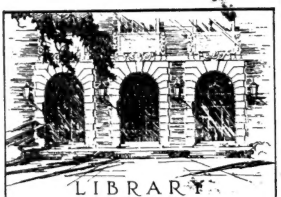

STUDIES OF THE ANATOMY OF THE EXTRAHEPATIC BILIARY TRACT IN MAMMALIA

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STUDIES OF THE ANATOMY OF THE EXTRAHEPATIC BILIARY TRACT IN MAMMALIA

BY STEWART CRAIG THOMSON[1]

In a study of the extrahepatic biliary tracts of twenty common domestic and laboratory animals, Mann, Brimhall, and Foster (1920) called attention to the inadequate knowledge of this field of comparative anatomy. They recognized that descriptions of the biliary tracts had been made in a variety of species but were widely scattered in the literature. Mann (1924) commented not only upon the incomplete data on the comparative anatomy of the biliary tract, but mentioned that "there are many contradictory statements concerning some of the species which have been dissected and reported. One anatomist records the presence of the gall bladder in a certain species, while another asserts that the species is without a gall bladder."

Interest in the extrahepatic biliary tract has been evidenced since the days of man's earliest experiences in anatomical observation. Thomson (1940) discussed the knowledge of the Babylonians, Assyrians, Greeks and Romans regarding this tract, and referred to observations of Aristotle, Pliny the Elder, and Galen on the presence and absence of the gall bladder.

Cuvier (1805), Wilson (1847), Milne-Edwards (1861), Owen (1866), and Flower (1872) tabulated data concerning the extrahepatic biliary tract. Macalister (1867) reviewed the findings in a large number of species. It is interesting to note that he stated that the gall bladder was absent "in the rat, common mouse, and other species of the genus *Mus.*" Rachford (1895) compiled data on the bile and pancreatic ducts in a series of mammals. Huntington (1902) observed the varieties in the arrangement of bile ducts in mammals.

Mann, Brimhall, and Foster (1920) studied twenty species of common domestic and laboratory animals. They were especially interested in the dimensions of the common bile duct in animals with and without a gall bladder. Mann, Foster, and Brimhall (1920) recorded data on the relationship of the common bile duct to the pancreatic duct in fifteen species, and attempted to group the species studied into three main divisions.

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Mentzer (1929a) studied the biliary apparatus in twenty-four species representing five orders of African mammals secured by Pope. He noted the site of entrance of the bile duct into the duodenum, and commented upon the proximity of the entrance to the pylorus in Carnivora, and the farther distance in most Artiodactyla. Gorham and Ivy (1938), from the literature and from dissections, tabulated data on the presence and absence of the gall bladder. Mentzer (1929b) was interested in anomalous bile ducts in man. Operative and autopsy records have indicated many variations in the extrahepatic biliary tract which are significant in surgical procedures. A study of the comparative anatomy of the biliary tract is an aid in the understanding of anomalies which are encountered clinically.

The purpose of this study was to make and record observations on a series of animals to which not only we, but other investigators, may add further data. In several instances only one specimen of a species was available for study. It was felt that the data on these single specimens which are neither readily nor frequently obtainable should be recorded. Other investigators who may dissect only single specimens may find the data of value.

It was first intended only to make a study of the intraduodenal portion of the common bile duct. From various discussions and through a perusal of the literature, it became evident that data on the gross structure of the biliary tract should be recorded.

The animals obtained were studied in as much detail as the amount of material or the condition of the specimen allowed. Some of the material consisted solely of the liver with the attached gall bladder; in a few instances only the duodenum and the dissected ducts were available because the liver had been used by other investigators. In the majority of dissections the entire extrahepatic biliary tract was available for study. The intraduodenal portions of the ducts were prepared and embedded in paraffin preliminary to studies in progress on the microscopical anatomy of this region.

In specimens which possessed a gall bladder, observations were made regarding the common bile duct, formed by the union of the cystic and common hepatic ducts. The common hepatic duct, formed by the union of the right and left hepatic ducts, was particularly observed in specimens in which there was no gall bladder. Unless especially stated, no marked pathology was demonstrable in the specimens. The character of the wall of the gall bladder was determined only by palpation of the structure and by its opacity.

Measurements recorded where two or more specimens were available are average measurements.

MARSUPIALIA

Wallaby (*Macropus* sp.). One specimen.

The gall bladder was piriform in shape and its wall was firm and relatively thick. The common bile duct was 11 cm. in length. The pancreatic duct and the common bile duct coursed together but remained separate structures until they reached a dilatation located outside the duodenal wall at a distance of 6.5 cm. from the pylorus. The opening from the dilatation into the duodenum was located on a small papilla situated in a shallow depression in the duodenal wall.

Tasmanian Devil (*Sarcophilus harrisii*). One specimen.

The gall bladder was elongated in shape and protruded beyond the margin of the liver. For two-thirds of its length it was attached loosely to the liver by a peritoneal fold. The fundus had no attachment to the liver. The bile and pancreatic ducts coursed side by side to their opening on a low duodenal papilla located 2.4 cm. from the pylorus.

Flying Phalanger (*Petaurus norfolcensis*). Two specimens.

The gall bladder was loosely lodged in its fossa and attached to the liver by connective tissue. The bile and pancreatic ducts coursed together and emptied into a large dilatation just outside the duodenal wall, as in the wallaby.

Tree-Kangaroo (*Dendrolagus matschiei*). One specimen.

A gall bladder was present. The ducts coursed together side by side but remained separate until just before their termination. They opened into a common ampulla in the duodenal papilla.

Mexican Opossum (*Didelphis mesamericana*). Four specimens.

On one surface the gall bladder was attached tightly to the liver by connective tissue almost to its tip. The common bile duct and the pancreatic duct coursed together for a distance of 2.3 cm. There was an elongated swelling located outside the duodenal wall. The common bile duct and the pancreatic duct opened into this structure. From it there was a communication with the duodenum by a short duct.

PRIMATES

Chimpanzee (*Pan satyrus*). Two specimens.

The long, cylindrical gall bladder had a firm, thick wall. In the adult specimen which was examined the fundus was bent on itself. There were no peritoneal bands holding it in this position. The gall bladder projected beyond the margin of the liver. The common bile duct and the pancreatic duct coursed together but remained individually distinct. They opened together on a prominent duodenal papilla located 16 cm. from the pylorus.

Orang-utan (*Pongo pygmaeus*). One specimen.

A gall bladder was present. The common bile duct and the pancreatic duct opened separately on a prominent duodenal papilla which was located 9 cm. caudad to the pylorus.

Rhesus Macaque (*Macaca mulatta*). Twelve specimens.

The gall bladder was long and narrow and had a thin wall. Approximately one-third of the viscus was closely related to the hepatic substance. The pancreatic duct coursed with the common bile duct. The two ducts opened on a prominent duodenal papilla located 1.8 cm. from the pylorus. A bristle passed through each of these ducts showed that the ducts either opened separately on the duodenal papilla (three specimens) or joined together in the duodenal papilla (nine specimens).

Marmoset (*Tamarin ursulus*). Two specimens.

The gall bladder was located in a deep fossa. The common bile duct and the pancreatic duct coursed side by side to the duodenum. A duodenal papilla was present.

EDENTATA

Armadillo (*Dasypus novemcinctus*). Three specimens.

The gall bladder was long and narrow and located in a shallow fossa of the liver. The pancreatic and common bile ducts entered the duodenum side by side, and opened separately on a small papilla situated 4.5 cm. caudad to the pylorus.

RODENTIA

African Porcupine (*Hystrix cristata*). Two specimens.

The gall bladder was elongated, did not project beyond the margin of the liver, and had firm walls. The common bile duct entered the

duodenum very near to the pylorus on a prominent papilla separately from the pancreatic duct. The latter opened 5.6 cm. caudad to the pylorus.

Guinea Pig (*Cavia porcellus*). Eight specimens.

The gall bladder had a very thin wall and was suspended loosely from the liver by a thin peritoneal fold. The common bile duct emptied into the duodenum just caudad to the pylorus. The pancreatic duct opened into the hepatic duct.

Brown Rat (*Rattus norvegicus*). Four specimens.

There was no gall bladder. The hepatic duct opened 2.2 cm. from the pylorus. The pancreatic duct opened into the hepatic duct.

House Mouse (*Mus musculus*). Four specimens.

The gall bladder was small and closely adherent to the substance of the liver. Its wall was thin. The common bile duct into which the pancreatic duct emptied, opened into the duodenum 1.6 cm. from the pylorus.

Striped Ground Squirrel (*Citellus tridecemlineatus*). One specimen.

The gall bladder was oval in shape and closely adherent to the liver. The common bile duct opened 6 mm. caudad to the pylorus.

Pocket Gopher (*Geomys bursarius*). One specimen.

There was no gall bladder. The hepatic duct opened 4.6 cm. caudad to the pylorus. The pancreatic duct opened into the hepatic duct.

Rabbit (*Oryctolagus cuniculus*). Four specimens.

The gall bladder was elongated and its wall was thin. The common bile duct entered the duodenum 1 cm. beyond the pylorus. There was a duodenal papilla. The pancreatic duct opened 42 cm. caudad to the opening of the common bile duct.

CARNIVORA

Little Panda (*Ailurus fulgens*). One specimen.

The gall bladder was oval in shape and loosely attached to the hepatic substance by connective tissue. The wall was firm. The pancreatic duct joined with the common bile duct before the latter entered the duodenum.

Binturong (*Arctictis binturong*). One specimen.

There was a deep fossa in the liver for the gall bladder, which was elongated in shape and did not extend beyond the margin of the liver. The pancreatic duct entered the common bile duct 3.6 cm. from the point of entrance of this duct into the duodenum. There was no duodenal papilla.

Black Bear (*Euarctos americanus*). One specimen.

The gall bladder was piriform, had thick walls, and was loosely connected to the substance of the liver by a peritoneal fold. The prominent duodenal papilla was located 11 cm. caudad to the pylorus.

Dog (*Canis familiaris*). Four specimens.

The gall bladder was located in a deep fossa. It was piriform in shape; its wall was firm. The pancreatic duct coursed with the common bile duct, and the two ducts opened separately on a low duodenal papilla located 4.5 cm. from the pylorus.

Cat (*Felis domestica*). Four specimens.

The gall bladder was piriform; its fundus projected beyond the liver's margin. The cystic duct was spiral in shape. The common bile duct opened into the duodenum 2.8 cm. from the pylorus. The pancreatic and common bile ducts coursed side by side to the duodenum. There was a low duodenal papilla.

CETACEA

Finback Whale (*Balaenoptera physalus*). One specimen.

The specimen was a 62-inch foetus. There was no gall bladder. The duodenum was closely attached to the liver. Within the duodenum there was a clearly defined longitudinal ridge, which was 3.4 cm. in length. At its distal extremity there was a small opening. Probing the hepatic duct with a bristle showed it to be continuous with the ridge. The duct opened 4.2 cm. from the pylorus.

HYRACOIDEA

Dassie (*Procavia* sp.). One specimen.

There was no gall bladder. There were two hepatic ducts. The right hepatic duct was 19 mm. in length and into it opened five interlobular ducts. The left hepatic duct was 7 mm. in length and had only two small interlobular ducts. The dilatation in the right hepatic

duct contained several yellow concretions. Four small concretions of irregular shape were found in the common hepatic duct. These calcareous masses in no place completely occluded the right hepatic duct or the common hepatic duct.

The common hepatic and pancreatic ducts opened separately into a shallow depression which was 22 mm. caudad to the pylorus. The margins of this depression were definitely elevated. There was no duodenal papilla. A fuller discussion of this interesting specimen was given by Thomson (1938).

SIRENIA

Florida Manatee (*Trichechus latirostris*). One specimen.

There was a pear-shaped gall bladder which projected beyond the margin of the liver. A short cystic duct united with the common hepatic duct. The common bile duct opened on a prominent papilla located 7 cm. from the pylorus. The pancreatic duct did not open into the duodenum with the bile duct.

PERISSODACTYLA

Zebra (*Equus burchelli*). One specimen.

There was no gall bladder. There was a distinct papilla in the duodenum. The main pancreatic duct entered the duodenum in company with the common hepatic duct. A second pancreatic duct opened near this opening.

Horse (*Equus caballus*). One specimen.

There was no gall bladder. The pancreatic duct and the common hepatic duct entered the duodenum side by side. There was a duodenal papilla. A second pancreatic duct opened 3 cm. caudad to the duodenal papilla.

ARTIODACTYLA

Sheep (*Ovis aries*). Seven specimens.

The gall bladder was located in a definite fossa and projected slightly beyond the margin of the liver. The wall was firm and thick. The pancreatic duct emptied into the common bile duct, which terminated on a duodenal papilla 34 cm. from the pylorus.

White-tailed Deer (*Odocoileus virginianus*). One specimen.

There was no gall bladder. The hepatic duct opened into the duodenum 16 cm. from the pylorus. The pancreatic duct opened into the hepatic duct before the latter entered the duodenum.

Domestic Cow (*Bos taurus*). Seven specimens.

The gall bladder was large in size and piriform in shape. Its wall was firm. It was loosely attached to the liver by connective tissue. Ducts were observed passing into the side of the gall bladder from the substance of the liver. These cysto-hepatic ducts were injected with gelatin, and their course ascertained. The common bile duct opened into the duodenum on a papilla which was located 61 cm. caudad to the pylorus. The pancreatic duct opened separately into the duodenum.

Pig (*Sus scrofa domestica*). Seven specimens.

The gall bladder was oval in shape. The common bile duct entered the duodenum 3.4 cm. beyond the pylorus. The pancreatic duct opened into the duodenum 12.5 cm. caudad to the opening of the common bile duct. The duodenal papilla was large.

DISCUSSION

1. On the presence or absence of the gall bladder.

The presence or absence of a gall bladder in the animals studied is indicated in Table 1. A gall bladder was absent in only seven of thirty-one species of mammals. These were the whale, the zebra, the horse, the dassie, the white-tailed deer, the brown rat, and the pocket gopher.

A gall bladder was present in all specimens of Marsupialia, Primates, Edentata, and Carnivora in this series. A gall bladder was present in three species of Artiodactyla and absent in one. In the one specimen of Sirenia there was a gall bladder. In Hyracoidea, Perissodactyla, and Cetacea there was no gall bladder. In Rodentia, as in Artiodactyla, there was decided variability among the species. There was no gall bladder in the brown rat; it was present in the house mouse. It was absent in the pocket gopher and present in the striped ground squirrel. The explanations for such variations have occasioned much discussion. Higgins (1926) called attention to the relatively similar environmental factors in the rat and mouse. Schmidt and Ivy (1937) and Gorham and Ivy (1938) have recently discussed the problem.

The relationship of the gall bladder to the liver showed extensive variation not only between, but also within, orders. The gall bladder was loosely connected to the liver in the Marsupialia studied, except in the opossum, in which one surface was attached tightly to the

liver. In the Tasmanian devil the gall bladder was loosely attached to the liver by a peritoneal fold for two-thirds of its length; in the flying phalanger it was loosely lodged in the fossa.

In Primates the close attachment of the gall bladder to the liver was particularly marked in the macaque. Among Carnivora the fossae for the organ were especially deep in the binturong and the dog. In the little panda and the black bear the gall bladder was loosely attached to the liver. In Artiodactyla and Rodentia the relationships between the gall bladder and the liver were exceedingly variable.

The wall of the gall bladder showed marked variations. It was firm in Marsupialia and Artiodactyla; thick in Carnivora and the Primates. There was much variability among the Rodentia, e.g., the wall was thin in the guinea pig and the house mouse but was thick in the African porcupine.

2. The relationship of the common bile duct or the common hepatic duct (when there is no gall bladder) with the pancreatic duct.

Mann, Foster, and Brimhall (1920) were interested in the relationship of the common bile duct or the common hepatic duct with the pancreatic duct. They studied this relationship in common domestic and laboratory animals. Table 2 is a tabulation of such data in the animals observed in this study. Three types of relationships may be considered:

Type A: That condition in which the pancreatic duct and the bile duct coursed together to the duodenal wall. The ducts retained their individuality until they reached the duodenum, where they either entered separately, but very close to each other, or entered a common ampulla.

From Table 2 it will be observed that all of the specimens of Marsupialia, all of the Primates, both species of Perissodactyla, and the one species each of Edentata and Hyracoidea are grouped under this type. Two species of Carnivora also belong in this classification. There appears to be no taxonomic correlation with the presence or absence of a gall bladder. The Primates, Marsupialia, one species of Edentata, and two of Carnivora possess the organ, but a gall bladder is missing in Perissodactyla and the one specimen of Hyracoidea.

Type B: That condition in which the pancreatic and common bile ducts entered into the duodenum separately at a variable distance from each other.

This condition was observed in four species of Rodentia, two of Artiodactyla, and one of Sirenia (Table 2). The greatest distance between the openings of the ducts was observed in the rabbit. The entrance of the pancreatic duct was 42 cm. caudad to the entrance of the common bile duct. It should be noted that a gall bladder was present in all of these species.

Type C: That condition in which the pancreatic duct emptied into the bile duct at a variable distance from the opening of the latter into the duodenum. By reference to Table 2, it will be observed that one species of Artiodactyla, two of Carnivora, and two of Rodentia are listed under this type.

There was particular variability among the Rodentia, the order in which the presence or absence of the gall bladder was especially variable. There was no correlation between the type of relationship of the common bile duct and the pancreatic duct and the presence or absence of the gall bladder. The house mouse (*Mus musculus*), which possessed a gall bladder, was in Type C, and the brown rat (*Rattus norvegicus*), which lacked a gall bladder, was also in Type C.

3. The presence of a duodenal papilla.

Table 3 indicates the presence or absence of a duodenal papilla. A study of this table reveals certain facts:

(*a*) The size of the duodenal papilla varied greatly. It was prominent in the black bear, which had a gall bladder, and equally prominent in the zebra, in which there was no gall bladder.

(*b*) The presence of the duodenal papilla was not related to the presence of a gall bladder, e.g., it was not present in the binturong, which had a gall bladder, nor in the dassie, which did not have a gall bladder.

(*c*) The duodenal papilla varied within an order in both its presence and size. It was absent in the binturong and present in the black bear. Both of these animals are species of Carnivora and possessed gall bladders. The duodenal papilla was prominent in the black bear and very small in the dog, yet both of these are species of Carnivora.

(*d*) The duodenal papilla was present in both carnivorous and herbivorous animals, e.g., the bear and the domestic cow.

4. The distance of the opening of the bile duct from the pylorus.

Reference to Table 4 indicates the marked variability in the distance from the pylorus to the opening of the bile duct. It is of

interest to note that the opening was nearest to the pylorus in two species of Rodentia, the African porcupine and the guinea pig, and that both of these species possessed gall bladders. A marked difference was seen in two species of Artiodactyla, which had gall bladders. In the domestic cow the opening was 62 cm. caudad to the pylorus; in the pig it was 3.4 cm. (the length of the small intestine of the cow is approximately three times that of the pig).

5. The relation of these studies to literature on the extrahepatic biliary tract.

Mann's comment (1924) to the effect that statements regarding the comparative anatomy of the extrahepatic biliary tract are often contradictory was borne out in our perusal of the literature and in these investigations. Macalister (1867) reported that there was no gall bladder in the "common mouse and other species of the genus *Mus*," but in the specimens studied in this series it was present. Mann, Brimhall, and Foster (1920) also reported its presence.

One of the interesting questions which arose concerned the presence or absence of a gall bladder in the dassie. In a review by Thomson (1938) of a series of reports which included descriptions of the extrahepatic biliary tract of the dassie, it was shown that eleven authors reported no gall bladder. Contrary to references in the clinical literature, neither Owen nor Macalister reported the presence of a gall bladder. In the available accounts of dissections of dassies no one has reported the presence of a gall bladder except Mentzer, who based his accounts on descriptions and drawings made by Pope. The dilatation described was undoubtedly just an enlargement of the hepatic duct and not a gall bladder. There was no gall bladder in the specimen of hyrax studied in this series, but the right hepatic duct was enlarged and contained yellow concretions.

SUMMARY

(1) Dissections of the extrahepatic biliary tract of ninety-one specimens representing thirty-one species of Mammalia were made. The gall bladder was absent in seven species.

(2) The shape, character of the wall, and relationship of the gall bladder to the liver showed marked variations.

(3) A study of the relationships of the pancreatic and common bile ducts to each other showed that (*a*) both ducts may enter the duodenum separately (porcupine, manatee, pig); (*b*) ducts may course together to the duodenal wall before uniting (marmoset, wallaby,

dassie, tree-kangaroo); (*c*) the pancreatic duct may empty into the common bile duct at a variable distance from the opening of the latter into the duodenum (binturong, rat, pocket gopher).

(4) The distance of the point of entrance of the ducts from the pylorus, and the presence of the duodenal papilla showed much variability.

(5) The duodenal papilla varied within an order both as to presence and prominence.

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TABLE 1.—THE PRESENCE AND ABSENCE OF THE GALL BLADDER

Order	Species	Gall bladder
Marsupialia	*Macropus* sp.	+
	Sarcophilus harrisii	+
	Petaurus norfolcensis	+
	Dendrolagus matschiei	+
	Didelphis mesamericana	+
Primates	*Pan satyrus*	+
	Pongo pygmaeus	+
	Macaca mulatta	+
	Tamarin ursulus	+
Edentata	*Dasypus novemcinctus*	+
Rodentia	*Hystrix cristata*	+
	Cavia porcellus	+
	Rattus norvegicus	−
	Mus musculus	+
	Citellus tridecemlineatus	+
	Geomys bursarius	−
	Oryctolagus cuniculus	+
Carnivora	*Ailurus fulgens*	+
	Arctictis binturong	+
	Euarctos americanus	+
	Canis familiaris	+
	Felis domestica	+
Cetacea	*Balaenoptera physalus*	−
Hyracoidea	*Procavia* sp.	−
Sirenia	*Trichechus latirostris*	+
Perissodactyla	*Equus burchelli*	−
	Equus caballus	−
Artiodactyla	*Ovis aries*	+
	Odocoileus virginianus	−
	Bos taurus	+
	Sus scrofa domestica	+

TABLE 2.—RELATION OF PANCREATIC AND BILE DUCTS

Key

Type A: Ducts course together to duodenal wall.
Type B: Ducts enter duodenum separately at variable distance from each other.
Type C: Pancreatic duct joins bile duct at distance from opening of the latter into the duodenum.

Species	Type	Gall bladder
Macropus sp.	A	+
Sarcophilus harrisii	A	+
Petaurus norfolcensis	A	+
Dendrolagus matschiei	A	+
Didelphis mesamericana	A	+
Pan satyrus	A	+
Pongo pygmaeus	A	+
Macaca mulatta	A	+
Tamarin ursulus	A	+
Dasypus novemcinctus	A	+
Hystrix cristata	B	+
Cavia porcellus	B	+
Rattus norvegicus	C	−
Mus musculus	C	+
Citellus tridecemlineatus	B	+
Geomys bursarius	C	−
Oryctolagus cuniculus	B	+
Ailurus fulgens	C	+

TABLE 2—*Continued*

Species	Type	Gall bladder
Arctictis binturong	C	+
Canis familiaris	A	+
Felis domestica	A	+
Procavia sp.	A	−
Trichechus latirostris	B	+
Equus burchelli	A	−
Equus caballus	A	−
Ovis aries	C	+
Bos taurus	B	+
Sus scrofa domestica	B	+

TABLE 3.—THE PRESENCE AND ABSENCE OF A DUODENAL PAPILLA

Species	Papilla		Gall bladder
Dendrolagus matschiei	+		+
Macropus sp.	+	(small)	+
Petaurus norfolcensis	+	(small)	+
Sarcophilus harrisii	+	(small)	+
Pan satyrus	+	(prominent)	+
Pongo pygmaeus	+	(prominent)	+
Macaca mulatta	+		+
Tamarin ursulus	+		+
Dasypus novemcinctus	+		+
Hystrix cristata	+		+
Cavia porcellus	+		+
Oryctolagus cuniculus	+		+
Arctictis binturong	−		+
Euarctos americanus	+	(prominent)	+
Canis familiaris	+	(small)	+
Felis domestica	+	(small)	+
Balaenoptera physalus (foetal)	+	(longitudinal fold)	−
Procavia sp.	+		−
Trichechus latirostris	+	(prominent)	+
Equus burchelli	+		−
Equus caballus	+		−

TABLE 4.—THE DISTANCE OF THE OPENING OF THE BILE DUCT FROM THE PYLORUS

Species	Distance in centimeters	Gall bladder
Macropus sp.	6.5	+
Sarcophilus harrisii	2.4	+
Pan satyrus	16.0	+
Pongo pygmaeus	9.0	+
Macaca mulatta	1.8	+
Dasypus novemcinctus	4.5	+
Hystrix cristata	Just distal to pylorus	+
Cavia porcellus	Just distal to pylorus	+
Rattus norvegicus	2.2	−
Mus musculus	1.6	+
Geomys bursarius	4.6	−
Oryctolagus cuniculus	1.0	+
Canis familiaris	4.5	+
Felis domestica	2.8	+
Balaenoptera physalus (foetal)	4.2	−
Procavia sp.	2.2	−
Trichechus latirostris	7.0	+
Ovis aries	34.0	+
Odocoileus virginianus	16.0	−
Bos taurus	61.0	+
Sus scrofa domestica	3.4	+

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