



Water Quality

Water Management Branch

Animal Weights And Their Food And Water Requirements

Environment And Resource Division
Ministry Of Environment, Lands And Parks

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INTRODUCTION

Data on the food and water consumption rates of animals is often required when calculating criteria so as not to exceed the recommended daily intake of an element or compound, and to partition the ration between the water and food intake routes. The following tables and narrative text should be useful and promote uniformity in setting criteria. Further reliable data are solicited, especially for wildlife; updated versions of this document are produced as warranted. The text gives ranges for the mean or usual values and some brief discussion of variables affecting the values, for simplicity the tables give only a mean value. References are also listed to document the source of the data so the reader may go back to the source for more information if required. The animals covered in this report are from three groups. The primary group is North American wild animals. The other groups are Domestic animals which includes pets and laboratory animals and Livestock which includes all farm animals.

Tables 1, 2, 3, 4 and 5 give mean values, or estimates of the usual value, for body-weights and water and food consumed, on a per day per animal basis and on a per day per kg of animal. Table 1 lists Livestock, Table 2 Domestic Animals, Table 3 North American Birds, Table 4 North American Wildlife, and Table 5 North American Marine Mammals. Animals may appear in more than one table if they are found in the wild and as laboratory or domestic strains. The sizes and food consumption rates often vary under these different situations and will be reflected in the values found for a species in the different tables. Where gaps occurred in the available data and the existing data seemed to be adequate, extrapolations were made to get approximate numbers into the tables. For total exposure assessment the inhalation rate may also be required.

Food consumption rates in grams per kilogram of animal body weight vary quite considerably. There are a number of reasons for this variation. Herbivores generally eat a lower energy per unit weight food than carnivores with more indigestible matter in their diet; particularly ungulate grazers who have obvious anatomical modifications to their gut to allow for this type of diet. They need more total food intake in order to acquire the needed daily energy intake. Fruit and nut eaters have a high energy diet and are not so constrained and can take in smaller quantities. Fish eaters, particularly fresh water fish eaters, need a larger total quantity to allow for the lower fat content in their diet; marine fish eaters do not generally face such a fat intake limitation. Insectivores also have a large proportion of indigestible material in their diet and need a concomitant larger total intake.

As animals get larger their linear dimensions grow linearly, their surface area increases with the square of the linear dimension increase and their volume/weight grows with the cube of the linear dimensions. Supporting bone structure mass also increases faster than the linear dimensions so the proportion of

relatively inert or non-metabolizing tissue increases as an animal gets larger and the food requirements on a per kilogram body weight drop. Heat loss is a function of surface area and temperature differential and the ratio of surface area to volume is much larger in small animals necessitating larger caloric intake just to maintain body temperature.

Large marine mammals have a mean 'grams-of-food-intake-per-kilogram-of-body-weight' ratio around 25; for large terrestrial mammals it is about 30 and rises to over 100 in small mammals. It may reach extreme values over 1000 in the smallest shrews who must consume more than their body weight in food every day to stay alive. Large birds have a mean value around 120, smaller birds around 140 and waterfowl eating a low-fat fish diet have a mean value around 170. Small active birds like hummingbirds living on nectar for energy and insects for protein have values well over 1000.

When insufficient data exists to document mammalian and avian feeding, drinking and inhalation rates, the following allometric equations (22, 23, 52, 53, 54, 55) may be used to estimate these daily rates, in liters (water), kilograms (food) or cubic meters (air), where W is the animals weight in kilograms:

$$\text{Mammal Feeding Rate} = 0.0687 \times (W)^{0.822}$$

$$\text{Mammal Drinking Rate} = 0.099 \times (W)^{0.9}$$

$$\text{Mammal Inhalation Rate} = 0.5458 \times (W)^{0.8}$$

$$\text{Bird Feeding Rate} = 0.0582 \times (W)^{0.651}$$

$$\text{Bird Drinking Rate} = 0.059 \times (W)^{0.67}$$

$$\text{Bird Inhalation Rate} = 0.4089 \times (W)^{0.77} \text{ (non-passerine birds)}$$

Use of these allometric equations appears to underestimate the food requirements of non-passerine birds. The values calculated for some diving ducks that do not feed primarily on fish appear to be too low on a g/kg basis. Animals and birds that are primarily or exclusively fish eaters are also underestimated by these equations. It may be that the energy content of fish is lower than that of seeds or mammalian

meat, or that the energy conversion efficiency is much lower. Freshwater fish are generally lower in total fats than mammals. The equations appear to work well for most other mid-sized animals but underestimate the very small, high metabolic rate animals, hummingbirds, shrews and mice, that have high surface area to volume ratios, and overestimate the very large herbivores and marine mammals.

Food estimates for many fish eating species are based on the estimate of 1 kcal/g of metabolizable energy in fish. If the energy requirements of the animal can be estimated then the weight of fish needed to meet this can be calculated. The equations to calculate the energy requirements for some birds follow. FMR is the 'field metabolic rate' in kcal/bird/day, and W is the weight of the bird in grams:

$$\text{non-passerine birds: } \log \text{ FMR} = 0.0594 + 0.749 \log (W)$$

$$\text{passerine birds: } \log \text{ FMR} = 0.327 + 0.749 \log (W).$$

Table 6 gives the composition and energy content of food fish commonly used for maintaining marine mammals. The carbohydrate and fat content of most fish is low compared to invertebrates but fish are rich in protein, vitamins, minerals and water. Marine mammals depend on this water and on the water derived from the metabolism of fats. Due to its high fat content a herring diet can provide up to 4 times the energy content as an equal weight of lean fish. The necessary energy requirements of some marine mammals are given in Table 7. The manatee is a large, sedentary, tropical vegetarian while the sea otter is a small, active, north temperate carnivore; note the differences in their energy requirements on a per kg body weight basis as a result of ambient water temperatures, surface area to volume ratios, size, diet and life style.

Water consumption is tremendously variable; for most species there is a factor of 2 for individual animals in a flock or herd. For animals in a north temperate climate and normal physiological conditions, 80-100 mL of water/kg of animal is a good estimate of water consumption. Pregnant and lactating animals have much higher water requirements; up to double the normal. Smaller animals, like shrews, with higher metabolic rates, and higher surface to volume ratios, have higher water loss and therefore higher consumption rates than larger animals, unless their food has a very high water content.

BIRDS

***North American
American Widgeon Ducks (*Mareca americana*)
WEIGHTS***

Widgeons weigh between 400 and 1200 g with a mean around 750 g. They breed primarily in central and western Canada but not on the Pacific Coast. They winter as far south as Central America and the West Indies.

FOOD

The allometric equation indicates that a bird of this size should eat about 50 g or 65 g/kg. This value is likely too low.

WATER

The allometric equation indicates that a bird of this size should drink about 50 mL or 65 mL/kg.

REFERENCES

14, 48, 62.

Bald Eagles (*Haliaeetus leucocephalus*)

WEIGHTS

These birds range over most of North America but are especially prevalent in the Pacific Northwest. Mature adults weigh between 3 and 7 kg.

FOOD

Eagles are opportunistic feeders and consume waterfowl, fish, small mammals, and carrion. If fish is available it will become their principal food and make up almost 100% of their diet. Captive eagles eat about 9.2% of their body mass in fish each day or about 414 g per day. Free ranging eagles overwintering on the Nootsack River, Washington, consumed about 490 g of fish per day. Adult eagles overwintering on the lower Connecticut River were estimated to consume about 520 g per day. The typical adult eagle is estimated to eat about 500 g of fish per day. This works out to about 110 g/kg. The range of food consumption per day is estimated at 300 to 1200 grams for different sizes of eagles and under different conditions. The proportion of their diet which is composed of aquatic organisms is estimated at 50% with a range of 6 to 90 depending on location, time of year, availability, etc. The allometric equation only estimates about 155 g per day for a 4.5 kg bird or 34 g/kg.

WATER

Using the allometric equation, water consumption is estimated to be about 160 mL per day or about 36 mL/kg.

REFERENCES

14, 21, 24, 25, 26, 27, 28, 30, 62.

Belted Kingfisher (*Ceryle alcyon*)

WEIGHTS

These birds breed and range over most of North America and into the West Indies, Panama, Trinidad and most of Central America. Kingfishers weigh about 150 g.

FOOD

Adult Kingfishers are estimated to eat about 50% of their body weight per day, of which 90% is small fish. The remainder is amphibians and insects. Other estimates are between 75 to 90 g per day, mostly as fish; this is about 570 g/kg. These are very active birds with high metabolic demands and could be very susceptible to accumulating toxic levels of contaminants which are

found in small fish. The allometric equation predicts that a 150 g bird should eat about 17 g per day or 113 g/kg.

WATER

Kingfishers drink about 17 mL per day based on the allometric model, which works out to about 110 mL/kg. Based on the activity and food consumption of this bird this estimate is probably too small.

REFERENCES

14, 21, 30, 32, 33, 34, 62.

Black Brant (*Branta bernicla*)

WEIGHTS

These birds breed in the Arctic islands and winter along both coasts as far south as Baja and South Carolina. Black Brant weigh between 1.3 and 1.5 kg with a mean value around 1.4 kg

FOOD

Aquatic organisms comprise about 100% of their diet. The allometric equation indicates that a bird of this size should eat about 75 g or 55 g/kg. This value is likely too low.

WATER

The allometric equation indicates that a bird of this size should drink about 75 mL or 55 mL/kg.

REFERENCES

14, 48, 62.

Bufflehead Ducks (*Bucephala albeola*)

WEIGHTS

Buffleheads breed in western and central Canada and range across Canada. They weigh between 330 and 450 g with a mean value around 400 g.

FOOD

Aquatic organisms comprise 100% of their diet which is about 80 g/day. The allometric equation indicates that a bird of this size should eat about 30 g or 80 g/kg.

WATER

The allometric equation indicates that a bird of this size should drink about 30 mL or 75 mL/kg.

REFERENCES

14, 30, 62.

Canada Geese (*Branta canadensis*)

NOTES

Canada geese are a complex of 11 subspecies or races with different mean weights: *B. c. canadensis*-4 kg, *B. c. interior*-4.2 kg, *B. c. occidentalis*-4.5 kg, *B. c. fulva*, *B. c. maxima*-5.7 kg, *B. c. moffitti*-4.5 kg, *B. c. parvipes*-2.8 kg, *B. c. taverneri*-2.7 kg, *B. c. hutchinsii*, *B. c. leucopareia*, *B. c. minima*-1.6 kg.

WEIGHTS

They breed across Canada and the northern US and range over most of North America. Canada geese weigh between 2.8 and 12.5 kg with a mean value around 4.5 kg.

FOOD

The allometric equation indicates that a bird of this size should eat about 240 g or 30 g/kg. This value is likely too low.

WATER

The allometric equation indicates that a bird of this size should drink about 240 mL or 30 mL/kg

REFERENCES

14, 48, 62.

Common Goldeneye Ducks (*Bucephala clangula*)

WEIGHTS

Goldeneyes breed to near the tree line in northern Europe, Asia and North America and are found throughout North America. They weigh between 900 and 1100 g with a mean around 1000 g.

FOOD

Aquatic organisms comprise about 75% of their diet which is about 200 g per day with a range of 180 to 220 g. The allometric equation indicates that a bird of this size should eat about 60 g or 60 g/kg.

WATER

The allometric equation indicates that a bird of this size should drink about 60 mL or 60 mL/kg.

REFERENCES

30, 62.

Common Loon (*Gavia immer*)

WEIGHTS

They breed across Canada and the northern US and in Greenland and Iceland and overwinter throughout North America and south to Britain and the Mediterranean. Common Loons weigh between 3.0 and 6.0 kg with a mean value around 4.5 kg.

FOOD

Aquatic organisms comprise about 80% of their diet and estimates put the actual value at 1500 g/day or 335 g/kg. The allometric equation indicates that a bird of this size should eat about 160 g or 35 g/kg, this value is much too low.

WATER

The allometric equation indicates that a bird of this size should drink about 160 mL or 35 mL/kg.

REFERENCES

14, 30, 62.

Common Merganser (*Mergus merganser*)

WEIGHTS

Common Mergansers breed and winter across Canada. They weigh between 1.02 and 2.0 kg with a mean around 1.5 kg.

FOOD

Aquatic organisms comprise about 100% of their diet and estimates put the real value at 300 g/day or 200 g/kg. The allometric equation indicates that a bird of this size should eat about 50 g/day or 60 g/kg, this value is too low.

WATER

The allometric equation indicates that a bird of this size should drink about 300 mL or 200 mL/kg.

REFERENCES

14, 30, 62.

Common Tern (*Sterna hirundo*)

WEIGHTS

Common Terns weigh about 140 g. They breed in central and eastern Canada and in Europe and Asia and winter down to southern Africa and South America. They are transient in BC.

FOOD

Aquatic organisms comprise about 100% of their diet and estimates indicate an actual value of about 28 g/day or 200 g/kg. The allometric equation indicates that a bird of this size should eat about 15 g or 110 g/kg, this value is too low.

WATER

The allometric equation indicates that a bird of this size should drink about 15 mL or 110 mL/kg.

REFERENCES

14, 30, 62.

Golden Eagle (*Aquila chrysaetos*)

WEIGHTS

These are locally distributed across North America, Europe, Asia and North Africa and weigh 2.7 to 5.9 kg, with a mean of 4.2 kg. Now rare in North America and found mostly in the northwest.

FOOD

Their diet is mainly small mammals and birds or carrion. The allometric equation indicates that a bird of this size should eat about 150 g or 35 g/kg. Judging by bald eagle data this value is much too low and a more reasonable value would be 750 g/day or 175 g/kg.

WATER

The allometric equation indicates that a bird of this size should drink about 155 mL or 37 mL/kg; again this is probably too low a value.

REFERENCES

14, 61, 62.

Great Blue Heron (*Ardea herodias*)

WEIGHTS

Great Blue Herons breed and winter in southern Canada, wintering primarily on the BC coast and weigh about 3 kg.

FOOD

Aquatic organisms comprise at least 90% of their diet and estimates indicate an actual value of about 600 g/day or 200 g/kg. The allometric equation indicates that a bird of this size should eat about 125 g or 40 g/kg, this value is too low, likely because the diet is mostly fish.

WATER

The allometric equation indicates that a bird of this size should drink about 125 mL or 40 mL/kg.

REFERENCES

14, 30, 62.

Great Cormorant (*Phalacrocorax carbo*)

WEIGHTS

These are east coast species in Canada and also breed in Europe, Asia, Africa, Australia and Greenland. They weigh 1.8 to 3.6 kg, with a mean of about 2.7 kg.

FOOD

Their diet is mainly fish, caught by diving in shallow inshore waters. The allometric equation indicates that a bird of this size should eat about 110 g or 40 g/kg.

WATER

The allometric equation indicates that a bird of this size should drink about 115 mL or 45 mL/kg.

REFERENCES

14, 61, 62.

Green Backed Herons (*Butorides virescens*)

WEIGHTS

Green Backed Herons weigh about 250 g. They breed in southern Ontario and the Maritimes in Canada and range across much of southern North America, the West Indies, Central America and northern South America..

FOOD

Aquatic organisms comprise about 75% of their diet and estimates indicate an actual value of about 50 g/day or 200 g/kg. The allometric equation indicates that a bird of this size should eat about 25 g or 100 g/kg, this value is too low, likely because the diet is mostly fish.

WATER

The allometric equation indicates that a bird of this size should drink about 25 mL or 100 mL/kg.

REFERENCES

14, 30, 62.

Herring Gull (*Larus argentatus*)

WEIGHTS

Herring Gulls weigh about 500 to 1300 g with the average being about 1 kg. They breed across Canada and the northern US except the BC coast and the east slope of the Rocky Mountains. They are also in Europe, Siberia and Iceland. They winter south to the West Indies, Panama, Africa, Indo-China and the Philippines.

FOOD

Aquatic organisms comprise about 50% of their diet and estimates indicate an actual value of about 200 g/day or 200 g/kg. The allometric equation indicates that a bird of this size should eat about 60 g or 60 g/kg, this value is too low, likely because the diet is mostly fish.

WATER

The allometric equation indicates that a bird of this size should drink about 60 mL or 60 mL/kg.

REFERENCES

14, 30, 62.

Lesser Scaup Ducks (*Aythya affinis*)

WEIGHTS

Lesser Scaup ducks weigh between 500 and 1100 g with a mean value around 800 g. They breed in central and western North America, except for the west coast, and winter as far south as the West Indies and northern South America.

FOOD

Aquatic organisms comprise about 100% of their diet. The allometric equation indicates that a bird of this size should eat about 50 g or 60 g/kg. This value is too low.

WATER

The allometric equation indicates that a bird of this size should drink about 50 mL or 60 mL/kg.

REFERENCES

14, 48, 62.

Mallard Ducks (*Anas platyrhynchos*)

WEIGHTS

Mallards weigh between 1100 and 1250 g with a mean value around 1200 g. They breed across Canada but primarily in the west, the Black Duck is prominent in the east. It is found over much of the north temperate zone and is the ancestor of most domestic breeds.

FOOD

Aquatic organisms comprise 10 to 45% of their diet which is about 250 g per day. The allometric equation indicates that a bird of this size should eat about 65 g or 55 g/kg. This value is too low.

WATER

The allometric equation indicates that a bird of this size should drink about 70 mL or 55 mL/kg.

REFERENCES

30, 48, 62.

Oldsquaw Ducks (*Clangula hyemalis*)

WEIGHTS

Oldsquaws weigh between 500 and 1000 g with a mean value around 830 g. They breed in the Arctic of North America and Eurasia and overwinter along the coasts down to Washington and South Carolina.

FOOD

Aquatic organisms comprise about 90% of their diet which is about 190 g per day. The allometric equation indicates that a bird of this size should eat about 50 g/day or 60 g/kg. This value is too low.

WATER

The allometric equation indicates that a bird of this size should drink about 50 mL or 60 mL/kg.

REFERENCES

30, 62.

Osprey (*Pandion haliaetus*)

WEIGHTS

Adults weigh between 1.1 and 2.0 kg. These are cosmopolitan birds.

FOOD

Live fish, generally in the 150 to 300 g size range, comprise almost 100% of an ospreys diet. Various estimates of fish consumption per day are 286 g, 274 g, 300 g and 300 to 400 g. They are assumed to need about 20% of their body weight per day which works out to about 300 g. This gives a value of about 200 g/kg. The allometric equation estimates a food consumption rate of 76 g per day for a 1.5 kg osprey or 50 g/kg. This is certainly too low a value, likely because the diet is mostly fish.

WATER

Water consumption, estimated by the allometric model, is about 77 mL per day or about 51 mL/kg. This is likely also too low for these large active birds.

REFERENCES

21, 23, 25, 27, 29, 30, 62.

Red Breasted Mergansers (*Mergus serrator*)

WEIGHTS

Red Breasted Mergansers weigh about 1.15 kg. These birds breed in the boreal zone of Canada and winter in coastal BC and the Maritimes.

FOOD

Aquatic organisms comprise about 100% of their diet and estimates put the actual value at 235 g/day or 205 g/kg. The allometric equation indicates that a bird of this size should eat about 65 g or 55 g/kg, this value is too low, likely because the diet is mostly fish.

WATER

The allometric equation indicates that a bird of this size should drink about 65 mL or 55 mL/kg.

REFERENCES

14, 30, 62.

Ring-Billed Gull (*Larus delawarensis*)

WEIGHTS

Ring-Billed Gulls breed in the Canadian prairies and the Maritimes. They winter throughout Canada and the northern US but not in coastal BC. They weigh about 450 g.

FOOD

Aquatic organisms comprise about 75% of their diet and estimates indicate an actual value of about 95 g/day or 210 g/kg. The allometric equation indicates that a bird of this size should eat about 35 g or 75 g/kg, this value is too low, likely because the diet is mostly fish.

WATER

The allometric equation indicates that a bird of this size should drink about 35 mL or 75 mL/kg.

REFERENCES

14, 30, 62.

Ruby-Throat Hummingbird (*Archilochus colubris*)

WEIGHTS

These hummingbirds breed primarily in south-eastern and south-central Canada and south to the gulf states. They winter in the gulf area and down to Costa Rica. They weigh only 28 g.

FOOD

Their diet is mainly nectar and insects and, according to the reference, they need to eat twice their body weight daily, or 56 g, and may put on fat equal to half their body weight prior to migration. The allometric equation indicates that a bird of this size should eat about 0.51 g or 18 g/kg. This value is too low due to the small size and high metabolic rate of this bird and also because the diet is primarily nectar. A more reasonable estimate is 50 g/day or 1800 g/kg.

WATER

The allometric equation indicates that a bird of this size should drink about 0.55 mL or 20 mL/kg. This value is surely too low due to the small size and high metabolic rate of this bird and also because the diet is primarily nectar. A more realistic value would be 2.5 mL/day and 90 mL/kg.

REFERENCES

14, 61, 62.

Wood Ducks (*Aix sponsa*)

WEIGHTS

Wood ducks weigh between 500 and 900 g with a mean value around 700 g. They breed in a few scattered locations in southern Canada, from coast to coast and down into the southern US. They winter down into central Mexico.

FOOD

Aquatic organisms comprise about 85% of their diet. The allometric equation indicates that a bird of this size should eat about 50 g or 65 g/kg. This value is likely too low.

WATER

The allometric equation indicates that a bird of this size should drink about 45 mL or 65 mL/kg.

REFERENCES

14, 48, 62.

Domestic

Budgies (*Melopsittacus undulatus*)

WEIGHTS

Budgies weigh between 35 and 60 g but the mean is around 45 g and 60 is an exception. For a bird of their size they are heavier than usual.

FOOD

Budgies are primarily seed eaters. The allometric equation indicates that a 45 g bird should eat 8 g of food per day or 180 g/kg.

WATER

Budgies drink up to 5 % of their body weight daily which is about 2 mL or 50 mL/kg. The allometric equation predicts that a bird of this weight should drink about 7 mL or 160 mL/kg

REFERENCES

14, 19.

Pigeons (*Columba livia domestica*)

WEIGHTS

There are 3 groups of pigeon breeds with differing weight ranges of the adult birds, 250 to 300 g, 450 to 500 g and up to 1 kg.

FOOD

Pigeons are all seed eaters. They eat about 10% of their body weight daily which amounts to about 20 to 100 g per day and 100 g/kg per day. The allometric equation estimates that a 475 g bird would eat about 36 g per day or 76/g.

WATER

Water consumption is about 36 to 60 mL per day or 100 mL/kg. The allometric equation estimates a pigeon this big would drink about 36 ml per day or 76 mL per kg. For laboratory birds water should be freely supplied

REFERENCES

14, 19.

Livestock

Ducks

WEIGHTS

The range of weights given for domestic adult ducks is about 2.5 to 3.0 kg. Some breeds which are bred for size will be heavier and have a higher mean value.

FOOD

The estimated food intake rate for ducks is about 6% to 12% of their body weights per day. The range of food intake per day is about 100 to 360 g and the estimated food consumption rate is 100 g per day per kg of body weight. The allometric equation predicts 113 g per day for a 2.8 kg duck or 40 g/kg. Using 9% gives a value of 252 g per day or 90 g/kg.

WATER

The estimated water consumption, using the allometric equation, is 120 mL per day or 43 mL/kg.

REFERENCES

6, 7, 14.

Fowl (*Gallus gallus*)

WEIGHTS

Broiler fowl weigh 1.5 to 2.5 kg and laying hens, depending on the breed, 1.5 to 4.5 kg.

FOOD

Broiler fowl have been bred for very high weight gain rates and are actively growing for their entire economical, and very short (6-10 weeks) lives. They have the highest known ratio, 0.5, of weight gain/food intake rate of any livestock; a ratio of 1 kg of weight gain for 2 kg of feed. Both types of chicken eat between 70 and 200 g per day. One literature estimate is 85 to 115 g/day for the average chicken. The digestible protein content should be about 13 to 17%. This is about 35 g/kg for the broilers and 55 g/kg for the layers where most of the intake goes towards egg production rather than maintenance or gain in body weight. The allometric equation predicts food consumption of 88 g for 1.9 kg broilers or 46 g/kg and 111 g per day for a 2.7 kg laying hen or 41 g/kg.

WATER

Broiler chickens also have a very high water consumption rate since water requirements are known to be correlated with the amount of dry matter metabolized. Both types of chicken drink between 150 to 450 mL per day. This is about 170 mL/kg for the broilers and 120 mL/kg for the layers. The allometric equation suggests water consumption rates of 91 mL per day for 1.9 kg broilers or 48 mL/kg and 115 mL per day for 2.7 kg laying hens or 43 mL/kg. Water should be freely available.

REFERENCES

1, 2, 3, 9, 11, 13, 14, 17, 18, 19.

Turkeys (*Meleagris gallopavo*)

WEIGHTS

Turkeys may get very heavy but most commercially raised birds are not allowed to reach maximum size because of market demands. They may range from 3 to 16 kg but a more usual upper limit would be 9 kg.

FOOD

Normal market sized turkeys eat between 200 and 250 g a day or 40 to 50 g/kg. The allometric equation estimates that a 5 kg turkey should eat about 165 g per day or 33 g/kg.

WATER

Turkeys drink between 270 and 600 mL of water a day or about 60 to 120 mL/kg. The allometric equation predicts that water consumption for a bird of this size should be about 175 mL or 35 mL/kg.

REFERENCES

1, 8, 9, 11, 12, 14, 17.

TERRESTRIAL MAMMALS

North American

Arctic Wolf (*Canis lupus arctos*)

WEIGHTS

These range over the North American high latitude arctic barrens. Males weigh up to 80 kg, with females a little lighter.

FOOD

They are carnivores feeding on hares, rodents, lemmings, musk ox and caribou. Food availability is not reliable and the wolf gorges when the opportunity arises; it may eat up to 5 kg at once. The allometric equation indicates that a mammal of this size should eat about 2.3 kg/day or 35 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 4.5 L/day or 65 mL/kg.

REFERENCES

14, 61.

Black Bear (*Euarctos americanus*)

WEIGHTS

Black Bears weigh about 135 kg, with a range of 120 to 150 kg. They are found throughout North America.

FOOD

The allometric equation indicates that a mammal of this size should eat about 3.9 kg/day or 30 g/kg. They eat nearly anything including vegetation, fruits, fungi, insects, birds, mammals and carrion.

WATER

The allometric equation indicates that a mammal of this size should drink about 8.2 L or 30 mL/kg.

REFERENCES

14, 57, 58.

Bobcat (*Felis rufus*)

WEIGHTS

These range over most of North America and usually weigh 6 to 11 kg, with a mean of 9 kg, but may reach 18 kg.

FOOD

They are carnivores feeding on rabbits, rodents, sheep, deer and birds. The allometric equation indicates that a mammal of this size should eat about 420 g/day or 50 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 715 mL or 80 mL/kg.

REFERENCES

14, 61.

Common Shrew (*Sorex cinereus*)

WEIGHTS

Adults weigh about 4 g, up to almost 6g, and are found from Alaska to New Mexico.

FOOD

This shrew consumes 3.3 times its own weight, 13 g, of small invertebrates, young mice and salamanders daily in the summer. This works out to 3200 g/kg. They do not hibernate and seeds may be the bulk of its winter diet. The allometric equation indicates that a mammal of this size should eat about 0.2 g/day or 50 g/kg, much too low for this size animal.

WATER

The allometric equation indicates that a mammal of this size should drink about 0.3 mL/day or 75 mL/kg. This is probably too low also.

REFERENCES

14, 59, 60.

Grey Squirrel (*Sciurus carolinensis*)

WEIGHTS

These are primarily eastern North America species and weigh 340 to 800 g with a mean estimated at 600 g.

FOOD

Their diet is mainly tree seeds but bark, buds, fungi, vegetation and birds eggs are also taken. They do not hibernate and need to eat daily. The allometric equation indicates that a mammal of this size should eat about 45 g/day or 75 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 65 mL/day or 110 mL/kg.

REFERENCES

14, 61.

Grizzly Bear (*Ursus arctos*)

WEIGHTS

Grizzly Bears weigh about 450 kg, with a range of 150 to 780 kg. They are now mostly confined to the Pacific Northwest and a few parks, Yellowstone and Glacier, but western North America was their range.

FOOD

The allometric equation indicates that a mammal of this size should eat about 10.4 kg/day or 25 g/kg. They eat almost anything, animal and vegetable.

WATER

The allometric equation indicates that a mammal of this size should drink about 24.2 L or 55 mL/kg.

REFERENCES

14, 57, 60.

Marsh Shrew (*Sorex bendirii*)

WEIGHTS

Marsh Shrews weigh about 20 g with a range of 14 to 25 g.

FOOD

Aquatic insects comprise much of their diet. The allometric equation indicates that a mammal of this size should eat about 3 g or 150 g/kg. This value is much too low due to the small size and high metabolic rate of this animal. A more reasonable estimate would be a value of about their own body weight, 20 g/day or 250 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 30 mL/day or 150 mL/kg.

REFERENCES

14, 49, 57, 58.

Meadow Vole (*Microtus pennsylvanicus*)

WEIGHTS

Adults weigh about 38 g, up to 70 g, and are found from Alaska to New Mexico, often at very high densities.

FOOD

This vole consumes its own weight, 38 g, of leaves, stems and roots of grasses, sedges and other herbs daily. They do not hibernate. The allometric equation indicates that a mammal of this size should eat about 1.4 g/day or 40 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 2.6 mL/day or 70 mL/kg.

REFERENCES

14, 59, 60.

Mink (*Mustela vison*)

NOTES

The various references do not agree on either the sizes or the food consumption rates of wild mink in particular. In Alaska riverine mink depend on salmon carcasses and fry with little seasonal variation in their diet. Coastal mink rely on intertidal organisms in spring and summer and salmon carcasses in the fall. Salmon are an important food resource during the peak lactation period which is the most nutritionally limiting time of year for mink. Mink are apparently very prone to reproductive effects by chlorinated organics.

WEIGHTS

Domestic adult males range from 0.9 to 1.6 kg and females from 0.6 to 1.1 kg; the mean weight is about 1.0 kg. Wild males range from 0.7 to 2.3 kg and females from 0.8 to 1.2 kg; the mean weight is about 1 kg. They range from the Arctic to the Gulf of Mexico.

FOOD

Mink are opportunistic carnivores but aquatic organisms make up almost 100 % of their diet and fish up to 50%. Wild mink eat many small meals daily, of about 40 to 53 g total, or by one reference 90 g of fish for a 0.9 kg female. They have a short intestinal tract, no caecum, a small stomach, and a rapid assimilation rate with a transit time of about 3 hours. In captive mink, food consumption is about 12 to 16% of adult body weight. Thus captive mink eat between 120 and 160 g a day and about 110 to 175 g/kg. Wild mink are reportedly larger on average and eat less but more often. The estimate for a 1 kg mink is 150 g/day or 150 g/kg. The allometric equation estimates food consumption for a 1 kg mink at 70 g per day of 70 g/kg.

WATER

The allometric equation estimates water intake at about 100 mL per day or 100 mL/kg for a 1 kg mink.

REFERENCES

14, 21, 30, 34, 37, 38, 39, 46, 58, 60, 64.

Mule Deer (*Odocoileus hemionus*)

WEIGHTS

Mule deer weigh about 90 kg and range over all of North America.

FOOD

Mule deer eat about 2 to 3 kg of vegetation per day, over half of this is herbs and the rest grasses and tree leaves. The allometric equation indicates that a mammal of this size should eat about 2.8 kg/day or 31 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 5.7 L or 63 mL/kg.

REFERENCES

14, 59, 60.

Muskrats (*Ondatra zibethicus*)

WEIGHTS

Muskrats weigh about 1 kg with a range of 0.54 to 1.82 kg and range over all of North America.

FOOD

Aquatic organisms comprise almost 100% of their diet. Food consists of aquatic plants, molluscs, fish, crustaceans, amphibians and some marine molluscs. The allometric equation indicates that a mammal of this size should eat about 100 g or 100 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 70 mL or 70 mL/kg.

REFERENCES

14, 49, 57, 58, 60.

Nutria (*Myocastor coypus*)

WEIGHTS

These are feral, semi-aquatic animals having escaped from fur farms and living in marshes in the US. They are native to temperate southern South America. Nutria weigh about 8 kg with a range of 2.3 to 11.4 kg.

FOOD

Aquatic vegetation comprises much of their diet. Estimates indicate a value of about 1.1 to 1.6 kg/day or 190 g/kg. The allometric equation indicates that a mammal of this size should eat about 380 g/day or 50 g/kg. This value is much too low, likely because the diet is mostly vegetation.

WATER

The allometric equation indicates that a mammal of this size should drink about 640 mL or 80 mL/kg.

REFERENCES

14, 49, 57, 58, 63.

Opossum (*Didelphis marsupialis*)

WEIGHTS

Opossums weigh about 3.5 kg, with a range of 1.5 to 5.5 kg. Their normal range is the eastern US and south to South America. Introductions to southern Canada and the western US have occurred.

FOOD

Food requirements are 85 to 150 g/day or about 35g/kg for laboratory animals. The allometric equation indicates that a mammal of this size should eat about 190 g/day or 55 g/kg. This is probably more realistic for a wild, active opossum..

WATER

Water requirements are 100 to 200 mL/day or about 40mL/kg. The allometric equation indicates that a mammal of this size should drink about 310 mL or 90 mL/kg.

REFERENCES

14, 19, 60.

Polar Bear (*Ursus maritimus*)

WEIGHTS

Male Polar Bears weigh about 425 kg, with a range of 400 to 450 kg; females average 325 kg, with a range of 300 to 350 kg. They occur all across the Canadian Arctic, primarily coastal.

FOOD

Their diet is primarily seal skin and fat and not the meat so they are susceptible to toxins with high fat solubility. They also eat carrion, small mammals, ducks and vegetation in the summer. The allometric equation indicates that a mammal of this size should eat about 9.9 kg/day or 25 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 23 L or 55 mL/kg.

REFERENCES

14, 50, 57, 60, 61.

Raccoon (*Procyon lotor*)

WEIGHTS

Raccoons weigh about 12 kg with a range of 1.8 to 22.2 kg. They range from southern Canada to South America except for the northern Rocky mountains and the Great Basin.

FOOD

Aquatic and marine organisms comprise much of their diet. They are opportunistic feeders taking eggs, fruits, nuts, birds, crops and garbage. The allometric equation indicates that a mammal of this size should eat about 530 g or 45 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 930 mL or 80 mL/kg.

REFERENCES

14, 30, 51, 56, 63.

River Otter (*Lutra canadensis*)

WEIGHTS

River otters weigh from 3 to 15 kg with a mean of about 10 kg. They range over most of North America north of Mexico.

FOOD

Wild European otters eat from 900 to 1000 g of live fish a day and captive North American otters eat from 700 to 900 g of prepared food a day. Over 90% of a river otters diet is fish and estimates indicate that the actual value is about 800 g/day or 80 g/kg. The allometric equation predicts that an 10 kg otter should eat about 455 g per day or 55 g/kg, this value is too low, likely because the diet is mostly fish.

WATER

Otters drink about 790 mL/day based on the allometric equation or about 80 mL/kg.

REFERENCES

14, 21, 30, 35, 36, 60.

Shrew Moles (*Neurotrichus gibbsi*)

WEIGHTS

Shrew Moles weigh about 10 g with a range of 5.5 to 12 g.

FOOD

Aquatic organisms comprise a small portion of their diet. Observations indicate actual values up to 14.4 g in 12 hours or 140% of the body weight. They are opportunistic feeders. Dead frogs and salamanders are taken but not live salamanders. The allometric equation indicates that a mammal of this size should eat about 1.6 g or 160 g/kg, this value is much too low due to the small size of these animals.

WATER

The allometric equation indicates that a mammal of this size should drink about 1.5 mL or 150 mL/kg

REFERENCES

14, 49, 57, 58.

Short-tailed Weasel (*Mustela erminea*)

WEIGHTS

Short-tailed Weasels weigh about 60 g with a range of 30 to 140 g. They range over the Arctic, northern and western portions of North America.

FOOD

Aquatic organisms comprise a small portion of their diet. Frogs and small fish are taken. The allometric equation indicates that a mammal of this size should eat about 7 g/day or 115 g/kg. This value is likely too low due to the small size and high activity of these animals.

WATER

The allometric equation indicates that a mammal of this size should drink about 8 mL or 130 mL/kg.

REFERENCES

14, 49, 57, 58, 60.

Vagrant Shrew (*Sorex vagrans*)

WEIGHTS

Adults weigh about 5 g.

FOOD

This shrew consumes about 8.4 g, of small invertebrates, earthworms, seeds, fungi and salamanders daily, about 1680 g/kg. The allometric equation indicates that a mammal of this size should eat about 0.26 g/day or 50 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 0.4 mL/day or 80 mL/kg. This is probably too low also.

REFERENCES

14, 59.

Water Shrew (*Sorex palustris*)

WEIGHTS

Water Shrews weigh about 20 g with a range of about 15 to 25 g.

FOOD

Aquatic insects comprise much of their diet. The allometric equation indicates that a mammal of this size should eat about 3 g or 150 g/kg. This value is much too low due to the small size and high metabolic rate of this animal. A more reasonable estimate would be a value of about their own body weight, 20 g/day or 250 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 30 mL or 150 mL/kg.

REFERENCES

14.

**Domestic
Cats (*Felis catus*)**

WEIGHTS

The weight of a cat depends upon sex and breed and varies widely from about 1 to 10 kg but an average value is about 2.5 kg.

FOOD

Cats eat between 110 and 250 g per day of high protein food. Adult cats require about 80 kcal /kg body weight; whole fish provides about 1 kcal /g therefore on a fish diet cats would need 80 g/kg. The digestible protein content should be about 30%. Other foods have different useful energy values, but for cats, which are meat eaters, the values are not greatly different. Cats have a high capacity and desire for fats and can consume 30 g per day without ill effect and fat levels up to 20% may be required for palatability. Cats may therefore be more than usually susceptible to organic toxins which are fat soluble. The allometric equation predicts food consumption of 150 g for a 2.5 kg cat or 60 g/kg.

WATER

Cats drink about 100 to 300 mL per day or about 160 mL /kg. The allometric equation predicts water consumption of 225 mL for a 2.5 kg cat or 90 mL/kg.

REFERENCES

14, 19.

Dogs (*Canis familiaris*)

WEIGHTS

There are many breeds of dog and sizes vary greatly from 2 to 70 kg. It is difficult to justify the choice of an average dog but 35 kg has been chosen.

FOOD

Due to the large range of dog sizes and activity levels the range of food intake also varies greatly from about 80 g to 2.8 kg assuming about 40 g/kg as a nominal requirement. The digestible protein content should be about 20%. The estimates for laboratory breeds are from 250 to 1200g/day. The allometric equation estimates 1.27 kg food for a 35 kg dog which corresponds to 36 g/kg.

WATER

Water intake will also vary widely depending on size and activity level of the dog. Using 80 mL/kg as an estimate gives a range of 160 mL to 5.6 L. The allometric equation yields 2.4 L for a 35 kg dog or 70 mL/kg. Literature values are 25 to 35 mL/kg. The actual value is likely dependent upon diet; a laboratory dog on a commercial dry diet will drink more than a dog eating meat.

REFERENCES

14, 19.

Ferrets (*Mustela putorius*)

WEIGHTS

Ferrets weigh from 0.4 to 3.5 kg. Males are twice as heavy as females and there may be a 40% fluctuation on an annual basis due to subcutaneous fat accumulation in the fall.

FOOD

Ferrets are opportunistic carnivores generally feeding on rodents and snakes in the wild. They eat mink, dog or cat food in the laboratory. Food consumption is estimated at 100 to 170 g a day, or about 50 to 85 g/kg. The allometric equation gives a value of 120 g per day or 60 g/kg for a 2 kg ferret

WATER

The allometric equation estimates water intake at about 95 mL per day or 50 mL/kg for a 2 kg ferret.

REFERENCES

14, 19.

Guinea Pigs (*Cavia porcellus*)

WEIGHTS

Guinea pigs have been domesticated for some time and a number of strains exist. The weight range is from about 300 g to 900 g or more in adult males. Young sows are usually mated in the 450 to 600 g weight range which occurs by about 3 months as guinea pigs are precocious and early maturing.

FOOD

Adults eat about 60 g/kg or 20 to 60 g per day. One literature reference suggests 20 to 35 g/day with vitamin C supplements. The digestible protein content should be about 25 to 30%. The allometric equation estimates food consumption at 51 g for a 700 g animal or 73 g/kg.

WATER

Captive Guinea pigs may drink up to 40 mL or more per day but spill a lot of water. The literature suggests 120 to 150 mL/kg. The allometric equation predicts water consumption of 72 mL for a 700 g animal or 100 mL/kg.

REFERENCES

14, 19, 42.

There are 54 species and 5 genera of hamsters. Three species from three different genera are widely used as research animals and pets. Most references are to 'golden' or 'Syrian' hamsters (*Mesocricetus auratus*) although some work is reported on 'Chinese' hamsters (*Cricetulus griseus*) and European or black hamsters (*Cricetus cricetus*). Hamsters are burrowers and food hoarders with large cheek pouches. Calculating daily intake needs for animals which may store away much of what they find can be difficult.

-Syrian or Golden Hampsters (*Mesocricetus auratus*)

WEIGHTS

The Syrian hamster weighs between 85 and 110 g; the female is larger and more aggressive.

FOOD

Food consumption ranges from 7 to 15 g per day or about 120 g /kg. The digestible protein content should be about 16%. The allometric equation estimates the food consumption for a 100 g Syrian hamster at 10 grams per day or 100 g/kg.

WATER

When eating dry laboratory rations, water consumption may be about 20 mL per day or 200 mL/kg. This may be less when fresh greens are available. One literature reference suggests 8 to 12 mL/day. The allometric equation estimates water consumption at 13 mL per day or 130 mL/kg for a 100 g Syrian hamster.

REFERENCES

14, 19, 43.

-Chinese Hampsters (*Cricetulus griseus*)

WEIGHTS

The Chinese hamster weighs between 39 and 46 g.

FOOD

Food consumption ranges from about 4 to 8 g per day or about 130 g /kg. The allometric equation estimates that a 45 g Chinese hamster will eat 5.5 g day or 120 g/kg.

WATER

When eating dry laboratory rations water consumption may be about 10 mL per day or 200 mL/kg. This may be less when fresh greens are available. The allometric equation predicts water consumption of 6 mL per day or 130 mL/kg.

REFERENCES

14, 19.

Mice (*Mus musculus*)

WEIGHTS

There are many laboratory strains of mice and their weights vary somewhat, an approximate range is 40 to 90 g.

FOOD

One literature reference suggests 3 to 6 g/day for laboratory mice. The digestible protein content should be about 12%. The allometric equation predicts food consumption of about 7 g of food for a 60 g mouse or 120 g/kg.

WATER

One literature reference suggests 3 to 7 mL/day for laboratory mice. The allometric equation estimates water consumption at 8 mL per day for a 60 g mouse or 130 mL/kg.

REFERENCES

14, 19.

Mongolian Gerbils (*Meriones unguiculatus*)

WEIGHTS

Adult gerbils weigh between 70 and 100 g.

FOOD

Adult males eat about 8 g per day. Females a little less unless pregnant and they are usually pregnant. They are compulsive sunflower-seed eaters and will consume them to the exclusion of other more balanced foods. However sunflower seeds are low in calcium and high in fat and are not a complete diet for these animals. The digestible protein content should be about 15%. The allometric equation predicts 9 g/day or 105 g/kg.

WATER

Gerbils are very efficient with water and need only about 3 to 4 mL per day. They will get it from fresh greens if necessary but should have some free water available. The allometric equation predicts water needs of 11 mL per day but since gerbils are especially adapted desert burrowers they do not drink this much. They need to be kept at relative humidities between 30 and 50%. Urine output is only a few drops a day; excretion of toxics by this route is minimal.

REFERENCES

14, 19, 40, 41.

Rats (*Rattus norvegicus*)

WEIGHTS

There are many laboratory strains of rats and sizes vary somewhat but not drastically. Males weigh about 400 to 500 g and females about 100 g less.

FOOD

Laboratory rats eat 12 to 30 g of dry food pellets daily; a wild rat eating moist food should eat more than this, depending on the nutritional status of the food, the moisture level of the pellets, and also due to the wild rats higher activity level. The digestible protein content should be about 12%. The allometric equation estimates about 30 g for a 400 g rat or 75 g/kg.

WATER

Laboratory rats on dry rations drink about 140 mL/kg. An estimate for wild rats is 125 mL/kg or 50 mL/day for a 400 g rat. One literature reference suggests 20 to 45 mL for laboratory rats. The allometric equation estimates about 45 mL for a 400 g rat or 100 mL/kg.

REFERENCES

14, 19.

Livestock

Cattle (*Bos taurus*)

WEIGHTS

Beef cattle range from 180 to 1100 kg, dairy cows from 320 to 870 kg, and heifers from 100 to 400 kg.

FOOD

The food intake rate for cattle varies from about 1.4 to 3.0% of body weight. Older beef cattle consume the lowest amount and dairy cattle the most. Cattle may ingest 100 to 1500 g of *soil* per day. Beef cattle eat about 7.5 to 15.0 kg of dry matter per day, dairy cows 8.8 to 22.8 kg and heifers between 5.8 and 8.2 kg. One literature estimate is 7.5 to 12.5 hg/day for average size cattle. The digestible protein content should be about 8.5 to 10%. On a g of food per kg of

body weight per day basis beef cattle consume between 15 and 30 g/kg, dairy cows 25 to 33 g/kg and heifers 24 to 30 g/kg. The allometric equation suggests 11.2 kg of food per day for a 500 kg beef cow or 23 g/kg, 13.9 kg per day for a 650 kg dairy cow or 21.4 g/kg and 7.4 kg per day for a 300 kg heifer or 25 g/kg.

WATER

Water consumption is very variable and depends upon external factors such as breed, climate, food supply, pregnancy and lactation status. There is a factor of 2.4 in water consumption as the temperature rises from 4 to 32 degrees. Heifers drink 20 to 80 L per day, dairy cows 38 to 200 L and beef cattle 15 to 91 L. One literature estimate is in the 45 to 65 l/day range for average cattle. Heifers drink 100 to 220 mL per kg of weight per day, beef cattle 74 to 140 mL, and dairy cows 25 to 33 mL. The predictions of the allometric equation are 26.6 L per day for a 500 kg beef cow or 53 g/kg, 33.7 L for a 650 kg dairy cow or 52 g/kg and 16.8 kg per day for a 300 kg heifer or 56 g/kg.

REFERENCES

1, 3, 4, 5, 6, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 31.

Goats (*Capra hircus*)

WEIGHTS

There are many breeds of goats: pets, milk and meat. Their body weights vary greatly from 10 to 100 kg. It is difficult to determine a usual weight but 60 kg has been chosen as an example.

FOOD

Food consumption will vary greatly and depend on breed, age and size. A range of 1 to 4 kg per day is estimated. The digestible protein content should be about 15%. The allometric equation predicts food consumption of 2 kg for a 60 kg goat or 33 g/kg.

WATER

Water consumption will likewise vary greatly and depend on pregnancy and lactation status. A range of 1.5 to 10 L per day is a reasonable estimate. One literature source suggests 1.5 to 4 l/day. The allometric equation estimates 4 L per day for a 60 kg goat or 66 mL/kg.

REFERENCES

1, 6, 19, 20.

Horses (*Equus caballus*)

WEIGHTS

Excluding Shetland ponies, miniatures and Clydesdales, horses vary in weight from 200 to 700 kg.

FOOD

Horses eat between 7.2 and 16 kg per day and on a per kg weight basis consume from 16 to 22 g/kg. The digestible protein content should be about 5.5 to 14%. The allometric equation estimates food consumption for a 550 kg horse at 12.1 kg per day or 22 g/kg.

WATER

Work output in horses has a large effect on water consumption. Horses drink between 20 and 91 L per day and about 100 mL per kg of weight per day. One literature source suggests 25 to 55 L/day for the average horse. The allometric equation predicts that a 550 kg horse would drink about 29 L per day or 53 mL/kg.

REFERENCES

1, 11, 12, 13, 14, 16, 18, 19, 20, 31.

Rabbits (*Oryctolagus cuniculus*)

WEIGHTS

There are about 30 breeds and 80 varieties of rabbits available and they vary greatly in size, but fall into 3 groups, small-up to 2 kg, medium-2 to 5 kg and large-over 5 kg. Wild males are up to 1.8 kg and females slightly less. These are all strains of the European wild rabbit.

FOOD

Rabbits are herbivores and coprophagy (re-ingestion of feces) is a normal and essential practice for adequate nutrition and normal intestinal physiology. Initially soft fecal pellets, which are partially digested food, are excreted and then eaten; later hard pellets of no further food value are excreted. This is however of concern when elimination of a single dose of toxin is being measured since rabbits may continue re-exposing themselves via their feces. Due to the range in sizes food consumption also ranges quite widely from about 120 to 300 g per day assuming about 60 g/kg. One literature source suggests 75 to 100 g/day for laboratory rabbits. The digestible protein content should be about 14%. The allometric equation estimates food consumption for a 3 kg rabbit at 170 g or 53 g/kg.

WATER

One literature source recommends 80 to 100 mL/kg. The allometric equation estimates water consumption for a 3 kg rabbit at 270 ml or 90 mL/kg.

REFERENCES

14, 18, 19, 61.

Sheep (*Ovis aries*)

WEIGHTS

Ewes range from 40 to 120 kg, depending on breed and lambs range from 27 to 54 kg. The marketing definition of lamb, which brings a higher price, is in excess of a year old, so they are quite large in proportion to ewes.

FOOD

For both ewes and lambs the food intake per day is from 1.1 to 2.6 kg, and they eat between 30 and 40 g of feed per kg of weight per day. The digestible protein content should be about 5%. The allometric equation predicts that a 64 kg ewe should eat about 2.1 kg per day or 33 g/kg, and a 45 kg lamb, 1.6 kg or 35 g/kg.

WATER

There is a factor of 12 for sheep water consumption between winter and summer and a factor of 2.2 depending upon nutritional status. Ewes drink between 0.6 and 22 L per day and lambs 2 to 4 L. Pregnancy is an important factor in sheep water consumption. Ewes drink between 53 and 247 mL per kg of weight and lambs from 67 to 74 mL. One literature reference suggests that 0.8 to 1.2 L/day is an average water consumption. The allometric equation estimates water consumption for a 64 kg ewe at 4.2 L or 66 mL/kg and for a 45 kg lamb, 3 L or 67 mL/kg.

REFERENCES

1, 6, 9, 10, 11, 12, 13, 14, 16, 17, 18, 20, 31.

Swine (*Sus scrofa*)

WEIGHTS

Sows weigh from 136 to 250 kg, piglets and miniature swine range from 23 to 100 kg. Miniatures are used as pets and as laboratory animals since their mature weight is about the same as mans.

FOOD

Sows eat 2.7 to 5.7 kg per day, piglets and miniatures range from 1.5 to 3.4 kg per day. One literature reference suggests 1.5 to 3.0 kg/day for miniature swine. The digestible protein content should be about 14%. On a per kg weight basis sows eat 20 to 28 g/kg and piglets and miniatures 30 to 50 g/kg. The allometric equation estimates that a 200 kg sow should eat 5.3 kg per day or 26 g/kg, and an 80 kg piglet or miniature 2.5 kg per day or 31 g/kg.

WATER

Sows drink 11 to 25 L per day, piglets and miniatures 2 to 8 L. Sows drink between 81 and 92 mL per kg of weight per day, and piglets and miniatures 88 to 261 mL/kg. One literature reference suggests 4.5 to 6.5 L/day as an average water consumption. The allometric equation predicts that a 200 kg sow should drink about 11.7 L per day or 58 mL/kg, and an 80 kg piglet 5.1 L per day or 64 mL/kg.

REFERENCES

1, 6, 9, 11, 12, 13, 14, 15, 17, 18, 20, 31.

MARINE MAMMALS

Introduction

Cetaceans include porpoises, dolphins, whales and killer whales; pinnipeds include seals and sea lions. Caloric requirements for some of these animals are listed in [Table 7](#) and may be divided by the caloric values of some of their prey, as given in [Table 6](#), to determine necessary intake rates of different prey.

These animals pose a special problem with regard to toxic lipophyllic compounds with K o/w values over about 3 or 4. The animals store large amounts of fat, and possibly fat soluble toxins, over much of the year and then rely exclusively on this fat as an energy source over a short period time, usually the breeding and nursing season. The toxins may not constitute a problem until the fat is metabolized subjecting the animals, and nursing young, to high levels on a continuous basis until the fat stores are used up. The time concentration factor may be 4 or 5 to 1.

Some of the favorite prey of marine mammals is fish such as herring, which have a very high fat content. This diet exacerbates the problem of toxin accumulation. It may be necessary to maintain very low levels of fat soluble toxins in prey species like herring in order to prevent a magnification of the toxins up the food chain. Killer whales may be the most susceptible since they eat other marine mammals as well as fish.

North American

Beluga Whales (*Delphinapterus leucas*)

WEIGHTS

Beluga Whales weigh about 1000 kg, with a range of 500 to 1500 kg. These are Arctic species.

FOOD

Aquatic organisms comprise 100% of their diet. The allometric equation indicates that a mammal of this size should eat about 20 kg/day or 20 g/kg. This value is probably low since the diet is mostly fish.

WATER

The allometric equation indicates that a mammal of this size should drink about 50 L/day or 50 mL/kg.

REFERENCES

14, 50, 57.

Blue Whale (*Balaenoptera cetacea*)

WEIGHTS

These range over most of the world's oceans but are found primarily in arctic and antarctic oceans. They weigh from 80,000 to 130,000 kg.

FOOD

They are exclusively plankton strainers. The allometric equation indicates that a mammal of this size should eat about 920 kg/day or 10 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 3300 L/day or 30 mL/kg.

REFERENCES

14, 61.

Bottle-nose Dolphin (*Tursiops truncatus*)

WEIGHTS

These range along the southeast coast of North America and usually weigh 150 to 200 kg, with a mean of 175 kg.

FOOD

They are carnivores feeding on inshore fish such as capelin, anchovy, salmon and shrimp. The allometric equation indicates that a mammal of this size should eat about 4.8 kg/day or 30 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 10.3 L/day or 60 mL/kg.

REFERENCES

60, 61.

California Sea Lion (*Zalophus californianus*)

WEIGHTS

California Sea Lions weigh about 275 kg, ranging from about 100 to 450 kg. They range from Baja to British Columbia.

FOOD

Aquatic organisms comprise 100% of their diet. The allometric equation indicates that a mammal of this size should eat about 7 kg/day or 25 g/kg. This value is probably low since the diet is mostly small fish, squid and herring eggs.

WATER

The allometric equation indicates that a mammal of this size should drink about 15.5 L/day or 55 mL/kg.

REFERENCES

14, 49, 50, 57, 58, 60.

Harbour Seal (*Phoca vitulina*)

WEIGHTS

Harbour Seals weigh about 85 kg ranging up to 135 kg. They are found in the Atlantic and the Pacific from the Arctic to California and Carolina.

FOOD

Aquatic organisms comprise 100% of their diet. They are opportunistic feeders and include salmonids in their diet as well as lamprey and rock fish. The allometric equation indicates that a mammal of this size should eat about 2.6 kg or 31 g/kg. This value is probably too low because the diet is mostly fish.

WATER

The allometric equation indicates that a mammal of this size should drink about 5.4 L or 65 mL/kg.

REFERENCES

14, 49, 57, 58, 60.

Killer Whales (*Orcinus orca*)

WEIGHTS

Killer Whales weigh about 3500 kg with a range of 2500 to 4500 kg and range over all the worlds oceans.

FOOD

Aquatic organisms comprise 100% of their diet. They are opportunistic feeders and take fish, cephalopods, birds and marine mammals. The allometric equation indicates that a mammal of this size should eat about 56.3 kg/day or 16 g/kg. This value is low, likely because the diet is high in fish. Estimates of the actual value are 130 kg/day with a range of 88 to 175 kg. This is equivalent to 37 g/kg.

WATER

The allometric equation indicates that a mammal of this size should drink about 113 L or 32 mL/kg.

REFERENCES

14, 50, 57, 58, 60.

Manatee (*Trichechus manatus*)

WEIGHTS

The Caribbean manatee can weigh up to 500 kg. They are sub tropical animals and can only be found where water temperatures do not drop below 18 degrees Celcius. They range from Florida and the West Indies to South America.

FOOD

Manatees are strictly herbivores eating aquatic plants and are non selective. They will consume up to 20% of their body weight per day or about 100 kg of plant material. The allometric equation indicates that a mammal of this size should eat about 9.5 kg or 25 g/kg but the energy content of aquatic plants is quite low and the water content very high so large volumes, and hence weights, are needed.

WATER

These animals live submerged and eat plants with a water content of over 90 %. The allometric equation indicates that a mammal of this size should drink about 21.8 L or 55 mL/kg. They get several times this much water from their diet of aquatic plants.

REFERENCES

14, 19, 45, 60.

Northern Elephant Seal (*Mirounga angustirostris*)

WEIGHTS

Female Northern Elephant Seals weigh about 900 kg; males up to 2300 kg. This is a very large sexual dimorphism in weight. The calculations below are based on an average weight of 800 kg for females and 2000 kg for males. They are normally found off California.

FOOD

Marine organisms comprise 100% of their diet. For females the allometric equation indicates that a mammal of this size should eat about 16.7 kg/day or 21 g/kg. For males the allometric equation indicates that a mammal of this size should eat about 35.5 kg/day or 18 g/kg. These values are probably a little low, likely because their diet is mostly deep-water fish, squid, small sharks and skates..

WATER

For females the allometric equation indicates that a mammal of this size should drink about 41 L or 51 mL/kg. For males the allometric equation indicates that a mammal of this size should drink about 93 L or 47 mL/kg.

REFERENCES

14, 49, 57, 58, 60, 61.

Northern Fur Seal (*Callorhinus ursinus*)

WEIGHTS

Northern Fur Seals weigh about 160 kg, with a range of 45 to 275 kg. These animals breed in the Bering Sea and winter in California and Japan.

FOOD

Aquatic organisms comprise 100% of their diet. According to several references the actual value is 22 or 43 kg/day, which is 140 or 270 g/kg. These values lead to quite high g/kg rates. In captivity they can maintain their weight on diets of 4 to 20% of their body weight. This would lead to values of 6.4 to 32 kg/day for a 160 kg seal. However under these conditions they are not as active, nor are they subjected to such temperature extremes as they are in nature so the higher estimated value of 43 kg/day or 270 g/kg is used in Table 5. Their food is mostly small schooling fish and squid. The allometric equation indicates that a mammal of this size should eat about 4.45 kg/day or 28 g/kg. This value is apparently too low, probably partly because these animals are fish eaters.

WATER

The allometric equation indicates that a mammal of this size should drink about 9.5 L or 60 mL/kg.

REFERENCES

14, 49, 50, 57, 58, 60.

Northern Sea Lion (*Eumetopias jubatus*)

WEIGHTS

Northern Sea Lions weigh about 650 kg, ranging from 300 to 1000 kg. They range along the Pacific coast from California to British Columbia.

FOOD

Aquatic organisms comprise 100% of their diet. The diet is mostly near-shore fish and cephalopods. The allometric equation indicates that a mammal of this size should eat about 14 kg/day or 22 g/kg, this value is probably a little low, likely because the diet is fish..

WATER

The allometric equation indicates that a mammal of this size should drink about 33.7 L or 52 mL/kg.

REFERENCES

14, 49, 57, 58, 60.

Sea Otter (*Enhydra lutris*)

WEIGHTS

Sea Otters weigh about 30 kg with a range of 23 to 36 kg. Their normal range is along the Pacific coast from California to the Bering Sea.

FOOD

Aquatic organisms comprise nearly 100% of their diet and estimates indicate an actual value of about 7.5 kg/day or 250 g/kg. Captive animals eat about 20 to 25% of their body weight per day

or 6 to 7.5 kg which equals 200 to 250 g/kg. Food consists of sea urchins, molluscs, crustaceans, cephalopods and some fish. The allometric equation indicates that a mammal of this size should eat about 1.6 kg or 55 g/kg. This value is much too low, likely because the diet is mostly fish.

WATER

The allometric equation indicates that a mammal of this size should drink about 2.1 L or 70 mL/kg.

REFERENCES

14, 49, 57, 58, 60.

Walrus (*Odobenus rosmarus*)

WEIGHTS

A Walrus weighs about 1400 kg with a range of 1250 to 1600 kg. These are northern animals ranging from the Arctic Ocean south to Hudson Bay and the Bering Sea.

FOOD

Aquatic organisms comprise about 100% of their diet. The allometric equation indicates that a mammal of this size should eat about 26.5 kg or 20 g/kg. This value is probably low because the diet is mostly fish.

WATER

The allometric equation indicates that a mammal of this size should drink about 67.2 L or 50 mL/kg.

REFERENCES

14, 57, 60.

REPTILES AND AMPHIBIANS

REPTILES

Snapping Turtle (*Chelydra serpentina*)

WEIGHTS

Snapping Turtles usually weigh about 9 kg but may go up to 22 kg. They are found in the wetlands of the southeastern US and into northern South America.

FOOD

Aquatic organisms comprise about 75 % (50 % to 100 %) of their diet. Estimates indicate a food consumption rate of about 900 g/day or 100 g/kg for the 9 kg size turtle. Intake rates are lower, on a gross weight basis, than for mammals and birds due to the relatively large skeletal mass which is not metabolically active.

WATER

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REFERENCES

14, 30, 51, 56, 63.

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TABLES

Table 1.
Body Weights and Water and Food Consumption Rates per day and per kilogram of Body Weight
-Mean Values for Livestock.

LIVESTOCK	BODY WEIGHTS	CONSUMPTION/day		CONSUMPTION/kg	
		WATER	FOOD	WATER	FOOD
	gram or kilogram	millilitre or litre	gram or kilogram	millilitre	gram
Cows (beef cattle)	500kg	59L	11.3kg	118mL	23g
Cows (dairy cows)	650kg	65L	15.8kg	130mL	29g
Cows (heifers)	300kg	60L	6.8kg	200mL	27g
Ducks	2.8kg	130mL	280g	45mL	100g
Fowl (broilers)	1.9k	320mL	130g	168mL	35g
Fowl (layers)	2.7kg	320mL	140g	119mL	57g
Goats	60kg	5L	2.5kg	80mL	30g
Horses	550kg	60L	10kg	100mL	19g
Mink	1kg	100mL	150g	100mL	150g

Pigeons	500g	50mL	50g	100mL	100g
Rabbits	3kg	300mL	180g	100mL	60g
Sheep (ewes)	64kg	11L	1.7kg	170mL	35g
Sheep (lambs)	45kg	3L	1.6kg	70mL	35g
Swine (piglets and small)	80kg	7L	3kg	88mL	40g
Swine (sows)	200kg	17L	4.2kg	85mL	24g
Turkeys	5kg	470mL	230g	94mL	44g

Table 2.
Body Weights and Water and Food Consumption Rates per day and per kilogram of Body Weight
-Mean Values for Domestic Animals.

DOMESTIC ANIMALS	BODY WEIGHTS	CONSUMPTION/day		CONSUMPTION/kg	
		WATER	FOOD	WATER	FOOD
	gram or kilogram	millilitre or litre	gram or kilogram	millilitre	gram
Budgies	45g	2mL	8g	50mL	180g
Cats	2.5kg	150mL	150g	160mL	80g
Dogs	35kg	2.5L	1.3kg	80mL	40g
Ferrets	2kg	100mL	150g	50mL	60g
Gerbils	85g	5mL	8g	60mL	95g

Guinea Pigs	700g	50mL	45g	70mL	60g
Hampsters (Chinese)	45g	8mL	6g	175mL	130g
Hampsters (Syrian)	100g	20mL	10g	200mL	120g
Mice	60g	8mL	7g	130mL	120g
Pigeons	500g	50mL	50g	100mL	100g
Rabbits	3kg	300mL	180g	100mL	60g
Rats	400g	50mL	24g	125mL	60g

Table 3.
Body Weights and Water and Food Consumption Rates per day and per kilogram of Body Weight
-Mean Values for North American Birds.

NORTH AMERICAN BIRDS	BODY WEIGHTS	CONSUMPTION/day		CONSUMPTION/kg	
		WATER	FOOD	WATER	FOOD
	gram or kilogram	millilitre	gram	millilitre	gram
American Widgeon Duck	750g	50mL	50g	65mL	65g
Bald Eagle	4.5kg	160mL	900g	35mL	200g
Belted Kingfisher	150g	35mL	75g	230mL	500g
Black Brant Goose	1.4kg	75mL	75g	55mL	50g
Bufflehead Duck	400g	30mL	80g	75mL	200g

Canada Goose	8kg	240mL	225g	30mL	30g
Common Goldeneye Duck	1kg	60mL	200g	60mL	200g
Common Loon	4.5kg	160mL	1.5kg	35mL	335g
Common Merganser	1.5kg	75mL	300g	55mL	200g
Common Tern	140g	15mL	28g	110mL	200g
Golden Eagle	4.2kg	155mL	750g	35mL	175g
Great Blue Heron	3kg	125mL	600g	40mL	200g
Great Cormorant	2.7kg	115mL	110g	45mL	40g
Green-backed Heron	250g	25mL	50g	100mL	200g
Herring Gull	1kg	60mL	200g	60mL	200g
Lesser Scaup Duck	800g	50mL	50g	60mL	65g
Mallard Duck	1.2kg	70mL	250g	55mL	200g
Oldsquaw Duck	830g	50mL	190g	60mL	230g
Osprey	1.5kg	70mL	300g	50mL	200g
Pigeons	500g	50mL	50g	100mL	100g
Red-Breasted Meganser	1.15kg	65mL	235g	55mL	205g
Ring-Billed Gull	450g	35mL	95g	75mL	210g
Ruby-throat Hummingbird	28g	2.5mL	50g	90mL	1800g
Wood Duck	700g	45mL	45g	65mL	65g

Table 4.
Body Weights and Water and Food Consumption Rates per day and per kilogram of Body Weight
-Mean Values for North American Wildlife.

NORTH AMERICAN WILDLIFE	BODY WEIGHTS	CONSUMPTION/day		CONSUMPTION/kg	
		WATER	FOOD	WATER	FOOD
	gram or kilogram	millilitre or litre	gram or kilogram	millilitre	gram
Arctic Wolf	80kg	4.5L	2.3kg	65mL	35g
Black Bear	135kg	8.2L	3.9kg	60mL	30g
Bobcat	9kg	715mL	420g	80mL	50g
Common Shrew	4.0g	0.5mL	13g	100mL	3200g
Grey Squirrel	600g	65mL	45g	110mL	75g
Grizzly Bear	450kg	24L	10.5kg	55mL	25g
Marsh Shrew	20g	3mL	3g	150mL	150g
Meadow Vole	38g	3mL	38g	70mL	1000g
Mice	40g	6mL	5g	80mL	125g
Mink	1kg	100mL	150g	100mL	150g
Mule Deer	90kg	5.7L	2.8kg	63mL	31g
Muskrat	1kg	70mL	100g	70mL	100g
Nutria (Coypu)	8kg	640mL	380g	80mL	50g

Opossum	3.5kg	300mL	190g	90mL	55g
Polar Bear	425kg	23L	9.9kg	55mL	25g
Rabbit	3kg	300mL	180g	100mL	60g
Raccoon	12kg	930mL	530g	80mL	45g
Rat	240g	30mL	15g	75mL	35g
River Otter	10kg	790mL	800g	80mL	80g
Short-tailed Weasels	60g	8mL	7g	130mL	115g
Shrew Mole	10g	1.5mL	10g	150mL	1000g
Snapping Turtle	9kg	...	900g	...	100g
Vagrant Shrew	5g	0.5mL	8.4g	100mL	1680g
Water Shrew	20g	3mL	3g	150mL	150g

Table 5.
Body Weights and Water and Food Consumption Rates per day and per kilogram of Body Weight
-Mean Values for North American Marine Mammals.

NORTH AMERICAN MARINE MAMMALS	BODY WEIGHTS	CONSUMPTION/day		CONSUMPTION/kg	
		WATER	FOOD	WATER	FOOD
	kilogram	litre	kilogram	millilitre	gram
Beluga Whale	1000kg	50L	20kg	50mL	20g

Blue Whale	105000kg	3300L	920kg	30mL	10g
Bottle-Nose Dolphin	175kg	11L	5kg	60mL	30g
California Sea Lion	275kg	16L	7kg	55mL	25g
Harbour Seal	85kg	5L	3kg	65mL	30g
Killer Whale	3500kg	113L	130kg	32mL	37g
Manatee (Caribbean)	400kg	20L	80kg	55mL	200g
Northern Elephant Seal	1100kg	54L	22kg	50mL	20g
Northern Fur Seal	160kg	10L	43kg	60mL	270g
Northern Sea Lion	650kg	34L	14kg	50mL	22g
Sea Otter	30kg	2L	8kg	70mL	250g
Walrus	1400kg	67L	27kg	50mL	20g

Table 6.
Composition of some Prey Species of Marine Mammals.

FOOD SPECIES	% water	% protein	% oil	% ash	Kcal/kg
capelin-<i>Mallotus villosus</i>	77-82	13-15	2-8	2	700-1200
herring-<i>Clupea harengus</i>	52-78	15-22	2-29	2	700-2500

mackerel- <i>Scomber scombrus</i>	61-78	13-25	0.3-18	3	1400-2000
smelts- <i>Osmerus mordax</i>	77-80	14-19	2-7	2	700-1200
squid- <i>Loligo brevis</i>	74-84	12-18	2	3	850

Table 7.
Energy Requirements of some Marine Mammals.

SPECIES	Kilocalories/kg/day
<i>Enhydra lutris</i> -sea otter	200 to 300
<i>Globicephala melaena</i> -pilot whale	40 to 60
<i>Mirounga angustirostris</i> -elephant seal	35 to 60
<i>Orcinus orca</i> -killer whale	40 to 80
<i>Phoca vitulina</i> -young, small harbour seals	70 to 100
<i>Phoca vitulina</i> -older, small harbour seals	45 to 80
<i>Phocoena phocoena</i> -harbour porpoise	130 to 150
<i>Trichechus manatus</i> -manatee (Caribbean)	5 to 20
<i>Tursiops truncatus</i> -older bottlenose dolphin	45 to 65
<i>Tursiops truncatus</i> -young bottlenose dolphin	60 to 90