



## Ms. Blue's Measurements

Based on 100 ton weight projection for Ms Blue

Some information given on fin whales when same information for blue whales not available

### Measurements, Growth, Swimming and Diving

- Length 86 feet 10 inches
- Weight 100 tons (perhaps increasing to 150 tons at the end of the summer feeding season.)
- Age at death 50
- Birth year 1929
- Birth weight 3 tons
- Length at birth 25 feet
- Doubled weight in first week of life
- Weaned at seven months in the Pacific far off the California coast
- Sexually mature at 4.5 to 6 years old (perhaps 10) at 79 feet in length
- Gestation period: 10 – 11 months
- Produced 15 – 20 calves (a calf every two to three years)
- Skeleton weighed 17 tons
- The mandibles of a blue whale are the largest single bones that have ever existed (the mandibles are 19 feet long in our blue whale).
- Bones were 30% oil by weight, the second most important part of the whale for oil.
- Heart weighs 1000 pounds
- Heart mass 6 feet wide
- Heart breadth exceeds the length
- Diameter of the aorta was 9 inches
- Blood supply 5000 gallons
- Internal temperature is 95 - 96 degrees F
- Lungs weighs 2000 pounds
- Trachea is more than foot in diameter
- Lungs of a 70-foot fin whale have a maximum capacity of 2000 liters of air.
- Lung pleura are thickened with elastic tissue.
- Exchanged 80-90% of the air at each breath.
- 180-decibel whistle of the blue whale is the loudest recorded sound made by an animal
- Diaphragm horizontal to aid buoyancy, it extends forward to the sixth rib
- Ribs are one headed or floating after the 4<sup>th</sup> rib to allow great mobility during diving, when they are compressed
- Brain weighed 15.25 pounds
- Brain fit in a pan 12 X 14 inches
- Vibrissae: 50-60 hairs
- One row on the edge of the upper jaw
- Another on either side of the centerline of the upper jaw from the tip to the blow hole

- There are hairs on the flat surface on the tip of the mandible as well
- 400 nerves are supplied to every hair
- Vibrissae used to detect krill density and determine when to open mouth at feeding
- Conical tooth buds will appear in a Fin whale fetus 4-8 months old (4.3-10 feet long).
- In the upper jaw these tooth buds lie slightly sunken within a white smooth glistening ridge from which the young baleen will later develop. (teeth and baleen are two different things)
- The beginnings of the baleen, a row of small cornified transverse ridges, first appears in fetuses when they exceed 10 feet.
- At this stage the rudimentary teeth of both the lower and the upper jaw disappear without a trace.
- Baleen weighed 400 pounds
- Baleen do not exceed 1 meter in length
- 270-395 plates of baleen per side.
- There are 400 fringe bristles or "shafts" forming a semicircle in front of the palate, connecting the baleen rows on the left and right sides.
- Fringes of old individuals may be gray
- 350 - 500 pounds at the tip of the jaw is the force necessary to open the mouth in water
- Tongue palate and baleen are black
- Tongue extended the length of the mouth (~ 18 feet)
- Tongue weighs 5000 to 8000 pounds (as much as an adult elephant)
- Tongue has countercurrent heat exchangers to prevent heat loss when feeding
- Tongue turns inside out when the whale lunges during feeding
- Engulfs over 2000 cubic feet of sea water (70 tons or two 11' X 11' X 8' rooms)
- Full gape would happen in about 4 seconds
- Water would enter the mouth at a rate of 5 - 20 tons per second
- Rorqual lunge-feeding has been described as the largest biomechanical event that has ever existed on earth
- Pharynx and esophagus diameter normally 4-5 inches, a blue whale can "probably" expand the esophagus to 10 inches
- Stomach could hold over a ton of krill (some estimates to two tons)
- When feeding eats about three tons of krill per day, equal to 2,750,000 calories, and gains about 401/2 kg (90 pounds) per day
- Stomach has 3 sections
- First chamber of the stomach is a dilation of the esophagus, analogous to the crop of birds
- Wall of the first stomach in a fin whale can be up to three inches thick
- In three to four hours, the krill ingested can be reduced to the consistency of a thin gruel
- Second compartment is larger than the first
- Second compartment secretes digestive enzymes and acid
- Intestines 450 – 500 feet
- Cecum is very short
- Liver weighs 1 ton
- There is no gall bladder
- Pancreas weighs 30 - 60 pounds
- Spleen weighs 50 pounds
- Kidneys weigh 400 – 800 pounds
- There are 3000 reniculi per kidney (each reniculi is a miniature kidney)

- Bladder of a fin whale holds 5.5 gallons of urine
- Ovaries of large rorquals can be up to one foot long and weigh 22 pounds
- Ovaries of one 83 foot pregnant female blue whale each weighed 75 pounds
- Corpus luteum has a diameter of 8 inches and a weight of 5.75 pounds
- Testes of blue whales may be 2.5 feet long and weigh up to 100 pounds
- Penis can be up to 10 feet long with a diameter of 1 foot (Slijper, 1979)
- Penis can be up to 2.5 meters (8.25 feet) (Discovery Reports, 1929)
- Mammary glands are 7 feet by 2.5 feet (up to one foot thick when nursing)
- Produce up to 25-50 gallons of milk per day (closer to 25 gallons)
- Milk up to 50% fat
- Milk 12% protein
- Adrenal glands 8"-12" X 6"-8" X 2"-4" together weigh 28 -88 ounces (2-5.5 pounds)
- Thyroid gland is 14 inches long weighs 2.25 -9 pounds
- Parathyroid gland is 2.75" X 1.5" weighs 0.33 - 4.5 ounces
- Pituitary gland is 1.25 ounces
- Throat pleats (ventral grooves): 55-88 and reach to the navel
- Blubber varied from less than 20% to 35% of total weight (20 -35 tons)
- Dorsal blubber is particularly thick with a fat content of 80%
- The thinner flank blubber may only have 34% fat
- The average for the blubber is 60% fat
- Blue whales have 6 inches thick blubber. The blubber is not uniformly thick on the whale.
- It is thickest on the dorsal side of the lumber and caudal regions and thinnest on the flanks.
- Moreover the blubber increases from front to back, so that the top and bottom of the tail are particularly fat.
- Thickenings of the blubber also occur on the upper side of the lower jaw, in front of the blowhole, at the base of the pectoral fins, and just in front of the dorsal fin.
- The blubber is particularly thin around the eyes and a little to the side of the blowhole, which is probably connected with movement of the eyes and walls of the blow hole.
- Pregnant cows have the thickest blubber and lactating cows the thinnest.
- The thinnest animal ever described was a 65-foot fin whale female, which stranded in 1944, the blubber thickness was 1.25 inches! And the fat content 1.7 -3.5%
- In the 1950s given the price for oil, an average whale might be worth \$4000
- In 1976 prices the Japanese value of the meat alone in a large specimen might be \$150,000
- Muscles weighed 40 tons
- Whale starts to heat after death. After 20 hours the meat begins to bake
- After two days the carcass may explode
- Swim speed of 2 to 6.5 km/hr while feeding (1.2 - 4 mph)
- Swim speed of 5 - 33 km/hr while migrating (5 - 20 mph)
- Maximum swim speed of 20 - 48 km/hr while being chased or harassed (12 - 30 mph)
- In order to make 15 knots (17 mph), the animal must develop 10 HP in laminar flow and 168 HP in turbulent flow
- From the weight of the muscles it appears that it can develop up to 62 HP
- 62 Hp would be required if in fact the animal was laminar in the first two thirds of the body and turbulent in the last third.
- 62 HP enables it to pull a catcher boat behind it at a rate of 4 – 7 knots (4 - 8 mph) even though the boat is pulling in the opposite direction.

- Normally make 10 - 20 shallow dives at 12 - 20 sec intervals followed by a deep dive of 10-30 min.
- If a catcher chases fin whales they may come up continually every 70 seconds (panting)
- Lifts tail higher than 10 feet when making a deep dive.
- Dive average is 200 feet, occasionally to 600 feet, (Schloander recorded 1200 feet from a wounded fin whale)
- Can stay down for up to 40 minutes (Slijper) 50 min (Ognev)
- Blow is 6 - 12 meters (20 – 40 feet) narrow and vertical.

## Feeding

The total volume and weight of krill the feeding zones and the amount eaten by whales is astonishing. The Russian biologist Zencovich has made some interesting calculations about them. In the 61 years from 1904, when Antarctic whaling began, to 1966 when it had declined disastrously due to scarcity of whales. 331,142 Blue whales were taken, as were 671,092 Fin whales, 145,424 Humpbacks, and 87,284 Sei whales- nearly half the latter in only two of the seasons because of the great decline in the number of Fin whales. The original stocks in 1904 before exploitation were about 100,000 blue whales, 200,000 fin whales, 50,000 Humpbacks, and 75,000 sei whales. The whales fill their stomachs at least four times a day, spend about 120 days feeding in the Antarctic each season; they digest their food quickly, in three to four hours, and consequently fatten quickly. [Matthews, 1978 #33]

The blue whale eats about one ton of krill at a meal, the fin whale about 700 kg, the humpback and sei about 300 kg. The total weight of food for the day is thus about four tons in the blue whale, three tons for the fin whale, two tons for the humpback and one and a half tons for the sei whale. [Matthews, 1978 #33]

In a feeding season of 120 days, a **blue whale takes some 480 tons**, a fin whale 360 tons, a humpback whale 240 tons, and a sei whale 150 tons. [Matthews, 1978 #33]

In 1904 the blue whales must have eaten 50 million tons in a season.

Fin whales 72 million tons

Humpbacks 12 million tons

Sei whales 11.25 million tons

The total was 150 million tons of krill in the 1904 season. [Matthews, 1978 #33]

6.21X10<sup>9</sup> miles (six billion miles) of 1 gram krill (60 -70 mm long) laid end to end is 30 round trips to the sun and back.

- **Krill swarms may be 10 kg /cubic meter in the Antarctic** [Matthews, 1978 #33]
- **150 million tons would be 15 billion cu meters of krill swarm**
- **Main dolphin pool is 90,000 gallons or 396.4 cu meters**
- **The krill swarm would fill the main dolphin pool 38,000,000 times**
- **Imagine pouring 219 main dolphin pools per minute continuously night and day for 120 days into the open mouths of 400,000 whales.**