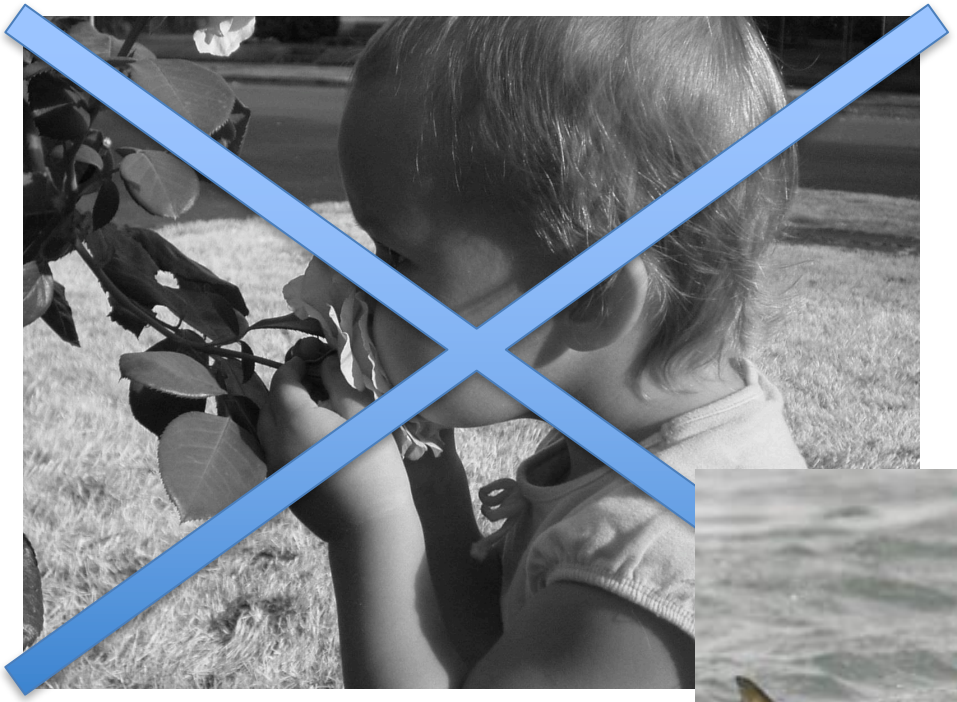
Tho can discriminate (moving) faces, etc.

Everything relevant
in their world
is always moving

“Spy hop” to see
distant events

NO color vision

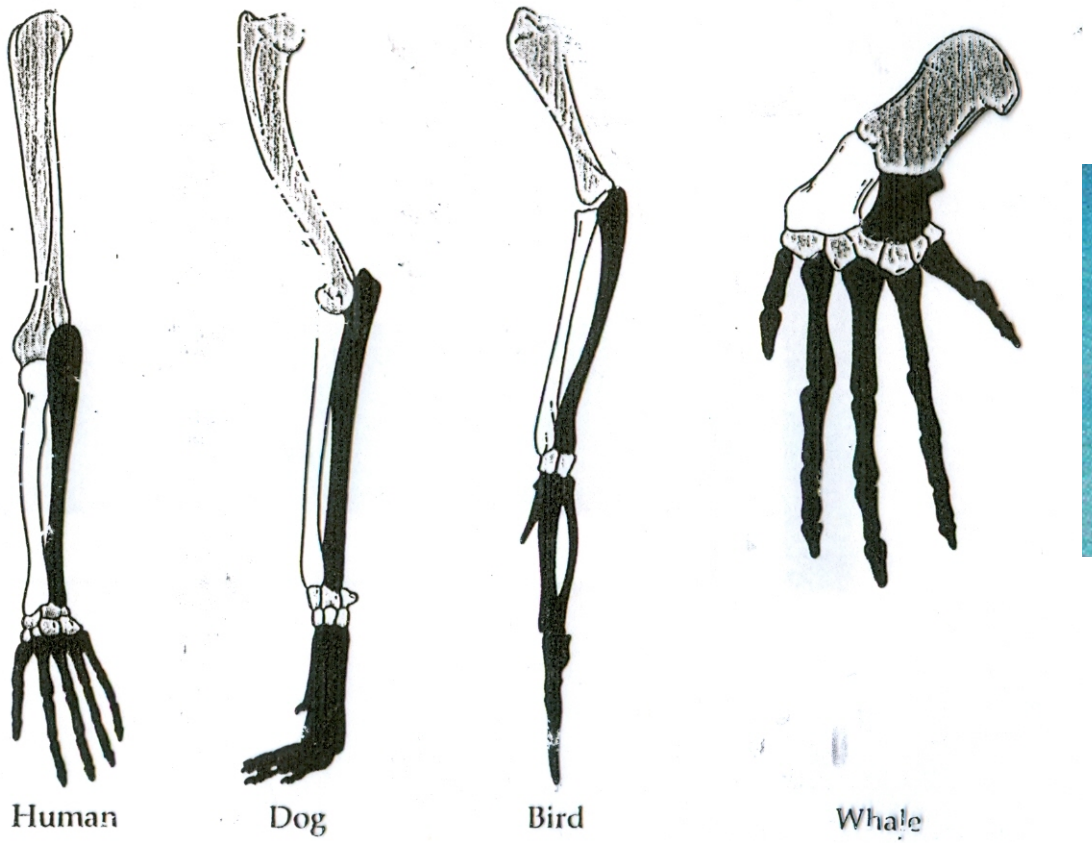
NO color vision

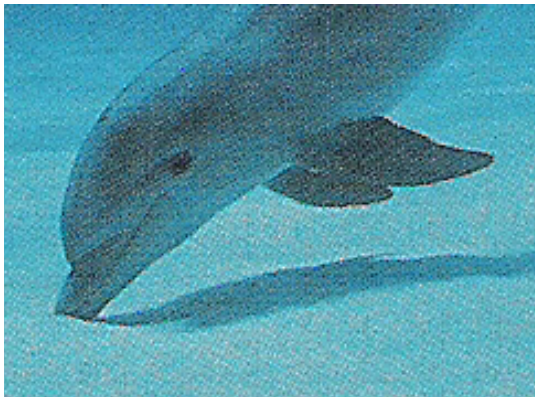


NO sense of smell

But some taste

Although still pendactl, hand bones are encased in flesh,
so, unlike Primates, cannot “handle” objects

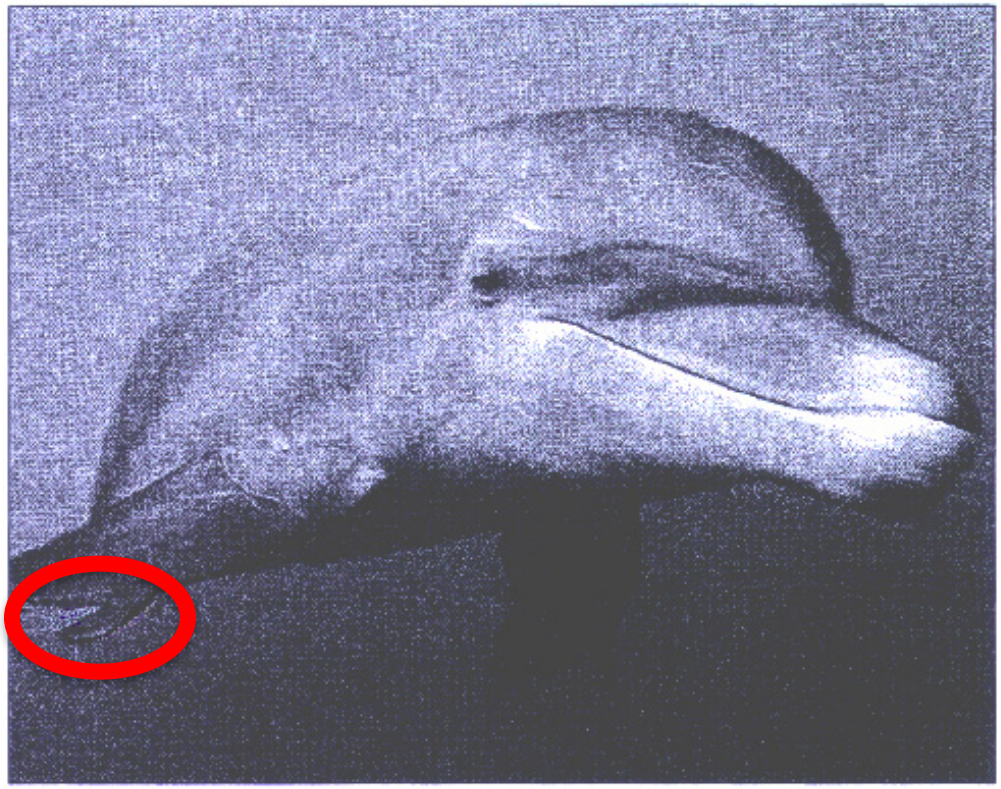




Nonetheless,
do occasionally
manipulate objects

Although, according to *The Onion*…

Dolphins Evolve Opposable Thumbs



Above: One of the evolved dolphins, whose opposable thumbs have struck fear in the hearts of humankind.

'Oh, Shit,' Says Humanity

HONOLULU—In an announcement with grave implications for the primacy of the species of man, marine biologists at the Hawaii Oceanographic Institute reported Sunday that dolphins, or family Delphinidae, have evolved opposable thumbs on their pectoral fins.

"I believe I speak for the entire human race when I say, 'Holy fuck,'" said Oceanographic Institute director Dr. James Aoki, noting that the dolphin has a cranial capacity 40 percent greater than that of humans. "That's it for us monkeys."

Aoki strongly urged humans, especially those living near the sea, to

see DOLPHINS page 65

Body language makes even these alien creatures interpretable to us mammals…

Social Cognition is what we have in common...

See Herman 2002